

DEVELOPMENT INDUCED DISPLACEMENT: A DATA MINING APPROACH TOWARDS VULNERABILITY AND IMPOVERISHMENT RISKS

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Domain of development-induced displacement assumes that vulnerable communities are further impoverished due to acquisition of lands and does not distinguish pre-existing vulnerability of households from their vulnerability to land-acquisition. While all households are vulnerable to land-acquisition and suffer impoverishment risks, the intensities of impoverishment as well as vulnerability vary with households.

This study attempts to fill the void in literature, by adopting a first-of-its-kind approach to categorize intensities of vulnerability and impoverishment risks of each household, by applying data-mining methods such as cluster analysis. Census-based base-line socio-economic surveys were carried out among 3574 families from whom lands were acquired for four thermal power projects in Odisha, India. The finding confirms a statistically significant inverse relationship between vulnerability and impoverishment risks.

Findings of this study can be useful for the policy makers and project proponents to follow a targeted approach while planning for Resettlement and Rehabilitation.

Key words: Development-induced Displacement, Data mining, Cluster Analysis, Vulnerability, Impoverishment.

JEL Classification: O10; O15; C12; C380

1. Introduction

Projects such as dams, industries, mines, infrastructure such as power, roads and transport are intended to enhance economic development of a country. However, one of the negative impacts of development projects is the involuntary displacement of people and acquisition of lands on which they are dependent for their lives and livelihoods. Estimates suggest that

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in recent times, nearly 10 to 15 million are being displaced every year due to development projects taken up around the world (Randell (2016), Kirchherr and Katrina (2016)). Displacement is traumatic to the affected people due to loss of home, lands and livelihoods, causing environmental, social, economic, cultural damages to them. Acquisition of lands decapacitates and disempowers the affected communities, rendering them impoverished. Since lands for development projects are acquired by the state, it has the responsibility to initiate steps to safeguard the interests of all those who lose lands for the projects. On the contrary, they have been left unprotected (De Wet, 2006) and continue to remain losers rather than beneficiaries of the projects.

Innumerable studies carried out so far, have shown evidences on various forms of impoverishment risks that the affected families had to suffer. Eminent scholars in the field, including Cernea (1997), Downing (2002), Terminski (2012), Price (2017) and several others have opined that certain categories of people such as women, children, elderly and those belonging to tribal and other ethnic groups tend to suffer more than the others, due to acquisition of lands for development projects. It clearly implies that vulnerable people suffer more impoverishment than the non-vulnerable ones. This conclusion raises a crucial conceptual question, namely, is vulnerability and impoverishment associated? If they are associated, are they positively related in a manner that more vulnerability is accompanied by more impoverishment? The view point that vulnerable segments of population tend to suffer more impoverishment seems to appeal emotionally more than being backed by sound logic and empirical evidence. If vulnerable people possess less than the others, how can they lose more and get more impoverished than the others? Scholars of the domain thus far, have not dwelt into the possible relationship that could exist between vulnerability and impoverishment. This is an empirical study, which primarily attempts to fill this lacuna by probing deeper into this aspect and thereby, uniquely contribute to the frontier of knowledge in this domain.

In project affected villages, every household is vulnerable, exposed to the risk of land acquisition, just as every household is expected to suffer impoverishment. Just as not every household suffers impoverishment in equal measures, not everyone belonging to vulnerable households possess vulnerability in equal measures. Summarily, while the extant literature concludes that vulnerable groups suffer more impoverishment than the others, this paper aims in its first-of-its-kind attempt to address the gap in literature, by: a. categorizing the intensity of pre-existing vulnerability as well as that of impoverishment risks that the households would suffer due to land acquisition; b. investigate whether any relationship exists between levels of vulnerability and impoverishment risks; c. probe whether the intensity of vulnerability as well as that of impoverishment vary between displaced (DP) and affected (AP) households¹.

This manuscript has attempted to attain this objective by applying data mining methods such as cluster analysis. The finding confirms a statistically significant (high)

¹ DP – Displaced Family is physically displaced due to acquisition of homestead land and house, with or without losing their agricultural lands; AP – Affected Family is not to be physically displaced as the house structure in which the family resides is not being acquired but affected due to acquisition of agricultural lands and/or any other plots of homestead land, which is not used for residing.

inverse relationship existing between vulnerability and impoverishment risks. This finding therefore, uniquely contributes to the frontier of knowledge in the domain of development induced displacement and rehabilitation. Moreover, laws, policies and planning for resettlement and rehabilitation of displaced families tend to focus more on the means to mitigate impoverishment risks, but often fail to lay adequate emphasis on households with more vulnerability. It is expected that the findings of this study have implications on planning for planning for resettlement and rehabilitation of DP and AP families.

This paper is divided into six sections. After a brief introduction providing the background, need and relevance of the study, the second section deals with a comprehensive review of literature pertaining to vulnerability and impoverishment risks in the context of development induced displacement. It also highlights certain research questions that emerge from the review. Research design is the focus for third section. A detailed analysis and discussion of findings of the study is presented in section four. It includes findings that have emerged from both descriptive statistics and inferential statistics. Section five deals with the recommendations that are derived from the findings. Sixth and final section provides the concluding remarks.

2. Review of Related Literature

Understanding and decoding the linkages between vulnerability and impoverishment necessitates better clarity in understanding these terms.

2.1. Vulnerability

The terms vulnerable and vulnerability are used extensively in studies on poverty (Philip and Rayhan, 2004), in fields relating to natural disaster such as cyclones, floods, famines, etc., and those regarding health hazards such as HIV/AIDS (Delor and Hubert, 2000), sustainability, livelihoods, and so on. But there is no consensus among the authors regarding its definition. It is often used with different meanings in different contexts, such as, degree of loss to a given element, potential to experience adverse impacts, robustness or the fragility of an element, caused by damage and losses (UNDP, 1994); exposure to uninsured risk, and liable to further impoverishment in risky environs (Hoogeveen, et al., 2004). These definitions of vulnerability seem to indicate vulnerable to exposure to adverse impacts or impoverishment. Due to vagueness in its definition, it is open to various interpretations and applications by the policy makers, planners, other professionals and funding agencies.

However, clarity emerged perhaps for the first time, with Robert Chambers (1989) tried to distinguish between two sides of vulnerability – external and internal. According to him, ‘Vulnerability here refers to exposure to contingencies and stress and difficulty in coping with them. Vulnerability has thus two sides: an external side of risks, shocks and stress to which an individual or household is subject; and an internal side which is defenseless, meaning a lack of means to cope without damaging loss. Loss can take many forms – becoming or being physically weaker, economically impoverished, socially dependent,

humiliated or psychologically harmed.’ Vulnerability refers to capabilities of an individual or groups to cope with disasters, or hazards. This definition has been widely adapted by many scholars, to cite a few, by Dow (1992), Wisner, et al (2003), Adger (2006), Ciurean, et al. (2013) and International Federation of Red Cross and Red Crescent Societies.

Paul, S.K. (2013) opines, ‘It is true that vulnerability has no universal definition, but undoubtedly it is a powerful analytical tool in describing the existing conditions of susceptibility to harm powerlessness and marginality of both physical and socio-ecological systems.’ Consensus exists among the authors in identifying the vulnerable groups in the society: elderly, orphans, internally displaced populations, landless labourers, (Hoogeveen, et al., 2004); pregnant and nursing women, destitute women, widows, migrants, marginalized (International Federation of Red Cross and Red Crescent Societies) .

2.2. Impoverishment

Impoverishment refers to the process of becoming poor, due to loss of wealth, leading to deterioration in the status or standard of living. This concept has found enormous application in the domain of development induced displacement and rehabilitation. Cernea (1997) made a seminal contribution by developing The Impoverishment Risks and Reconstruction Model (IRR model) in the late 1990s. This model, which is an outcome of extensive research studies carried out among dam projects world-wide, provides a conceptual tool for identifying the intrinsic risks that cause impoverishment through involuntary displacement and resettlement. Involuntary displacement of people can cause impoverishment among them, exposing them to the risks of landlessness, joblessness, homelessness, marginalization, food insecurity, loss of access to common property resources, increased morbidity and mortality, and social disarticulation. In his contribution, Cernea (2008) underscores the need to recognize and anticipate impoverishment risks so that preventive and mitigating measures can be built into the projects. His pioneering contribution resulted not only in several theory-led field research, but also in evolving methodological framework and in influencing policy formulation. An assessment of various impoverishment risks would form critical inputs for planning for relocation, resettlement and rehabilitation of the displaced families.

Subsequently, Downing (1996), Mahapatra (1996) and Robinson (2003) have added three more risks namely, loss of access to public services, disruption of formal education activities, and loss of civil and human rights. Scudder (2005) found that the standard of living declined among sizable proportion of the communities displaced by large dam projects. Hwang et al. (2011) and Wilmsen, et al. (2011) observed higher incidence of poverty, indebtedness and poorer health among displaced people. According to Terminski (2013), ‘Development-caused displacement has had especially negative social consequences in countries characterized by a land-based economy and low employment flexibility, together with strongly rooted social stratification.’ Parasuraman (1999) concludes that ‘loss of land is the single most important cause of post-displacement impoverishment in India.’

More specifically, many authors have highlighted the kind of impoverishment risks suffered by the affected populations due to development projects. Evidences are found

that land acquisition leads to various kinds of impoverishment risks, such as, reduction in size of agricultural land holdings (Mburugu, (1994), Desai, et al. (2007), Ravindran (2007)); status of farmers reduced to unskilled landless labourers (Majumder, Guha (2007), Ravindran (2007), Sharma (2008), Saha (2018)); loss of livelihood and lack of job opportunities (Acharya (2002), Sarkar (2007), Lobo and Kumar (2009)); reduction in livestock population (Ravindran (2007), Rawat, et al. (2011)); decline in the collection of forest produce (Ravindran et al., (1998), Kumaran (2013)); reduction in family income (Fernandes (2007), Pati, (2012)); and increase in poverty and food insecurity (Pandey, (1998), Mathur and Marsden, (1998), Ding, (2004), Guha (2007)).

2.3. Vulnerability versus Impoverishment

Literature on development induced displacement and rehabilitation has so far failed to address the possible linkages between vulnerability and impoverishment of households. Studies have identified certain categories of people to be belonging to vulnerable groups and have generalized that these groups suffer more impoverishment due to acquisition of lands. Few notable among them are mentioned here. Terminski (2012), Downing (2002), Stanley, Hemadri, et al. and Internal Displacement Monitoring Centre (IDMC) have categorized women, children, the elderly, people with low elasticity of employment, rural communities (resettled in the cities), indigenous communities, illegal settlers without formal rights to land and properties, and the different categories of minorities, the Dalits and other low-caste groups who were originally landless or owned very little land as vulnerable groups, and implementation of development projects affect these groups disproportionately. As Price (2017) opines, ‘Development investments therefore, risk further marginalizing and impoverishing people who are already vulnerable...’ Many authors have concluded that at the individual and community levels, impoverishment risks associated with resettlement can be felt more intensely by vulnerable segments of the displaced population. Based on the findings from such studies, The World Bank (2017) has set out mandatory requirements for ‘the identification of disadvantaged or vulnerable individuals or groups, and the process whereby differentiated measures will be developed to address the particular circumstances of such individuals or groups.’

