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Adaptive Responses to Flooding Incidents in Ilorin, Kwara State, Nigeria

Habiba I Jimoh, *University of Ilorin*
Kayode A Iroye, *University of Ilorin*

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Adaptive Responses to Flooding Incidents in Ilorin, Kwara State, Nigeria

H.I. Jimoh (PhD) and K.A. Iroye (PhD)

Abstract
Incidents of floods which are mainly caused by changes in landuse is fast becoming a city life experience in Ilorin as in most urban centres in Nigeria causing untold hardships and sometimes loss of lives. This extreme hydro-meteorological event is also being exacerbated by climate change which thus calls for adaptive response by residents towards reducing its risks, hence this study. Data used were generated from direct field measurements and questionnaire administration. Descriptive statistics and cross tabulations were used in analyzing the data. Results obtained indicate that most respondents use a wide range of non-structural adaptive response to flood. The study also revealed that respondents in the study have low adaptive capacity which is a function of their low socio-economic characteristics, hence their occupation of flood plains for building purposes. The study thus suggests a number of recommendations towards abating flood risk in the city.

Keywords: Adaptive, Responses, Flooding, Incidents, Ilorin, Nigeria

Introduction

Excessive release of greenhouse gasses (C02, CH4, CFs, N020) into the atmosphere by man trap much of the heat that would otherwise escape from the earth, resulting in global warming (Ayoade, 2004) . This produces diverse effects on both physical and biological systems. McCarthy *et al.*, (2001) identified some observed changes with linkage to climate change to include shrinkage of glaciers, coastal storm surges, high temperature, intense wind and high precipitation.

Effects of climate change according to Adefolalu (2007) is already taking place at the local level in Nigeria, especially in the Sudano-Sahelian ecological zone where cases of drought, desertification, increased temperature and flooding has been widely reported (Babatolu, 1998; Mortimore and Adams, 2001; Odekunle, Andrew and Aremu, 2008; Jimoh, 2010). The frequency and intensity of climate change disasters such as flood have badly affected many urban centres in Nigeria (Rasid, 1982; Odemerho, 1988; Emuh, 2007; Tobrise, 2007; Iroye, 2008).

Essentially, flood is any high stream flow which overtops natural or artificial banks of a stream. Flooding when it occurs affects landuses adjacent to the affected stream, river or channel causing great losses of lives and properties (Jimoh, 2003).

Correspondence Author: Dr H.I Jimoh Email: drhijpapa@yahoo.com
Department of Geography and Environmental Management, University of Ilorin, Nigeria

According to United Nations (2001), floods have the greatest damage potential of all natural disasters worldwide and affect the greatest number of people. In same vain, International Federation of Red Cross and Red Crescent Societies (2001, 2003) reports that weather related disasters from a global perspective have been rising since 1996 and increasing from an annual average of 200 (1993-1997) to 331 (1998 – 2002).

Climate change influence flooding because hydrological response of any drainage basin is principally defined by the production of runoff against a given rainfall, though soil characteristics and basin geomorphology have their roles (Iroye, 2008). Increase in flood damages can thus be linked to global warming which is leading to more intense storms (Green, 1999; Emuh, 2007). However, since mankind cannot possibly avoid the causes of climate change and its follow up effects for now, it is then necessary to develop coping strategies towards reducing its negative effects.

Ward (1978), identified four main thrusts of flood studies to include

(i) Understanding of natural and man induced reasons for flooding,
(ii) Evaluating and educating man's awareness of flood hazards,

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(iii) Prediction of flood frequency; and
(iv) Development of sound economic responses to flood situation through properly costed programme of adjustment, abatement and protection.

This study was carried out to fulfil the forth objective by investigating residents adaptive responses to floods in Ilorin; a city where flooding as for sometimes now being a common occurrence (Table 1).

Result of this investigation will not only aid in curtailing the extreme hydro-meteorological event in the city, but will also help in developing flood management strategies. Essentially, Adeloye, (2008) has observed that human need to adapt and adjust to the evolving features of climate change.

Study area

Ilorin, the capital city of Kwara State, Nigeria is the study area in this investigation and the experimental sites are the four urbanized basins of Agba, Alalubosa, Aluko and Okun river catchments (Fig. 1). Ilorin lies on latitude $8^0 30^'$N and longitude $4^0 35^'$E. The city has humid tropical climate and it is characterized by wet and dry seasons (Ilorin Atlas, 1981).

