

Vulnerability of Tourism Industry to Disasters: (A Case Study of July 2010 Flood in SWAT, Pakistan)

Bilal Shaukat¹, Abdul Majid Khalil²

Institute of Peace & Conflict Studies, University of Peshawar, Pakistan

COMSAT, Abbotabad

Abstract: *Tourism is a backbone of the economy for the areas whose serene beauty attracts people all around. Swat is one of those places where people love to come, nevertheless in recent past some factors have severely affected tourism, like, terrorism, army operation and floods. The current study is focused to find out the effects of July 2010, floods on tourism in general and on business in particular in Swat. The data was collected from 233 randomly selected respondents of the most affected areas of district Swat of Khyber Pakhtunkhwa (KP) of Pakistan. Findings of the study indicated that number of tourists decreased significantly after the floods as flash floods awfully demolished roads in the area, which not only created obstacles in the relief activities in emergency time but also said good bye to tourists. Most of the Natural and man-made tourist spots had lost their beauty and attraction. Hostels and restaurants in the area were destroyed by flood water, which severely affected the business of the natives in the area. It was suggested that the government should give special attention to promote tourism industry by enhancing the natural beauty of the surroundings and provide facilities to the tourists. Tourist spots that are at risk from flood water should be safeguarded, and access to these spots should be made easy through good and comfortable roads.*

Keywords: Tourism, flood affectees, business, internal displacement

1. Introduction

Floods occur when water overflows the artificial or natural confines of a river or a stream, or other body of water, or accumulates by drainage over low-lying areas, (Du, et al 2010 & NWS, 2008). Flood is an extreme hydrological event which occurs periodically and is chronically hazardous and disastrous; it is the most common environmental hazard. The reason behind floods is the vicinity of human settlements with rivers; deforestation and urbanization increase their magnitude, level and intensity (Vlachos, 1995) besides these global warming is also an alarming factor for the frequent floods on the earth (Du, et al 2010 & Haines & Patz, 2004).

Tourism plays a significant role in the development of a country; however it requires sound government policies and strategies. Tourism industries promote small scale business in crafts, foods, farming, fishing etc. (UNEP, 2008). Tourism industry is an integral part of the world economy as it engages 625 million individuals and involved USD 445 million only in the year of 1998 according to World Tourism Organization (WTO, 1999). However, tourist spots face risky situations or scenarios due to their magnificent as well as remote locations (Murphy & Bayley 1989) that could be exposed to flooding due to water streams.

Tourism and natural disasters has a close link, as in the event of a natural disaster tourism is significantly affected and in most of the cases tourism industry is destroyed. Tourism is an important part of a country's economy and in less economically developed countries such as those affected by the tsunami, on Boxing Day 2004, the local economy greatly relies upon the industry's services for the livelihood of its population. The massive effect of natural disasters on tourism is related to the negative multiplier effect, which involves the impact of the event spreading through the economy.

Tourism is growing both in volume and economic development. Nevertheless tourism is highly climate sensitive economic sector. The places which were inaccessible in recent past are now frequently visited by the tourists. Nonetheless, they are vulnerable to climatic change due to global warming. This will result in the rise of sea level on the islands, for instance, the islands in Maldives, which are popular tourist spots, can face serious perils of the rise of sea level and hence increase the occurrence of floods (Viner & Agnew, 1999).

Tourism is often concentrated in the mountainous areas; near the rivers and coastal zone but these spots near to seas and big rivers has serious effects on the native people. Mountainous areas are vulnerable mostly to earthquakes while the coastal zone confronted with the frequent floods. Infrastructural developments like hotels; restaurants, picnic spots etc. for the propagation of tourism in the area near the rivers, look increasingly vulnerable to natural disasters (IRT, 2005).

July 2010 flood caused unprecedented damage and threatened human lives on a national scale including the provinces of Gilgit-Baltistan, Khyber Pakhtunkhwa, Punjab, Sindh, and the Azad Jammu and Kashmir. However Khyber Pakhtunkhwa was one of the most affected province and it took a heavy toll of human lives (1156) and severely impacted a wide-range of infrastructure including tourist hotels and restaurants, livestock, agriculture, forests, and wildlife (Khan, 2010).

