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Assessing Community Preparedness and Institutional Role in Reducing Vulnerability of Flood Prone Areas of Balochistan

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Abstract

Flooding is an unvarying devastating recurring event in Pakistan producing serious economic and social damages. Despite its recurring nature extensive research on flood hazards and its management specifically in the Baluchistan province of Pakistan has been delimited. The aim of the study was therefore to evaluate the role of flood management institutes and the preparedness of the community against flooding to reduce the vulnerability of flood prone areas of the Baluchistan province of Pakistan. For this purpose, primary data was collected from 100 families from the most flood affected district Jaffarabad, of province Baluchistan by adopting a random and non-probability sampling method. The primary data was collected through questioners and interviews of house heads of flood affected families, farmers, and professions of Flood management institutes (FMI). Several technical reports, policy documents, and research papers allied to flood management related studies were reviewed as secondary data. The data collected was analyzed statistically by t-test. Questionnaires were developed to cover the study variables related to community livelihood state, physical and socio-economic vulnerability, and available structural facilities of the study area. The data revealed significant ($p < 0.05$) increase in average income/day of the affected families from the year 2014 (PKR 180/day) to 2020 (PKR 320/day) after 2010 (PKR 170/day) with significant ($p < 0.05$) reduction in overall damage to household assets. Our analysis also showed 30% statistically a significant ($p < 0.05$) reduction in loss of agricultural land of Jaffarabad with significant less agricultural sector loss from 103.77 USD million to 36.51 USD million after successive flood events from 2010 to 2015. The results of physical vulnerability showed a significant reduction in displacement rate allied to overall significant reduction in drop of GDP growth and poverty rate. Significant ($p < 0.05$) improvement in the structural units from 20% (2010) to 52% (2015) in housing units and from 28% (2010) to 38% (2015) in the cultivation units represents the role of FMI in improving available infrastructure to mitigate flood hazards in this area. These findings underline the impact and successful outcomes of flood rectifying policies and implementation of FMI to reduce damage caused by the 2010 flood in Baluchistan.

Keywords: Flood Prone areas of Pakistan, FMI, community preparedness, Jaffarabad (Baluchistan).

1. Introduction

Flooding is considered a major natural hazard globally which results in life and property loss with reduced economic growth. Although it is impossible to avert the incidence of floods, but the adverse impacts of floods could be curtailed significantly through proper management, planning, and active preparations (Ahmad and Afzal, 2020). The risk of floods can be managed by a precise and appropriate predictions by the activation of warning and forecasting systems along with the implementation of risk reducing measures (Abbas et al., 2015). Pakistan had been hitting with flood disasters nearly every year since the last decade. During 2008-2018, an overall economic loss of 38.165 USD billion has been projected due to major flood waves in Pakistan. Approximately, 616,598 km2 zone of land and 12,000 human beings were affected in these floods (Neelam et al., 2014). Change in climatic conditions has also been predicted to surge in magnitude and frequency due to floods in upcoming years in Pakistan as a result of glacial melting with the thawing of mountains tops and rise in monsoon rainfall in this region (NDMA (National Disaster Management Authority), 2013). This alarming situation strains for a sustainable and effective management of flood

events to minimize overall damage (Fahad and Wang, 2020). In spite of recurrent flood catastrophes, Pakistan has developed significant progress in the economic and social sectors by managing flood hazards by the development of advancement in flood management plans and by implementing flood rectifying policies through FMI and community preparedness against this disaster (World Bank 2017). This study identifies the prospects of effective flood risk management particularly in the most prone areas of Pakistan. The study aims also seek to analyze critically the existing flood related research so far conducted in Pakistan emphasizing flood prone areas like Balochistan province. In the year 2010, this area was massively damaged due to flash floods with the huge displacement of around 300 families/districts. The major affected districts of this province were Jaffarabad, Turbot, Tump, Nasirabad, and Dasht, where 1,5000 people were displaced and 40,000 suffered according to an estimation (Adnan, 2014). Massive damage to the economy and infrastructure was also reported in these districts due to the floods that cause loss of housing and other services such as sanitation, water, and electricity (Afridi and Siddiqui, 2013). Keeping in view the disastrous effects of the 2010 flood in this region the current study was proposed to highlight the importance of effective management by elevating the role of flood management institutes and community preparedness in reducing flood risk and damages caused by such flood events. This research study also reviewed previous systematic literature to understand and develop an effective comparison of flood related research in different flood prone areas of Pakistan. This study suggests clearly that the research related to forecasting, modeling, and management in the Baluchistan province of Pakistan is far less emphasized which could aid the authorities to focus on major aspects of flood risk during policy making as mitigation measures in flood management projects. The outcomes will help adapt advanced flood mitigating measures to respond better to the flood chronic problem of the country.

2. Materials and methods

The current study intended to evaluate the role of basic flood management institutes and preparedness of the community against flooding to reduce the vulnerability of flood prone areas of the Balochistan province of Pakistan (Fig.1). The major points in the focus of the study were flood challenges, management and prospects for sustainable and effective flood management in most flood prone areas of Balochistan province. For this purpose, primary data was collected from the worst flood affected district (Jaffarabad) of province Balochistan by adopting a random and non-probability sampling method. The primary data was collected through questioners and interviews of house heads of flood affected families, farmers, and officials of FMI from the Jaffarabad district of Balochistan during the field survey. Several technical reports, policy documents, and research papers allied to flood management related studies issued by different research, academic, and consulting institutes were also reviewed as secondary data to derive important findings and key recommendations related to strategic flood management in flood prone areas of Pakistan. The data of dependent variables versus the independent variables was presented in the form of graphs and tables.