Wet season in the town begins towards the end of March when Tropical maritime airmass is prevalent and ends in October, often abruptly. Dry season in the town begins with the onset of Tropical continental airmass which is predominant between the months of November and February. The mean annual total rainfall for Ilorin is 1200mm (Olaniran, 2002). Analysis of rainfall values for the town shows that rainfall sparsely occur in the months of January, February, November and December (Oyegun, 1983). Rainfall concentration is usually between the months of March and October, exhibiting double maxima rainfall pattern with peak periods in the months of June and September and a period of dry spell in July. Temperature in the town is uniformly high (between 25^0c – 28^0c) and open-air insolation can be very uncomfortable during the dry season (Oyegun, 1983). Evaporation values in Ilorin range between 3.1mm and 7.8mm while potential evapotranspiration is usually highest in January. Ilorin is covered mainly by ferruginous tropical soil on crystalline acidic rock (Areola, 1978). The soil type has both sandy and clayey deposits lying on each other. The city is drained mainly by River Asa, tributaries of which form the four sub-drainage basins under this investigation.

Urbanization process is fast replacing the natural surfaces in the town with artificial surfaces with its consequent effect on runoff generation.

Materials and Methods

This work was based largely on data collected from direct fieldwork exercises and questionnaire administration. The direct fieldwork involved measurement of house distances away from river channels on both flanks of rivers in the study basis. This was carried out to determine the degree of human encroachment on floodplains. Questionnaire was thereafter administered on residents of buildings located within 30 meters distance away from the river valley on both flanks of the 24.9km total stream length in the four drainage basins. Flooding has been a common occurrence in these areas (Enendu, 1981; Olaniran, 1983; Jimoh, 1994; Iroye, 2008). The questionnaire was used in generating information on residents adaptive response to the extreme hydro-meteorological events in the city. The questionnaire was however administered only after a pilot survey to statistically determine the optimum sample size derivable from the sample frame. Hence, the 24.9km total stream length in the four basins was divided up at equal intervals of 250meters; this resulted in a sample frame of 72 sampling points, as some sites do not have buildings on them; they are either forested or made up of farmlands or fallow areas. The standard deviation of number of buildings in the 72 sampling frame was then calculated as 0.385; thus, the optimum sampling size required was determined using the formula;

$$n = \frac{Z^2 . S^2}{L^2}$$

where,
n = Optimum sample size
Z = Table value at 0.05 significant level
S = Standard deviation of the pilot survey
L = Confidence limit

This gave an optimum sample size of 227.76 (approximately 228 questionnaires). However, 250 copies of the questionnaires was administered using ratio analysis (Table 2) as values of total stream length differ in all the studied basins.

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Table 1 Flood Problems in Ilorin

Year of flood	Areas affected by flooding	Damage caused	Rivers Responsible
1991	Badari, Baboko, Mogajin Geri, Osin, Balogun and Stadium road	Houses submerged, one life lost and properties worth millions of naira damaged	River Okun
1992	Peter Olorunnishola area of Sabo-Oke, Kulende, Ojagboro, Panada, Agbeyangi, Okaka, Iponrin and Joroma	Houses submerged and properties damaged	River Asa, Amule, Aluko and their tributaries
1993	Peter Olorunnishola area of Sabo-Oke, Kulende, Agbeyangi and Ojagboro	Houses and drainage channels submerged and properties worth thousands of naira damaged	River Asa, Amule, Aluko and tributaries
1994	Baboko, Agbeyangi, Mojagin Geri and Stadium road	Severe damage to building and properties	River Aluko, Okun and tributaries
2003	Ojagboro, Okelele, Elesinmeta, Dalemo Kulende, Panada, Agbeyangi, Iponrin, Gegele, Ita Alade, Oke Andi, GRA, Oke Aluko, Stadium road area, Baboko, Badari, Mogajin Geri, Osin, Balogun Ajikobi, Ero omo, Ita Alamu and Maraba	Lives lost, severe damaged to buildings and roads. Drainage channels submerged, motor cars displaced from where parked and damaged	River Asa, Amule, Aluko, Okun, Abata, and their tributaries
2004	Parts of Mogajin-Geri, Down Taiwo area and Joroma	Houses submerged and properties damaged	Rivers Asa and Okun and their tributaries

