29th WEDC International Conference Abuja, Nigeria, 2003

TOWARDS THE MILLENNIUM DEVELOPMENT GOALS

Understanding vulnerability in the Niger floodplain

Tamuno, P.B.L., Ince, M.E., and Howard, G., UK

ALL OVER THE world, vulnerable people often suffer repeated, multiple, mutually reinforcing shocks to their lives, their settlements, and their livelihoods (Blaikie, *et al.* 2001), with people living in hazard-prone areas in developing countries being the most vulnerable (Miller, 1997). Vulnerability to hazard or disaster is the product of interaction between the ecosystem (of which people are an integral part), and human socio-economic arrangements that are used to flourish and prosper within the environment (Alley, 1993).

People are particularly vulnerable if they have weak social supports and limited resources available to help them to cope after damaging loss of physical assets (Neefjes, 2000). Vulnerability is a measure of the susceptibility of individuals or groups to fail, or fail to recover after exposure to stress, shock and or hazards within a reasonable time frame (Lewis, 1999). In contrast, resilience is the capabilities of individuals or groups to cope and withstand stress, shocks, and or hazards. The higher the level of vulnerability of individuals or groups, the lower their resilience and ability to reconstruct their livelihoods following disaster.

Poverty and livelihood components are functions of vulnerability and resilience, and the magnitude of "resultant vulnerability" of individuals or groups is a holistic measure of their vulnerability and resilience indices. The authors defined "resultant vulnerability" as the difference between traditional vulnerability and resilience.

The current understanding of "resultant vulnerability" is inadequate, because most researchers have focused primarily on vulnerability and poverty reduction, while the issue of resilience of the residents of hazard-prone areas has received little attention in the context of hazard mitigation and poverty reduction. Flooding affects a far greater number of people than any other natural disaster; consequently, for residents of floodplains their vulnerability (and its range) may be wider than for communities affected by most other natural hazards.

This paper aims to investigate an appropriate method for understanding and including resultant vulnerability to hazard (flood level, hazard severity and flood return periods) in flood mitigation and poverty reduction strategies. The study area is Bayelsa State, which is located in the Niger Delta region of Nigeria.

Study area

Flooding remains an integral part of the natural development of the Niger Delta because of the relatively low, flat, and poorly drained terrain whose elevations does not exceed 30m inland and 8m at the coast above sea level (Abam, 1999; Okagbue, 1989). In the Niger Delta, flood hampers agricultural development and severely affecting the livelihoods of residents of this region (Perins, and Opdam, 1981). The numbers of the poor are increasingly and unacceptably high in the Niger Delta region (NDES, 1997). Bayelsa State is located within the Niger and lower Niger floodplain in the Niger Delta region. It has a population of about 1.6 million based on projections from the Nigerian 1991 census. Almost all communities in Bayelsa annually experience the devastating effect of floods, though in varying degrees. The annual inundation of this region impacts on livelihoods particularly those of residents in rural communities. Two communities prone to river flooding located in different geographical locations of Bayelsa State were selected for field studies: these were Otuobhi and Odi (see Figure 1).

Methodology

A questionnaire was designed to investigate traditional vulnerability and resilience and, hence, resultant vulnerability to flood hazard. A stratified sampling technique was adopted to ensure data collected provided representative perceptions, experiences, and resilience capabilities, of those vulnerable to flooding in Bayelsa. In July 2001, face-to-face questionnaires were administered to 26 and 27 respondents from Odi and Otuobhi, respectively. Respondents were drawn from all nine compounds in Odi (New Layout, Colony, Ifidi, Ebereze, Ubaka, Ogboloma, Oborigbengha, and Isuonbiri) and all five compounds in Otuobhi (Abile, Agili, Awoli, Obumunu, and Omomema). The data collected were analysed and used to develop a vulnerability and resilience matrix based on risks associated with residing in rural flood-prone communities in Bayelsa State. The principle used was that of a weighted matrix, which emphasises magnitude and significance of components of impacts, and has been reported to be easily understood and could be applied in a wide range of impact assessment (Glasson, *et al.,* 1999).