2.1 Research Design

Primary data was collected from the worst flood affected district (Jaffarabad) of province Balochistan by adopting a random probability sampling method based on the quantitative method of research design.

2.2 Sampling Design

A simple random design of sampling was adopted for sampling from the Jaffarabad district of Balochistan where every participant from a population has an equivalent chance of being selected. The sample size (100 house heads) for this research is determined using the following formula:

$$n = \frac{z^2 \cdot N \cdot p \cdot q}{N \cdot E^2 + z^2 \cdot p \cdot q}$$

Calculation of the sample size (n) of simple random sampling for the finite populations ($f < 0.05$) at confidence level (z) as 95%, max population variability ($p = q = 0.5$),

the population size (N), with assumed 3% sampling error (E) (Aslam et al., 2017).

2.3. Selection of the study area

The Jaffarabad district of Balochistan province was the major area of the sampling owing to the following factors.

1. The district Jaffarabad is among the most flood disposed of areas of the province of Baluchistan. After the 2010 flood, this area has been affected by four successive floods resulted in drastic damage to this area (Afridi and Siddiqui, 2013).

2. After the 2010 flood, many relief personnel from both governmental and private organizations have arrived in this area to mitigate the disastrous effects of floods, so this area was suitable to study the effect of flood management role of such institutions in flood prone areas.

2.4. Background of Jaffarabad

District Jaffarabad shares southern borders with province Sindh and north borders with Nasirabad, Jacobabad, and Larkana. Jaffarabad was princely associated with the Sibi district until 1975. This district occupies an area of 2,445 km2. District Jaffarabad is located between27°56'3"-28°40'26" North latitudes and 67°37'36"-69°07'39" east longitudes. It consists of four tehsils and 45UCs (Afridi and Siddiqui, 2013).

2.5. Sampling Procedure

District Jaffarabad is comprised of different villages and councils. As population information was not clear, a clustering technique was applied and randomly two villages were selected and from these urban councils, Gandakha Tehsil and Sobdarani tehsil of two locations Challo ziyarat and Khawasi banda were selected. Respondents from flood affected 100 families, 50 families per Tehsil were selected.

2.6. Study Variables

The data relevant to different aspects of floods and community vulnerability was presented in the form of graphs and tables. The following aspects/variables were included in the present study to achieve the desire objectives of the current study.

- State of livelihood in the affected area
- Degree of damage to the agricultural land
- Physical vulnerability/displacement
- Socio-economic vulnerability
- Reforms to maintain infrastructure

2.7. Units of Analysis

The units of simple random analysis were

- Local Units: household heads, farmers, and the general public.
- Organizational units: Government Organization (GOs) and Nongovernmental Organizations (NGOs).
- Administrative Unit: Union council, Tehsil, District and Province administration

Jaffarabad
Balochistan

Fig.1. Showing the map of the study area.

2.8. Data Processing and Statistical Analysis

The initial data collected from the respondents through questionnaires and interviews was arranged in tables and then was properly interpreted and analyzed by calculating score of success for each response. Each response was assigned by a score adopting Likert Scale containing five options for each response.

- Strongly agree (SA) : 5
- Agree (A) : 4
- Neutral : 3
- Disagree (DA) : 2
- Strongly Dis- Agree (SDA) : 1

$$\text{Mean Score: } \frac{F_{SA} X 5 + F_A X 4 + F_{UD} X 3 + F_{DA} X 2 + F_{SDA} X 1}{N}$$

The data acquired was subjected to descriptive statistical analysis by means of percentage, mean, standard deviation with standard error and t-test. SPSS (Statistical Package for Social Sciences) was used for data analysis. For each response percentage, mean and standard deviation was calculated.t-test (independent variables) was applied for the comparison of difference of response at 0.05 level of significance.

3. Results

Pakistan has an extended flood history of 23 main floods from 1947 to 2015. Through this time, these floods caused damage of variable magnitude to a large area of land and infrastructure in different areas of Pakistan including the worst affected regions of Balochistan province. The super flood event of 2010 with variable intensity in different regions of Pakistan was one of the biggest floods in the latest history which remained highly damaging for the physical and socio-economic state of the province adversely affecting the livelihood of the inhabitants (Ahmed et al., 2014). However, due to rapid progress and advancement in the flood management system of Balochistan consists of flood policy and strategy, flood laws, flood institutions, flood planning, and flood management measures in the last few years had drastically reduced the damage caused by flood in most flood prone areas of Balochistan (Arslan et al., 2016). In the present study the role of flood managing institutes and community preparedness was assessed by considering the basic variables.

3.1 Institutional Role in Reducing Vulnerability of at-Risk Communities

Pakistan's existing flood management structure entails flood strategy, policy, laws, flood institutions, and flood control measures. The main purpose is the expansion of water storages, reservoirs, watersheds, development of flood impedance structures, preservation of existing infrastructure, advance flood warning and forecasting system, enforcement of flood allied laws to protect flood plains (Saunders et al., 2016).

