Reduction of disaster vulnerability through Indigenous knowledge

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Abstract

Linking indegenious knowledge of the community with modern techniques to mesure, analyse and reduce disaster vulnerability is one way of engaging and moblising community capacity. This paper discuses he use of the local/ indegenious knowledge into disater management. It suggest a way to moblise available human and technical resources in order to strengthen a good partnership between local communities and local and national institutions. The study conducted through field work in two districts "Thatta and Badin" of coastal area of Sindh Province of Pakistan. Multistage cluster sampling technique has used to select the sample size of 360 households from the area. Data was collected through well structured questioner. With the increasing socio-economic changes in this global village, local knowledge is wear away unremittingly and having no severe to sightsee. New peers are accepting new ways of life and grownup groups reminisce very less. Proper utilization of local wisdom, knowledge along with modern tools and techniques can give rid from disaster worst situation and can reduce risk. To measure local knowledge and wisdom of the community statistically new model has developed through primary data, Model for local knowledge. In the model Local Knowledge is dependent variable whereas, age, experience, living status and prediction about disasters are independent variable. The impact of these independent variables on dependent variable has measured through multiple regressions and in the end suggestions and recommendations put forward in the light of local vulnerability to have minimum loss in upcoming disasters.

Key Words: Disaster, Disaster Management, Local Knowledge, Vulnerability, Hazards, Taluka, Global Warming, Reconstruction, Awareness.

Reduction of Disaster Vulnerability through Indegenious Knowledge

By

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1. Introduction:

Cyclone and flood have been the cause of tremendous loss of life and property in both urban and rural areas across the world. In developing countries, their impact is very severe on coastal and rural communities due to several social and economic factors that have contributed towards their physical vulnerability to Cyclone/Floods.

According to (D.P.Rao, 2000) various disasters like earthquake, landslides, volcanic eruption, fires, floods and cyclones are natural disasters that kill thousands of people and destroy billions of dollars of the habitant and property each year. In the middle of 1980 and 2007 over 8093 natural hazard events has been recorded throughout the world, with an average of 343 events per year over the past decade and an average year, some 243 million people affected by disasters (98% of all the people affected by natural disasters in this period). By 2015, on average over 375 million people per year are likely to be affected by climate-related disasters. This is over 50% more than have been affected in an average year during the last decade (Diamon & Ganeshan, 2009).

According to (Khan & Khan, 2008) the coastal areas of Sindh are most vulnerable and exposed to cyclones. The entire length of the coastline was subjected to tropical cyclone particularly along Sindh, 1999 cyclone ravaged large tracts in coastal districts of Thatta and Badin causing widespread loss to life and property. These coastal areas are also inundated by torrential rains, as in 2003. Although not a frequent phenomenon, cyclones can cause large-scale damage to the coastal areas of Sindh and Baluchistan. (Khan & Khan, 2008)

The present study play central role in the development of disaster management for coastal areas of Pakistan. This study consider as significant manuscript for identifying the local knowledge of the people to reduce their vulnerability from natural disasters. Both modern techniques and indegenious knowledge will help to determine the longer term needs of the population that are exacerbating vulnerability and will therefore contribute to the development of sustainable relief strategies.

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2. Literature Review:

With the passage of time, researchers put keen interest in disaster management due to huge socioeconomic losses by ongoing disasters. Researchers find out many solutions and develop various techniques and methods to deal with different types of disasters. Despite many advanced and cohesive practices and policies for the disaster management there is still need of more ideas and methods to prevent huge losses from disasters. Scientists and researchers suggest educating young people from an early age about natural hazards and train them that how to be saved oneself during different disasters (Wahlstrom. M., 2010.) Among these new techniques, one is to relieve the local knowledge of communities to enhance their coping capacity. This technique is most useful and applicable in remote areas of Africa, Asia and America. As such areas are vulnerable to disasters due to their aloofness from emergency/ disaster management authorities' access. Moreover in developing countries such areas are also vulnerable to disasters due to their socioeconomic backwardness. Therefore, scientists assess their existing local knowledge, and empower them to tackle with disasters advisably to save themselves from major losses.