Thus, literature has created a void, by not considering the fact that the intensity of vulnerability could differ among the vulnerable households. Poverty, which is one of the indicators of the existing status of vulnerability, is not experienced in equal degree by all poor households. Likewise, other indicators of vulnerability too are not prevalent in equal measures. This study therefore, aims to fill the void in literature, with the basic understanding that:

- a. Vulnerability refers to a situation which exists for a person or a family even without being affected by a development project. Impoverishment means reduction in the status of a person or a family, due to dispossession of assets and/or lose livelihood because of a development project.
- b. Everyone is left impoverished due to acquisition of their lands, but among them, those who have less resilience to cope up are vulnerable people. They are more liable to succumb, because of the inherent or intrinsic weakness.

- c. Just as impoverishment risks are not present in equal degree for every household, same is true for vulnerability and therefore should be categorized based on their intensities.
- d. A person or a family, not considered in the vulnerable category in literature, may suffer more loss of assets and income, and therefore could suffer higher degree of impoverishment. For example, a household which owning large quantum of agricultural lands has low vulnerability; whereas, when its entire land is acquired, the household becomes highly impoverished. Based on this argument, there is a strong logical reason to justify that vulnerability and impoverishment are possibly inversely related. This linkage between vulnerability and impoverishment levels, needs to be proven empirically, which is missing in the field of development induced displacement and rehabilitation.

Research Questions. Regarding the linkage between vulnerability and impoverishment risks, the following research questions emerge:

- (i) Is there any association between vulnerability and impoverishment of households from whom the lands were acquired?
- (ii) Does any difference exist between the DP and AP households regarding intensity of their pre-existing vulnerability?
- (iii) Does any difference exist between DP and AP households regarding intensity of impoverishment that they are expected to suffer after acquisition of their lands?

These research questions have given rise to a set of hypotheses, which are mentioned in the fourth section.

3. Materials and Methods

This paper is an outcome of base-line census surveys conducted in project affected areas in Odisha, one of the eastern states in India.

3.1 About Odisha

Odisha occupies a distinctly advantageous position on the mineral resource map of India. Out of total mineral reserves of the country, it has 28 percent of Iron ore, 24 percent of Coal, 59 percent of Bauxite and 98 percent of Chromite deposits, which offers business opportunities for mining and metallurgical industries. In recent times, the State is witnessing an unprecedented influx of industrial investments resulting in some significant growth in the mining and industrial sector. In 2018, it received investment intents to the tune of Rs. 4.19 trillion across 15 diversified sectors such as mineral and metal, chemical and fertilizer, petrochemical, food processing, renewable energy, and so on. More investment in manufacturing sector would lead to more acquisition of lands. Ironically, the State is also one among the low-income-states of the country, lagging behind many other states in five major parameters namely, '(i) Poverty, Growth and Inequality, (ii) Jobs, (iii) Health and Education, (iv) Gender and (v) Social Inclusion.' (The World Bank, 2018), thus indicating high vulnerability of her people. Thus, the State provides an ideal setting for carrying out research studies focusing on vulnerability and impoverishment.

3.2 About the Study

To address the issue of development induced displacement, Government of Odisha formulated the Resettlement and Rehabilitation Policy (2006). The policy makes it mandatory that: ‘Ordinarily within two months of publication of notice for acquisition of land² for the development project, a socioeconomic survey would be undertaken in the manner to be decided by the Government for identification of displaced families; and for preparing their socioeconomic baseline.’ Furthermore, the Policy also stipulates that the socioeconomic survey must be ‘conducted by an independent agency to be identified by the Government to ensure proper benchmarking.’ Considering neutrality, expertise, and previous experience in conducting similar studies, Xavier Institute of Management, Bhubaneswar was empaneled by the Government of Odisha to conduct socio-economic surveys in project areas. Socio-economic Surveys were carried out, in accordance with guidelines issued by Government of Odisha. This study is based on surveys that were conducted in 25 villages affected by four development projects, two each in industrial and mining projects in Odisha.

Table 1. Number of affected villages, area of land proposed to be acquired: project-wise

Project Code	No. of Affected Villages	Area of Land Proposed to be Acquired (in Hectares)
P01	2	487.65
P02	8	657.00
P03	5	682.90
P04	10	797.14
Total	25	2624.69

The Government proposed to acquire 2624.69 hectares of lands that includes Government land, forest land and private land. It is also inclusive of both homestead land and agricultural land.

Altogether 3574 families residing in these villages, were covered in the surveys. Among them, 669 (18.7 percent) were DPs. The remaining 2905 families (81.3 percent) were APs. Equal focus is given in this study, to both DPs and APs, although the latter category is largely ignored in the policies and plans.

Table 2. Number of DP & AP families: project-wise

Project Code	DP		AP		Total	
	No.	%	No.	%	No.	%
P01	160	16.81	792	83.19	952	100.00
P02	307	54.63	255	45.37	562	100.00
P03	111	29.9	260	70.1	371	100.00
P04	91	5.39	1598	94.61	1689	100.00
Total	669	18.7	2905	81.3	3574	100.00

² It is called 4(1) notification, which is issued under section 4, clause 1 of the Land Acquisition Act of 1894, in which, the Government notifies its intention to acquire the land for the project. Date on which the notice was displayed in the affected village, is the ‘cut-off date.’

While assessing the baseline demographic and socio-economic status of these families, the study also identified several variables indicating various dimensions of pre-existing vulnerability as well as impoverishment risks that they would suffer after acquisition of lands.

3.3 Objectives of the study:

Major objective of this study is to address the three research questions raised in the previous section, namely by categorizing the vulnerability and impoverishment risks depending on their intensity; to probe whether there is any association between vulnerability and impoverishment risks; and to find out whether the intensity of these risks vary between DP and AP families. Accordingly, to empirically investigate these objectives, hypotheses were formulated regarding the association between vulnerability risks and impoverishment risks among DP and that, among the AP households. Additionally, the study also aims to investigate whether the intensity of vulnerability and impoverishment risks vary significantly between the DP and AP households.

3.4. Collection of data

Empirical studies based on census data collected from land-losing families are too few and far between. As Hogeveen, et al. (2004) observe, ‘household surveys lack a sufficient number of observations to present reliable estimates about their vulnerability. This hinders prioritization amongst vulnerable groups and hampers policy dialogue. In such instances, census data can be of use, as they can certain welfare information for even the smallest vulnerable group.’ The same logic applies to presenting reliable estimated about the impoverishment risks.

The survey employed both quantitative and qualitative research methods for collection of data. Primary data and other information were collected from each family by using a pre-tested schedule. Information pertaining to the habitation; demographic features; caste system; occupations; ownership of land and other productive assets; availability and accessibility of natural and other resources; income; resettlement and rehabilitation preferences; and grievances and other views of displaced and affected families were collected. As Price (2018) states, ‘Disaggregated data on the numbers, the distribution and characteristics of forcibly displaced people allows better understanding of their risks, vulnerabilities and priority solutions.’ Secondary data too were collected on: a. Population census; b. voter’s list; c. Records of Rights on land; d. land schedule prepared by the proponents and revenue department in the concerned district; and e. reports, if any, prepared earlier about the project area and people.

3.5. Variables considered for this study

Ability, or lack of it, to cope with acquisition of lands determines the level of vulnerability, which in turn, depends on demographic and social factors (caste, marital status, age, literacy status, skills, physical or mental disability, orphan), and economic factors indicated by the

ownership of asset/resource base (type of house, income, ownership of agricultural lands). A household faces the risk of impoverishment, due to acquisition of assets and loss of livelihood, which has the potential of reducing the economic and social status. Variables considered for categorizing the vulnerability and impoverishment risks for each of the DP and AP families, are appended.

3.6 Methods of Data Analysis

Data entry, filtering and cleaning of data were done in MS Excel and SPSS package was used for generating tables, which are appended. Since, the variables lacked clear categorization of vulnerability and impoverishment levels, the emphasis was to categorize families based on varied levels of intensities pertaining to the two aspects. To achieve the desired objective, data mining methodology was applied by using cluster analysis. Clustering is a statistical technique whose task is to assign objects or entities into multiple groups. The fundamental mechanism is that the objects within a group should possess similar characteristics with other members or objects of the same group, thus attaining homogeneity within groups. Simultaneously, the members between two (or more) groups are expected to be diverse in nature, thus ensuring heterogeneity between groups. (Han, J., & Kamber, M., 2001).

In this study, k-means cluster analysis was performed on the 'R' language. For statistical computing, 'R' is the conspicuous open source environment and representation (Gentleman, R. C. et al, 2004). k-means technique is a centroid based clustering method, which computes distances (Euclidean) of each object with the group centroid. This technique thus needs crucial intervention from the researchers to ascertain the number of groups needed for the study. However, there are certain statistical means to aid this decision-making through pseudo F-scores or Silhouette coefficient. Based on these, vulnerability or impoverishment levels were categorized into three groups, namely, low, medium and high. Preliminary analysis (optimal number of clusters are appended in Figures 1 to 4) also substantiate the decision in favour of having three groups.