FFC has implemented ten years' national flood protection plans (NFPPs) as shown in Table 1. Federal organizations and PID (provincial irrigation departments) have developed these plans. The project mainly serves to construct spurs and embankments, involved in the upgradation and improvement of flood warning and forecasting systems. The NFPPs developed total of 5240 flood fortification schemes by spending 25.45 billion PKR.

3.2 Community Preparedness towards Flood Hazard

3.2.1 Preparedness at Household Level

The practice of prompt preparedness measure is key to minimize the negative impact of flood however little is known about preparedness against this hazard at the household level in areas where no effective measures have been taken to initiate learning related to preparedness against flood before this event. In this study, data was collected from the families which were living in flood prone areas and had been exposed to frequent flood waves in the last five years after 2010. The analysis showed that 8% of the total families had accessible maps of flood susceptible areas, 4% with flood alerts systems on their cell phones, 60% had other safe shelter places to make displacement during floods. 23% had modified their homes and business places to withstand

floods, 29% of families had protected wetlands by planting trees to avoid soil erosions and to improve soil conditions. 33% had developed small local water storage areas at their homes and field to mitigate the damage caused by flood to their homes and fields.

3.2.2 Preparedness at Agricultural and Farm Level

Farmers of flood prone areas were also adversely affected due to drastic climatic change resulting in a huge flood in 2010. In this study conducted in the Jaffarabad district of Balochistan, it was detected that the loss of the agriculture sector was reduced by up to 50 % till 2015 by adopting land management practice at the local level by the framers. The 53% of local farmers used mounds to mitigate the effects of flooding and the damage reduced to 36% from 75% till 2015 after the 2010 flood. The risk of damage was further reduced to 40% by planting flood resistant varieties of the crop in this region by the local farmers. 23% of farmers in this district grow hybrid seed varieties which give a high yield of flood tolerant crops like DR92 flood resistant variety of rice cultivation started in this region after the 2010 super flood damage to the crops. More food and water storage capacity building also reduced damage to the agriculture sector by 10% in this region. 5% damage to agricultural land was reduced by planting more trees by the local farmers on field boundaries which reduced soil erosion during the flood.

Some well-oriented programs initiatives also played important role in local farming inputs and to help the farmers bring them back to stable farming after the shattering flood. AusABBA II (Australia-Balochistan Agri-Business Programme-Phase II) promoted 1750 farmers in this district of Balochistan. FMCs (Farmer Marketing Collectives) allied to marketplaces for commodities specifically of Balochistan. The team group arranged meetings with the state representatives to provide improved plantains specifically maize (early maturing crop) to the farmers to enhance crop production in less time.

3.3 Analysis of the Effect of Flood Management Institutes and Community Preparedness in Reducing the Risk of Floods in Flood Prone Areas of Balochistan

The successive floods from 2010 to 2014 have emphasized the need for instant attention and a wider vision towards the management of severity of floods in flood prone areas. Due to the cross damage mainly in urban areas caused by the 2010 flood, it became necessary to develop structural and non-structural measures with an integrated system of flood management policies and approaches to mitigate the hazard in less developed areas like the Balochistan province of Pakistan. In this perspective, FFC played a central role in monitoring, planning and, executing a flood safety plan, as a result, the extend of hazard got significantly reduced to flood prone areas. In this milieu, the data related to the following variables were collected from the most flood prone areas of Balochistan to evaluate the role of FMI and community preparedness in reducing the risk of flood in these areas.

3.3.1 State of Livelihood in the Affected Area

The financial resources management institute is responsible for allocating, controlling, and procuring financial resources at the lowest cost in flood prone areas. There are several funding agencies (Islamic development bank, Asian development bank) that offer short and long-term loans to the affected families for the reconstruction of household and agricultural facilities to stabilize their livelihood. Flood relief cards were also distributed to families that were affected badly due to the 2010 flood. The financial aid programs of these agencies with flood relief subsidies offered by the government played a vital role in flood disaster management by making affected families financially stabilized. It was revealed from the data collected from Jaffarabd district that due to financial aid programs offered by the government resulted in the overall stabilized livelihood of inhabitants living in flood prone areas after the 2010 super flood disaster. There was a significant ($p < 0.05$) increase (Table 2) in average income/day of the affected families from the year 2014 to 2020 after the 2010 super flood (Fig. 2). In Year 2008 the average income per family was PKR 350/day which reduced to PKR 170/day in year

2010 till 2012. Increase in average income was seen in 2014 (PKR 180/day) to 2020 (PKR 320/day). After 2008 the highest income rate was observed in 2018 which was (PKR 330/day). Instant wide versions of flood management at the provincial level resulted in the improved livelihood of flood-affected families in the understudy flood-prone district of Balochistan.

The outcomes also revealed significant ($p < 0.05$) reduction in overall damage to household assets from 42% to 20% (Table 3) in five years after 2010 flood damage as a result of effective measures taken by institutes after the super flood (Fig. 3).

