

Vulnerability Profile of Different Livelihood Groups in West Bengal

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ABSTRACT

A number of international agencies reflected concerns about the possible increase in vulnerability of populations across the world. This paper depicted the vulnerability profile of different livelihood groups in West Bengal. The findings of this study showed that labourers and crop farmers and rural artisan are particularly hit hard by any shocks with landless labour class suffered the most. Further, in terms of both exposure to shocks and its impact on the households the Darjeeling district was more vulnerable than Uttar Dinajpur district. The vulnerability index of Darjeeling District was 3.40 while in Uttar Dinajpur District it was 3.29. The study area was highly vulnerable to natural disaster, price falls of products due to market fluctuation, breadwinner's death and moderately vulnerable to illness, conflict. Higher exposure index for Darjeeling (19.76) indicated that shocks are more frequent there as compared to Uttar Dinajpur District (19.68). While higher impact index for the same region (15.40) indicated that the regions capacity to adopt and household's ability to cope with shocks are least in Darjeeling district. Households with better education, owning productive assets like land or cattle, having non-farm employment opportunities, income diversification and access to resources, higher social participation and markets were less vulnerable. All these have a large contribution in household income. Therefore, improving the ability of the poor to cope with vulnerability is the best way to reduce the impact of different shocks.

Key words: Livelihood; Vulnerability; Shocks; Adaptation;

The problems of poverty and vulnerability in the Indian context are generally associated with nature of the activities that poor and vulnerable groups engage in. Those who lack of assets, education and social networks are most likely to be found in the worst category. They also engage in activities that tend to be intermittent and seasonal so that they have to engage in a multiplicity of poorly paid occupations to survive. Vulnerability takes different forms because it reflects different causes. Like poverty, it can be structural in nature or it can be transitory, the product of temporal phenomena. It can be the product of idiosyncratic risks, which are unique to a household or individual. It can also reflect co-variate risks, which affect entire groups, communities.

In this paper vulnerability refers a combination of exposure to risk, sensitivity to shock (impact when it happens), and lack of resilience (to bounce back). Vulnerability is a dynamic concept, as it allows for changing processes and circumstances (Moser, 1998).

Chaudhuri, Jlan and Suryahadi (2002) pointed out that vulnerability is the ex ante risk that households will be poor, if not so currently, and if they are currently poor, the risk that they will remain poor. Poverty is therefore an ex post measure of wellbeing, and vulnerability an ex-ante measure (Chaudhuri, Jlan & Suryahadi, 2002; Kamanou & Murdudh, 2002). Vulnerability thus has two sides: an external side of risk or shock to which an individual or household is subject; and an internal side which is defenselessness, meaning a lack of means to cope without damaging loss. Vulnerability has physical, social and economic aspects with overlapping dimensions of sustainability, poverty, ecology and empowerment. People can become vulnerable due to several factors and poverty is one of them. Therefore, vulnerability is often discussed in relation to poverty. Vulnerability is also influenced by changes in climate variability as well as economic changes. Often, these changes interact with each other influencing the changes in the pattern and distribution

of vulnerability. On the other hand, shocks have a rapid on-set and result in an immediate impact. Examples are contagious diseases and collapses in market prices. A shock is a relatively short acting stress, such as drought, epidemic, or fall in output prices. However, the effects may be long-lived, or a series of individually minor impacts may 'ratchet up' into a major one over time. If shocks are more gradual, then they become a trend.

Reducing vulnerability is not simple. Policies and programmes are generally based on the assumption on how people live, what they need, and how they respond to crisis, incentives, regulation, and opportunities. Livelihood analysis helps improve such understandings, therefore, was used in this study. Further, the livelihood analysis puts vulnerable people and their priorities at the centre. The degree, to which a livelihood is able to insure against or mitigate risk, or to cope or adapt after a hazard, is central to our understandings of poverty and opportunity.

The possibilities for any large-scale adaptation programmes by governments in developing countries are few because of resource scarcity and immediate poverty eradication and development goals. Therefore, efforts by those who feel the impacts of shocks are crucial in ameliorating potential adverse impacts of shocks. The objective of the paper is to study the vulnerability profile of different livelihood groups towards major shocks that come frequently in people's livelihood and have an idea regarding the different factors determining households' vulnerability to shocks in selected districts of West Bengal.