According to (Eveleigh , Mazzuchi, & Sarkani, 2006) much of the recent literature exploring the estimation of disaster damages and scope has called for further use of geographic information system (GIS). Eveleigh argued that GIS system can and should be developed to examine the damage sustained to the man-made infrastructural system in a society. Since GIS can be applied to a wide variety of emergency situations ranging from flooding, to hurricanes, terrorist attacks. However, there have been relatively few efforts to quantify the accuracy with which emergency management agencies have been able estimate the scope of natural disasters. One of the most successful implementations of a GIS system has been the HUZUS model in the United States. Thorough examinations into the accuracy of this system are still forthcoming. (Downton & R, 2005) argued that these estimates, and especially the cost of damage inflicted, have been historically inaccurate. They supported their claim by an instructive case study of flood losses in California.

Schnieder and Shauer argued that inherent uncertainty of natural disasters, and specifically the behavior of tropical cyclones, have also been explored (Schnieder & Shauer, (2006)). Some have attempted to measure this uncertainty for use in better prediction models. The National Hurricane Center (NHC) in fact has implemented a model based on similar arguments.

Wallace and Balogh said that most encouraging, have been the cells by many to examine the uncertainty in disaster situation from an emergency manager's perspective. Wallace has called for these new technologies to be developed into the deplorable decision support system for use in the humanitarian relief community (Balogh, 1985).

Coordination between relief agencies during disaster relief scenarios has also been a well examined issue. Malone argued that coordination is required to improve efficiency in any situation where many organizations operate in common arena the complications between agencies specifically in the disaster relief content (Malone 2010).

The activities relating to review and finalization of disaster management policy, law and national plan need to be pursued with earnestness along with strengthening of institutional mechanisms through decentralization and local level disaster planning. The planning process at the central level needs to recognize the interface between disaster and development. There is also a need to

mount a high level awareness and advocacy programs to create a better level of perception of disaster management. All these and related activities call for a higher level of investment in preparedness, shelter construction, institutional arrangement, policy formulation and community involvement for improved cyclone disaster mitigation (Miyan, 2005)

This Study is undertaken with a development objective aimed at identifying key issues essential for formulating long term planning and mitigation measures for reducing disaster vulnerability of coastal community in Pakistan, analyze the impact of previous disasters and role of Public and private sector on it.

3. Research methodology

The present study selected two districts from coastal area of Sindh. i e. Badin and Thatta However, the study would applicable to coastal area of Balochistan also. The total length of Pakistan's coastal line is 990Km. From it Sindh coast stretches over 350Km from Hub River to Sir Creek. It has two parts; Karachi coast and Indus Delta.
Thatta district has the population of 1.1 million according to 1998 census. Two Union Councils Kothi and Karmalik with population of 23,439 and 19,936 respectively has selected from selected TalukaJati. Thus 97 respondents were selected from UC Kothi and 83 from UC Karmalik as a sample size. Similarly, Badin district has a population of 1.2 million. Taluka Badin was selected. Bughra Memon and seerani are the selected UCs from Taluka with the population of 32,089 and 29,674 respectively. Thus 86 respondents from Bughra Memon UC and 94 respondents from Seerani have selected as a sample size. About 160 respondents from each district have taken.

Table 3.1: Multistage sampling for selection of households

District	Stages				Total
	First	Second	Third	Fourth	
	Selected Taluka	UCs/Taluka	Villages/UC	H.H/ village	
Badin	Badin	2	10	9	180
Thatta	Jati	2	10	9	180
Total					360

A total sample of 360 households will be selected from two districts. The sample size is appropriate at 5% error rate, 95% level of confidence, with 60% of response distribution from the population 105138. Multistage sampling plan will be used to select households. Cluster sampling has two important advantages over Simple Random Sampling and Stratified Sampling. Firstly, it is economical and secondly it is suitable for selecting a sample when the sampling frame of individual elements is not available. Cluster Sampling only needs a list of elements in the clusters sampled (Anderson *et al.,* 1993).

In fist stage, one Taluka will select from each district; in second stage, 2 union councils will select from each taluka; in third stage, 10 villages will select from each union council; and in fourth stage, 9 households will be selected from each village. Thus, a sample of 160 households have selected from each district.