3.3.2 Degree of Damage to the Agricultural Land

Analysis of the key indicative measures and processes in the FRM (Flood risk management) system at provincial and district levels conducted through a structured questionnaire completed by 27 professionals from the Department of agriculture, Irrigation department, District administration, Local government, Livestock dairy department, and water management department. The inferred outcomes of the recorded response of the respondents revealed an overall 30% (reduction from 50% to 20% as shown in Fig. 4) which is statistically a significant ($p < 0.05$) reduction (Table 4) in loss of agricultural land of Jaffarabad after successive flood events from 2010 to 2015 with significant less agricultural sector loss from 103.77 USD million to 36.51 USD million (Fig. 5). These findings underline the impact and successful outcomes of flood rectifying policies and implementation of FMI to reduce damage to the agricultural sector caused by the 2010 flood in Balochistan.

Table. 1 An Overview of National Flood Protection Plans (NFPPs)

Plan	Action	Total Cost (PKR Billion)
NFPP-I (1978-1988)	311 flood-protection schemes completed	1.73
NFPP-II (1988-1998)	4444 flood-protection schemes completed	14.92
NFPP-III (1998-2008)	485 flood-protection schemes completed	8.80
Total	5240 protection schemes completed	25.45

(Commission., 2012)

Table. 2 Average income/day of the inhabitants of Jaffarabad District during 2008-2020.

Annuals	Average income in PKR/day	t-value	Significance (p-value)
2008	350	.741	0.01*
2010	170	.112	0.06
2012	170	.112	0.06
2014	180	.522	0.03*
2016	220	.651	0.03*
2018	330	.737	0.01*
2020	320	.732	0.01*

* significant p-value as $p < 0.05$

Table. 3 Overall House hold assets damage during successive flooding years from 2010-2015.

Flooding Years	Overall house hold assets damage (%)	t-value	Significance (p-value)
2010	42	.344	0.07
2012	40	.343	0.07
2014	28	.311	0.03*
2015	20	.275	0.02*

* significant p-value as $p < 0.05$

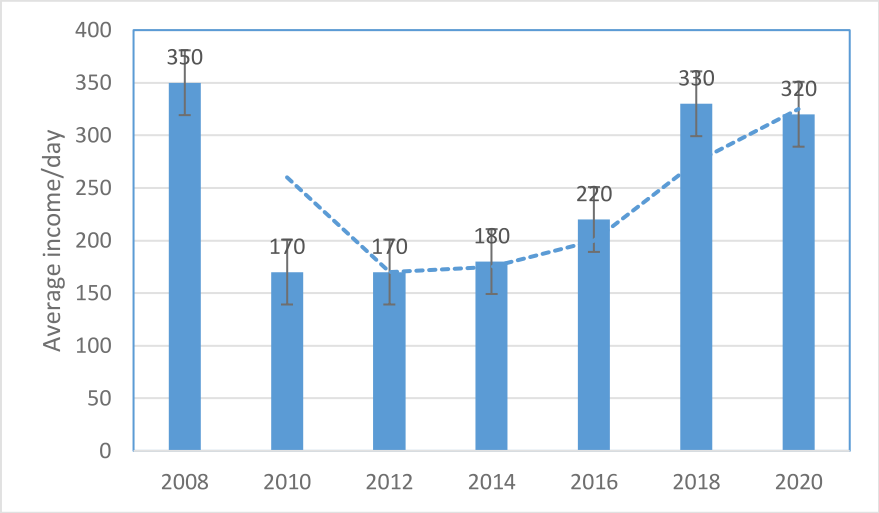

Fig. 2. Graphical representation of analysis of major indicative measures taken by FMI in improving the average income/day of the affected families of district Jaffarabad. As a result of effective indicative measures taken after the 2010 flood event the average income/day increase significantly from 170PKR/day to a maximum 330PKR/day in the last decade.

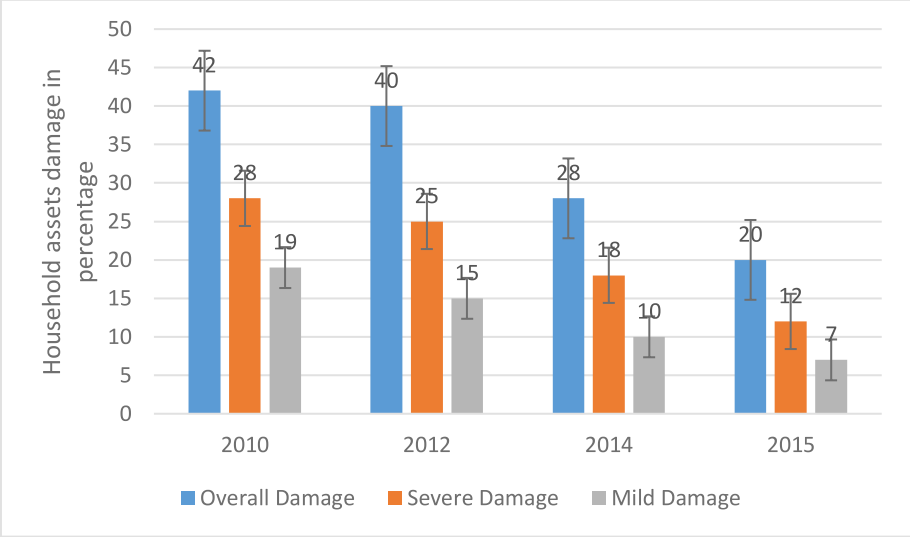

Fig. 3. Graphical representation of analysis of major indicative measures taken by FMI in reducing damage to the household assets of the affected families of district Jaffarabad. A significant reduction in damage to overall household assets was observed in 2015 as compared to the damage observed in the 2010 super flood.