METHODOLOGY

The study was conducted in the state of West Bengal. Vulnerability of different livelihood groups were assessed through household survey in Uttar Dinajpur and Darjeeling districts of West Bengal. These two districts also represent different type of agro-climatic and socio-economic conditions of the state. Besides, two blocks from each district and two villages from each block were also being selected randomly. Out of total households one twenty households from each district were selected in probability proportionate to different livelihood groups in the selected area as per their major occupation. Both secondary and primary data were used for the study. Village level information was collected from group interactions, taking inputs from panchayat officials and from government official in block and district

departments. The village heads, important decision makers, government persons living in the village or having knowledge about the village were thoroughly interviewed to collect information about the village, its resources, programmes and plans.

Measurements of vulnerability usually include both the sensitivity, which is the extent of the response, and the resilience, which is the ability to recover, of economic units to a shock (*Ligon & Schechter, 2003; Kamanou & Morduch, 2002; Hulme et al. 2001*). Vulnerability is a dynamic concept, as it allows for changing processes and circumstances. Here in this paper the vulnerability means a combination of exposure to risk, sensitivity to shock (impact when it happens), and lack of resilience (to bounce back).

To form vulnerability profile, it is important to know the prevalence of the different livelihood exist in the study area. The information about probability of different shocks that affect livelihood of the people was needed. The five most important shocks were listed with the help of suitable literature and consultation with experts. These were; illness, natural disaster, breadwinner's death, price fall, conflict. These are measurable and relatively easy to collect the required information. In this paper we find out the elements of livelihood vulnerability matrix in 5 point scale.

Livelihood sensitivity matrix : It provides a first-order vulnerability assessment based on expert judgment. This analysis works best if focused on livelihood groups against the events of shocks in a particular region or ecosystem. The purpose of the matrix is to show who is vulnerable and how different groups are sensitive to each climatic risk. The vulnerability matrix was constructed on the line of *Selvarajan and Roy (2004)*. The construction of such matrix requires the followings.

- Listing of livelihoods in the study domain along with their prevalence (Rows). The livelihoods groups were crop farmers, traders, labourers, formally employed, rural artisans, service providers.
- Listing of shocks (threats) along with probability of occurrence (Columns). On the basis of available literature; informal discussion with social scientists as well as formal authority of the study area, and from personal experience, the five major shocks were identified as illness, natural disaster, breadwinner's death, price fall of the product, conflict

- Filling in the matrix by taking the average score (5 point scale). Then using the values in rows and columns the matrix calculates exposure score, impact score, weighted exposure index and weighted impact index in the following way:
- *Exposure score*: Sum of the columns for each row divided by the total possible score. This is calculated against each shock.
- *Impacts score*: Sum of the rows for each column divided by the total possible score. This is calculated for livelihood groups.
- *Weighted exposure index*: This takes each cell in the row and multiplies it by the probability for the shock. The sum of these weighted values is then divided by the sum of the probability.
- *Weighted impact score*: As above, this takes each row in the column and multiplies it by the prevalence of each livelihood groups. The sum of these weighted values is then divided by the sum of the prevalence.

This two weighted index values are useful in comparing the sensitivity of different livelihood groups to different shock.

Household Vulnerability Index :In the study area not all the households are exposed to various shocks to the same extent. Therefore, in order to access the vulnerability to shocks at household level each household was asked to assign a hardship value, in a five point scale, against each types of shock that represents the extent of hardship faced by the concerned household during such extremes. A value of 5 meant extreme hardship and that of zero was for no impact (0=nil, 1=little, 2=moderate, 3=high, 4=very high, 5=extreme). Then using the long term probability of such shocks and the hardship value assigned by the households, a vulnerability index is constructed for each household.

$$\text{Vulnerability Index (VI)} = \sum P_i V_i \times 20$$

Where,

P_i = Probability of i th extreme events

V_i = Hardship value assigned to i th extreme events by the concerned household

This gives a weighted index of vulnerability to shocks at household level. In order to convert 5-point scale to percentage term we have multiplied the weighted sum by a factor 20. This vulnerability index (VI) is essentially the weighted impact index for the household and thus depends upon the probability of occurrence of different shocks. Another measure that

is independent of such probabilities of occurrences is Exposure Index (EI) and calculated as follows.