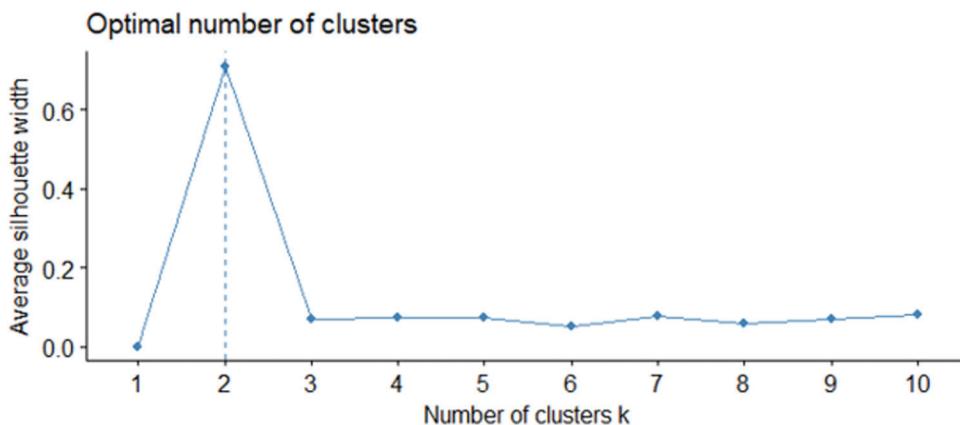


Figure 1. Optimal number of clusters- DP Vulnerability

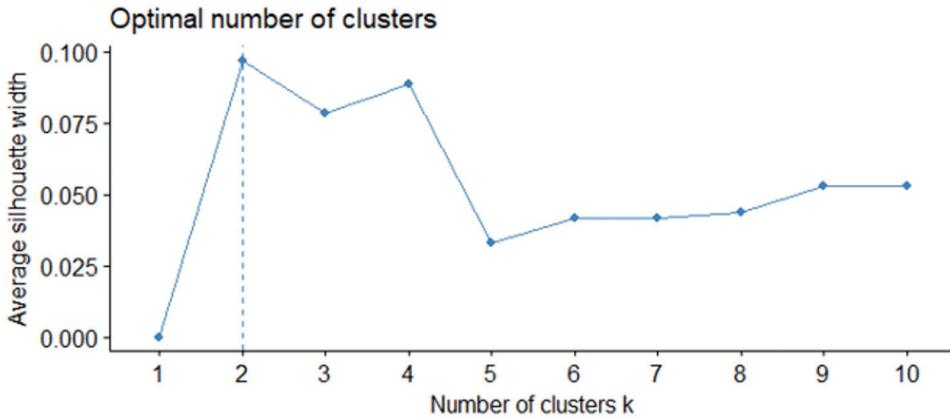


Figure 2. Optimal number of clusters- AP Vulnerability

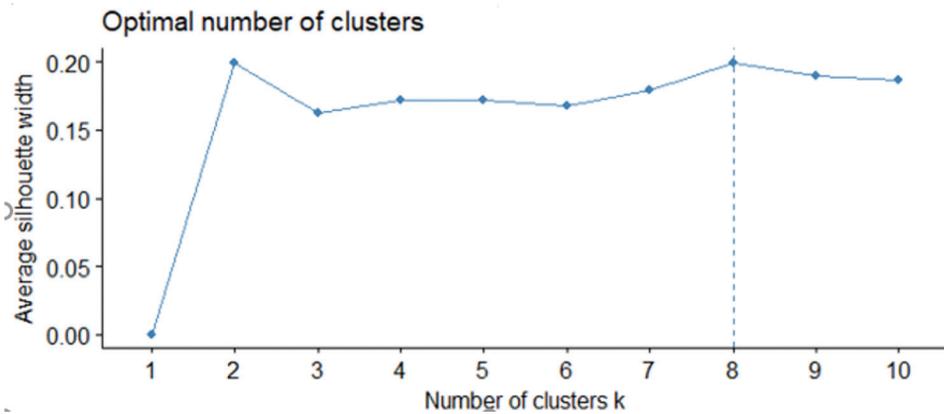


Figure 3. Optimal number of clusters-DP Impoverishment

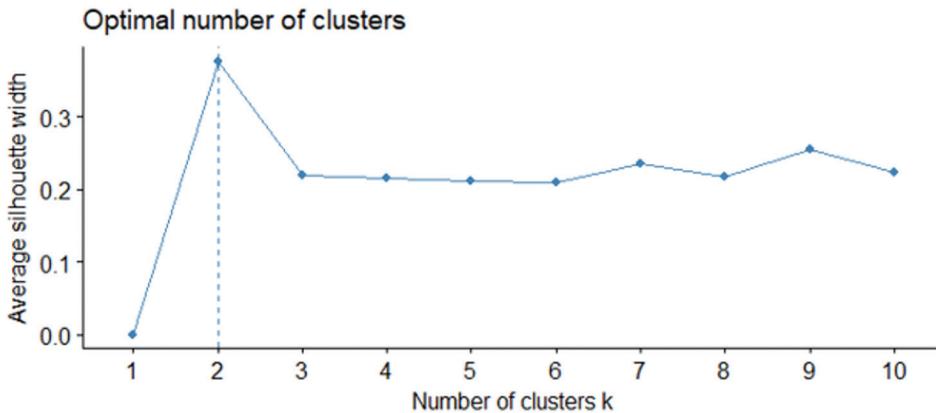
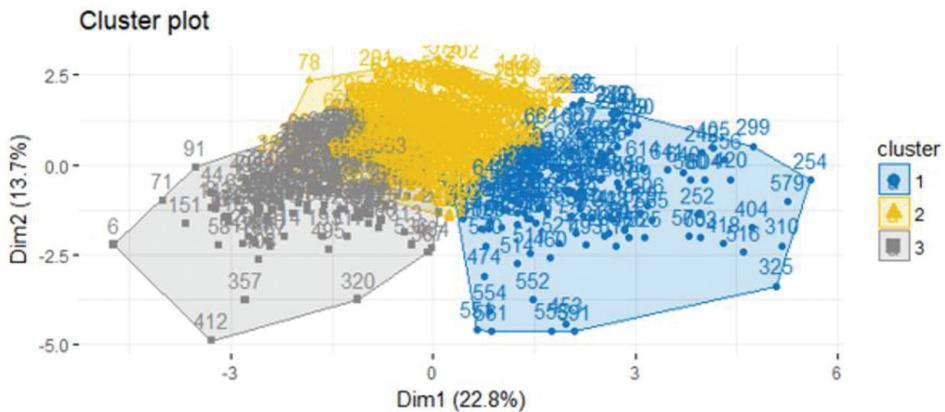


Figure 4. Optimal number of clusters- AP impoverishment

The outcome of analysis based on pseudo F-scores or Silhouette coefficient yield group membership of all objects (households, in this case) for vulnerability and impoverishment for each of the DP and AP households. The output derived from the above analysis are depicted in Cluster plots presented in Figures 5 to 8, which are appended.



*1 – High; 2 – Medium; 3 - Low

Figure 8. Cluster plot- AP Impoverishment

They reveal varied intensities of vulnerability as well as impoverishment risks for both DP and AP families. A contingency table was generated by accounting the frequency count of group membership of DP and AP households with (low, medium, high) levels of vulnerability and (low, medium, high) levels of impoverishment. Cluster centroids were computed to arrive at the intensity (low, medium, high) of vulnerability and impoverishment.

4. Results and Discussion

Findings on the base-line status of DP and AP households are reported here in two parts:

- a. Descriptive statistics: for summarization of all DP and AP households on various factors
- b. Inferential statistics: for performing hypotheses testing based on the frequency count of DP and AP households belonging to various derived categories for vulnerability and impoverishment levels.

4.1 Descriptive Statistics

4.1.1 Inferences on Vulnerability.

Table 3. Inferences on Vulnerability

Variables	Findings	Inferences and Implications
Caste¹	Table A1: Out of 3574 families, ST and SC families accounted for 22.94 percent and 13.23 percent respectively. Tribal families constituted 43.35 percent of DPs while they were only 18.24 percent among the APs.	36.17 percent of the families belonged to ST and SC, which are socially vulnerable groups. Indicates high intensity of tribal displacement.
Population	Table A2: The average size works out to be 4.13 and 4.36 per DP and AP family, respectively.	Larger the family size, more the vulnerability.

Variables	Findings	Inferences and Implications
Age distribution of population	<p>Tables A3-A and A3-B: Children below seven years of age constituted 12.6 percent of DP and 10.98 percent of AP population.</p> <p>18.28 percent of DP and 16.09 percent of AP population belonged to the age group of 7 to 17 years,</p> <p>8.4 percent of the DPs and 8.74 percent of the APs were above 60 years of age.</p>	<p>Many studies have included children and elderly persons in the category of vulnerable population. Hence special provisions are to be made in the R&R programmes to mitigate their vulnerability.</p>
Women-headed households	<p>Table A4: 18.54 percent of DP families and 17.31 percent of AP families were headed by women, who were widows or destitutes.</p>	<p>Vulnerability among women who are heading the families has a lot of social as well as economic implications.</p>
Literacy status²	<p>Tables A5-A and A5-B: Among the DP families, 16.7 percent were illiterates³; while only 7.5 percent of men were illiterates, those among women was 26.1 percent. Among AP families, 10.1 percent were illiterates; while only 5 percent of men were illiterates, it was 15.6 percent among women.</p> <p>34.3 percent of DP and 29 percent of AP family members were either undergoing primary level of education⁵, or had dropped out from the school before class V.</p> <p>Among the DP population who were considered for assessing the literacy status, only 17.1 percent of DP population have had education of matriculation and above. It is 32.3 percent among AP families.</p> <p>Among them, 0.8 percent of DP and 2.7 percent of AP family members, possessed technical qualifications.</p>	<p>High level of illiteracy contributes to vulnerability of individuals as well as their families. Among both DP and AP families, the gender disparity seems to be more glaring among the illiterate population⁴, indicating enhancement of vulnerability among women.</p> <p>Nearly one-third of DP and AP population have had less than primary level of education, Low level of literacy too indicates vulnerability of households.</p> <p>Because of higher educational qualifications, one can expect that those who are matriculates and above, especially those with technical qualifications have better capability to cope up with the impoverishment, as they have better potential for employment in the companies.</p>
Homestead land, type of houses owned and basic amenities	<p>Tables A6.1, A6.2 and A6.3: Both DP and AP families on an average owned a very negligible area of 0.04 hectares of homestead land.</p> <p>A clear majority of both DP and AP families, owned and lived in 'kutcha'⁶ houses. Fewer DPs owned 'pucca' houses, as compared to APs.</p> <p>Only 29.62 percent of DP and 21.31 percent of AP households had separate toilet in their homes.</p>	<p>Very high percentage of DPs lived poor-quality houses as compared to AP households, which is indicative of higher vulnerability of the former category.</p> <p>Majority of households not having separate toilet facilities in their houses is certainly an indicator of vulnerability, having implications on sanitation and health. However, the surveys were conducted before the Government of India started 'Swachh Bharat Mission'⁷ in 2014.</p>