Source: Kwara State Environmental Protection Agency (2006)

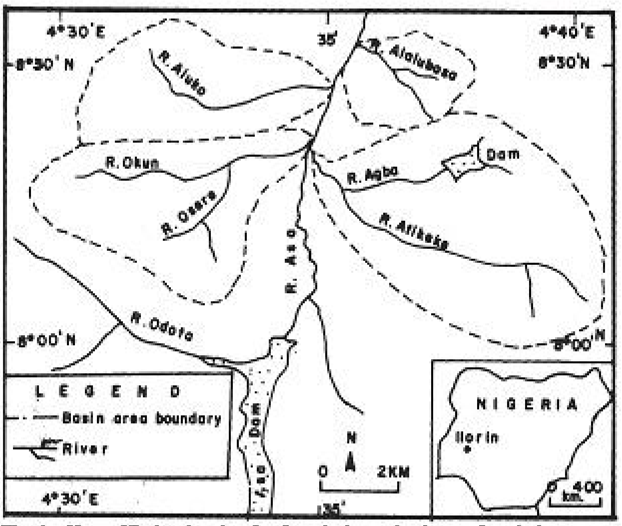

Fig. 1. Map of Ilorin, showing the four drainage basins as the study area
Source: Oyegun (1980)

Tables 2 Ratio analysis of number of questionnaire administered in the studied basins

Basin	Total stream length (Km)	Number of questionnaires administered
Agba	11.3	114
Alalubosa	2.7	27
Aluko	3.8	38
Okun	7.1	71
Total	***24.9***	***250***

Source: Author's fieldwork (2006)

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Data Analysis and Discussion of Results

Flood incidents in the study area.

The occurrence and severity of flood event is a function of a number of factors amongst which include catchments characteristics, local thunderstorm events, antecedent soil moisture conditions and degree of deforestation. Abnormal weather pattern and large scale climatic events such as Elnino may produce devastating flood.

Flood in Ilorin can be regarded as urban flooding. It is principally caused by twin factor of meteorological condition and environmental changes related to landuse. Most respondents (72.3%) in this study observed that flooding usually occur in their areas after heavy rainfall events, especially when they occur in quick successions usually around the month of September. This time coincides with the period when the water table in the city is usually high. This observation supports Olaniran (1983) earlier finding which linked flood incidents in the city to heavy rainfall greater than 25.4mm/day when they occur within a month about three or more times during the period of moisture surplus. Reynard *et al*., (1998) also linked increase in flood magnitude in Thames and Severn catchments of United Kingdom to increase in winter precipitation. They revealed that volume of rainfall rather than peak intensity of rainfall over several days played a major role in the two catchments.

Environmental changes related to landuse also induce floods in the study area. As vegetation is cleared and land is covered by impervious surfaces, infiltration of rainwater into the ground decreases leaving more water to runoff. Oyegun (1987) observed the built-up area in Ilorin to have grown from 20.40sqkm in 1963 to about 58.00sqkm in 1982, while the area occupied by grass, fallowland and tall covers decrease from 35.84sqkm. To 9.70sqkm within the same period. In the same vain, Aderamo (1990) observed that urban development in the city increased from 1235.8 hectares in 1963 to 4515.8 hectares in 1988 representing almost 400% growth rate within a period of 25years. Evidently, as Viramontes and Descroix (2002) observed, changes in landuse, especially the replacement of vegetated surfaces with built-up area will increase the source area from which streams collect water directly on account of reduced infiltration capacity of the surface.

On the trend of flood events in the city, more than 80.2% of the respondents indicates increasing trend, 16.10% were indifferent while less than 4% observed a decreasing trend (Table 3). However, only 9.2% of respondents who observed increasing trend in flood in the study area linked it up with climate change (Table 4), most of the respondents (90.8%) considered flooding a landuse issue which is caused by changes in land cover (17.8%), encroachment on floodplains (28.2%) and indiscriminate refuse disposal methods.