$$\text{Exposure Index (EI)} = \frac{1}{n} \sum V_i \times 20$$

where n =no of climatic extremes considered

Determinants of Household Vulnerability to shocks:

In this study, regression analysis was carried out to check the hypotheses that household vulnerability is a function of its exposure to various shocks as well as its coping capacity i.e., resource endowment, access to resources and facilities, sources of livelihood, caste, education, quality of life, etc. Accordingly, the vulnerability and exposure indices are modelled in a linear function of a set of determinants as given below.

$$VI = f(X_1, X_2, \dots, X_n) \quad \& \quad EI = f(X_1, X_2, \dots, X_n)$$

Where the following set of indicators was used as explanatory variable.

Resource endowment indicators:

X_1 = Resource possession (wealth ranking in 1-5 scale)

X_2 = Resource mobilisation potentiality

X_3 = Per capita cultivable land (acres/capita)

X_4 = Livestock asset (no/capita)

Poverty related indicators:

X_5 = Current category of ration card (1=below poverty line, 2=above poverty line)

X_6 = Per capita income (Rs/year)

Access and social capital related indicators:

X_7 = Social Participation

X_8 = Caste (1=general, 2=backward, 3=scheduled caste, 4=scheduled tribe)

X_9 = Family education Status

Livelihood diversification related indicators:

X_{10} = Share of non farm income in gross income of the family (%)

X_{11} = No of crop grown (No/capita)

X_{12} = No of activity (No.)

X_{13} = Extent of cash crop (%)

Quality of living related indicators:

X_{14} = Quality of dwelling unit (0=kuccha, 1=pucca)

X_{15} = Sources of drinking water (1=pond/dug well, 2=tube well, 3=piped water)

RESULTS AND DISCUSSION

Livelihood groups in Uttar Dinajpur District:

Although agriculture and its allied sectors remained central to the livelihoods of most of the poor, access to non-farm sources of income emerged as critical for moving up the income ranks. Diverse classes and castes engaged as agricultural labourer. There were clear

disparities in bargaining power, information on opportunities, and terms of employment among different livelihood groups. The poorest, landless and marginal households took what work there is locally at the beginning of the *kharif* season. Both poor and well-off farmers practiced sharecropping, agricultural labouring and borrowing. Paddy, vegetables and jute were major crops in this area. However presently a good number of farmers were diversified their crops to flower, oilseeds, pulses etc. Petty trading, locally called *pheriwala* was an important source of livelihood in the village where the job of the traders is to sale household items in other villages. Fishing, poultry were gaining popularity among large traders in this area. Mat weaving, basket making, rattan furniture were famous livelihood activity in this region. Many women were engaged in bidi, making, papad making etc.

Vulnerability profiles : Table.1 depicted the relative exposures to various shocks and their impact on livelihood groups. It showed that the livelihood group was at risk and which hazardous shock was more difficult to manage by the households. A large part of the region was dominated by rain-fed farming. Lack of rain fall in the time of *kharif* paddy caused crop loss and left farmers in very drastic situation. Then the farmers were forced to sell their own land or agricultural assets. Thus they had to shift into agricultural labour, migrant labour, fuelwood collection, or cattle herding. Sometimes the severe flood also led to substantial crop losses and large scale damage to dwelling units. Most of the households were vulnerable but the labourers and rural artisans suffered the most. They were more vulnerable because of their lack of access to education, their low wealth status, and lack of credit-seeking and utilisation behaviour, lack of power in decision making was also more likely to affect these groups and these

people may experienced it more difficult to access other means to diversify. They solely depended on their agricultural labour or at marginal land. They were trying simply to survive in a poorer, riskier world, rather than to improve livelihoods and invest in other production units. Employment fell sharply in calamity years. Natural disaster, illness cut-off their regular income and made their family more vulnerable. This resulted to increased food insecurity. In the time of shocks (market fluctuation, death of bread's winner, natural disaster) majority of them, eroded down the productive assets and diversified into many low return and push driven diversification activities for staying above destitution. They did not have the resources to make preparations of shocks. They were therefore more vulnerable to the impact of shocks and less able to seize new opportunities. The vulnerability index of Uttar Dinajpur district is 3.29.

