Bibliometric analysis of flood risk research: A Review

Dr. Raja Majumder1

1Post Doctoral Research scholar, Department of Geography, Manipur International University, Imphal, Manipur.

Abstract

From bibliometric research statistical information on paper publication is available. This method is used to categorize data with different parts of research importance such as paper publications, paper citation, study area, journals H-index, journals impact factors and authors. This review paper discusses several important aspects of research on floods, one of the most impactful environmental disasters. From 1982 to 2017, a total of 300 flood disaster papers and 193 journals were collected by different methods and found to have different importance. Papers have been downloaded from different journal websites using different keywords. The number of flood disaster research papers published in any given year in the past years was found. Citation numbers and research areas of the collected flood disaster papers were found. The H-index value and impact factors of the collected 193 journals are arranged. A total of 20 authors of the collected 300 papers were found, their Author H-Index and Author i10-Index were found.

Keyword: - *Flood hazards, papers, journal, author, H-Index, impact factors, Citation*

1. Introduction

Floods are the most critical environmental hazard and regularly affect about 41 million people in South East Asia, including India. As a result of natural disaster floods in South-East Asia every year close to one thousand people are killed and thousands of houses, schools and hospitals are destroyed (UN news, 24 August 2017). Flood arises every year in river flood plain area and lower flat area and deposit fertile clay soil in river side area. One of the main reasons behind the over flow of rivers and the reduction in capacity of rivers and regular floods during monsoons is the regular deposition of sand and silt in the river basins (Deltawerken.com). Causes of floods are both natural and man-made. Among the natural causes are mainly heavy rains, storms and tsunamis, snow and ice melting, overflowing rivers, lack of vegetation (manzi, floods, causes, effects). On the other hand, human factors are urbanization, increase of river banks, development of fisheries in rivers, bursting of water mains, poor drainage system, collapse of dams due to faulty construction or maintenance, deforestation, impermeable surfaces, emission of greenhouse gases, construction of additional flood dams (greentumble.com/what-are-the-human-causes-of-floods).

The most important causes of Indian floods are heavy monsoons, depletion of river carrying capacity, poor drainage in urban areas, climate change (rising temperatures, rapid melting of Himalayan glaciers, disruption of rainfall patterns) etc. (Balachandran and Thomas, 2016).

Important causes of floods in West Bengal are heavy monsoon rains, tropical cyclones, slow flow of rivers, over flow of rivers due to heavy rains, release of water from various dams by DVC, low pressure in Bay of Bengal etc (WBDM & CD).

One third of the deaths, injuries and damages caused by natural disasters are caused by floods. (Askew, 1999). Indian economy is heavily affected by floods every year. Before 1999, three major floods occurred in India's history. In October 1943 the city of Madras suffered brutal floods, the estimated loss of life and property was unclear. In August 1979, another dangerous flood occurred in Morbi town of Rajkot district in Gujarat due to the failure of the Macchu dam, killing around 1800 to 2500 people. Bihar experienced the worst floods in 1987 when the Koshi river overflowed, resulting in the loss of about 1399 human lives, 302 animal deaths, total loss of government property worth Rs 68 billion.

Since 2000 till now India has faced many terrible floods. On 26 July 2005 metropolitan Mumbai faced a flash flood, resulting in 1094 deaths. Mumbai International Airport was closed for 30 hours, the Mumbai-Pune Expressway was closed for 24 hours and government property worth Rs 550crore was destroyed. June 2013 floods in northern India claimed 5700 lives. June 2015 floods in Gujarat damaged Gir forest and killed 70 people. The South Indian floods in 2015 caused financial losses and adversely affected human lives. The Assam floods of 2016 affected 1.8 million people and killed around 200 wild animals in Kaziranga National Park. 2017 Gujarat floods killed 200 people. Last August 2018 floods in Kerala claimed 445 lives (Wikipedia_ floods in India).