July 2010 flood was the worst flood in the history of Pakistan where all provinces were damaged in one or the other form. However Khyber Pakhtunkhwa was the most affected one where the flash floods destroyed the entire structure of the province. According to the OCHA (2011) report 3.8 million people were affected in the province, where 200,000 homes were destroyed or damaged, and people were compelled to go out from their home and took

temporary shelters in the 786 schools. In Khyber Pakhtunkhwa, district Swat was more vulnerable to flood where 725,319 people were affected directly and indirectly.

District Swat was considered paradise on the earth and known as Switzerland of Pakistan due to its serene beauty that attracts tourists from all over the country and abroad as well. The recent July 2010 flood dims the beauty of Swat and people found no more attraction. Flood affected the tourist spots, roads and tourist hotels very badly, which ultimately decreased the number of tourist in the area (Reliefweb, 2010). The residences of Swat are directly and indirectly dependent on the tourism and its related activities, like hotels, restaurants, handicraft etc and they earn their livelihood from tourism. The study was focused on the following objectives to highlight the problems of tourism in the area.

Flood → tourism → local Economy

Tourism motivational theory clarifies that most of tourists are attracted by the natural beauty of the area/s rather than the artificial, although the natural beauty is enhanced by the developers for more attraction, through fine expressways to the spots, residential area and daily life requirements.

Objectives of the Study

- To study socio-economic characteristics of the respondents.
- To analyze the effects of flood on tourism
- To highlight the effects of tourism on the livelihood of local community

2. Methods and Materials

Simple random sampling technique was applied for collection of relevant information about the effects of July 2010 flood on tourism in the beautiful district of KP, Swat, which was the most affected district in the province (<http://pdma.gov.pk>). Data was collected from 233 randomly selected respondents, who were directly affected from flood or indirectly suffered from the decline of business and tourism in the area on larger scale. An interview schedule was pre-designed and properly constructed for collection of data. The interview schedule was refined and reconstructed after the pilot study in the area, and highlight those issues which were more affected from the floods and decline in tourism. Due to cultural constraints it was difficult to collect data from female slot directly that is why female staff was hired for gathering information from the affected women. The hired staff was properly trained on the prescribed interview schedule for the precession and accuracy of the data. The collected information was then analyzed through univariate and bivariate analysis which told the whole story of the destruction of the floods in general and on tourism in particular. Univariate was presented in the form of the frequency distribution and their percentages, while bivariate was tested through chi-square, gamma and lambda test statistics.

Following Chi-square statistics formula was utilized

$$x^2 = \sum \frac{(fo - fe)^2}{fe}$$

$$x^2 = \sum \frac{(frequency\ observed - frequency\ expected)^2}{frequency\ expected}$$

Gamma formula;

$$\gamma = \frac{C - D}{C + D}$$

Where C indicates total number of concordant pairs of observations and D shows the total number of discordant pairs of observation, when C is greater than D it indicates the positive association and vice versa and the range is between -1 and 1.

3. Results and Discussion

Table 1: Distribution of the respondents by age, profession, level of education and monthly income

Category	Frequency	Percent
1.1 Age of the respondents (years)		
i. 20-30	63	27
ii. 31-40	86	36.9
iii. above 40	84	36.1
Total	233	100.0
1.2 Profession of the respondents		
i. Unemployed	87	37.3
ii. Govt. Service	30	12.9
iii. Farming	34	14.6
iv. Business	27	11.6
v. Private Services	22	9.4
vi. Labor	33	14.2
Total	233	100.0
1.3 Level of Education of the respondents		
i. Illiterate	92	39.5
ii. Middle >=8	53	22.7
iii. Matric =10	23	9.9
iv. Intermediate =12	35	15
v. Graduation =14	21	9
v. Post-Graduation <=16	9	3.9
Total	233	100.0
1.4 Monthly income of the respondents (Pak. Rs)		
i. Jobless	87	37.3
ii. Up to 10000	70	30
iii. 10000-14000	42	18.1
iv. Above 14000	34	14.6
Total	233	100.0

Socio-Economic Characteristics

Table 1 is about socio-economic characteristics of the respondents like age, profession, level of education and their personal monthly income. These variables are very much significant for the analysis of the other variables; these have deep rooted influence on the ideas and opinion of the respondents during the field survey. With the growing age one's authority as well as responsibilities increases in the community. For the current study middle and old age people have deep insight on the tourism related problems created by flood. Profession of the respondents has also great social importance which is a valued determinant of the social position of an individual. Education is for the differentiation between good and bad on the basis of religion and culture it may change the future of the society and bring it to the top of the rank. Education is not only significant for individual growth but also for the development of entire community. Educated persons are well aware about their problems and

express them in convincing way and highlight its negative effects on the general public.