4. Analysis/ Results

4.1 Local Knowledge

This sort of knowledge has different names in the literature depending on its immensity. Besides "local knowledge", it is also called as "traditional knowledge" and "indigenous knowledge". Indigenous knowledge is a narrower term, for this it is necessary for communities having all the innate members. Whereas nowadays, due to modernization various communities reformulated by new migrated members and hence very few communities existed with innate members, therefore ease of research the term "local knowledge" is using now by various researchers. The term local knowledge includes those members also who join old communities after migration from other parts, live with them and adopt their cultural values. The term "traditional knowledge" often used along with local knowledge in a broader sense, well it could occupy a broader area than a "local knowledge". The term local knowledge bounded to a certain locality, whereas, traditional knowledge could be applied to the wider geological region, having approximately same traditions, i.e., Province or state (Langill, 2002).

4.2 Local Knowledge and Disaster Management

Local refers to and emphasizes, a place, a region, a location as much as the regular movements between different points (e.g., Knowledge related to the routes or different locations of groups of people who migrate on a routine basis such as nomads, commuters, seasonal migrants (Antweiler 1998, p 17) rather than time (a knowledge that is anterior to another, traditional versus contemporary knowledge).

It is important to learn how people (local and indigenous) in a particular area view and interact with their environment; whether or not they have local knowledge that helps monitor, interpret, and respond to dynamic changes in ecosystems and the resources and services that people generate; and whether or not their knowledge can be used to design appropriate interventions, including disaster preparedness (Berkes et al. 2000; Langill 1999). Local knowledge is dynamic and is always changing over time through experimentation and adaptation to environmental and socioeconomic changes (Thrupp 1989, p 15).

Disaster preparedness refers to a combination of short- and long-term strategies that help minimize or reduce the negative effects of natural hazards, prevent their impacts on assets, and escape certain peak values (e.g., During periods of excessive rainfall, etc.) or their consequences. As such disaster preparedness is defined broadly and goes well beyond emergency preparedness which is used by nations to refer to crisis management based on command-and-control (civil defense) and short-term response strategies. It is difficult to isolate disaster preparedness from other components of disaster management (e.g., Disaster relief) as they are interrelated.

4.3 Use of Local Knowledge in Study Area

Considering the vulnerability of the local population of the area and absence of solid organizational support, the present study analysis the trends of local knowledge in the area. Various developing countries are using this knowledge in their Disaster management systems. The trends of local knowledge analyzed through chi square test.

Table: 4.2 Test Statistics of Chi Square on Use of Local Knowledge in Forecasting Disasters

Test Statistics

	Age	Do you come to know about Disaster in Advance with Radio Announcement	Do you come to know about Disaster in Advance with Community	Do you come to know about Disaster in Advance with Self Forecasting
Chi-Square	156.778[a]	.100[b]	5.878[b]	141.878[b]
Def.	3	1	1	1
Asymp Sig.	.000	.752	.015	.000

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 90.0.

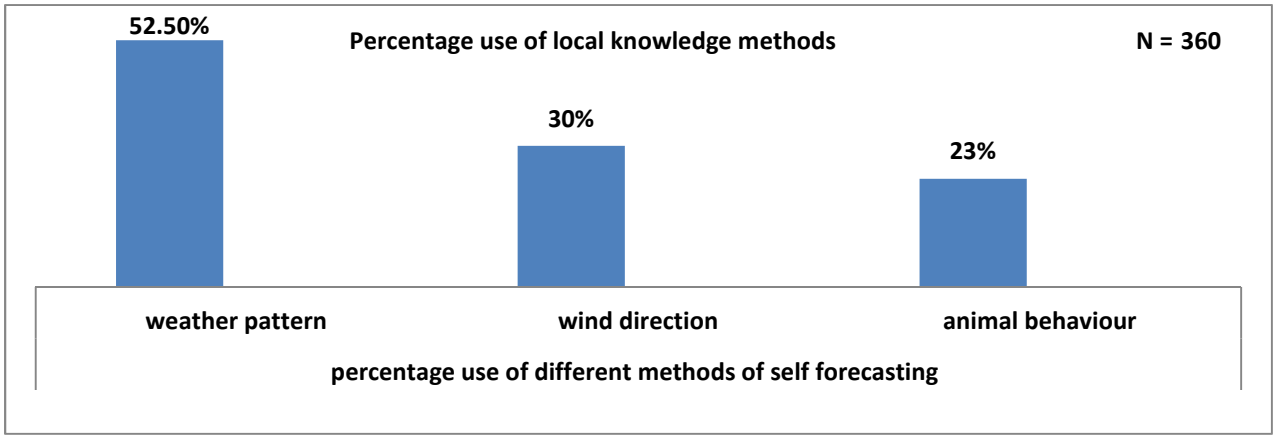
b. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 180.0.