Table. 4 Degree of Damage to the Agricultural Land during successive flooding years from 2010-2015.

Flooding Years	Loss of agricultural land (%)	t-value	Significance(p-value)
2010	50	.457	0.06
2012	43	.411	0.06
2014	23	.323	0.01*
2015	20	.311	0.01*

* significant p-value as $p < 0.05$

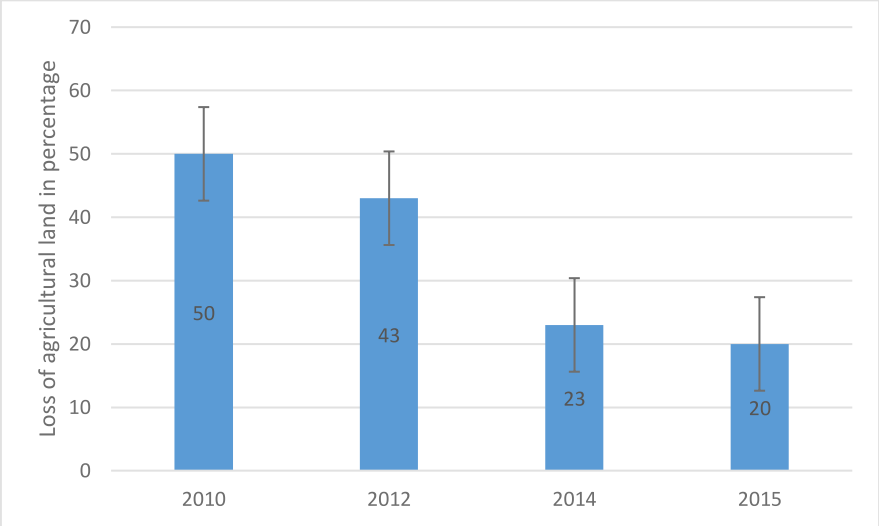

Fig. 4. Graphical representation of analysis of major indicative measures taken by FMI in reducing damage to the loss of agricultural land of district Jaffarabad. Significant reduction in damage to agricultural land up to 30 % was observed from 2010 to 2015.

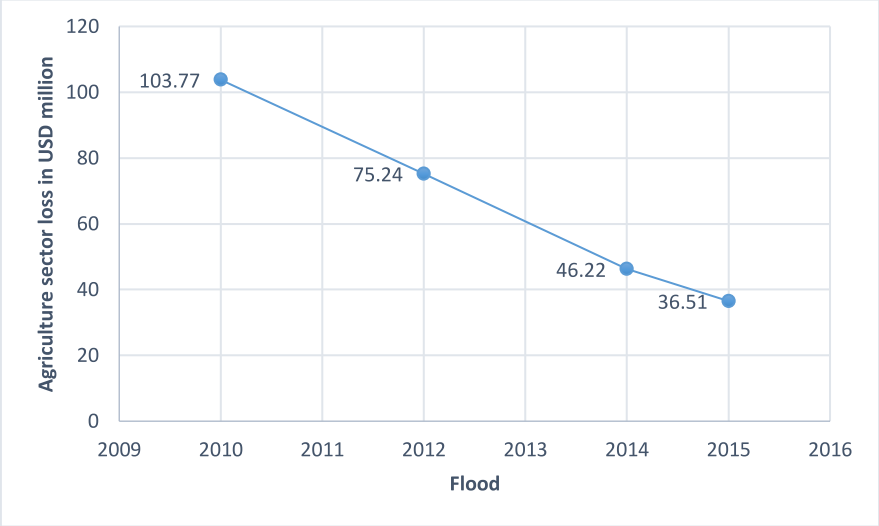

Fig. 5. Graphical representation of the effect of FMI flood fortifying measures in managing loss to the agriculture sector. Significant reduction in loss from 103.77 USD million to 36.51 USD million in successive flood event from 2010 to 2015 is represented here as outcomes of the response of the respondents from the Jaffarabad district of Balochistan.

3.3.3 Physical Vulnerability/Displacement

To evaluate the rate of displacement (physical vulnerability) of individual's flood-affected families, data of response of individuals from 100 families was recorded and evaluated. The outcomes revealed a significant ($p < 0.05$) reduction in displacement rate from 402 individuals in 2010 to 13 individuals in 2015. In 2012 number of individuals displaced was 72 which was further reduced to 50 individuals in 2014 and 13 individuals in 2015 (Table 5). Overall significantly less number of displaced individuals was observed in five successive years of flood after 2010 (Fig. 6).

The results indicate the significance of better provisions of policies taken by FMI in conjunction with the community preparedness against flood hazard.

3.3.4 Socio Economic Vulnerability

FFC framed NFPPs to evaluate the effect of floods on the socio-economic state and focus on the need to provide an uninterrupted solution for the problems developed due to flood disasters. To review the impact of such plans, develop for flood management, the data related to average GDP growth and poverty rate in flood prone area was collected from 25 District administration officials and house heads of 100 families through questionnaires and interviews. The outcomes revealed that a reduction of 1.16% GDP growth was seen in 2010 after flood which was up to 0.85% in 2012, 0.64% in 2014 and 0.6% in 2015 (Fig. 7) with the concomitant reduction in poverty rate by 22.2% (from 71.2% to 49% after the 2010 flood) in flood prone area of Balochistan (Fig. 8). Overall significant ($p < 0.05$) reduction in drop in GDP growth rate (Table 6) with significant ($p < 0.05$) reduction in poverty rate (Table 7) was observed in flood prone area after 2010.