Livelihood groups in Darjeeling: Large number of households in the Darjeeling district were characterised by high level of emigration (particularly of male), predominance by female-headed households. The poorest, landless and marginal households took any type of locally available work in the area otherwise migrated to seeking whatever work and returns they can. These households diversified to cope with underemployment. The small and marginal farmers access only low return land, get low-paid jobs, and invariably rely for credit on moneylenders or large farmers charging higher interest rates. They tend to get caught in low-return markets. In the time of shock they have little to draw on but their own labour, so tend to diversify into casual labour in construction, road building, collecting non-timber forest products, keeping goats and lower earning servicing activities such as shoe polishing, repair work etc. The bulk of the households were dependent on trading, crop farming and wage earning. Trader was the dominant

Table.1: Livelihood Vulnerability Matrix for Uttar Dinajpur district, West Bengal

Uttar- Dinajpur	Shocks	Illness	Natural Disaster	Bread earner's	Price fall	conflict	Exposure score	Weighted exposure
Livelihood	Probability Prevalence	0.09	0.15	0.15	0.14	0.05	58	19.68
Crop farmers	42.5	2.16	3.72	3.53	3.86	1.20	55	3.26
Traders	20	2.26	2.79	3.95	3.63	1.21	54	3.08
Labourers	10	3.20	4.20	4.00	3.83	0.80	60	3.62
Formally employed	5	2.17	2.50	4.00	2.86	1.17	57	2.81
Rural artisans	12.5	3.18	4.00	4.25	4.00	1.00	59	3.68
Service Providers	10	2.22	4.00	3.44	3.67	0.78	56	3.23
Impact score	100	51	71	77	73	21	-	-
Weighted impacts	14.62	2.42	3.58	3.77	3.76	1.09	-	3.29

livelihood group in the study area. The value of traditional skill had gone down to such an extent that this region was seen as a reservoir of unskilled labour. Farming in this area was rain fed with perennial and seasonal springs competing for drinking and irrigation requirements. Majority of the farmers were small and marginal having operational holding less than one hectare. Rice, maize, citrus, gladiolus, vegetables cultivation were the dominating activities for cultivator group. Large number of households was dependent on livestock and non-farm activities like handicrafts, trading etc.

Vulnerability profiles: The vulnerability profile of the major livelihood groups in the study area was presented in Table 2. From the table, it was evident that all the major livelihoods were at risk but labourers and crop farmers being the most vulnerable among all. They were much more vulnerable to shocks than others because:

- They were exposed to more shocks (e.g. due to climatic factors where they live);
- They were less able to cope with its immediate aftermath (more sensitive);
- They were less able to bounce back in the longer-term (less resilient).

Sensitivity and resilience were highly dependent on the household's financial health, and ability to deal with change. These in turn depended on their diversification options and their access to or exclusion from key markets and opportunities. Even the small traders/businessmen and the people engaged in service were highly vulnerable, as natural disaster spared none. Severe frost and heavy cold were the most difficult climatic hazard in this area. Maize cultivation was the dominating activities for crop farming group. Livestock rearing was mostly integrated with crop farming in this area which was affected by the heavy rain and flood. During heavy rain and cold livestock were particularly

vulnerable, as the poor households even couldn't think of providing them concrete cattle shed. Farmers were resource poor and heavily depended on crop farming for their livelihood. The options, other than crop farming, available to them were limited as maximum households in this livelihood group did not have any other source of income. Any damage of crops and market fluctuation made their livelihood more miserable. The labour households did not have enough capacity to cope with recurrent disasters. Even short-term necessity made them to draw down assets, leaving it more vulnerable to future shocks and less able to break out of exploitative market arrangements. Its ability to increase earnings was therefore heavily constrained, and the chance of earning enough to produce a surplus and kickstart investment was small. On the other hand, a good number of households from the livelihood groups of trader, formally employed were able to prepare for change before it happen ('ex ante'). They diversified across different activities or built up liquid assets, or buffers, to draw upon when shocks hit. If a specific negative change can be predicted (e.g. fall in price of a crop, spread of a disease), they can take evasive action or insure themselves (by switching to other activity/labour-uses, health insurance). If a positive change can be predicted, they can build up the necessary skills or tools to seize the opportunity when it arises. The vulnerability index of Darjeeling District is 3.40