Flood is one of the major calamities of West Bengal which is like an annual festival of the state. Almost all the districts of West Bengal are affected by floods from July to October. In 1991, flash floods completely damaged around 35000 houses across the state. In 1995, a major flood occurred in the state, which damaged several agricultural lands and caused outbreaks of various diseases. The 1999 floods

affected 500 villages and a large area of Kolkata, Burdwan, Birbhum was also affected. Unfortunately the next year in 2000 there was a terrible flood in South Bengal which claimed 1262 lives and affected millions of people. A major flood hit North Bengal in 2002. The flash flood inundated ten villages, resulting in four deaths and displacement of 11,000 people. 2004 Heavy monsoon rains affected many districts and again displaced many people. 2005 Heavy rains caused flooding in coastal areas of Bengal, inundating 3,000 coastal villages and washing away 60,000 huts and many roads. In 2006 Birbhum, Murshidabad, Burdwan faced the worst monsoon floods and tropical cyclones, killing a total of 50 people, injuring 300 and destroying 30000 mud houses. The city of Kolkata was also flooded by this monsoon rain, resulting in the evacuation of 2000 people from the city. Again in 2007 heavy rains from a tropical depression in the Bay of Bengal caused flooding. The floods killed 51 people and affected 3.2 million people. In 2013 West and East Midnapore, Howrah, Hooghly, Burdwan and Bankura districts were affected by floods. Water was released from various dams by the DVC due to heavy rainfall. 17 people died in this flood, 8790 villages and 21 lakh people were affected (West Bengal Disaster Management & Civil Defence Department).

It is necessary to establish various flood risk management agencies to control the current and future risk of river floods and to adopt various policies to reduce and manage the risk of such floods. The International Decade for Natural Disaster Reduction (IDNDR) was organized by the United Nations General Assembly in 1987 and continued from 1990 to 2000. IDNDR aims to reduce human deaths, property damage and socio-economic losses due to natural disasters. One-third of all deaths, injuries, and damages resulting from natural disasters are caused by floods (Askew, 1999).

In May 1994, the United Nations held a World Conference on Natural Disaster Reduction in Yokohama. In this conference, vulnerability to flood risk is clarified by analyzing historical data with expected frequency of 10 years, 20 years or 50 years. At the World Climate Conference 3 held in Geneva in 2009, it was decided to provide more technical and financial assistance to reduce the risk of floods in developing countries facing such natural disasters.

The Government of India established the Ganga Flood Control Commission with its headquarters at Patna in 1972 to control floods in the Ganges basin states. Government of India adopted flood management program in 11th and 12th five year plan. In the Eleventh Five Year Plan (2007 to 2012), the government undertook programs related to river management, flood control, erosion prevention, drainage system development, flood prevention works, restoration of damaged flood management works and prevention of sea erosion. The total expenditure during XI Plan was Rs. 8000 crores. During the XII Five Year Plan (2012 to 2017) the government expenditure amounted to Rs. 8000 to 10000 crores, which was used for river management, flood control, prevention of land erosion, development of drainage system, flood prevention works, restoration of damaged flood management works and prevention of marine erosion and restoration of wetlands (Indian ministry of Water Resource, River Development & Ganga Rejuvenation).

West Bengal government is taking various steps to control floods. The Government of West Bengal established the Irrigation and Waterways Department in 1920 to control floods. The department has been able to install velocity and water level sensors along with telemetry equipment at 60 river gauge stations on 60 bridges identified in 2017 (Irrigation and Waterways Department of Government of West Bengal).

West Bengal government has come up with a work plan and allocates Rs 100 crore to handle floods 2016 in North Bengal (ET news).

For the first time in 2017, the West Bengal State Irrigation Department planned to install big screens with CCTV cameras at five different locations to show live video footage of water levels in various reservoirs (ET news).

DVC plays a major role in floods in West Bengal. Hence the Government of West Bengal on 6th December 2017 took up a scheme for flood control by the Department of Irrigation and Waterways. The name of the project was ‘West Bengal Major Irrigation and Flood Management’’. Approved by the Government of West Bengal the estimated cost of the project was 123 million (US) (www.aiib.org/en/projects/2017/wb-major-irrigation-flood-management.html)

Flood risk is a function and result of hazard and vulnerability (Ologunorisa, 2001). That is, Risk = Hazard x vulnerability. Flood hazard mapping is very important to control flood, taking flood control programs, marked the high-medium-low vulnerable area etc. Rainfall and runoff data are the essential hydrological elements in the flood hazard mapping. Accurate mapping and location of structures such dams, bridges, river gradient, river meanders, embankments, culverts, levee, sewage disposal plants, switch gates, guard wall etc is essential to understand the likelihood of flood recurrence.