*Corresponding author: Email: P.B.L.Tamuno@lboro.ac.uk

Table 1. Vulnerability and resilience matrix

Vulnerability Index	Component	Weighting	Significance	Resilience Index	Component	Weighting	Significance
Location	Odi Otuobhi	**6**	**xxxx** **xxxxx**	**Other income earners/ household**	None 1 2 3 4 5 and above	**8**	**Nil** + ++ +++ ++++ +++++
Sex	Male Female	**5**	**xxx** **xxxxx**	**Educational Qualification**	Graduate NCE/Diploma SSC PSC None	**7**	+++++ ++++ +++ ++ +
Compound	**Odi**: Category A Category B Category C **Otuobhi**: Category A Category B	**5**	**xxxxx** **xxx** **xx** **xxxxx** **xxxx**	**Artisan Skill(s)**	Carpentry Canoe Carving Masonry Elect./Electronics Auto mechanics Others None	**5**	+++ +++ +++ ++ ++ ++ Nil
Physical Assets	Farm Land (Category A) Farm Land (Category B) Farm Land (Category C) House (Cement-block) House (Plank)/wood) House (Mud) None	**10**	**x** **xx** **xxx** **x** **xx** **xxx** **xxxxx**	**Average Income (N/cap/month)**	< N5, 000 5, 000 ≤ 13, 000 13, 000 ≤ 22, 000 22,000 ≤ 30, 500 ≥ N30, 500	**10**	+ ++ +++ ++++ +++++
Source(s) of income	Formal: Civil servant/Pension Farming Fishing Farming and Fishing Trading / Commerce Others	**10**	**x** **xxxx** **xx** **xxx** **xxx** **xxx**	**Assets**	Dug-out Canoe: Large Medium Small Fishing pond: 50 m^2 25 m^2 Less than 25 m^2 Set of Fishing gears Economic trees: Above 30 Between 10 & 30 Less than 10	**8**	 ++++ +++ ++ ++++ +++ ++ ++ ++++ +++ ++
Type of House Lived in	Mud walled House Plank House Cement Block House	**8**	**xxxxx** **xxxx** **xx**	**Social Net work**	Yes* No*	4	++ +
Dependents	None 1 2 3 4 5 and above	**8**	**Nil** **x** **xx** **xxx** **xxxx** **xxxxx**				
Age	Less than 5 Between 5 and 15 Between 15 and 65 Above 65	**6**	**xxxxx** **xxxx** **xxx** **xxxxx**				
Height of House Foundation	Less than 0.4 m Between 0.4 and 0.8 m Between 0.8 and 0.12 m Between 1.2 and 1.6 m Between 1.6 and 2. 0 m	**8**	**xxxxx** **xxxx** **xxx** **xx** **x**				

Level of Significance

Very minor Impact/ Asset	x	+
Minor Impact/Asset	xx	++
Significant Threshold	xxx	+++
Major Impact/Asset	xxxx	++++
Very major Impact/Asset	xxxxx	+++++

Yes*: Membership of cooperative associations; No*: Depends only on family and friends
SSC – Secondary School Certificate; PSC – Primary School Certificate

Results and discussion

Vulnerability and livelihoods

The literature supports the view that vulnerability is dynamic because it depends upon conditions that are continually changing over time. Changes in social and economic conditions may bring about an increase, or decrease, in vulnerability, even where the context of recurrent natural hazards remains constant (Lewis, 1999). Vulnerable conditions are far more prevalent in developing countries, because the level of resilience is low, and these countries lack and, or do not have appropriate level of preparedness measures, such as insurance and social security.