The above table shows age of the respondent in which 36.9 percent were in the age group of 31-40 and 36.1 percent were above 40 years and 27 percent were in the age set of 20-30 years. The data shows that majority of the respondents were middle and old aged who were better in position to explain and describe the problems created by flood and particularly tourism related problems.

The table under discussion clearly illustrates that a major portion of the respondents (37 percent) in the area were jobless and they had no means of earning, while 49.8 percent of the respondents were in private engagements that comprises of 11.6 percent having their own business, 9.4 percent were in private services and 14.2 percent were working as labor and 14.6 were involved in farming. A smaller part of the respondents (12.9 percent) were in government services, this because of low literacy rate in the area. Private workers were mostly rendering their services in the hotels and restaurants in one or other form ranging from owners to servicemen.

Level of education also under discussion in the above table that demonstrates the results that 39.5 percent of the respondents were illiterate is due to non availability of schools, non awareness and out of access educational institutions from students, while 22.8 percent of the respondents were below ten years of education and 24.9 percent were matriculate and intermediate whereas a smaller portion of the respondents (12.9 percent) were graduate and post graduate. The residents of the flood affected areas have either none or very limited access to higher none or very limited access to higher educational institution, also their financial unsoundness prevents them from going out of their own area to get education. This predicament leaves them in the darkness of the ignorance. The last part of the table displays monthly average income of the flood affected people in the area. The table shows that a larger part of the respondents (37.3) percent was jobless and 30 percent had monthly income up to Rs.10000 while 18.1 percent of the earning part of the respondents had income in the range of Rs.10000-14000. A significant smaller portion of the respondents were earning income more than Rs. 14000. The data proved that majority of the flood affected people were jobless or having below average monthly income and living in miserable conditions. The standard of living in the area is also clear from the data the people need even basic provisions of life.

Table 2: Distribution of the respondents by distance from river(s), flood experiences and intensity, level and frequency of flood before 2010

Category	Frequency	Percent
2.1 Distance from river		
i. Within Km	44	18.9
ii. One Km	119	51.1
iii. Two Km	70	30.0
Total	233	100.0
2.2 Flood experienced before 2010		
i. Yes	189	81.1
ii. No	44	18.9
Total	233	100.0

2.3 Level of water in frequent flood		
i. No flood before	44	18.9
ii. up to 1ft	176	75.5
iii. 2-4ft	13	5.6
Total	233	100.0
2.4 Level of water in 2010 flood		
i. 2-4ft	28	12.0
ii. 5-7ft	178	76.4
iii. above 7ft	27	11.6
Total	233	100.0

Flood Experiences

The above table no. 2 shows information about the distance from the river, flood experience before 2010 and intensity level of flood before and in the 2010. First off, the table shows that distance of river from the residence of the respondents. The data given explains that more than half of the respondents (51.1 percent) were living in the area where the river was one kilometer away from their residence and 30 percent were little far away from the river about two kilometers while 18.9 percent of cases reported that respondents residential area were within the one kilometer of the river. The data shows that majority of the respondents were living in the area where river is near to their homes when it overflows. In the hilly areas flash floods water made their way and rushed over the nearby houses and business area.

The table also demonstrates experience of respondents with floods before July 2010. The data shows that a significantly larger portion of the respondents (81.1 percent) have been frequently confronted with floods in the area, nevertheless the level and intensity of the floods may vary with the time and space, but in one or the other form floods happened and destroyed the existing setup of the people. There was only smaller part of the respondents (18.9 percent) who did not experience this because they lived on top the hills and the water passage was opposite to their residence. The area where people had no prior experience of floods, replied that; water overflow has never been harmful for them and property of the local area. Data shows that the area is at risk every year, and in the rainy season people suffered from floods in the urban areas.