This study analyzes to know the discussion of flood risk, disaster stage and social vulnerability of the local population regarding flood vulnerability, flood causes and flood protection measures. The character of floods is numerous and an unusual phenomenon, occurring as short and long term environmental hazards. Human activities such as urbanization, industrialization and structural defenses (e.g., levees, dams, seawalls) have a big impact on the appearance and cruelty of flooding; heighten impacts in some cases, but grow strong them in others. It is widely believed that the severity of flood disasters will increase due to land use patterns, population activities and climate change.

2. Methods

I completed a review of the literature focusing on the risk of flooding to the environment and our area affecting human life, the economy, domestic animals and ecosystems. To analyze this review paper, I first search for many flood-related papers, articles from the

web by various keywords, such as ``flood and natural hazard papers", ``flood hazard, vulnerability and GIS papers", ``Flood Hazard & disaster papers" etc and search various journal websites like ReasearchGate, Spiringerlink, Academia.edu, Google Books etc.

After narrowing the search topic I selected several papers with a specific focus on social and environmental flood risk. Here I have selected papers with a strong focus on ecological aspects of floods, impacts of floods on ecosystems, multi-hazard vulnerability and local climate change.

After selecting all these papers by journal, by author, by country, by year, the whole papers were studied and the case studies were investigated through the purpose of each research paper, survey method, survey area, importance of authors, results of case studies and literature review etc. Also through the website each journal's impact factor, H-index, citations of each paper, scholars' H-index, i10-index, author's institution etc have been studied.

After sorting all these data in Microsoft Excel the data and information are sorted by total number, percentage of journals, total citations, H-index, impact factor etc. The data is sorted by number of authors, percentage of authors, author h-index, i10 index, author paper citations and journal h-index etc.

Finally, the data are sorted by total number and percentage of study area by country or continent.

3. Result and Discussion

A total of 400 publications were selected in this analysis from the period 1982 to 2017. More than 400 publications were downloaded through Google search engine by different keywords (Table 1) and the most perfect papers were selected for research. Finally, the current study was focused only on research papers published in important journals, which reduced the total number of publications from 400 to 300 with this analysis and limited them only to the period 1982 to 2017.

Table 1: Papers search keywords from goggle search engine

KEYWORDS	NUMBERS OF PAPERS
Flood and natural hazard papers.	25
Flood assessment papers.	23
Flood Hazard, vulnerability and GIS papers	15
Flood hazard and management papers.	18
Flood Hazard, disaster and remote sensing papers	26
Flood Hazard, disaster papers	50
Flood management and remote sensing, GIS papers.	42
Flood prediction modeling papers.	22
Flood prediction papers.	05
Flood risk perception papers	26
Flood risk and climate change	17
Flood risk in coastal region and sea level rise	09
Miscellaneous	18

The majority of papers resulting from this analysis came from the keywords 'flood hazards, disaster papers' (50 papers) and 'flood management and remote sensing, GIS papers' (42 papers). During the paper collection some papers are downloaded which are not related to flood analysis. Therefore those non-related papers are to be avoided and the downloaded papers are carefully discarded which are not related to the direct analysis of flood events.

Here we find that flood analysis research has been increasing from past to present years, which is evident in Figure 1. It is confirmed that the number of research papers published in various journals has increased. The maximum number of papers were published in 2013 and 2014 as 36 papers (12%) and 33 papers (11%) respectively, which can be seen from Table 2 on flood analysis. Here it appears that very small percentages (below 1%) of papers were published before 2000.

Table 2: Total Publications per year represent of the flood research analysis

Year	Number of papers	% of papers
2017	12	4
2016	22	7.33
2015	32	10.66
2014	33	11
2013	36	12
2012	22	7.33
2011	24	8
2010	17	5.66
2009	17	5.66
2008	20	6.66
2007	9	3
2006	9	3
2005	12	4
2004	6	2
2003	8	2.66
2002	6	2
2001	3	1
2000	5	1.66
1999	1	0.33
1996	1	0.33
1995	2	0.66
1990	1	0.33
1983	1	0.33
1982	1	0.33

The average citation of the publication is most important for this study. Here the citation rate of the 300 papers is calculated because it was highly significant in the entire study. The citation rate of these selected papers is classified in three ways (Table 3) mainly depending on the number of papers and the percentage of papers. Here it is evident that 28.67% (86) papers have above 50 citations (Table 3). It was not so much but obviously not so small about the flood research.