Variables	Findings	Inferences and Implications
Agricultural land - Ownership^j, landlessness and Encroachment	<p>Ownership: Table A7.1: 560 DP (83.7 percent) and 2803 AP families (96.49 percent) owned agricultural lands. Mean holding size was 0.74 hectare and 0.94 hectare respectively, per DP and AP family.</p> <p>Moreover, 393 DPs (56.22 percent) and 2028 APs (69.81 percent) were marginal farmers, owning less than one hectare of agricultural lands.</p> <p>Landlessness: Table A7.2: 109 DPs (16.3 percent) and 102 APs (3.51 percent) did not own any land. Some of the DP families, who were landless, were found to cultivate agricultural lands as share-croppers, tenants and by encroaching lands to cultivate crops.</p> <p>Encroachment: Table A7.3A and A7.3B: The area of lands encroached by the DPs works out to be 30.2 percent of the area owned by them, whereas that for APs is 8.27 percent. Encroachment of lands for cultivation was done not only by the landless families, but also by those who owned agricultural lands.</p>	<p>Significant percent of both DP and AP households being marginal farmers proves that the ownership of land was much skewed towards small and marginal farmers, contributing to significant disparity in the ownership of land, and therefore vulnerability.</p> <p>Landless households are those who do not own either agricultural land or homestead land. Therefore, they are considered vulnerable.</p> <p>Families with low size of holdings had tried to cover their vulnerability risk and enhance their family income by cultivating on encroached lands. The intensity of encroachment by the DPs is much higher than that by the APs. This perhaps indicates that the vulnerability relating to ownership of agricultural lands is higher for DP as compared to AP households.</p>
Occupation	<p>Table A8:</p> <p>Dependents: 44.4 percent and 57 percent respectively, of members of DP and AP families were dependents, not having income from any sources.</p> <p>Earning member to dependent ratio works out to be 1:0.79 for DPs and 1:1.33 for APs.</p> <p>Among the DP families, while only 33 percent of male members were dependents, it was as high as 50 percent among the females. In the AP families, dependence was 40.1 percent among male and as high as 82.7 percent among females.</p> <p>Members with Vocational skills: Among the members of DP and AP households, merely 5 percent and 8 percent, respectively, were found to possess vocational skills.</p>	<p>Dependents included, children, homemakers, old, the infirm, students and other unemployed persons. High number of dependents indicates lower per-capita income and hence, higher vulnerability. Scrutiny of raw data reveals that there is significant level of gender disparity in the dependency status among DP and AP families. Higher level of dependence among female signals higher vulnerability.</p> <p>That 95 percent and 92 percent of family members of DP and AP respectively, did not possess any vocational / technical skills, shows their vulnerability.</p>
Annual family income and per-capita income	<p>Annual family income and per-capita income: Tables A9-A and A9-B: Agriculture acts as source of income for as much as 81.7 percent of DP families and 82.4 percent of AP families⁸.</p>	<p>Low income from farm sector has forced farmers to resort to other sources of livelihood to supplement the family income.</p>

Variables	Findings	Inferences and Implications
	<p>Whereas, income from cultivation was low due to low size of land holdings, fragmented holdings, lack of irrigation facilities, seasonality of occupation, and so on.</p> <p>Among the other sources of income, wages from non-farm sector, mostly in construction sector, yielded relatively higher incomes⁹.</p> <p>Although income from salaried jobs, business and other self-employment was way above the average, only fewer pursued these occupations.</p> <p>Households were earning income from different sources. On an average each DP and AP family were having income from 4.03 and 2.83 sources, respectively.</p> <p>Distribution of annual family income and per-capita income: Tables A9.1 and A9.2: 70.5 percent of DP and 65.5 percent of AP households earned average annual income, which was lower than Rs. 100,000.</p> <p>59.4 percent of DP and 57.1 percent of AP households lived with less than Rs. 20,000 of per-capita income per annum.</p>	<p>Raw data reveals that in occupations such as farm labour, animal husbandry and collection of forest produces, involvement of women was much higher as compared to all other occupations.</p> <p>Whereas, these sources yielded lower incomes. This finding also indicates enhancement of economic vulnerability of women, as their productive contribution to family's income was unremunerative.</p> <p>It perhaps indicates that more DPs than APs try to cover their economic vulnerabilities by pursuing many occupations.</p> <p>Inequality in the distribution of income among the DP and AP households is evident because, the frequency distribution of both family income and per-capita income is heavily skewed towards lower levels of income. It therefore, indicates their vulnerability.</p>
Below poverty level (BPL) families	<p>Table A10: 34.9 percent families covered in the surveys were provided with BPL (Below Poverty Line) card by the Government of Odisha¹⁰. The percentage of DPs, who were BPL (49.6 percent), is much higher than that for the APs (31.5 percent).</p>	<p>This category of families is economically vulnerable and hence requires more focus, while planning for their R&R.</p>

¹. The Central Government of India classifies its citizens based on their social and economic condition as Scheduled Tribe (ST), Scheduled Caste (SC), General and Other Backward Class (OBC). According to the population Census of India (2011), the percentage of population belonging to ST and SC were, 8.2 and 16.2 and, respectively. Odisha is one of the states in India, with higher percentage of tribal population. According to the population Census of Odisha (2011), the percentage of population belonging to ST and SC were, 22.85 and 17.13 and, respectively.

². Categories of literacy status of family members:

- i. Illiterate
- ii. Less than primary (Literate + below Class V + pre-primary)
- iii. Primary completed but less than Matriculate (completed Class V but less than Class X)
- iv. Matriculate (Class X completed)
- v. +2 completed
- vi. Graduation and above
- vii. Technical education

³. Illiterates are those who cannot even affix their signatures; Literates are those who have not had formal education but can affix their signatures, included in category, ii.

⁴. Finding on the gender disparity in literacy rate, also corroborates with that of population census carried out for India in 2011, according to which, while the illiteracy among males was only 17.86 percent, that among women was as high as 34.54 percent. For the state of Odisha, the male and female illiteracy were 18.41 percent and 35.99 percent, respectively

⁵ To find the literacy status, 230 children of DP and 906 children of the AP families, were excluded, as they were below the school-going age. As can be seen in Tables A3-A and A3-B, the number of children below the age of seven among DP and AP families were, 348 (175 boys and 173 girls) and 1391 (744 boys and 647 girls), respectively. During the time of survey, it was found that, among them, 118 children of DP and 485 children of AP families were going to the Anganwadi centres to attend pre-school education. Anganwadi centres across the country, are providing pre-school (nursery) education to children aged between 3 and 6 years. Anganwadi is a type of rural mother and child care centre in India. They were started by the Indian government in 1975 as part of the Integrated Child Development Services program to combat child hunger and malnutrition. Anganwadi means courtyard shelter in Indian languages Hence, while assessing the literacy status, these children have been included in the category of 'below primary'.

⁶ *Kuchcha house is simply made of mud or clay or lime mortar with weaker materials. Pucca house means with proper cementitious material like cement and complete RCC or regular load bearing one but with proper roofing. Mixed or 'semi-pucca' house is one in which, only either the roof or the walls (not both) is made of pucca materials like burnt bricks, stone, cement, concrete or timber.*

⁷ Government of India launched 'Swachh Bharat Mission' on October 2, 2014 with the objectives of eliminating open defecation, and to bring about a behavioural change in sanitation practices. Financial support is extended to households to construct toilets in houses.

⁸ Out of 2905 AP families, 2395 cultivated crops. The remaining 510 families did not cultivate their land during the year, before the surveys were conducted in these projects because of absentee landlordism, families engaged in business and salaried jobs, legal disputes among the legal heirs, land located inside the forest area and very small size of land holdings.

⁹ The areas in which the affected villages are located has several mining and industrial activities, which has given rise to absorption of labour force in construction of buildings and other infrastructure such as roads, etc., and wage rates were higher than those prevalent among agricultural labourers.

¹⁰ The Panchayati Raj Department of Government of Odisha considered eight exclusion criteria for eliminating people from BPL category.

4.1.2 Inferences on Impoverishment.

Table 4. Inferences on Impoverishment

Variables	Findings	Inferences and Implications
Acquisition of Homestead land and house structures	Acquisition of Homestead land - Tables A11.1-A and A11.1-B: From 82.96 percent of the DPs, entire homestead land was acquired, which is in sharp contrast with APs, 86.54 percent from whom homestead land was not acquired.	While houses of all DPs were acquired, houses were not acquired from any of the APs. This finding confirms that the impoverishment of homesteadlessness as well as homelessness for DPs is much higher, as compared to APs.
Acquisition of Agricultural land	Acquisition of Agricultural land - Tables A11.2-A and A11.2-B: One of the types of impoverishment is landlessness. It can be measured by assessing the land loss intensity. As much as 50.7 percent of DP as opposed to only 9.2 percent of the AP families lost their entire agricultural lands for the projects.	While the entire agricultural lands were acquired from majority of DPs, majority of APs have lost less than one-third of their lands for the project. This indicates that among the displaced families, risk of landlessness is also more intense for the displaced communities.
Annual family income likely to be lost¹¹	Tables A12-A and A12-B, respectively for DPs and APs: While DPs are expected to suffer 50.61 percent fall in their annual family income, that for the APs works out to be only 26.95 percent.	Although inter-project variations exist, on the whole, it can be inferred that DPs suffer higher intensity of economic impoverishment as compared to APs, due to loss of livelihood and income.

¹¹ Because, it is difficult to precisely anticipate and measure the loss of income post displacement or land acquisition, the impoverishment risk of joblessness and loss of livelihood and income is analysed based on three presumptions that after the project: a. households' occupation and income from animal husbandry, wages from non-farm sector, business, self-employment, salaries, pension and other remittances will remain unaffected by land acquisition and/or displacement; b. households would lose their livelihood and income from cultivation, wages from labour in farming sector and income from trees owned in proportion to the intensity of land loss suffered by each household; and c. entire income from collection of minor forest produce, assuming that people would have no access to forests due to acquisition of forest lands.

4.2 Inferential Statistics:

This study has adopted an empirical approach to find evidences on the questions mentioned in section 2.2.

4.2.1 Vulnerability versus Impoverishment among DP households

Table 5 presented here reveals that intensity of vulnerability was high for as much as 57.40 percent of DP households. But only 20.33 percent are likely to suffer high levels of impoverishment. Low to medium intensity of vulnerability was observed among 42.6 percent; while low to medium intensity of impoverishment was as high as 79.67 percent of the DP households. To confirm empirically whether vulnerability and impoverishment are associated, chi-square test was performed.

Table 5. Vulnerability Versus Impoverishment – DP

		188 (28.10)	345 (51.57)	136 (20.33)	Total (100.00)
Vulnerability Risk	High	139 (20.78)	199 (29.75)	46 (6.88)	384 (57.40)
	Medium	49 (7.32)	145 (21.67)	89 (13.30)	283 (42.30)
	Low**	0 (0.00)	1 (0.15)	1 (0.15)	2 (0.30)
		Low	Medium	High	669
		Impoverishment Risk			

* Figures in parentheses are percentages to the total number of DPs

** Since the number of households with least vulnerability is insignificant, it was clubbed with households with medium vulnerability before conducting test of independence

The above results were tested for a hypothesis as follows:

H1: there is no association between vulnerability risks with impoverishment risks of DP households.

H1(a): association exists between vulnerability risks with impoverishment risks of DP households.

To test the above formulated hypothesis, a test of independence was performed using chi-squared statistic, as the variables under consideration are categorical in nature. The statistical test results are provided in the following findings. Detailed analysis of the test of independence using chi-squared test is provided in Appendix II. This test has been documented in various resources dealing in applied statistics (Levin (2011), Anderson, et al. (2016)).

χ^2 (actual) = 51.95, whereas

χ^2 (critical for $(2-1) \times (3-1) = 2$ degrees of freedom) = 5.99 for 5% significance level, and

χ^2 (critical for $(2-1) \times (3-1) = 2$ degrees of freedom) = 9.21 for 1 % significance level.

Since χ^2 (actual) \gg χ^2 (critical), there is enough evidence to conclude that there exists a statistically significant association between vulnerability risks and impoverishment risks

of DP households. This suggests that vulnerability and impoverishment are associated, and the association seems to be inverse.