The findings of this study showed that labourers and crop farmers and rural artisan were particularly hit hard by any shocks with landless labour class suffered the most (Table.3). Due to over dependence on crop cultivation especially rain fed rice, in most cases the farmers lost their only source of livelihood. Either they lost the standing crops or could not plant them again, once the early drought/flood is over, due to poor irrigation

Table 2: Livelihood Vulnerability Matrix for Darjeeling district, West Bengal

Darjeeling	Shocks	Illness	Natural Disaster	Bread earner's	Price fall	conflict	Exposure score	Weighted exposure
Livelihood	<u>Probability Prevalence</u>	0.09	0.15	0.15	0.14	0.05	58	19.68
Crop farmers	30	3.25	4.20	3.98	4.00	1.45	68	3.72
Traders	32.5	2.18	3.10	3.77	3.82	1.09	56	3.13
Labourers	12.5	4.50	3.90	4.40	3.94	1.22	72	3.92
Formally employed	5	2.00	1.50	4.00	2.67	0.67	43	2.39
Rural artisans	10	2.00	3.71	4.00	3.43	1.71	59	3.24
Service Providers	10	2.22	4.00	3.44	3.67	0.78	56	3.23
Impact score	1100	79	66	58	24	72	-	-
Weighted impacts	15.40	3.92	3.54	2.90	1.26	3.78	-	3.40

Table 3: Comparative vulnerability profiles of the study locations

Study area	State	Impact Index	Exposure	Index Index	Most sensitive shock	Most vulnerable livelihood
Darjeeling	West Bengal	15.40	19.76	3.40	Market fluctuation, Natural disaster	Labourers and crop farmers
Uttar Dinajpur	West Bengal	14.62	19.68	3.29	Breadearner's death, Natural disaster	Labourers and rural artisan

facilities. Sometimes crop damaged drastically due to pest and disease attacks. After damaging crop the farmers had left nothing to repay the loan to moneylender. Even to meet the basic needs of the family they had to erode the productive assets which made their condition more susceptible to future shocks. As a consequence, the labourers could not find employment within the village. They tried to get employment through migration and/or wage earning under government sponsored various employment generation schemes but those were not sufficient. Rural artisan also solely depended on one activity. In case of lack of market and price fall their life saving income reduced. Illness also cut down the income. Sudden death of breadwinner made the rest of family hopeless.

Further, in terms of both exposure to shocks and its impact on the households the Darjeeling district was more vulnerable than Uttar Dinajpur district. Higher exposure index for Darjeeling indicates that shocks were more frequent there as compared to Uttar Dinajpur.

While higher impact index for the same region indicates that the regions capacity to adopt and household's ability to cope with shocks are least in Darjeeling district.

Determinants of household vulnerability : In this study, regression analysis was carried out to check the hypotheses that household vulnerability is a function of its exposure to various shocks as well as its coping capacity i.e., resource endowment, access to resources and facilities, sources of livelihood, caste, education, quality of life, etc. Fifteen variables considered for regression analysis (Table.4). These 15 variables together explained more than 52 per cent variation in the household vulnerability. The regression analysis showed strong negative relationship between per capita income and vulnerability i.e., poor people are more likely to suffer from shocks. There was significant negative relationship between quality of residential units and vulnerability. The reason was simple as in one hand *kutchha* houses are more prone to flood and cyclone, on the other hand such houses are mostly owned by the

Table 4: Determinants of vulnerability from shocks

Determinants	Vulnerability Index	t-value	Exposure Index	t-value
Constant	+44.301	+67.85	+30.314	+82.12
Resource possession(1-5 scale)	-0.004	-3.29	-0.105	-4.11
Resource mobilisation potentiality	-0.003	-3.22	-0.092	-4.47
Land holding (acre/capita)	-0.009	-0.77	-0.015	-0.98
Livestock asset (no/capita)	-0.062	-5.39	-0.161	-5.30
Ration card category (BPL/APL)	-0.270	-1.17	-0.705	-4.28
Per capita income (Rs/annum)	-0.021	-4.15	-0.188	-4.98
Social participation	-0.450	-2.80	-.119	-2.25
Caste	+0.011	+1.62	+0.030	+1.24
Family education status	-0.011	-2.13	-0.081	-3.27
Share of non-farm income sources (%)	-0.051	-3.26	-0.005	-2.14
Number of crop grown(no/capita)	-0.571	-0.86	-0.015	-1.10
Number of activity	-0.019	-2.03	-0.050	-1.47
Extent of cash crop	-0.189	-2.18	-0.049	-1.70
Type of dwelling unit (Pucca/kuccha)	-0.290	-3.17	-0.040	-2.24
Source of drinking water	-0.041	-2.00	-0.108	-2.12
No of observation	240	-	240	-
Adjusted R ²	0.5246	-	0.5295	-