Table 3: The citation structure represent of the flood research analysis

Number of citation	Number of papers	% of papers
>50	86	28.67
20 to 50	49	16.33
<20	165	55
Total----------	300	

16.33% (49) papers have between 20 and 50 citations and 55% (165) papers have less than 20 citations. Many countries and continents are listed as the study area of these selected papers, but some papers selected the study area on a global basis (Fig. 2). Among the selected papers, Asia, Africa, Europe and North America are the preferred study areas of the authors. However, South America, Oceania and South Central Asia are at the bottom of researchers' preferences (Table 4). About half of the total papers analyzed in all the research studies are in Asia and Africa.

Table 4: The study area of all papers represent of the flood research analysis

Study Regions Name	Number of Case Study	% of Case Study
ASIA	104	34
AFRICA	50	17
EUROP	44	15
NORTH AMERICA	39	13
SOUTH AMERICA	3	1
WEST & MIDDLE ASIA	10	3
OCEANIA	5	2
GLOBAL	45	15

Out of these 300 papers, most study areas are located in India (39 papers), USA (33 papers), Nigeria (25 papers), Bangladesh (16 papers) and Pakistan (10 papers). These countries have experienced flood disasters many times and have been affected by floods from time to time. Many research papers have been published about floods in these countries in the past years and most researchers are more interested in flood risk analysis in different disasters of those countries.

Journal H-index is a measure of quality of a journal, which can be calculated using web of science and google scholar data. Like the impact factor, the journal H-index does not take into account the different citation practices of research fields. (https://guides.library.unisa.edu.au/c.php?g=169983&p=1119055).

The H-index is an author-level metric that attempts to measure both the productivity and citation impact of a scientist or scholar's publication. This index is based on a scientist's most cited papers and the number of citations they have received in various publications.

First I search journals by various keywords, select 300 important and relevant journals and then I search the h-indexes of journals, which provide a good journal dimension. SCImago (www .scimagojr.com/journalsearch.php?q=rna&page=338&total_size=21206) is another source of journal h-index, freely available on the web. SCImago is a journal search tab that helps to view individual title information, subject area, subject category and h-index etc.

Hirsch concluded after 20 years of research that an h-index of 20 is good, 40 are outstanding, and 60 are truly exceptional. The advantage of the H-index is that it expresses productivity and impact together in one number. Out of 193 collected journals, 24 journals had an h-index of 20 to 40(12%) and 43(23%) journals had an h-index of more than 60 (Table 5).