The table illustrates the level of flood that is experienced before July 2010 by level of flood mean that height (in feet) of flood water in the homes or in the business setups or in the overall area. The third part of the table shows that 18.1 percent of the respondents had no experience of floods before July 1st, and among the respondents who experienced the prior floods, majority of them (75.5 percent) were threatened by below than one foot water in the area while only 5.6 percent had the experience of two to four feet high floods. The data shows that although people of District Swat experienced floods in the past but they were not of high magnitude and did not affect the residents much in the social and financial terms. Last part of the table is about the level of floods in the July 2010 where everyone was defiled with the floods. The data in the table shows that a little more than two third of the respondents (76.4 percent) were hit hard with a very high level of flood, which was in the range of five to seven feet height of flood water in the area, while some of the cases (12 percent) dealt with two to four feet

high flood in the July 2010 floods and a smaller portion (11.6 percent) had experience of very high level of flood that is above seven feet high in their area. The data shows that about 80 percent of the respondents were confronted with a very high flood, which damaged all their belongings in homes, shops, hotels as well as severely affected the beauty of the area, whereas forests and tourist spots were destroyed.

Table 3: Distribution of the respondents by their extent level of damages to tourism

Category	Frequency	Percent
3.1 Decrease in number tourists		
i. Yes	214	91.8
ii. No	19	8.2
Total	233	100.0
3.2 Hotels destroyed		
i. To great extent	184	79.0
ii. To some extent	43	18.5
iii. Not at all	6	2.6
Total	233	100.0
3.3 Tourist spots damaged		
i. To great extent	185	79.4
ii. To some extent	44	18.9
iii. Not at all	4	1.7
Total	233	100.0
3.4 Roads badly affected		
i. To great extent	187	80.3
ii. To some extent	37	15.9
iii. Not at all	9	3.9
Total	233	100.0

Tourism Affected

Tourism industry is an important part of world economy as it engages 625 million individuals and involves USD 445 million only in the year of 1998 according to World Tourism Organization (WTO, 1999). However, mostly tourism faces risky situation because of its magnificent as well as remote location (Murphy & Bayley, 1989) that could be exposed to flooding due to water streams.

The above table shows the number of the variables that affect tourism in the area in one or other way like number of tourists, hotels, tourist spots and road damages in the July 2010 flood. First part of the table illustrates that more than 90 percent of the respondents were of the view that flood exerts negative effects on the tourism in the form that it decreased most respondents were of the view that floods exerts negative effects on tourism because it decreased the number of tourists in the area when their natural beauty is affected by the catastrophe, while only 8.2 percent of them were of the opinion that floods did not decrease the number of tourists in the area, rather more people came from outside for provision of relief activities and supplies, they visited different areas which may help in raising the vogue of tourism in the area.

The above table demonstrates the condition of tourist hostels and restaurants, which are directly proportional to the propagation of tourism. The data shows that almost all of the respondents (97.5 percent) were of the view that hotels were damaged, whereas 79 percent cases showed that damages to hotels were severe and almost all of the hostels were destroyed, while 18.5 percent of them told that damages were not that much brutal. A very smaller portion of the

sample (2.6 percent) told that the hotels were not damaged from the flood. A similar type of study was conducted in Scotland where 170,000 residential and commercial properties, some 10-12 percent of the total, are thought to be at risk of flooding at present (Werritty with Chatterton, 2004).

The table under discussion illustrates another most important aspect that exerts negative effect on the tourism in the area, is the damage of the tourist natural and man-made spots. The data shows that 79.5 percent of the respondents were of the opinion that tourist spots were completely damaged in the flood, and most of the spots were no more attractive for visitors, that is why they are reluctant to visit the area, while 18.9 percent of the cases thought that floods partially destroyed tourist spots and some of the spots were still in condition to be visited. The data shows that majority of tourist spots were damaged which significantly decreased the number of tourist.

The last part of the table is about the road condition in the area after the July 2010 flood. The table shows that a significantly larger portion of the sample size (96.2 percent) of the respondents told that the access road were damaged and people had faced difficulty in movement and access to other areas, and took much of the time, energy and money, this portion comprises of 80.3 percent of the respondents that were of the view that flood severely affected roads, and 15.9 percent of them thought that roads were partially affected, while only 3.9 percent viewed that flood did affect roads. The data shows that roads were much affected by the floods and people faced problems in movement. Damaged roads not only affected tourism in the area but also exerted negative effects on the relief activities. Activists did not reach the affected area in time because of the damaged roads.