The chi square test applied to variables age, knowing about disasters using radio announcement, from the community or by self-forecasting. The chi square test results show that most of the people prefer self-forecasting as significance value is zero for it. After, self-forecasting most of people prefer forecasting with the help of the community. However, for radio announcement, the result become insignificant i.e. 0.752 which is more than 0.05, which shows that people do not prefer radio announcements. This is not also because of the fact that they cannot understand or could not hear because of living in a distant place, but most of people also do not rely on government's radio announcements because of their poor studies about expected disaster. Sometimes, there are chances that cyclone may turn its direction before its onset, but government announcements do not support this fact and do not announce accordingly. Moreover, sometimes, government does not tell clearly about the severity of the cyclones and hence communities disturbed from their normal routine. Hence most of the community depends on their own self forecasting. Using self-forecasting there are three major methods to forecast i.e. Weather pattern forecasting, wind direction forecasting, and forecasting using animal behavior.

Forecasting through weather patterns include; turning depressingly dark of the sky because of dark clouds, the shape of clouds also observed as thick roles. The weather unusually becomes hot and humid and this hotness trances by rain. Wind direction forecasting includes the self-assessment of winds blowing from the south and north and their cohesion. Strong winds start blowing and wind blowing becomes strong at full moon. Forecasting using animal behaviors is most old local knowledge and also difficult to support scientific phenomena. There is a strong need to analyze them scientifically because this way of forecasting makes the people able to forecast even 14 days before. This group of local knowledge includes; cattle felt depressed by owners, they stop eating food and could not sleep well at night. Dogs wailing continuously along with cattle and other animals in the area also make sad sounds continuously. People get afraid of such sounds because, they feel that animals behave like this mostly before the occurrence of disasters. Local people make such observations about 10 to 14 days before. During these days if local people observe other patterns of animal behaviors also then they start to get ready for any disaster. These other patterns include climbing of ants on trees with eggs, bees displacement in cluster, birds roam in the sky, fish in the sea also become restless, crows fly and cool at night and foxes bark during the day.

The graph in figure 4.1 shows that how the different groups of local knowledge used by the local people. It has been observed that animal behaviors used least, because most of people consider them as old fashioned and do not believe. The information about animal behaviors mostly provided by the women and they still rely on them because they live within their homes and observe their cattle's movement and behavior continuously. The most commonly used groups of local knowledge are weather patterns. This is because the areas get clouded very often and the intensity of being clouded and depressed dark environment tell them about the intensity of the disaster. But this forecasting mostly did before one to four days before. Wind direction also widely used but most of people confuse over directions and that's why now do not use and rely over it too much. Although old people in the area are highly expert in studying weather patterns and wind directions.

Figure 4.1 Percentage Use of Each Local Knowledge Method Used by Target Population



Source: Study Survey 2010

Results from above graph shows that most of the people use weather patterns to predict or forecast any disaster in the area. Now how much time before they forecast the weather by using these methods shown in following frequency table 4.3

Table 4.3 With Traditional Ways How Much Time Before They Can Forecast The Disaster

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A Day before	38	10.6	10.6	10.6
	1 to 5 Days	113	31.4	31.4	41.9
	6 to 10 Days	119	33.1	33.1	75.0
	11 to 15 days	90	25.0	25.0	100.0
	Total	360	100.0	100.0	

Results show that 33 to 25 percent of people are able to forecast 6 to 15 days before. These days are enough to adopt preventive measures. However, people ignore their forecasting and take risks. This is because of many obstacles. They do not willingly ignore their forecasts and either wants to live with the risks. There is a need to know the factors that force them to ignore their self-forecasting. The following descriptive table 4.4 shows those factors;