3.3.5 Reforms to Maintain Infrastructure

Following the 2010 flood, the focus FPPs were to maintain, upgrade, and new constructions in some places. These reforms resulted in significant improvement in structural units (housing and agricultural protective units). The collected data from Jaffarabad also showed significant ($p < 0.05$) improvement in the structural units (Table 8), from 20% (2010) to 52% (2015) in housing units which was 15% in 2012 and 50% in 2014 with concomitant significant ($p < 0.05$) improvement in the cultivation units from 28% (2010) to 38% (2015) through 22% (2012) and 34% (2014) representing the role of FPPs in improving available infrastructure to mitigate flood hazards in this area (Fig. 9).

Table. 5 Physical Vulnerability/Displacement during successive flooding years from 2010-2015.

Flooding Years	No. of individuals displaced/year	t-value	Significance (p-value)
2010	402	2.721	0.07
2012	72	2.123	0.01*
2014	50	1.634	0.00*
2015	13	1.121	0.00*

* significant p-value as $p < 0.05$

Table. 6 GDP growth rate (%) during successive flooding years from 2010-2015.

Flooding Years	Reduction in GDP growth (%)	t-value	Significance (p-value)
2010	1.16	.311	0.05
2012	0.85	.272	0.02*
2014	0.64	.222	0.00*
2015	0.62	.211	0.00*

* significant p-value as $p < 0.05$

Table. 7 Overall poverty rate during successive flooding years from 2010-2015.

Flooding years	Overall poverty rate (%)	t-value	Significance (p-value)
2010	71.2	.441	0.07
2012	70.2	.433	0.07
2014	50.2	.357	0.01*
2015	49	.348	0.01*

* significant p-value as $p < 0.05$

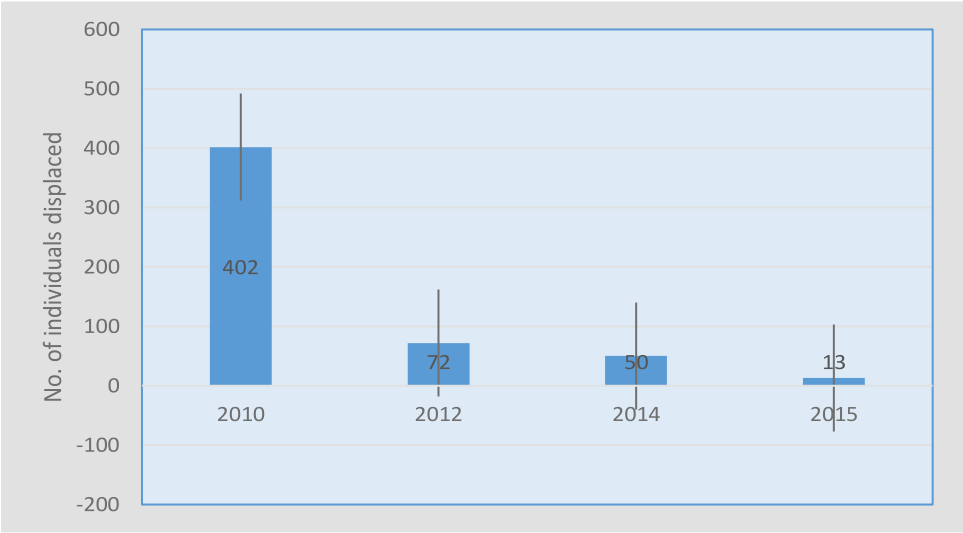

Fig. 6. Graphical representation of the rate of physical displacement of flood affected families of the Jaffarabad. The respondent response showed a decrease in the rate of displacement after the 2010 flood event under FMI policies provisions and community preparedness against flood hazards.

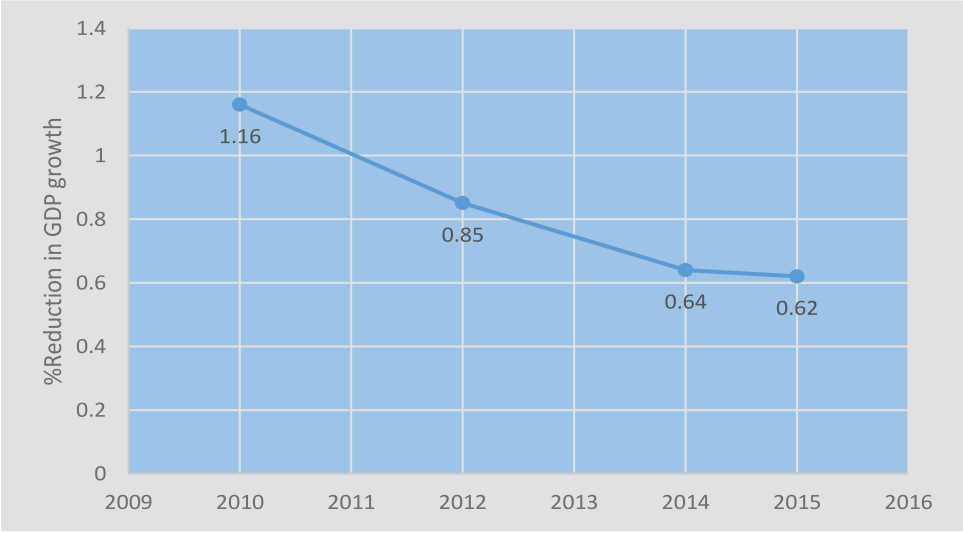

Fig. 7. Graphical representation of %GDP growth in flood prone area in successive five years after 2010. The response showed less effect of the flood on GDP growth in successive flood events after 2010 as compared to the flood event of 2010.