Table 4: Distribution of the respondents by affected businesses, exchange of cultures, unemployment, purchasing power and mental stresses

Category	Frequency	Percent
4.1 Business suffered		
i. To great extent	199	85.4
ii. To some extent	26	11.2
iii. Not at all	8	3.4
Total	233	100.0
4.2 Exchange of culture affected		
i. To great extent	191	82.0
ii. To some extent	33	14.2
iii. Not at all	9	3.9
Total	233	100.0
4.3 Unemployment increased		
i. To great extent	196	84.1
ii. To some extent	33	14.2
iii. Not at all	4	1.7
Total	233	100.0
4.4 Purchasing power declined		
i. To great extent	190	81.5
ii. To some extent	35	15.0
iii. Not at all	8	3.4
Total	233	100.0
4.5 Mental stress rose		
i. To great extent	187	80.3
ii. To some extent	37	15.9

iii. Not at all	9	3.9
Total	233	100.0

Tourism Affected Business

The above table shows information about the area that were visited by tourists where business suffered, effect on exchange of culture, increased unemployment, decline in the purchasing power of common man, and rise in mental stress. The data shows that 85.4 percent of the respondents viewed that business of the area was severely affected by floods, because majority of people were concerned directly and indirectly with tourism and its related activities. While 11.2 percent of them told that businesses were damaged to some extent, only 3.4 percent of the respondents were of the view that flood has less directly affected business of the area.

Tourism is one of the important and most prominent ways of exchange of culture among different societies and in instrumental in familiarizing the local and alive culture. In the recent floods, along with other impacts, one of the bad impact was on the culture exchange, due to damage to tourist spots, destroyed tourist hotels, and the deteriorated conditions of the road, there is a significant decrease in recorded tourists in the area which on one hand affected economy of the area and on the other hand affected the cultural exchange among other people in and outside of the country. The second part of the table shows that a very large section of the respondents (96.2 percent) some part of the sentence seems to be missing here, another group of respondents, which comprises of 82 percent, were of the view that cultural exchange is severely affected by the floods and 14.2 percent told that its effects were not that much severe while only a smaller part of the sample (4.3 percent) of the respondents said that floods did not affect cultural exchange because the people from outside come for relief activities, which may prove helpful for exchange of culture in the area.

The above table shows employment conditions in the district Swat after July 2010 flood which are affected by the lack of tourism in the area. People in the area were directly or indirectly concerned with tourism, which was badly affected by the floods. The table clearly shows that 84.1 percent of the respondents were of the view that unemployment increased in the area after the floods because of significant decrease in the tourist and business activities due to which people were in search of jobs, 14.2 percent of the respondents were of the view that up to some extent floods increased the level of unemployment in district Swat. Data in the first table clearly mentioned that only about 12 percent of the respondents were in government jobs and the rest of the people were in private employment like running their own business, working in hotels and restaurants as labor.

The table no 4 illustrates the fluctuation of purchasing power of general people after the floods in the area, due to decrease in tourism. The data shows that purchasing power of the people decreased after the damage experienced by tourism. A significant portion of the respondents (96.5%) were of the view that purchasing power of the common people declined after the weakening of tourism, 81.5 percent respondents told that all the members of the community were directly or

indirectly affected by flood, as their business and services were disturbed, whereas 15 percent were of the opinion that purchasing power was affected to some extent only. A smaller portion (3.4 percent) of respondents recorded that purchasing power is not affected by flood or tourism; these respondents were mostly in government services.

The above table clearly shows that weakening of tourism industry affects all aspects of common people, such as it adversely affected business in the area and purchasing power of the people on one hand and on the other hand people are mentally disturbed from such situations. The data shows that a very large portion of the respondents (96.1 percent) told that people were mentally disturbed from the floods induced tourism which included 80.3 percent thought that it severely affected people's mental condition, while according to 25.9 percent respondents its affects were up to some extent. Whereas 3.9 percent of the selected people were of the view that mental level of the common people were not affected.