The loss of a home is a major livelihood set-back, because of the burden on limited finances in providing some replacement. This cost may not be in terms of cash outlay, but instead the loss of time which would otherwise be used in livelihood activities. Other losses may be directly disruptive of household livelihood. For poorer families, agricultural loss may perhaps be the most serious aspect of flooding. In many areas of the world, there is an unhappy coincidence because the season in which floods are more likely to occur is also the one in which the crops ripen for harvest (Blaikie, *et al.,* 2001). The harvest season for most annual crops cultivated in the Niger floodplain coincides with the annual flood periods, which is usually between August and November.

Vulnerability is compounded by the degree to which a community is at risk and to which socio-economic and socio-political factors affect the community's capacity to absorb and to recover (Lewis, 1999). Mapping vulnerability is complex because investigations of vulnerability are investigations into workings of human society, and human societies are complex and diverse that cannot be confined within neatly drawn frameworks, models, categories and definitions (Twigg, *et al.,* 1998).

The consequences of living in floodplains are, therefore, widespread, variable and dynamic depending on the "resultant vulnerability" of individuals within households and communities. The components of the resilience and vulnerability are indications of the severity of the impact of flood

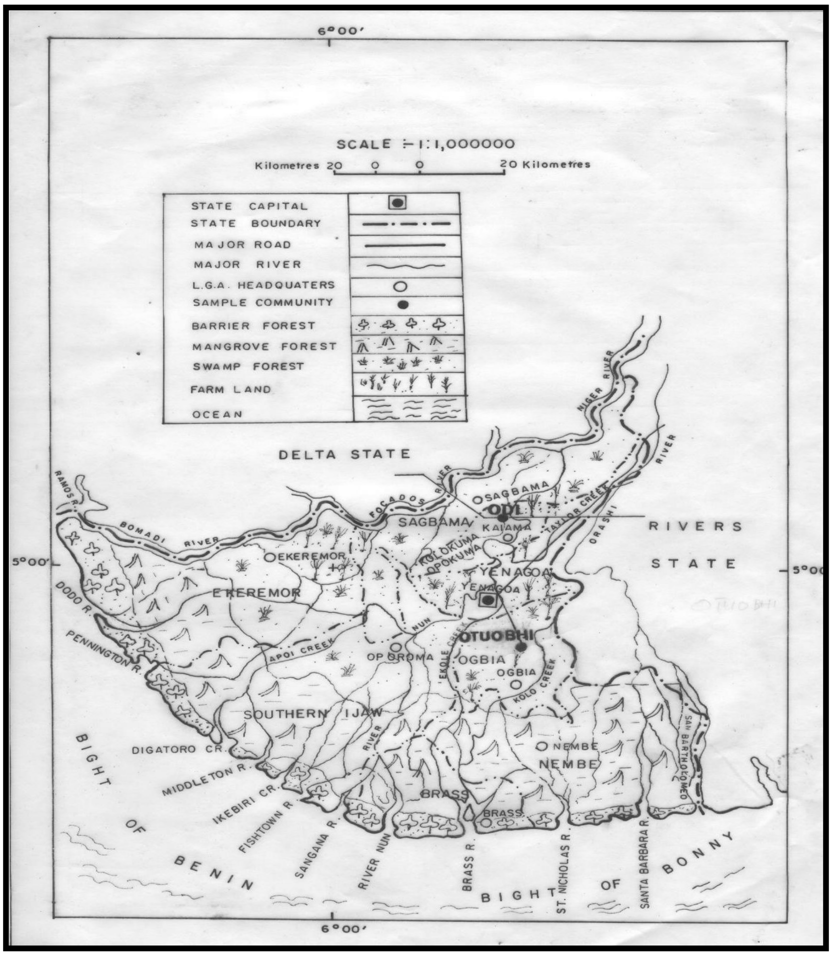

Figure 1. Map of Bayelsa showing sample communities

on population at risk and vary within and between geographical locations. The major components identified from the literature review and the questionnaires included: livelihoods, household incomes, house type and foundations (height above ground level), educational qualification, physical and social assets and flood exposure level (highest floodwater mark).