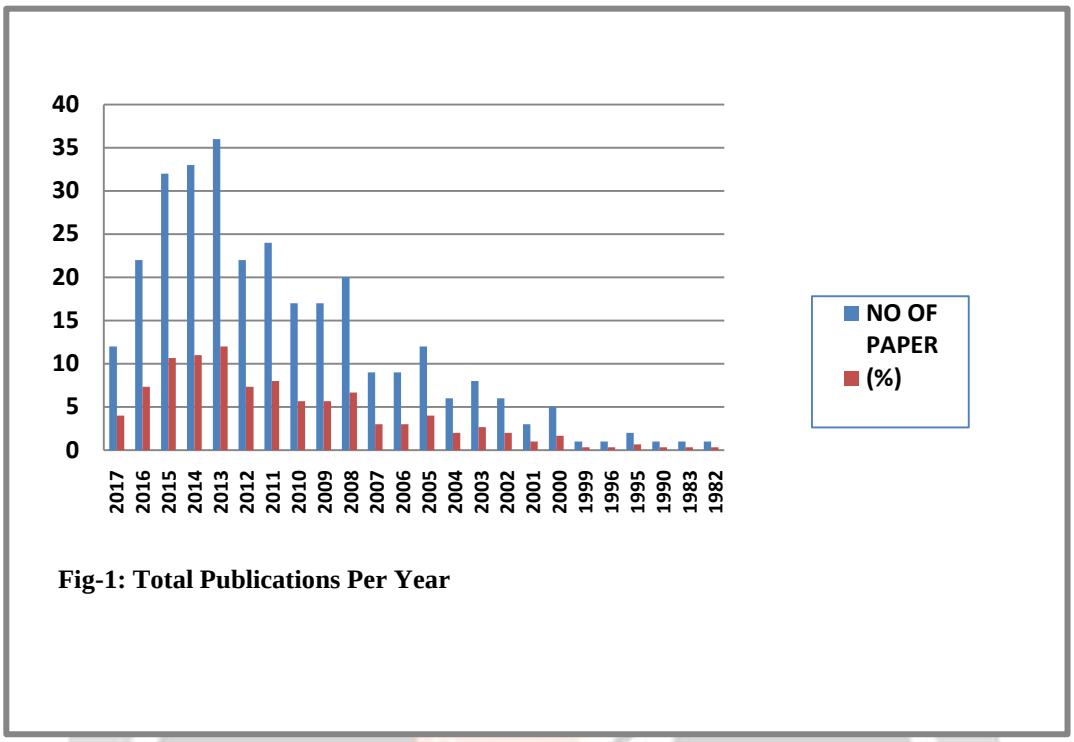

Fig-1: Total Publications Per Year

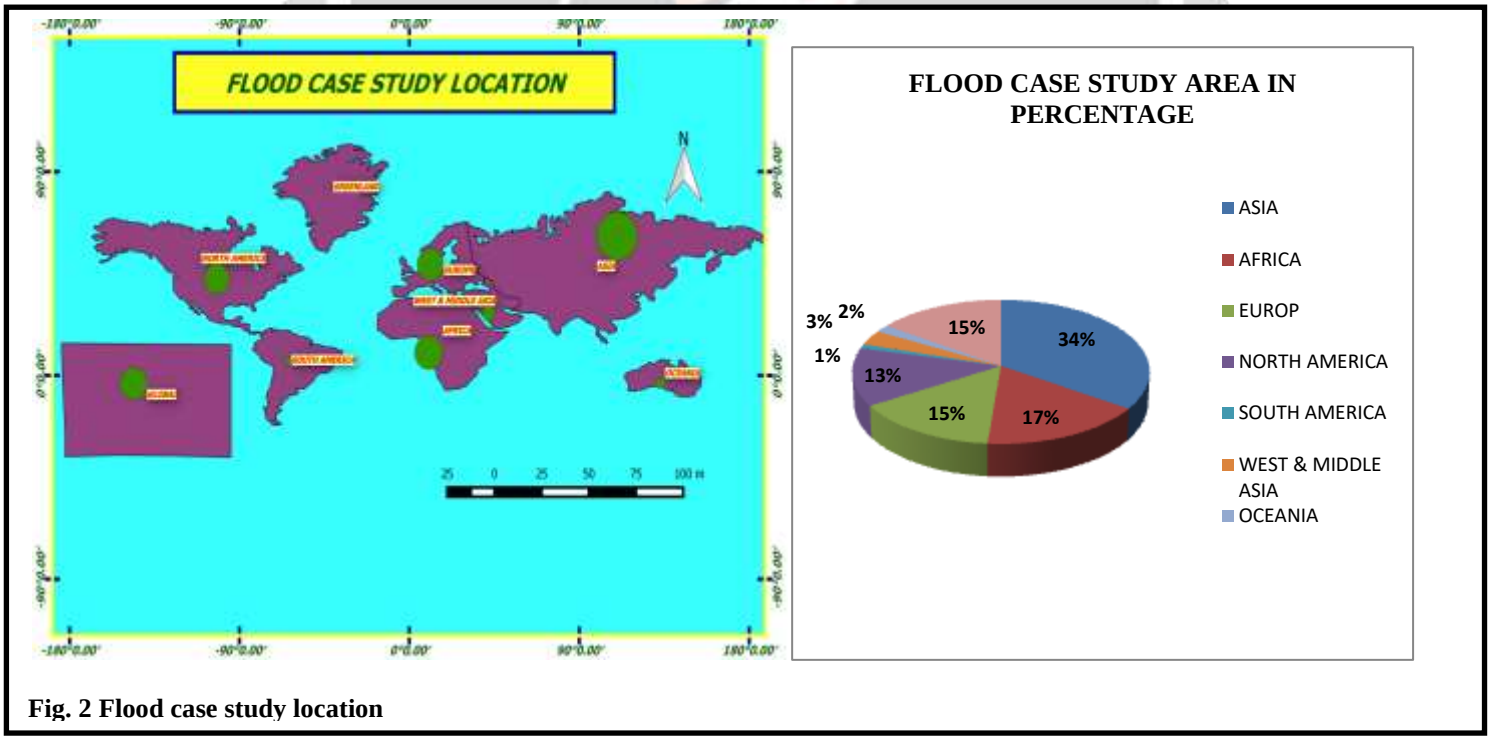

Fig. 2 Flood case study location

Table 5: The H-index structure represent of the flood research analysis

Value of H-index	Number of Journals	% of journal
<20	118	61

20 to 40	24	13
40 to 60	08	5
>60	43	23
Total----------	193	

We know impact factor above 05 is excellent, 03 to 05 is good, 01 to 02 is average and less than 01 is normal. The impact factors of 193 journals are first searched and then they are categorized differently. Here it is seen (Table 6) that only 13 (7%) journals have excellent impact factor, these journals have impact factor above 5, the highest impact factor here is 12.364. It also shows that 48 (25%) and 30 (16%) journals have less than 5 impact factor but above 01 impact factor. But 38 journals less than 01 impact factor and 64 NIL impact factor journals are clear from this study.

Table 6: The Impact Factor structure represent of the flood research analysis

Value of Impact Factor	Number of Journals	% of journal
NIL	64	33
<01	38	20
01 to 03	48	25
03 to 05	30	16
>05	13	7
Total----------	193	

This study shows that the number of publications of all the authors is almost the same, but five authors - Atreya, Baldassarre, Bhatt, C.J. van Westen and Uddin have 03 publications on flood, less than 03 publications of other authors (Table 7).

The Author H-Index is a metric that measures both the productivity and citation impact of a scientist's or scholar's publications. The index is based on the number of citations received in the scientist's set of most cited papers and other publications. By citations, Susan L. Cutter ranks highest with 1541 citations (Table 7). Usually, C.J.Van westen has obtained the highest H-index (138) and also highest publications among the boundless influential and originative authors in field of publications.

The i10-index introduces the number of academic publications an author has written that have at least ten citations from others. i10 index created by Google Scholar and used in Google's my citations feature. This very simple measure is only used by Google Scholar, and is another way to help compute the productivity of scholar. This review analysis of flood risk showed that Lei jiang of Sun Yat-sen University had the highest i10-index (984) (Table 7), which is the most important factor for authors to publish any publication.