Table. 8 Available infrastructure units in Jaffarabad district.

Flooding years	Available housing unit (%)	t-value	Significance (p-value)	Available cultivation unit (%)	t-value	Significance (p-value)
2010	20	.391	0.08	28	.286	0.06
2012	15	.382	0.08	22	.271	0.06
2014	50	.322	0.00*	34	.211	0.01*
2015	52	.339	0.00*	38	.252	0.01*

* significant p-value as $p < 0.05$

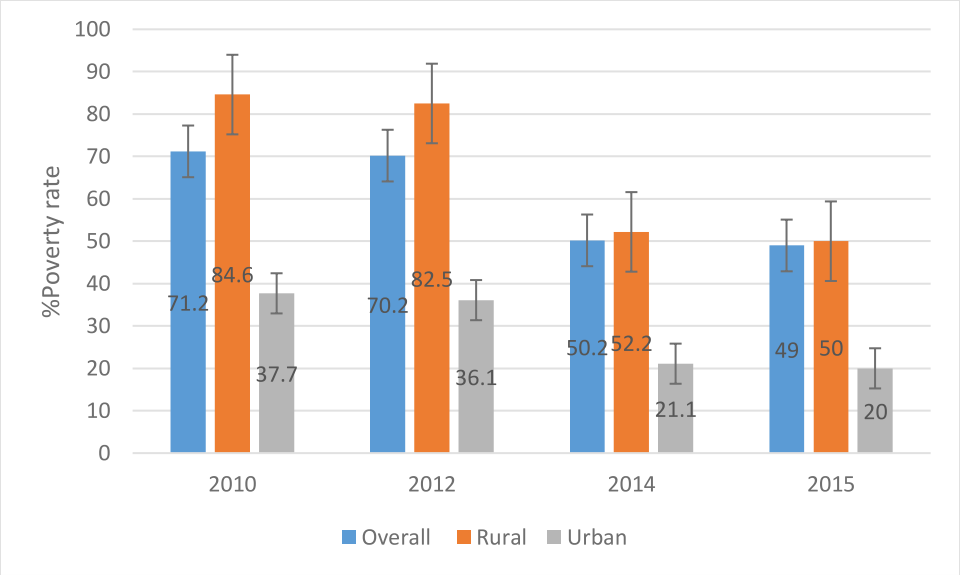

Fig. 8. Graphical representation of poverty rate in Jaffarabad district in successive five years after 2010. The response showed less rate of poverty in successive flood events after 2010 as compared to the major flood event of 2010.

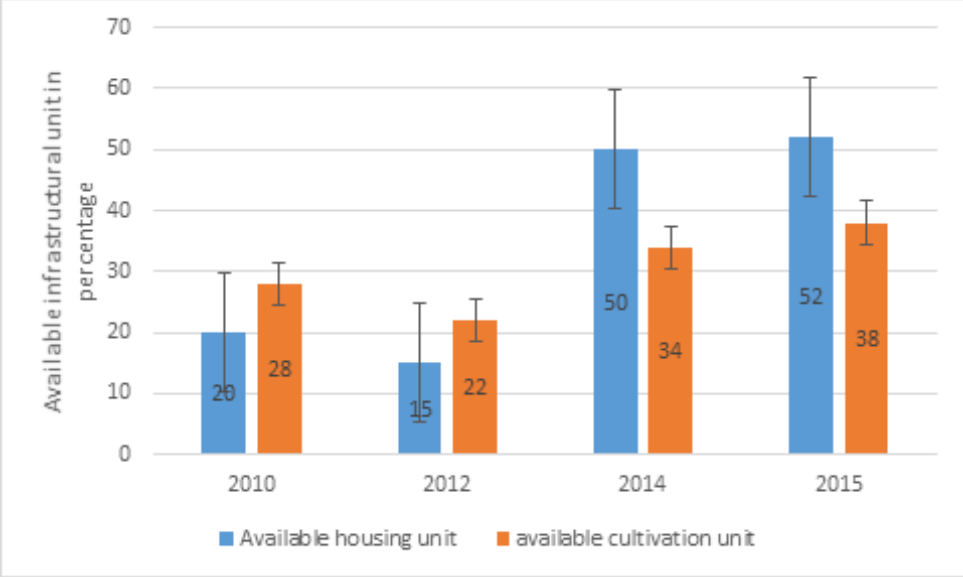

Fig. 9. Graphical representation of the comparison of percent available infrastructural units in Jaffarabad district in successive five years after 2010. The response showed improved available infrastructural units in successive flood events after 2010 under FPPs implemented against flood hazards.