Vulnerability and Resilience Matrix (table 1)

The matrix was developed by assigning weights to components that contributed to resultant vulnerability. The weighting criteria used in the matrix were assigned based on the perception of the respondents from the sample communities on the degree of resilience or susceptibility to flooding. For example, respondents identified their means of livelihoods as their major concern whenever it floods, the disruption of which often leads to economic hardship and poverty, hence it was assigned a relative weighting of 10. In contrast, criteria such as geographical location of the sample community, artisanal skills, social network, age, sex, or compound lived in are all of relatively lower relevance as resilience/vulnerability factors, so are assigned weightings of 6, 5, 4, 6, 5, and 5 respectively. The weighting for all factors considered are summarised in table 1.

The highest floodwater mark on the walls of buildings in both sample communities was 1.5 metres (as measured during the survey). However, these communities have been assigned different vulnerability based on the differences in the availability and accessibility to social services. Furthermore, because compounds within each community differed in their susceptibility to flooding, they were categorised, based on the relative flood level marks on the walls of the buildings, with **A** representing the most vulnerable and **C** the least vulnerable. This same criterion was used to classify farmlands.

The matrix could be used for floodplain mapping in small catchment in areas where peoples livelihoods are affected by flooding, in developing flood mitigation approaches relevant to livelihoods and aimed at poverty reduction in Bayelsa State and could be adapted for other areas unsafe due to natural hazards.

Conclusion

This paper advocates that the understanding of "resultant vulnerability" should be an important prerequisite and component of sustainable flood mitigation and poverty reduction. This approach has been developed through the analysis of the impact of flood and flood mitigation in Bayelsa State, Nigeria. A considerable proportion of the world poor live and earn the livelihoods in unsafe areas such as floodplains, and halving this proportion by 2015 may be daunting. Adopting the holistic "resultant vulnerability" approach in the flood mitigation and in developing appropriate and effective poverty reduction strategies could improve the present trends towards achieving this MDG in developing countries.

References

Abam, T. K. S. (1999). "Impacts of dams on the hydrology of the Niger Delta." Bulletin of Engineering Geology and Environment 57: 239-251.

Alley, E. E. (1993). Combating the vulnerability of communities. In Merriman, P. A., and Browitt, C.W.A. (Eds.) Natural Disasters: Protecting Vulnerable Communities. Proceedings of the Conference held in London, 13 - 15 October 1993. Thomas Telford, London, UK.

Blaikie, P., Cannon, T., Davis, I., and Wisner, B. (2001). At Risk: natural hazards, people's vulnerability, and disasters Routledge, London, UK.

Glasson, J., Therivel, R., and Chadwick, A. (1999). Introduction to Environmental Assessment The Natural and Built Environment Series, University College London (UCL), London, UK.

Lewis, J. (1999). Development in Disaster-prone Place: Studies of vulnerability Intermediate Technology Publications Group, London, UK.

Miller, J. B. (1997). Floods - People at Risk, Strategies for Prevention United Nations Department for Humanitarian Affairs, New York and Geneva.

NDES.(1997). Niger Delta Environmental Survey Phase 1 Report. Niger Delta Environmental Survey (NDES), Lagos, Nigeria

Neefjes, K. (2000). Environments and Livelihoods: Strategies for Sustainability Oxfam GB, Oxford, UK.

Okagbue, C. O. (1989). "Geotechnical and environmental problems of the Niger Delta." Bulletin of the International Association of Engineering Geology.

Perins, A., and Opdam, H.J. (1981). Long Term and Short Term Development of the Niger Delta. Seminar on Flood and Erosion in the Niger Delta (25th - 26th March 1981), Port Harcourt, Nigeria.

Twigg, J., and Bhatt, M.R. (1998). Understanding Vulnerability: South Asian Perspectives Intermediate Technology Development Group, London, UK.

TAMUNO P.B.L., INCE M.E. AND HOWARD, G, Water Engineering and Development Centre (WEDC), Institute of Development Engineering (IDE), Loughborough University, Leicestershire, UK