Urban Growth Factor on Flood Generation

Though, the rate of catchments flooding depends in part upon the channel configuration, the nature of soil and precipitation amounts, frequency and intensity, it is also being influenced by the ways land is being managed. Results obtained from this study indicates that substantial portion of floodplains in the study area have houses located on them (See Plates I, II, III and IV). Table 5 also shows that, more than 51% of the houses sampled are erected within 20 meter distance from the river channels. Most of the alluvial plains hitherto being used for farming have been occupied with residential houses.

Table 3 Trend of Flood Events in Ilorin

Basin	Increasing Trend	Decreasing Trend	Indifferent	Total
Agba	76	2	7	85
Alalubosa	18	1	8	27
Aluko	31	1	4	36
Okun	49	4	16	69
Total	174	8	35	217
%	80.2	3.7	16.1	100

Source: Authors Field Work (2008)

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Table 4 Reasons for Increasing Trends in Flood

Basin	Climate Change	Reforestation Activities	Indiscriminate Waste Disposal Methods	Encroachment on Flood plans	Total
Agba	7	22	31	16	76
Alalubosa	3	2	10	3	18
Aluko	1	2	13	15	31
Okun	5	5	24	15	49
Total	16	31	78	49	174
%	9.2	17.8	44.8	28.2	100

Source: Authors Field work (2008)

Table 5 Distances of Buildings from Nearest Stream

Basin	Less Than 10 meters	Between 10-20 meters	Between 20-30 meters	Total
Agba	8	38	39	85
Alalubosa	13	7	7	27
Aluko	12	3	21	36
Okun	19	33	17	69
Total	52	81	84	217
%	24	37.3	38.7	100

Source: Authors Field Work (2008)

Reasons adduced for people living in flood prone area according to the respondents includes easy access to unregulated farming, proximity to city centres and low level of incomes. However, other reasons may include low level of education and inefficiency on the part of town planning unit. This action by the people has, over the years, been causing flood events in the city. Building on the flood plains, hem in river banks, block the right way of water and reduce the channel capacity to carry load. Consequently, such rivers are forced to deposit their excess loads on the beds of their channels. Thus, the river beds are gradually raised; hence, the quick initiation of floods in such area following, even moderate rainfall, most especially, between the months of June and September.

As a result of urban growth accompanied by high population density, waste generation and disposal has become a serious issue of concern in the city. Peoples' poor attitude towards refuse disposal which make them dump refuse into flowing water whenever it rains also encourages flooding. Adedibu (1983), Jimoh (1994), and Olorunfemi (1995) have also observed this problem in the city. While light weight materials such as leaves, nylon materials, broken plastics, and woods thrown into gutters flow into the main rivers when runoff volumes are very high; these materials stop moving when rain ceases, thus causing debris pile-ups which obstruct the flow of subsequent stormflow and cause flooding. The dumping of heavy materials such as stones and iron debris into moving water reduces the channel's depth, affects the river competence to carry load, and results in flooding. Thus, most of the respondents had at one time or the other experienced or suffered losses from flooding. These losses ranged from material damages to loss of lives. Damages incurred, however reflected much degree of encroachment on floodplains. Globally, the economic cost of flood disasters has been increasing. According to IPCC (2001), future climate change is expected to increase this problem with possible increase in extreme precipitation events. Vulnerability to this extreme hydro-meteorological event in developing countries is daily increasing due to rapid population growth.

Adaptive Strategies to Flooding events in Ilorin

Adaptation is an activity which is undertaken to minimize adverse effects of climate change and maximise its advantages. It is an important approach for protecting human life, ecosystem and economic system from risk posed by climate variability and change, and for exploiting beneficial opportunity provided by changing climate.

Adaptive response to flood can either be structural or non-structural. While structural adaptive responses are usually technological in nature, requiring considerable investment in achieving effectiveness, non-structural adaptive response is basically organizational (Rogers, 1985). Examples of non structural adaptive response to floods include zoning laws, sheltering, sand bagging and flood insurance programme. Other indirect organizational responses include monitoring of weather and river systems.

Most respondents in this investigation (91.5%) use a wide range of non-structural adaptive response to reduce flood risk (Table 6).