Table 5: Relationship between flood and Tourism

Intensity of flood (Level of flood)	Tourism effected			Total
	Great extent	Some extent	Not at all	
Less Severe (2-4 ft)	46.4% (13)	35.7% (10)	35.7% (5)	12% (28)
Moderate (5-7 ft)	81.5% (145)	18.5% (33)	.0% (0)	76.4% (178)
More severe (<7 ft)	96.3% (26)	.0% (0)	3.7 % (1)	11.6% (27)
Total	79 % (184)	18.5% (43)	2.5% (6)	100% (233)
Chi Square value = 44.535 df = 4 Significance = 0.000				
Gamma value = -.701 Significance = 0.000				

Table No. 5 depicts the close relationship between independent variable like level of water in 2010 floods and dependent variable that is affected tourism. Tourism in the area was badly affected like access roads, tourist spots, hotels and restaurants were damaged, which decreased the number of tourists in the area. Level of water was measured by its height in the affected people's home during and after the floods. The table under discussion shows that tourism is more affected in the area where level of water was very high and situated in close vicinity of rivers. The data was tested by the three test statistics like chi square, gamma and lambda. Value of chi-square test was 44.53 at .01 level of significance gamma value was -.701, which is the evidence of the direct relation of flood water and tourism effects.

4. Conclusion

Tourism is directly affected by floods as the tourist spots are in vicinity of rivers which enhance its beauty on one hand but it poses a regular treat for these spot in particular and tourism in general. July 2010 floods in Pakistan changed the entire situation in the KP province and snatched the serenity from the so-called heaven Swat. Significant decrease in tourists' number is the result of flood that devastated the tourist spots, access roads, hotels and restaurants. This devastation left adverse effects on the business of the area which increases unemployment ratio and poverty at large scale. Cultural exchange among the local people and tourists is greatly affected by the recent floods.

5. Recommendations

Flood is a natural disaster and no one can stop it or its adverse effects completely, nevertheless we can reduce its influence on the life of people at some level. Governmental and Nongovernmental organizations should work on capacity development through training of risk and crises management plans, as larger the capacity to disaster respond lower will be the risk. Risk is the product of vulnerability and probability of a disaster divided by capacity to cope it,
$$\text{Risk} = (\text{Probability of a Disaster} \times \text{Vulnerability}) / \text{Capacity}$$

The effects of a disaster like floods can be minimized if communities are informed in prior about possible hazards (UNEP, 2008). The direct effects of flood on the tourism can be controlled through establishments of strong river banks that resist the flood water from overflow. Government should prepare disaster management agencies for the time of emergencies like floods, and earth quakes etc. to reconstruct and rebuilt the access lines by using heavy machineries, and construct them up to the mark that local and international tourists face no problems and difficulties. Local handicrafts are the center for the tourists and it may be preserved through mechanized production in industries. The natural beauty and serenity of the area could be enhanced through remodeling the tourist spots and create more attractions.

References

- [1] Du, W., FitzGerald, G.J., Clark, M. & Hou, X.Y. (2010) Health impacts of floods. *Prehosp Disaster Med*;25(3):265–272
- [2] Haines A, Patz JA: Health effects of climate change. *JAMA* 2004;291(1):99–103.
- [3] International Centre for Responsible Tourism (ICRT) 01/01/2005
http://travel.independent.co.uk/news_and_advice/story.jsp?story=597146
- [4] Khan A., Khan M. Ayaz, Said A., Ali Z., Khan H. Ahmad N. and Garstang, R. (2010). Rapid Assessment of Flood Impact on the Environment in Selected Affected Areas of Pakistan. Pakistan Wetlands Programme and UNDP Pakistan. Pp 35.
- [5] Murphy, P.E. & Bayley, R. (1989). Tourism and Disaster Planning. *Geographical Review*, 79(1): 36-36
- [6] National Weather Service. Weather glossary. Available at <http://www.erh.noaa.gov/er/rnk/glossary.html>. Accessed 29 August 2008
- [7] OCHA. (2011). Pakistan Humanitarian and Early Recovery Overview (HERO).
- [8] Reliefweb. (2010). Pakistan: flood-2010. Available at: [Pakistan_Floods__Jul_2010-OCHA-88FJ4Q](http://reliefweb.org/report/pakistan-floods-jul-2010-ocha-88fj4q)
- [9] United Nations Environment Programme (UNEP). (2008) Disaster risk management for coastal tourism destinations responding to climate change: A Practical Guide for Decision Makers. UNEP; Paris
- [10] Viner, D. & Agnew, M. (1999). Climatic Change and Its Impacts on Tourism. Norwich: Climatic Research Unit, University of East Anglia
- [11] Vlachos E. (1995). socio-economic impacts and consequences of extreme floods. hydrometeorology, impacts, and management of extreme floods: Perugia

[12] Werritty, A. & Chatterton, J (2004) *Future Flooding Scotland*, London: Office of Science and Technology.