4.2.2 Vulnerability Versus Impoverishment among AP households. According to Table 6, the intensity of vulnerability was found to be high for as much as 60.69 percent of AP households. But only 15.35 percent are likely to suffer high levels of impoverishment. Low to medium intensity of vulnerability was observed among 39.31 percent; whereas low to medium intensity of impoverishment was as high as 84.65 percent of AP households. To confirm whether vulnerability and impoverishment are associated, chi-square test was performed.

Table 6. Vulnerability Versus Impoverishment – AP

	2215 (76.25)	244 (8.40)	446 (15.35)	Total (100.00)	
Vulnerability Risk	High	1387 (47.75)	87 (3.00)	289 (9.95)	1763 (60.69)
	Medium	827 (28.47)	157 (5.40)	155 (5.34)	1139 (39.21)
	Low**	1 (0.03)	0 (0.00)	2 (0.06)	3 (0.10)
	Low	Medium	High	2905	
Impoverishment Risk					

* Figures in parentheses are percentages to the total number of APs

** Since the number of households with least vulnerability is insignificant, it was clubbed with households with medium vulnerability, before conducting test of independence

The above results were tested for a hypothesis as follows:

H2: there is no association between vulnerability risks with impoverishment risks of affected families.

H2(a): association exists between vulnerability risks with impoverishment risks of affected families.

To test the above formulated hypothesis, a test of independence was performed using chi-squared statistic, as the variables under consideration are categorical in nature. The statistical test results in the following findings. Detailed analysis of the test of independence using chi-squared test is provided in Appendix II.

χ^2 (actual) = 70.70, whereas

χ^2 (critical for $(2-1)*(3-1) = 2$ degrees of freedom) = 5.99 for 5% significance level, and

χ^2 (critical for $(2-1)*(3-1) = 2$ degrees of freedom) = 9.21 for 1 % significance level.

Since χ^2 (actual) \gg χ^2 (critical), there is enough evidence to conclude that there exists a statistically significant association between vulnerability risks with impoverishment risks of AP households. This suggests that vulnerability and impoverishment are associated, and the association seems to be inverse.

4.2.3 Vulnerability - DP versus AP

A cursory glance at Table 7 suggests that the base-line status of vulnerability is similar for both DP and AP households. Very high percentage of both DPs and APs had medium to

high intensity of vulnerability, which was their base-line status, before land acquisition. However, to test empirically, whether the vulnerability status of DPs has any association with that of APs, chi-square test was attempted.

Table 7. Vulnerability - DP versus AP

Vulnerability	DP		AP	
	No.	%	No.	%
High Vulnerability	384	57.40	1763	60.69
Medium Vulnerability	283	42.30	1139	39.21
Low Vulnerability	2	0.30	3	0.90
Total	669	100.00	2905	100.0

The actual (observed) chi-squared test statistic value is 2.45, while the critical values are: 1% significance level ~ 6.63, & 5% significance level ~ 3.84. Thus, the hypothesis gets rejected to confirm that there is no significant association between the DP and AP households regarding vulnerability risks.

In addition, test of significance was performed to find out whether a significant difference exists between proportion of DP and AP households so far as their vulnerability is concerned. Since the Z value is -1.57 (which is less than 1.96), there is enough evidence to conclude that proportion of DP and AP households having high level of vulnerability is not different between the two categories.

4.2.4 Impoverishment - DP versus AP. Table 8 reveals that majority (71.9 percent) of the DPs would suffer medium to high impoverishment; whereas, majority (76.25 percent) of the APs would suffer low impoverishment after land acquisition. To test empirically, whether the intensity of impoverishment of DPs has any association with that of APs, chi-square test was attempted.

Table 8. Impoverishment - DP versus AP

Impoverishment	DP		AP	
	No.	%	No.	%
High Impoverishment	136	20.33	446	15.35
Medium Impoverishment	345	51.57	244	8.40
Low Impoverishment	188	28.10	2215	76.25
Total	669	100.00	2905	100.00

The actual (observed) chi-squared test statistic value is 810.67, while the critical values are: 1% significance level ~ 9.21, & 5% significance level ~ 5.99. Thus, the hypothesis gets rejected to confirm that significant association exists between the DP and AP households regarding impoverishment risks.

In addition, test of significance was performed to find out whether a significant difference exists between proportion of DP and AP households so far as their impoverishment is concerned. Since the Z value is 2.879 (which is more than 1.96), there is enough evidence

to conclude that proportion of DP and AP households having high level of impoverishment is significantly different between the two categories.

This finding is also substantiated by that arrived from descriptive statistics. a. entire homestead land is acquired from 82.96 percent of DPs as opposed to only 5.16 percent of APs; b. house structures are acquired from all the DPs, while none of the APs would lose their houses; entire agricultural lands are acquired from 50.7 percent of DPs as against only 9.2 percent of APs; and d. while DP households are expected to suffer 50.61 percent loss in their family income due to acquisition of lands, it is only 26.95 percent for the AP households.

Intensity of homestead-land loss, loss of homes, intensity of agricultural-land loss, and proportion of decline in income have been found to be much more among the DP than among the AP households.

5. Summary and Recommendations

5.1 Summary:

5.1.1 Descriptive Statistics.

Findings regarding each of the factors pertaining to vulnerability of DP and AP families reveal the following.

Firstly, demographic vulnerability is indicated by ST and SC communities constituting high percentage; high intensity of displacement among the tribal communities; nearly one-fifth of the population comprising of children (below seven years) and elderly (above 60 years); and nearly 18 percent of the DP and AP families headed by either widows or destitute women.

Secondly, vulnerability relating to Illiteracy/Low level of literacy is indicated by the finding that more than two-fifth of DP and AP population, who were above the school-going age were either illiterates or had education below primary level; glaring gender disparity in literacy status is revealed, as more women as compared to men, were illiterates; very negligible proportion of family members possessed any vocational / technical skills.

Thirdly, type of houses and basic amenities is another indicator vulnerability. More than four-fifth of DP and nearly two-fifth AP households lived in *kutcha* houses. Majority of households not having separate toilet facilities in their houses is a major cause for concern, having severe implications on sanitation and health.

Fourthly, ownership of land is more skewed towards marginal farmers, as majority of farmers owned less than one hectare of agricultural lands, indicating vulnerability.

Fifthly, cultivation on encroached lands, as the landless and marginal farmers tried to cover their vulnerability risk and enhance their family income.

Sixthly, large number of dependents were found, because 55.55 percent of members of both DP and AP families had no source of income. Significantly high gender disparity in the dependency status was found. More number of dependents indicate lower per-capita income and therefore, higher vulnerability.

Seventhly, over dependence on agriculture was noticed. Even though nearly 82 percent of DP and AP families were dependent on agriculture, this occupation yielded lower income. It has forced farmers to resort to other sources of livelihood to supplement their family income. On an average each displaced family was having income from 4.03 sources, and it was 2.83 sources for AP families.

Eighthly, low level of family income was found as more than two-thirds of households earned an income of less than Rs. 100,000 in a year. About 60 percent of households lived with less than Rs. 20,000 of per-capita income per annum, indicating their vulnerability.

Lastly, 49.6 percent of DP and 31.5 percent of AP households were identified by the Government as BPL families, who were economically vulnerable.

Findings regarding each of the factors pertaining to impoverishment of DP and AP families reveal the following.:

Firstly, homesteadless and homelessness: Entire homestead land is acquired from 82.96 percent of DPs as opposed to only 5.16 percent of APs. House structures are acquired from all the DPs, while none of the APs would lose their houses.

Secondly, landlessness (agricultural lands): Entire agricultural lands are acquired from 50.7 percent of DPs as against only 9.2 percent of APs.

Lastly, joblessness (loss of income, livelihood): While DP households are expected to suffer 50.61 percent loss in their family income due to acquisition of lands, it is only 26.95 percent for the AP households.

Observations based on descriptive statistics seem to indicate that majority of both DP and AP households have higher levels of vulnerability. However, intensity of homestead-land loss, loss of homes, intensity of agricultural-land loss, and proportion of decline in income have been found to be much more among the DP than among the AP households. All of them indicate that the impoverishment of DP households was more than that of APs.

5.1.2 Inferential Statistics

The findings summarized above, indicate the vulnerability and impoverishment risks for each of the factors. But the intention was to categorize households based on the intensities of vulnerability and impoverishment risks. This was attained by resorting to inferential statistical techniques. This study provides empirical evidences by performing cluster analysis and statistical tests of significance.

Vulnerability versus impoverishment: There is enough evidence to conclude that there exists a statistically significant association between vulnerability risks and impoverishment risks. This suggests that vulnerability and impoverishment are associated, and the association seems to be inverse. This conclusion is valid for both DP and AP households.

Vulnerability – DP versus AP: It is proved with empirical evidence that proportion of DPs and APs having high level of vulnerability is not different between the two categories of households.

Impoverishment – DP versus AP: It is proved with empirical evidence that proportion of DPs and APs having high level of impoverishment is significantly different between the two categories of households. DP households are more impoverished than AP households.

5.2 Recommendations

5.2.1 For researchers

Certain limitations of this study also are pointers towards directions for future research.

Firstly, a longitudinal study may be more appropriate to compare the socio-economic status of the people pre and post displacement or land acquisition.

Secondly, among various types of impoverishment risks, only landlessness, homelessness and loss of income are considered here. The analysis can be extended to other measurable types too.

Thirdly, this study is based on few mining and industrial projects. In India, majority of displacement of people is due to water resources projects (Fernandes and Paranjpye, 1997). Since findings from this study have broader implications it can be replicated not only in other types of projects, but in other regions as well.

Last but not the least, yet another empirical approach, namely factor analysis can be applied to ascertain which among the factors contribute enough to explain vulnerability and impoverishment risks.

5.2.2 For laws and policy makers

More the vulnerability lower would be the capability to cope with adverse consequences arising out of land acquisition and/or displacement. More the impoverishment, more difficult the restoration would be. R&R laws, policies and programmes are heavily skewed towards addressing risks of impoverishment but lay little focus on addressing vulnerability. It is recommended that all R&R efforts should focus on segments of affected population having higher intensity of vulnerability and/or impoverishment risks. Serious attempts should be made to enhance coping up ability of vulnerable households among both DPs and APs, even before their lands are acquired.

Special provisions for ST and SC: Both R&R Act (2013) and Odisha's R&R Policy (2006) do have special provisions for ST and SC families; but should incorporate institutional mechanisms for monitoring to ensure the enforcement of provisions.

Caring for old aged: It is certainly a category that needs more social security, to improve the quality of their lives. For the elderly persons, the rehabilitation option should include specific schemes to cover the risks associated with food and other insecurities. Therefore, policies can incorporate monthly cash remittances for the elderly. In addition, dove-tailing with Government schemes on old age pension, widow pension, disability pension and other social welfare benefits is important to see to it that the risks and vulnerability faced by old persons are mitigated.