4. Discussion

Pakistan is amongst the highest flood-prone realms in South Asia, which suffered from an estimated 18 million USD/flood event in losses and damages in the past decade. Despite the recurring flood catastrophes, Pakistan has paved substantial progress in economic and social development by rectifying flood hazards through advancement in flood management plans and by implementing flood rectifying policies through FMI and community preparedness against this disaster (Bank., 2017). The current study was therefore designed to explore the role of FMI and community preparedness in reducing the risk of damage caused by floods with special reference to most flood prone districts of Balochistan province of Pakistan such as Jaffarabad district. For this purpose, the data was collected from

Analysis of the livelihood state of the local inhabitants revealed overall stabilized due to financial aid programs offered by government after 2010 flood disaster. For the analysis of livelihood state, two major indicatives, the average income/day of the affected families and house hold assets damage after 2010 flood was measures. The data revealed significant ($p < 0.05$) increase in average income/day of the affected families from the year 2014 (PKR 180/day) to 2020 (PKR 320/day) after 2010 (PKR 170/day). The outcomes also revealed significant ($p < 0.05$) reduction in overall damage to household assets from 42% to 20% in successive five years (2010-2015) after 2010 flood damage as a result of effective measures taken by institutes after the super flood. Instant wide versions of flood management at the provincial level resulted in the improved livelihood of flood-affected families in the understudy flood-prone district of Balochistan which was in line with the work of (Gall et al., 2014) where they also find improved livelihood state of locals living in China.

Our analysis also showed less physical and socioeconomic vulnerability to flooding hazard with improved agricultural and infrastructural facilities. The inferred outcomes of the recorded response of the respondents revealed an overall 30% (reduction from 50% to 20%) which is statistically a significant ($p < 0.05$) reduction in loss of agricultural land of Jaffarabad after successive flood events from 2010 to 2015 with significant less agricultural sector loss from 103.77 USD million to 36.51 USD million. The results of Physical vulnerability showed a significant ($p < 0.05$) reduction in displacement rate from 402 individuals in 2010 to 13 individuals in 2015. Which was in line with the work of (Haque et al., 2020; Shah et al., 2019) where they described less number of individual displaced in forthcoming years after flood in rural region of Bangladesh. These findings underline the impact and successful outcomes of flood rectifying policies and implementation of FMI like NFPPs of FCC to reduce damage caused by the 2010 flood in Balochistan. On contrary it was also found in this study that regarding water management the reforms and policies implemented by the government were not satisfactory in this province. Watersheds management or development of dams was less focused or ignored in Balochistan province which is the top need of this province in the coming years to fight with natural disasters like floods and drought.

To review the impact of flood rectifying plans, the data related to average GDP growth and poverty rate in flood prone area was collected. The outcomes revealed overall significant ($p < 0.05$) reduction in drop in GDP growth rate with significant ($p < 0.05$) reduction in poverty rate in successive five years of flooding from 2010 to 2015 in line with similar work of (Shah et al., 2021) in Khyber Pakhtunkhwa province of Pakistan. The collected data from Jaffarabad also showed significant ($p < 0.05$) improvement in the structural units from 20% (2010) to 52% (2015) in housing units with the concomitant significant ($p < 0.05$) improvement in the cultivation units from 28% (2010) to 38% (2015) representing the role of FPPs in improving available infrastructure to mitigate flood hazards in this area. (Khayyam and Noureen, 2020) also described important role of FPPs in rectifying flood hazards by improving infrastructure in Punjab province of Pakistan.

It was inferred from the outcomes that the overall improvement in the livelihood state, GDP growth, physical and socioeconomic vulnerability and agricultural and structural facilities of the study area is allied with effective indicative measures taken by flood management institutes under the NFP program.

5. Conclusion

It was concluded from the outcomes that the flood rectifying policies and implementation of FMI and community preparedness following the 2010 flood had significantly reduced the vulnerability of flood prone areas of Balochistan by the reforms helpful in reducing socioeconomic and physical vulnerability and improving livelihood states of the locals. But the 2010 flood event presented many key lessons not only on how to coordinate an Emergency better, but also on how necessary it is to integrate prevention, relief assistance, and rehabilitation

into long-term risk reduction programs. The 2010 floods and cyclones tested the Pakistan government's capacity to respond efficiently; exposing its institutional weaknesses and limited capacity. At the onset of the event, there were no clear programs or plans for responding to the emergency including preparedness, evacuation, and response. Existing plans did not take account of an event of such magnitude nor the type of impacts that resulted. The main argument presented was that communities also did not anticipate an event of such magnitude, inhibiting appropriate responses, particularly to early warning. The 2010 event did however represent an opportunity for the government to understand its institutional vulnerability against flood hazards.

Ethics Approval and Consent to Participate:

Ethical approval was obtained from the institutional review board, University of Balochistan Quetta, Pakistan. After explanation of the objectives of this project, written informed consent was obtained from all the participating individuals.

Competing interests:

The authors declare that they have no conflict of interest.

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Authors' Contribution

Muhammad Ashraf Ansari projected the main concept and design of the study with field data acquisition; analysis, interpretation of the data, and drafting of the manuscript. Muhammad Ashraf supervised the whole research and manuscript work. Ghulam Murtaza provided basic facilities for the collection of field data, Muhammad Zaigham Javed performed analysis, interpretation of the data, and revision of the manuscript critically for important intellectual content. All authors read and approved the final manuscript.

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