poor people. As expected, off-farm income or employment acted as a buffer with shock stress. Households that were more diverse and rely on livestock activities appear to have a consistent income in crisis period. Poor and underprivileged households seem to have little access to resources or support systems and thus most vulnerable to any kind of extreme events. They were not only the most vulnerable to different shocks but any such events forced them to sell their productive assets and thereby reinforce the poverty permanently. The negative correlation between vulnerability and literacy was also on the expected line. In fact those engaged in salaried job or trading are better educated than casual labours, artisans and crop farmers. The poor were more vulnerable to natural disasters as they normally have limited savings to tide over the crisis period. Their lower caste status, limited assets and weak contacts with sources of power/governance structures affected them adversely during the time of crisis.

What do these results mean in terms of coping and adaptation? The regression results indicated that vulnerability is not entirely the result of shocks. Shocks only increased the vulnerability of those who were even otherwise vulnerable to all kinds of crisis. Households with better education, owning productive assets like land or cattle, having non-farm employment opportunities, income diversification and access to resources, higher social participation and markets are less vulnerable. All these have a large contribution in household income. Therefore, improving the ability of the poor to cope with vulnerability is the best way to reduce the impact of different shocks.

CONCLUSION

Recurring climatic hazards such as flood, drought, frost and other shocks in the study area have made the rural population extremely vulnerable. To minimize the

losses in such exigencies and to safeguard the livelihood of the people it is necessary that a system be created for increasing preparedness at all levels i.e. government, civil society and community itself. This paper revealed that coping mechanisms to reduce vulnerability that were adopted by households in the study area provide them with greater flexibility to reduce different types of shock. These coping mechanisms were able to sustain the poor people but only at marginal level (economically, ecologically, and geographically).

Although, shock is a part of livelihood, and cannot be totally escaped. But household's vulnerability to various crises can be managed and its effects can be reduced to certain extent. Nonetheless, continued investment on rural infrastructure, particularly road and irrigation; programmes for encouraging forests and water harvesting; efficient public distribution system and relief mechanisms through engaging village level organizations; and targeted cash transfers and credit programmes to poor are needed to reduce the sufferings of the poor in the study area. It can be concluded that vulnerability is not entirely the result of shocks. Shocks only increase the vulnerability of those who are even otherwise vulnerable to all kinds of unexpected events. Improving the ability of the poor to cope with vulnerability is the best way to reduce the impact of crisis period. Disaster mitigation efforts should also need to look at ways and means to improve the livelihoods of the poor. Therefore, there is an urgent need for shift in focus from food aid to long-term mitigation measures such as drought proofing, development of resistant cultivars (against drought, flood and salinity), infrastructural development in terms of road and irrigation, self-help group formation and generating non-farm employment opportunities.

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REFERENCES

- Chaudhuri, S., Jalan J., Suryahadi A. (2002). Assessing household vulnerability to Poverty from cross-sectional data: A methodology and estimates from Indonesia. Columbia University, Deptt. of Eco., Discussion Paper Series 0102-52.
- Hulme, M., Doherty R., Ngara T., New M., Lister D. (2001). African climate change: 1900-2100. *Climate Research*, **17**, 145-168.
- Kamanou, G and Murdugh, J (2002). Measuring vulnerability to poverty. NYU Wagner
- Ligon, E., Schechter, L. (2003). Measuring vulnerability, *Economic Journal*, **113**: C95-C102
- Moser, C. (1998). The asset vulnerability framework : reassessing Urban Poverty Reduction Strategies. *World Dev.*, **26**: 1-19.
- Selvarajan, S., Roy, B.C. (2004). Resource analysis for sustaining water-food security, proceedings series 12, National Centre for Agricultural Economics and Policy Research, New Delhi, xvi : 215.