Special provisions for BPL families: Land acquisition and displacement would decapitalize and decapacitate these families more. It throws up a great challenge to devise ways and means of bringing these families above the poverty level through proper rehabilitation assistance and follow-up. Hence it requires provisions in R&R laws and policies.

5.2.3 For implementors of R&R programmes in projects

As Vanclay (2017) points out, ‘Typically, there has not been enough attention given to resettlement within projects; project developers have not given the social issues associated with resettlement enough consideration; and inadequate resources and time have been allocated for the resettlement process.’ Resettlement and rehabilitation should be considered as an opportunity for overall development of the people – development, which is holistic, inclusive and sustainable. Few key issues that call for attention are specified here:

Caring for children: To mitigate vulnerability of children below seven years of age, R&R programmes should include provisions for health care, nutrition and early childhood education. Seven to 17 years is the prime age for school going boys and girls. Specific focus must be laid for easier access to the schools and training institutions for skill development. Companies can invest in promotion of education among children in the project affected areas through their CSR (Corporate Social Responsibility) programs.

Engendering R&R programs: Women, especially widows and destitutes face challenges such as social isolation, lack of social protection and so forth. High female illiteracy also tends to have significant implications on the socio-economic status, level of awareness, fertility, infant mortality, maternal mortality, lack of livelihood opportunities and amenable to exploitation.

High level of gender disparity prevails in literacy and occupational status, enhancing the dependence of women. While planning for livelihood promotion, it is important to identify women from among DP and AP families, who can be gainfully employed, so that they can be engaged in various income-generating schemes, with adequate support by creating strong backward and forward linkages.

Skill development: As agricultural sector is unable to provide employment opportunities to the rural masses, there is a dire need for development of vocational skills, more so among younger generation, to make them employable. Strong linkages between skill development, productivity and potential for employment have been well established. It contributes to inclusive growth, thereby reducing economic vulnerability of people.

Promotion of small and micro enterprises: It is the key towards achieving sustainability of gainful livelihood activities. Continuous and concerted efforts are required to make them sustainable and enable people from DP and AP families to take care of their livelihood in future.

Participation and involvement of DP and AP families: Key to success in any R&R program lies in enabling participation and involvement of affected communities. As stipulated in the Resettlement Framework of Asian Development Bank (ADB), R&R programs must ‘ensure their participation in planning, implementation, and monitoring and evaluation of resettlement programs. Pay particular attention to the needs of vulnerable groups, especially those below the poverty line, the landless, the elderly, women and children, and indigenous peoples, and those without legal title to land, and ensure their participation in consultations.’

6. Conclusion

While all households are vulnerable to land acquisition and liable to suffer impoverishment risks, the intensities of impoverishment and vulnerability vary with households. Empirical association between vulnerability and impoverishment has not been established so far.

The central objectives of the study therefore are: (a) to categorize the intensities of vulnerability and impoverishment of both DP and AP households; and (b) to investigate the relationship between levels of vulnerability and impoverishment risks.

Crucial empirical evidences of this study are: (a) A statistically significant association exists between vulnerability risks and impoverishment risks, and the association is inverse. This conclusion is valid for both DP and AP households. (b) Proportion of DPs and APs having high level of vulnerability is not different between the two categories of households; (c) Proportion of DPs and APs having high level of impoverishment is significantly different between the two categories of households. DP households are more impoverished than AP households.

Price (2018) opines that, ‘all people forcibly displaced urgently need an injection of innovative approaches to reach durable, sustainable solutions.’ This paper attempts an innovative approach to investigate empirically, the relationship between levels of vulnerability and impoverishment risks, by applying data mining methods such as cluster analysis. It is hoped that these findings have enhanced the scope for further research, not only in development projects, but also in all fields where displacement of human population occurs.

Goal of any resettlement and rehabilitation (R&R) policy is to improve, or at least restore the standard of living of displaced and affected families. The finding confirms a statistically highly significant inverse relationship existing between the vulnerability and impoverishment risks. Having proved an empirically significant association between the risks of vulnerability and impoverishment, this study recommends that all R&R efforts should focus more on the segments of affected population having higher intensity of vulnerability and/or higher intensity of impoverishment. Moreover, R&R laws and policies can only make generic provisions which are common for all communities affected by projects. Inferences made from one project may not be equally applicable to all projects. Real solutions are project-specific, as there can be no one-size-that-fits-all kind of solutions.

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Appendix - I

List of Variables on Vulnerability and Impoverishment Risks

Vulnerability Risks

1. Demographic	Variables Caste of the family % < 7 years of age % 7 – 17 years of age % 18 – 39 years of age % 40 – 60 years of age % > 60 years of age Size of family women headed household
2. Literacy level	Variables % of Illiterates in the family % of Less than Primary % of Primary but < Matric % of Matriculate % of + 2 completed % of Graduation and above % of tech. education
3. Ownership of Assets: (house-related)	Variables Area of homestead owned by the family Type of house structure owned by the family Whether house has electricity connection Whether house has separate toilet Whether house has separate cattle-shed
4. Ownership of Assets: (Agricultural land related)	Variables Area of agri. land owned Landless family – share-cropper* Landless family – tenant* Landless family – encroaching land* Landless family – agricultural labourers*
5. Occupational	Variables % of dependents in the family % of migrant workers in the family % of members with vocational skill in the family
6. Economic: (Income related)	Variables cultivation animal husbandry Labour (farm) Labour (non-farm) Trees Minor Forest Produce Business and self-employment Salary pension and other remittances

Total annual Family Income
 Per-capita family income
 Whether identified as the BPL family

* Not mutually exclusive, combinations possible

Impoverishment Risks

1. Landlessness: (Loss of agricultural land)	Variables
	Area of agri. land acquired
	% of agri. land acquired
2. Homelessness: (Loss of homestead land and house)	Variables
	Area of homestead acquired owned by the family
	% of homestead land acquired from the family
	Type of house acquired from the family
3. Joblessness: (Loss of income / livelihood)	Variables
	Income from cultivation
	Income from Labour (farm)
	Income from Trees
	Income from Minor Forest Produce

Descriptive Statistics

Table A1: Caste Composition of DP and AP Families: Project-wise

Project Code		ST		SC		OBC		General		Total	
		No.	%	No.	%	No.	%	No.	%	No.	%
P01	DP	108	67.50	12	7.50	37	23.13	3	1.88	160	100.0
	AP	215	27.15	104	13.13	450	56.82	23	2.90	792	100.0
P02	DP	98	31.92	43	14.01	159	51.79	7	2.28	307	100.0
	AP	88	34.51	41	16.08	113	44.31	13	5.10	255	100.0
P03	DP	84	75.68	2	1.80	25	22.52	0	0.00	111	100.0
	AP	161	61.92	10	3.85	74	28.46	15	5.77	260	100.0
P04	DP	0	0.00	11	12.09	79	86.81	1	1.10	91	100.0
	AP	66	4.13	250	15.64	1209	75.66	73	4.57	1598	100.0
Total	DP	290	43.35	68	10.16	300	44.84	11	1.64	669	100.0
	AP	530	18.24	405	13.94	1846	63.55	124	4.27	2905	100.0
Total		820	22.94	473	13.23	2146	60.04	135	3.78	3574	100.0

Table A2: Population of DP and AP Families, Gender-wise: Project-wise

Project Code	DP				AP				Total			
	M		F		M		F		M		F	
	No.	%	No.	%								
P01	343	50.9	331	49.1	1700	50.4	1670	49.6	2043	50.52	2001	49.48
P02	583	49.7	591	50.3	585	53.9	501	46.1	1168	51.68	1092	48.32
P03	299	50.7	291	49.3	656	51.9	608	48.1	955	51.51	899	48.49
P04	175	54.0	149	46.0	3682	52.9	3270	47.1	3857	53.01	3419	46.99
Total	1400	50.7	1362	49.3	6623	52.3	6049	47.7	8023	51.98	7411	48.02

Table A3 A: Age Distribution of Population of DP Families, Gender-wise: Project-wise

Project Code		Below 7 Years		7 to 17 Years		18 to 39 Years		40 to 60 Years		Above 60 Years		Total	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
		P01	Male	43	12.54	73	21.28	128	37.32	74	21.57	25	7.29
	Female	43	12.99	68	20.54	136	41.09	65	19.64	19	5.74	331	49.1
	Total	86	12.76	141	20.92	264	39.17	139	20.62	44	6.53	674	100
P02	Male	70	12.01	89	15.27	241	41.34	141	24.19	42	7.20	583	49.7
	Female	86	14.55	98	16.58	225	38.07	122	20.64	60	10.15	591	50.3
	Total	156	13.29	187	15.93	466	39.69	263	22.40	102	8.69	1174	100
P03	Male	35	11.71	59	19.73	122	40.80	56	18.73	27	9.03	299	50.7
	Female	30	10.31	72	24.74	105	36.08	55	18.90	29	9.97	291	49.3
	Total	65	11.02	131	22.20	227	38.47	111	18.81	56	9.49	590	100
P04	Male	27	15.43	23	13.14	66	37.71	41	23.43	18	10.29	175	54
	Female	14	9.40	23	15.44	65	43.62	33	22.15	14	9.40	149	46
	Total	41	12.65	46	14.20	131	40.43	74	22.84	32	9.88	324	100
Total	Male	175	12.50	244	17.43	557	39.79	312	22.29	112	8.00	1400	50.7
	Female	173	12.70	261	19.16	531	38.99	275	20.19	122	8.96	1362	49.3
	Total	348	12.60	505	18.28	1088	39.39	587	21.25	234	8.47	2762	100.0

Table A3-B: Age Distribution of Population of AP Families, Gender-wise: Project-wise

Project Code	Below 7 Years		7 to 17 Years		18 to 39 Years		40 to 60 Years		Above 60 Years		Total		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
P01	Male	155	9.12	268	15.76	667	39.24	444	26.12	166	9.76	1700	50.4
	Female	173	10.36	256	15.33	646	38.68	445	26.65	150	8.98	1670	49.6
	Total	328	9.73	524	15.55	1313	38.96	889	26.38	316	9.38	3370	100
P02	Male	90	15.38	86	14.70	249	42.56	126	21.54	34	5.81	585	53.9
	Female	79	15.77	68	13.57	213	42.51	109	21.76	32	6.39	501	46.1
	Total	169	15.56	154	14.18	462	42.54	235	21.64	66	6.08	1086	100
P03	Male	74	11.28	104	15.85	284	43.29	139	21.19	55	8.38	656	51.9
	Female	76	12.50	108	17.76	250	41.12	134	22.04	40	6.58	608	48.1
	Total	150	11.87	212	16.77	534	42.25	273	21.60	95	7.52	1264	100
P04	Male	425	11.54	582	15.81	1478	40.14	835	22.68	362	9.83	3682	52.9
	Female	319	9.76	567	17.34	1339	40.95	776	23.73	269	8.23	3270	47.1
	Total	744	10.70	1149	16.53	2817	40.52	1611	23.17	631	9.08	6952	100
Total	Male	744	11.23	1040	15.70	2678	40.43	1544	23.31	617	9.32	6623	52.3
	Female	647	10.70	999	16.52	2448	40.47	1464	24.20	491	8.12	6049	47.7
Total	Total	1391	10.98	2039	16.09	5126	40.45	3008	23.74	1108	8.74	12672	100.0