Table 7: The most productive and influential author's represent of the flood research analysis

Rank	Name of Authors	Total Paper	Citations of papers	Journals H-Index	Author H-Index	Author i10-Index
1.	Baldassarre et al	3	189	333	87	174
2.	C.J. van Westen	3	89	92	138	312
3.	Bhatt et al	3	16	56	21	15
4.	Atreya et al	3	54	69	18	9
5.	Uddin et al	3	23	0	24	21
6.	Jiang et al	1	8	22	134	984
7.	Cutter et al	1	1541	120	59	126
8.	Slovic et al	1	603	99	137	373
9.	LU et al	2	169	201	88	242
10.	Eleutério et al	1	7	99	93	347
11.	Botzen et al	2	138	194	60	110
12.	Hinkel and Klein	2	179	120	64	106
13.	Kundzewicz et al	2	245	124	0	0
14.	Liu and Smedt	2	95	107	10	6

15.	Bastawesy et al	2	22	125	22	22
16.	Singh et al	2	12	70	20	24
17.	Akhtar et al	2	87	22	6	4
18.	Mmom et al	2	5	23	16	8
19.	Adeloye et al	2	1	16	0	0
20.	Barman et al	2	1	0	8	0

4. Conclusions

This review paper has shown the interest of researchers worldwide in flood research, as well as the amount of research on this subject in different countries and continents of the world. The main objective of the discussion study was to find out what is the stage of worldwide research on floods. To find out, bibliometric information has been collected and analyzed. The following points were found from the bibliometric analysis.

- The maximum number of papers were published in 2013 and 2014
- 28.67% (86) papers have above 50 citations, which gives importance to this topic.
- Asia is the most influential and active continent in terms of flood research.
- 23% (43) journals have above 60 H-index, which is truly exceptional.
- 7% (13) journals have above 5 Impact Factor, which is considered excellent.
- Moreover, Baldassarre and Cutter is found to be the most active author among all in flood research with the highest number of published articles and good citations received.

5. References

1. Agusomu, T., & Paki,F. (2011). Perception of natural hazards in riverine area of Bayelsa State, Nigeria using statistical techniques with primary survey. International Journal of Business and Social Science, Vol. 2 No. 18, 200-206.

2. Jha, V.C., & Bairagya, H. (2011). Environmental impacts of flood and their sustainable management in deltaic region of West Bengal, India using statistical method i.e. Gumble‟s Method, topographical sheet and satellite imageries. Caminhos de Geografia, v. 12, p. 283 – 296.