These strategies include clearing of gutters to release flood water into rivers (48.4%), building landfills along house walls (23.5%), planting of trees to aid infiltration and prevent erosion (13.4%) and temporary relocation during flood incidents to relative residents (6.9%). Only 7.83% of the respondents use structural adaptive response. This is mainly by reinforcing buildings to withstand flood. None of the respondents use river bank stabilization as adaptive strategy. Reason for this may not be unconnected with large capital outlay required by such projects. However, impact of food in an area is not just a junction of resident's adaptive response, it is also determine by people's adaptive capacity. While adaptive responses are those actions taken to enhance the resilience of vulnerable system from problems induced by climate change and vulnerability, adaptive capacity is the ability to adjust to observed or expected changes in climate.

Most respondents in this investigation have low adaptive capacity. This is due to their poor socio-economic characteristics. While only 33.8% of the respondent posses secondary school certificate and above, 68.3% of economic are active group are in agrarian activities and the average family size is large. This finding supports. Ginexi *et al.,* (2000) observation which linked increase in symptoms as a function of flood impact to poor socio-economic status. Other factors which may influence residents adaptive capacity apart from socio-economic status include knowledge of the environment, period or residence in such an area and memories of past events.

Conclusion and Recommendation

With evidences that global climate is changing, residents of Ilorin, particularly those residing in flood prone areas of the city have no option than to take adaptive strategies towards investigating the incessant effects of floods.

The role of adaptation as an important component of climate change impact and vulnerability assessment has long being recognized. According to United Nation Framework Convention on Climate Change (UFCC, 1998), parties are committed to formulate and implement national or personal programmes containing measures to investigate climate change. Adaptation should not however, be considered as government policy response alone, but should also involve decision making by the people directly affected by any hazard either individually or collectively. Whichever adaptive strategy that is being embraced should however be sufficiently robust to protect life, shelter and livelihoods. For example, while seemingly minor factors such as low house foundation can induce flood, seemingly minor factors such as raised window level can play an important role in flood abatement.

Based on the findings from this investigation the researcher thus put up to the following recommendations towards reducing incessant flood problem in the study area.

i. The uncontrolled use of floodplains for building activities should be discontinued by various governmental agencies responsible, and if need be, houses presently occupying such areas should be demolished and residents resettled elsewhere. To achieve this goal, the government may first need to raise residents awareness of flood risks through the various mass media.
ii. Because the study area is highly built-up already, recharge basins can be constructed to take care of period of high storm flow. This can be done by diverting some of the storm water at peak periods of rainy season into large "soak away" pits. This suggestion will not only prevent flooding activities, but will also aid in recharging the ground water reserve which can be subsequently tapped in dry periods.
iii. Issues of environmental degradation such as flooding, desertification, soil erosion etc brought about by climate change should be enshrined in education curriculum from primary school. Such topics should be taught using audio-visual aids to help in evolving acceptable pattern of man-environment relationship.

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Table 6 adaptive Response to Floods in Ilorin

Basin	Tree planting	Clearing of gutters	Lawful along house walls	Reinforced house construction	River Bank Stabilization	Temporary Relocation
Agba	18	1	19	5	-	2
Alalubosa	3	12	7	3	-	2
Aluko	-	18	8	2	-	8
Okun	8	34	17	7	-	3
Total	29	105	51	17	-	15
%	13.4	48.4	23.5	7.83	-	6.9

Source: Authors Fieldwork (2008)

References

Adefolalu, D.O (2007), Climate Change Scenarios How Vulnerable is Nigeria. *Paper Delivered at National Jorkshop on Climate Change and Natural Disaster in Nigeria,* FUT, Minna pp18.

Adeloye, A.A (2008), Global Warming Impacts: Flood Events, Wet Dry Conditions and Changing Scene in World Food Security *Proceeding of 50th Annual Conference, Association of Nigerian Geographers.*

Ayoade, J.O (2004) *Climate Change.* Vantage Publishers, Ibadan

Aderamo, J.A (1990) Road Development and Urban Expansion: The Case of Ilorin. *Unpublished Ph.D Thesis* Department of Geography, University of Ilorin

Babatolu, J.S (1989) Climate Change and its Implication for Water Supply in the Niger River Basin Development Authority area of Nigeria. *Unpublished Ph.D. Thesis;* Department of Geography, University of Ilorin.