Table A4: No. of DP & AP Women-headed Families: Project-wise

Project Code	Women- headed households DP		Women- headed households AP		Women- headed households Total	
	No.	%	No.	%	No.	%
P01	33	20.63	141	17.80	174	18.28
P02	53	17.26	52	20.39	105	18.68
P03	27	24.32	58	22.31	85	22.91
P04	11	12.08	252	15.77	263	15.6
Total	124	18.54	503	17.31	627	15.57

Table A5-A: Literacy Status of DP Family Members, Gender-wise: Project-wise

Project Code	Illiterate		Less than Primary		Primary < than Matric.		Matric. completed		+ 2 completed		Graduation and above		Technical education		Total	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
	I(1) Male	47	14.8	112	35.2	99	31.1	40	12.6	11	3.5	7	2.2	2	0.6	318
I(1) Female	97	31.5	103	33.4	75	24.4	21	6.8	11	3.6	1	0.3	0	0.0	308	100.0
I(1) Total	144	23.0	215	34.3	174	27.8	61	9.7	22	3.5	8	1.3	2	0.3	626	100.0
I(2) Male	26	4.9	194	36.3	191	35.8	50	9.4	36	6.7	29	5.4	8	1.5	534	100.0
I(2) Female	119	22.5	192	36.3	139	26.3	39	7.4	23	4.3	15	2.8	2	0.4	529	100.0
I(2) Total	145	13.6	386	36.3	330	31.0	89	8.4	59	5.6	44	4.1	10	0.9	1063	100.0
I(3) Male	20	7.3	83	30.4	125	45.8	21	7.7	18	6.6	3	1.1	3	1.1	273	100.0
I(3) Female	94	34.6	80	29.4	76	27.9	11	4.0	9	3.3	2	0.7	0	0.0	272	100.0
I(3) Total	114	20.9	163	29.9	201	36.9	32	5.9	27	5.0	5	0.9	3	0.6	545	100.0
I(4) Male	3	1.9	57	36.3	54	34.4	20	12.7	10	6.4	9	5.7	4	2.5	157	100.0
I(4) Female	16	11.3	48	34.0	51	36.2	11	7.8	10	7.1	5	3.5	0	0.0	141	100.0
I(4) Total	19	6.4	105	35.2	105	35.2	31	10.4	20	6.7	14	4.7	4	1.3	298	100.0
Total Male	96	7.5	446	34.8	469	36.6	131	10.2	75	5.9	48	3.7	17	1.3	1282	100.0
Total Female	326	26.1	423	33.8	341	27.3	82	6.6	53	4.2	23	1.8	2	0.2	1250	100.0
Total	422	16.7	869	34.3	810	32.0	213	8.4	128	5.1	71	2.8	19	0.8	2532	100.0

Table A5-B: Literacy Status of AP Family Members, Gender-wise: Project-wise

Project Code	Illiterate		Less than Primary		Primary < than Matric.		Matric. completed		+ 2 completed		Graduation and above		Technical education		Total	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%	No	%
	P01 Male	120	7.5	372	23.3	418	26.2	238	14.9	173	10.8	179	11.2	97	6.1	1597
P01 Female	246	15.7	462	29.4	387	24.6	156	9.9	145	9.2	137	8.7	38	2.4	1571	100.0
P01 Total	366	11.6	834	26.3	805	25.4	394	12.4	318	10.0	316	10.0	135	4.3	3168	100.0
P02 Male	40	7.7	170	32.7	166	31.9	50	9.6	42	8.1	37	7.1	15	2.9	520	100.0
P02 Female	90	20.2	153	34.4	114	25.6	39	8.8	26	5.8	22	4.9	1	0.2	445	100.0
P02 Total	130	13.5	323	33.5	280	29.0	89	9.2	68	7.0	59	6.1	16	1.7	965	100.0
P03 Male	29	4.8	131	21.7	231	38.2	79	13.1	53	8.8	47	7.8	34	5.6	604	100.0
P03 Female	108	19.2	134	23.8	199	35.3	48	8.5	38	6.7	28	5.0	8	1.4	563	100.0
P03 Total	137	11.7	265	22.7	430	36.8	127	10.9	91	7.8	75	6.4	42	3.6	1167	100.0
P04 Male	117	3.4	1075	31.6	944	27.8	556	16.4	300	8.8	308	9.1	99	2.9	3399	100.0
P04 Female	437	14.2	920	30.0	909	29.6	367	12.0	241	7.9	167	5.4	26	0.8	3067	100.0
P04 Total	554	8.6	1995	30.9	1853	28.7	923	14.3	541	8.4	475	7.3	125	1.9	6466	100.0
Total Male	306	5.0	1748	28.6	1759	28.7	923	15.1	568	9.3	571	9.3	245	4.0	6120	100.0
Total Female	881	15.6	1669	29.6	1609	28.5	610	10.8	450	8.0	354	6.3	73	1.3	5646	100.0
Total	1187	10.1	3417	29.0	3368	28.6	1533	13.0	1018	8.7	925	7.9	318	2.7	11766	100.0

Table A6.1: Area (in Hectares) of Homestead land owned by DP and AP Families: Project-wise

Project Code	DP			AP		
	No.	Total Area	Average Area	No.	Total Area	Average Area
P01	160	6.49	0.04	792	40.92	0.05
P02	307	11.70	0.04	255	14.03	0.06
P03	111	5.46	0.05	260	12.92	0.05
P04	81	4.58	0.05	1598	49.75	0.03
Total	669	28.23	0.04	2905	117.62	0.04

Table A6.2: Type of Houses owned by DP and AP Families: Project-wise

Project Code	Type of Houses	DP		AP	
		No.	%	No.	%
P01	Kuchcha	149	93.13	482	60.86
	Pucca	4	2.50	199	25.13
	Mixed	7	4.38	111	14.02
	Total	160	100	792	100
P02	Kuchcha	256	83.39	168	65.88
	Pucca	26	8.47	73	28.63
	Mixed	25	8.14	14	5.49
	Total	307	100	255	100
P03	Kuchcha	106	95.50	200	76.92
	Pucca	2	1.80	28	10.77
	Mixed	3	2.70	32	12.31
	Total	111	100	260	100
P04	Kuchcha	31	34.07	763	47.75
	Pucca	57	62.64	693	43.37
	Mixed	3	3.30	142	8.89
	Total	91	100	1598	100
Total	Kuchcha	542	81.02	1613	55.52
	Pucca	89	13.30	993	34.18
	Mixed	38	5.68	299	10.29
	Total	669	100	2905	100

Table A6.3: Basic Amenities in Houses owned by DP and AP Families: Project-wise

Project Code	Basic Amenities in Houses	DP		AP	
		No.	%	No.	%
P01	Electricity Connection	57	35.63	583	73.61
	Separate Toilet	30	18.75	320	40.40
	Separate Cattle-shed	113	70.63	531	67.05
P02	Electricity Connection	228	74.27	147	57.65
	Separate Toilet	136	44.30	72	28.24
	Separate Cattle-shed	208	67.75	162	63.53
P03	Electricity Connection	56	50.45	158	60.77
	Separate Toilet	7	6.31	48	18.46
	Separate Cattle-shed	92	82.88	168	64.62
P04	Electricity Connection	70	76.92	1124	70.34
	Separate Toilet	24	26.37	179	11.20
	Separate Cattle-shed	69	75.82	994	62.20
Total	Electricity Connection	411	61.80	2012	69.26
	Separate Toilet	197	29.62	619	21.31
	Separate Cattle-shed	482	72.48	1855	63.86

Table A7.1: Area of Agricultural Land owned by the DP and AP Families – Project-wise

Project Code	DP			AP		
	No. of families	Total area (in hectares)	Average area (in hectares)	No. of families	Total area (in hectares)	Average area (in hectares)
P01	122	77.45	0.63	734	1175.55	1.6
P02	249	241.6	0.97	232	214.16	0.92
P03	105	133.16	1.27	246	338.8	1.38
P04	84	43.79	0.52	1591	1016.34	0.64
Total	560	496	0.74	2803	2744.85	0.94

Table A7.2: No. of Landless DP Families Engaged in Cultivation: Project-wise

Project Code	Engaged in Cultivation as	DP	
		No.	%
P01	Share-cropper	7	4.38
	Tenant	0	0.00
	Encroacher	5	3.13
P02	Agricultural labourers	30	18.75
	Share-cropper	7	2028
	Tenant	0	0.00
P03	Encroacher	36	11.73
	Agricultural labourers	40	13.03
	Share-cropper	0	0.00
P04	Tenant	2	1.80
	Encroacher	4	3.60
	Agricultural labourers	5	4.50
Total	Share-cropper	2	2.20
	Tenant	0	0.00
	Encroacher	0	0.00
Total	Agricultural labourers	1	1.10
	Share-cropper	16	2.39
	Tenant	2	0.30
Total	Encroacher	45	6.73
	Agricultural labourers	76	11.36

Table A7.3-A: No. and Area of Lands (in hectares) Encroached by DP Families– Project-wise

Project Code	Revenue Lands			Forest Lands			Other Types of Lands		
	No.	Total	Average	No.	Total	Average	No.	Total	Average
P01	4	0.83	0.21	20	6.68	0.33	-	-	-
P02	80	51.03	0.65	80	59.49	0.73	-	-	-
P03	54	28.4	0.53	-	-	-	-	-	-
P04	6	4.33	0.73	-	-	-	-	-	--
Total	144	84.59	0.59	100	65.17	0.65	-	-	-

Table A7.3-B: No. and Area of Lands (in hectares) Encroached by AP Families– Project-wise

Project Code	Revenue Lands			Forest Lands			Other Types of Lands		
	No.	Total	Average	No.	Total	Average	No.	Total	Average
P01	16	8.50	0.53	181	100.08	0.57	1	0.97	0.97
P02	19	12.14	0.65	16	15.0	0.93	-	-	-
P03	122	72.03	0.61	4	4.45	1.13	2	1.13	0.57
P04	39	12.02	0.32	-	-	-	2	0.61	0.32
Total	196	104.69	0.53	201	119.53	0.59	5	2.71	0.54

Table A8: Occupational Vulnerability Status of DP and AP Families – Project-wise

Project Code	Occupational Status	DP		AP	
		No.	%	No.	%
P01	No. of Dependents	278	41.2	1790	53.1
	No. of Migrant Workers	0	0.0	3	0.08
	No. with Vocational Skills	17	2.5	358	10.6
P02	No. of Dependents	505	43.0	533	49.1
	No. of Migrant Workers	2	0.6	0	0.0
	No. with Vocational Skills	71	6.1	72	6.6
P03	No. of Dependents	247	48.9	578	45.7
	No. of Migrant Workers	5	0.8	60	4.7
	No. with Vocational Skills	25	4.2	134	10.6
P04	No. of Dependents	199	61.4	4327	62.2
	No. of Migrant Workers	0	0.0	3	.04
	No. with Vocational Skills	26	8.0	445	6.4
Total	No. of Dependents	1226	44.4	7228	57.0
	No. of Migrant Workers	7	0.2	66	0.5
	No. with Vocational Skills	139	5.0	1019	8.0

Table A9-A: No. of DP Families and Income from various sources – Project-wise

Project Code	Average Annual income per family from various sources (in Rs.)											
	Agriculture		Animal Husbandry		Labour (Farm)		Labour (Non-Farm)		From Trees owned		Collection of minor forest produce	
	No.	Income	No.	Income	No.	Income	No.	Income	No.	Income	No.	Income
P01	126	11503	32	5331	85	8305	126	23390	78	2964	108	4174
P02	262	30627	75	5183	119	6176	139	19926	210	5477	200	18204
P03	109	19755	63	9593	73	3787	90	14335	107	9264	104	9421
P04	74	25909	10	14360	7	5507	19	26137	51	12751	4	6525
Overall	571	23720	180	7263	284	6182	374	20063	446	6778	416	12254

Table A9-A Contd.