3. Birkland, T.A.; Burby, R, J.; Conrad, D.; Cortner, H.; Michener, W. K. River ecology and flood hazard mitigation in Mississippi flood plain, USA. Natural Hazards Review, 4:1~46.

4. Masozera, M.; Bailey, M.; Kerchner, C. (2006). Distribution of impacts of natural disasters across income groups: A case study of New Orleans, Louisiana, USA using GIS. Ecological Economics, 299-306.

5. Baldassarre, G.D.; Schumann,G.; Bates, P.D.; Freer, J.E.; Beven, K.J. Flood-plain mapping: a critical discussion of deterministic and probabilistic approaches, UK using hydrodynamic numerical solutions. Hydrological Sciences, 55:3, 364-376.

6. Jonkman, S.N., & Vrijling, J.K. (2008). Loss of life due to floods. journal of flood risk management, 43-56.

7. Roder, G.; Ruljigaljig, T.; Lin, C.W.; Tarolli, P. (2016). Natural hazards knowledge and risk perception of Wujie indigenous community in Fazhi village, Taiwan using primary survey. Natural Hazards, 81:641–662.

8. Aminuzzaman, MD. (2015). Spatial Distribution of Flood Affected Areas & Its' Impact on Agriculture: A Case Study of Murshidabad District, West Bengal, India. International Journal of Scientific Engineering and Research, Volume 3 Issue 7, 173-175.

9. Louhaichi, M.; Hassan, S.; Etteieb, S. (2013). Assessing the risk of flooding in Kairouan, Central Tunisia using GIS and satellite imageries. Australian Journal of Basic and Applied Sciences, 7(8): 868-874.

10. Rongoei, P. J. K.; Kipkemboi, J.; Okeyo-Owuor, J. B.; Van Dam, A. A. (2013). Ecosystem services and drivers of change in Nyando floodplain wetland, Kenya using field surveys and transects walks. African Journal of Environmental Science and Technology, Vol. 7(5), pp. 274-291.

11. Haile, A.T.; Kusters, K.; Wagesho, N. (2013). Analysis Loss and damage from flooding in the Gambela region, Ethiopia by conducted a household survey. International Journal of Global Warming, Vol. 5, No. 4.

12. Anwar, S.; Abdullah, F.M.; Alkahtani, M.S.; Ahmad, S.; Alatefi, M. (2018). Bibliometric analysis of abrasive water jet machining research conducted through web of science database. Journal of King Saud University – Engineering Sciences.

13. Nascimento, N.; Guimarães, E.; Mingoti, S.A.; Moura, N.; Faleiro, R. (2008). Assessing public perception of flood risk and flood control measures in urban areas. International conference on urban drainage.

14. Adeloye, A.J.; Mwale, F.D.; Dulanya, Z. (2015). A metric-based assessment of flood risk and vulnerability of rural communities in the Lower Shire Valley, Malawi Using the IPCC Framework. International Association of Hydrological Sciences, 370, 139–145.

15. Ogah, A.T.; Abiola, K.A.; Magaji, J.I.; Ijeogu, E.O.; Opaluwa, O.D. (2013). Flood risk assessment of river Mada: A case study of Akwanga local government area of Nasarawa state, Nigeria using rainfall data and statistical methods. Advances in Applied Science Research, 4(1):407-416.

16. Musungu, K.; Motala, S.; Smit, J. (2012). Using Multi-criteria Evaluation and GIS for Flood Risk Analysis in Informal Settlements of Cape Town: The Case of Graveyard Pond in Philippi, South Africa using GIS. South African Journal of Geomatics, Vol. 1, No. 1, 77-91.

17. Czymzik, M.; Dulski, P.; Plessen, B.; Grafenstein, U. V.; Naumann, R.N.; Brauer, A. (2010). A 450 year record of spring-summer flood layers in annually laminated sediments from Lake Ammersee (southern Germany) applying a novel methodological approach. Water Resources Research, VOL. 46, W11528.

18. Sinha, R.; Bapalu, G.V.; Singh, L.K.; Rath, B. (2008). Flood Risk Analysis in the Kosi River Basin, North Bihar Using Multi-Parametric Approach of Analytical Hierarchy Process (AHP). Journal of the Indian Society of Remote Sensing, 36:293–307.