Emuh, C.N (2008), Sustainability Science in Flood Disaster Risk Reduction. *Proceeding of 50th Annual Conference, association of Nigeria Geographers.* pp. 179-185.

Enendu, S.N (1981, Flood Problems in Ilorin. *Unpublished B.Sc. Project.* Geography Department, University of Ilorin 68pp.

Ginexi, E.M; Weihns, K. Simens, S.J and Hoyt, D.R. (2000); National Disaster and Depression: A prospective Investigation of Reactions to the 1993 Midwest Floods, *American Journal of Community Psychology,* 28(4), pp. 495-518.

Green, C.H (1999), The Economic of Flood Plain Use *Hiniganga;* 1 (3), pp. 4-5

International Federation of Red Cross and Red Crescent Societies (2001), *World Disaster Report 2001* Int. Fed of Red Cross and Red Crescent Societies, Geneva, Switzerland.

International Federation of Red Cross and Red Crescent Societies (2003), *World Disasters Report 2003* Int. Fed of Red Cross and Red Crescent Societies, Geneva, Switzerland

IPCC (2001), Climate Change 2001: The Scientific Basis. *Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge University Press, U.K

Iroye, K.A (2008), Effects of Landscape and Climatic Parameters on Basin Management; A Case Study of Ilorin, Nigeria. *Unpublished Ph.D Thesis* Geography Department, University of Ilorin, Ilorin 281pp.

Jimoh, H.I (2003), Drainage Problems in a Tropical Environment: Perspective on Urban Quality Management. *Ilorin Journal of Business and Social Sciences,* 8 (1 & 2): 136 – 143

Jimoh, H.I. (2010), The Role of Resource Control Modalities in the Crisis of Niger Delta, *Nigerian Journal of Geography and Planning Science* Vol. 3 (1)

Mc Carthy, J.J, Canziani, O.F., Learty, N.A Dokken, D.J. and While, K.S (2001), Climate Change 2001: Impacts Adaptation and Vulnerability. *Intergovernmental Panel on Climate Change,* Geneva. Cambridge University Press, Cambridge, UK and New York, USA, 1032pp

Odekunle, O.T, Andrew, O., Aremu, O.S, (2008), Towards a Wetter Sudano-Sahelian Ecological Zone in the Twenty-first Century *Nigeria. Journal of Weather and Environmental* Vol. 63, No.3.

Odemerho, F. O (1988), Benin City: A case study of Urban Flood Problems. *In Sada, P.O and Odemerho, F. O. (eds.) Environmental Issues and Management in Nigerian Development* Evans, Ibadan pp. 97-107.

Olaniran, O.J. (1983), Flood Generating Mechanism in Ilorin, Nigeria. *Geojournal* 7 (3); 271-277

Olorunfemi, J.F. (1995), Pattern of Change in Accessibility and Interstitial Space in Ilorin. *Environmental Issues* Vol. 1 pp. 106-117

Oyegun, R.O (1987), Man-Induced Movement of Earth Materials into Ilorin City, Nigeria. *Environmental Education and Information* 6(2):142-152

Rasid, H. (1982), Urban Flood Problem in Benin City, Nigeria: Natural or Manmade. *Malaysian Journal of Tropical Geography* 6, 17-30.

Reynard, N.S Prudhomme, C. and Crooks, S. (1998), The Potential Effects of Climate Change on the Flood Characteristic of a large catchments in the U.K *In: Proceedings of the 2nd Int. Conference on Climate Change and Water* Espoo, Finland 17-20 Aug 1998, Vol. I pp. 320-332.

Rogers G.O (1985), Community Response to Recurring and non- recurring floods. *Proceedings of 9th Annual_Conference, Association of State Floodplain Managers*, PIHSburgh

United Nations (2001) Guild lines for Reducing Flood Losses *Report on International Strategy for Disaster Reduction*. UN Dept. of Economic and Socio Affairs 79pp.

Viramontes, A. and Descroix, J.F (2002), Changes in the Surface Water Hydrological Characteristics or an Endoreic Basin of Northern Mexico from 1970-1998. *Hyd. Proc*. 17, 1291-1306.

Ward, Roy (1978), *Floods-A Geographical Perspective*. The Macmillian Press Ltd. London, 244pp.

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