Project Code	Average Annual income per family from various sources (in Rs.)									
	Business & other self-employment		Salary		Pension & Other Remittances		Average Annual Income per Family			
	No.	Income	No.	Income	No.	Income	No.	Income		
P01	12	155828	31	79800	21	12686	160	66032		
P02	50	89433	97	100944	85	12144	307	104248		
P03	13	46808	30	62233	16	8475	111	80238		
P04	16	277825	36	120694	16	8850	91	134112		
Overall	91	125223	194	95244	138	11419	669	95187		

Table A9-B: No. of AP Families and Income from various sources – Project-wise

Project Code	Average Annual income per family from various sources (in Rs.)											
	Agriculture		Animal Husbandry		Labour (Farm)		Labour (Non-Farm)		From Trees owned		Collection of minor forest produce	
	No.	Income	No.	Income	No.	Income	No.	Income	No.	Income	No.	Income
P01	712	22326	72	6236	167	7002	327	22311	223	3981	201	4108
P02	196	19258	23	6283	71	6391	128	25083	122	3226	122	12747
P03	242	26013	41	7021	80	4970	116	19653	205	8830	143	7065
P04	1245	20267	183	8102	206	6225	669	26519	436	5133	16	1644
Overall	2395	21377	319	7411	524	6304	1240	24619	986	5405	482	7090

Table A9-B Contd.

Project Code	Average Annual income per family from various sources (in Rs.)							
	Business & other self-employment		Salary		Pension & Other Remittances		Average Annual Income per Family	
	No.	Income	No.	Income	No.	Income	No.	Income
P01	133	85783	298	218466	149	39124	792	137456
P02	30	109513	87	139740	94	11030	255	102007
P03	54	70541	107	124681	43	24753	260	116520
P04	140	192956	719	149514	417	21669	1598	119870
Overall	357	127500	1211	163585	703	24135	2905	122797

Table A9.1: Distribution of Annual Family Income of DP and AP Families– Project-wise

Project Code	Annual Family Income (in Rs.)	DP		AP	
		No.	%	No.	%
P01	< 50 000	101	63.1	341	43.1
	50 000 – 100 000	42	26.3	183	23.1
	100 001 – 200 000	10	6.2	111	14.0
	200 001 – 500 000	6	3.8	113	14.3
	> 500 000	1	0.6	44	5.5
P02	< 50 000	69	22.5	88	34.5
	50 000 – 100 000	120	39.1	88	34.5
	100 001 – 200 000	84	27.4	46	18.0
	200 001 – 500 000	33	10.7	29	11.4
	> 500 000	1	0.3	4	1.6
P03	< 50 000	29	26.2	51	19.6
	50 000 – 100 000	55	49.5	98	37.7
	100 001 – 200 000	24	21.6	79	30.4
	200 001 – 500 000	3	2.7	30	11.5
	> 500 000	0	0.0	2	0.8

Project Code	Annual Family Income (in Rs.)	DP		AP	
		No.	%	No.	%
P04	< 50 000	28	30.8	549	34.3
	50 000 – 100 000	28	30.8	506	31.7
	100 001 – 200 000	24	26.4	363	22.7
	200 001 – 500 000	10	11.0	150	9.4
	> 500 000	1	1.0	30	1.9
Total	< 50 000	227	33.9	1029	35.4
	50 000 – 100 000	245	36.6	875	30.1
	100 001 – 200 000	142	21.2	599	20.6
	200 001 – 500 000	52	7.8	322	11.1
	> 500 000	3	0.5	80	2.8
Total		669	100.0	2905	100.0

Table A9.2: Distribution of Annual Per-Capita Income of DP and AP Families– Project-wise

Project Code	Annual Family Per-capita Income (in Rs.)	DP		AP	
		No.	%	No.	%
P01	< 10 000	59	36.9	229	28.9
	10000 – 20000	74	46.3	234	29.6
	20001 – 40000	18	11.3	155	19.67
	40001 – 100000	9	5.6	113	14.3
	> 100000	0	0.0	61	7.7
P02	< 10 000	20	6.5	52	20.4
	10000 – 20000	121	39.4	95	37.3
	20001 – 40000	100	32.6	58	22.8
	40001 – 100000	61	19.9	41	16.1
	> 100000	5	1.6	9	3.5
P03	< 10 000	29	26.1	36	13.9
	10000 – 20000	53	47.8	99	38.1
	20001 – 40000	28	25.2	73	28.1
	40001 – 100000	1	0.9	47	18.1
	> 100000	0	0.0	5	1.9
P04	< 10 000	11	12.1	363	22.7
	10000 – 20000	30	33.0	552	34.5
	20001 – 40000	32	35.2	422	26.4
	40001 – 100000	16	17.6	231	14.5
	> 100000	2	2.2	30	1.9
Total	< 10 000	119	17.8	680	23.4
	10000 – 20000	278	41.6	980	33.7
	20001 – 40000	178	26.6	708	24.4
	40001 – 100000	87	13.0	432	14.9
	> 100000	7	1.05	105	3.61
Total		669	100.0	2905	100.0

Table A10: No. of DP and AP BPL* Families

Project Code	DP			AP			Total		
	No. of Families	No. of BPL Families	% of BPL Families	No. of Families	No. of BPL Families	% of BPL Families	No. of Families	No. of BPL Families	% of BPL Families
P01	160	96	60.0	792	262	33.1	952	358	37.6
P02	307	138	44.9	255	83	32.5	562	221	39.3
P03	111	90	81.1	260	83	31.9	371	173	46.6
P04	91	8	8.8	1598	488	30.5	1689	496	29.3
Total	669	332	49.6	2905	916	31.5	3574	1248	34.9

*BPL: Below Poverty Line

Table A11.1-A: Homestead Land loss Intensity of DP Families – Project-wise

Project Code	Intensity of loss of Homestead land					
	100%	66.67% - 99.99%	33.33% - 66.66%	0.01% - 33.32	0%	Total
P01	95	18	22	25	0	160
P02	286	11	10	0	0	307
P03	106	5	0	0	0	111
P04	68	13	9	1	0	91
Total	555	47	41	26	0	669
%	82.96	7.03	6.13	3.89	0.00	100.0

Table A11.1-B: Homestead Land loss Intensity of AP Families – Project-wise

Project Code	Intensity of loss of Homestead land					
	100%	66.67% - 99.99%	33.33% - 66.66%	0.01% - 33.32	0%	Total
P01	19	26	64	39	644	792
P02	49	19	27	24	136	255
P03	71	4	4	2	179	260
P04	11	19	9	4	1555	1598
Total	150	68	104	69	2514	2905
%	5.16	2.34	3.58	2.38	86.54	100.0

Table A11.2-A: Agricultural Land loss Intensity of DP Families – Project-wise

Project Code	Intensity of loss of Agricultural land					
	100%	66.67% - 99.99%	33.33% - 66.66%	0.01% - 33.32	0%	Total
P01	73	26	17	5	39	160
P02	147	14	28	23	95	307
P03	86	10	3	5	7	111
P04	33	28	21	3	6	91
Total	339	78	69	36	147	669
%	50.7	11.6	10.3	5.4	22.0	100.0

Table A11.2-B: Agricultural Land loss Intensity of AP Families – Project-wise

Project Code	Intensity of loss of Agricultural land					Total
	100%	66.67% - 99.99%	33.33% - 66.66%	0.01% - 33.32	0%	
P01	95	88	154	376	79	792
P02	28	21	39	120	47	255
P03	85	9	50	98	18	260
P04	58	96	354	1076	14	1598
Total	266	214	597	1670	158	2905
%	9.2	7.4	20.5	57.49	5.44	100.0

Table A12-A: Loss of Income - DP

Project Code	No. of Families	Income Earned		Income Loss		% Income Loss
		Total	Average	Total	Average	
P01	160	10565120	66032	5955019	37219	56.37
P02	307	32004136	104248	16708627	54425	52.21
P03	111	8906418	80238	6295287	56714	70.68
P04	91	12204192	134112	3272419	35961	25.81
Total	669	63680103	95187	32231362	48178	50.61

Table A12-B: Loss of Income - AP

Project Code	No. of Families	Income Earned		Income Loss		% Income Loss
		Total	Average	Total	Average	
P01	792	108865152	137456	26523606	33489	24.36
P02	255	26011785	102007	9532168	37381	36.65
P03	260	30295200	116520	12080800	46465	39.88
P04	1598	191552260	119870	48002934	30039	25.06
Total	2905	356725285	122797	96139590	33095	26.95

Inferential Statistics
Vulnerability Versus Impoverishment – DP

Vulnerability Risk	Impoverishment Risk			Total
	High	Medium	High	
High	188	345	136	669
Medium & Low	139	199	46	384
	49	146	90	285
	Low	Medium	High	669

			Expected Frequency distribution	chi-squared statistic	p - value
			107.9103	198.0269	78.06278
			80.08969	146.9731	57.93722
corresponding to each cell			8.957147	0.004782	13.16917
(actual freq - expected freq) ² / expected freq			12.06858	0.006443	17.74372
				51.94984	2.62E-12

Vulnerability Versus Impoverishment – AP

Vulnerability Risk		2215	244	446	Total
	High	1387	87	289	1763
	Medium & Low	828	157	157	1142
		Low	Medium	High	2905
Impoverishment Risk					

			Expected Frequency distribution	chi-squared statistic	p - value
			1344.25	148.0799	270.6706
			870.7504	95.92014	175.3294
corresponding to each cell			1.359568	25.19417	1.241243
(actual freq - expected freq) ² / expected freq			2.098878	38.89433	1.91621
				70.7044	2.22E-16