Table 4.4: Factors Forcing People to Ignore Forecasts

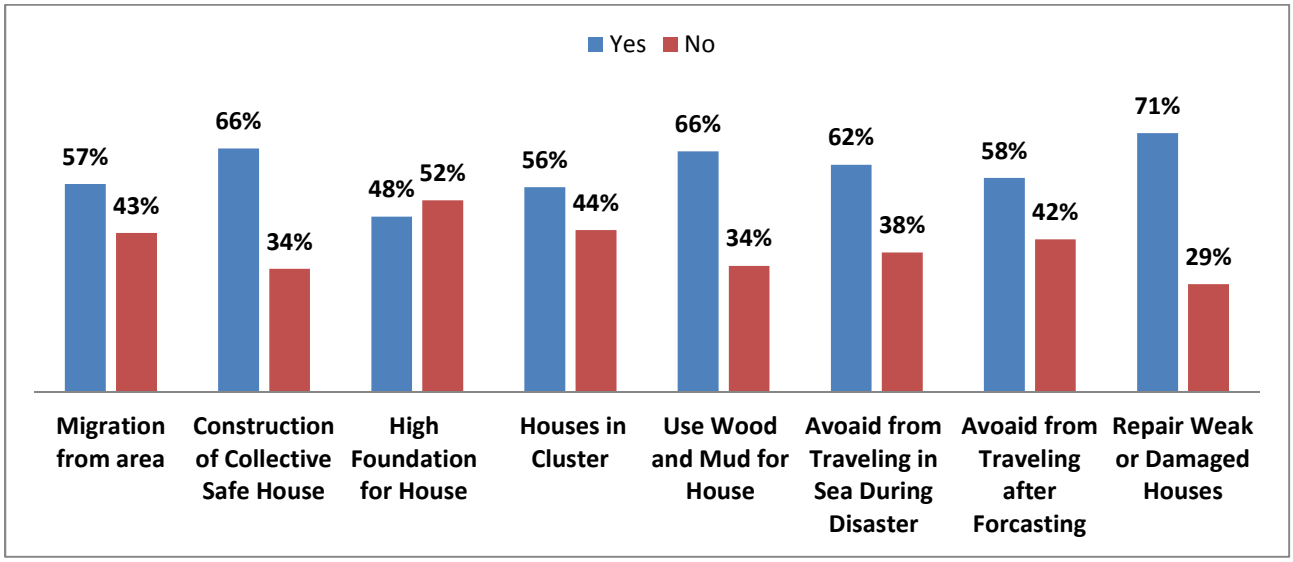
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poverty	102	28.3	28.3	28.3
	Lack of resources	154	42.8	42.8	71.1
	Social barriers	104	28.9	28.9	100.0
	Total	360	100.0	100.0	

The results in the above table show that other than poverty and social barriers, lack of resources is the major factor that compels them to ignore their self-forecasting. Lack of resources refers to have no boats or shelters and enough food stocks that they could move. Because of extreme poverty, they thought that if they move then they may lose their few assets and if they do not displace then they may be able to save their assets. They want to displace along with their cattle and other livelihood assets because their poverty do not able them to recover them after a disaster and neither the government and NGOs help in this regard.

Local knowledge does not work only for post disaster activities or for prediction. During face to face interviews and focus group discussion I came to know that there were some tips used by the community for preparedness and disaster mitigation. Participatory approaches to disaster management and preparedness often pre-suppose a basis in local knowledge and practices because communities in disaster-prone areas have accumulated a lot of experience over time (Battista and Baas 2004, p 10). These approaches also recognize that local people are the primary actors by default when a disaster strikes. From a local knowledge perspective, according to Battista and Baas (2004, p 29), it is more interesting to examine recurrent shocks that gradually increase the vulnerability of communities. Exceptional disasters require external means, beyond normal coping strategies.

Fig 4.2 shows that local people keep special concern on mitigation measures for disaster in advance.

Fig 4.2 Parentages Lesson for Disaster Mitigation **N= 360**



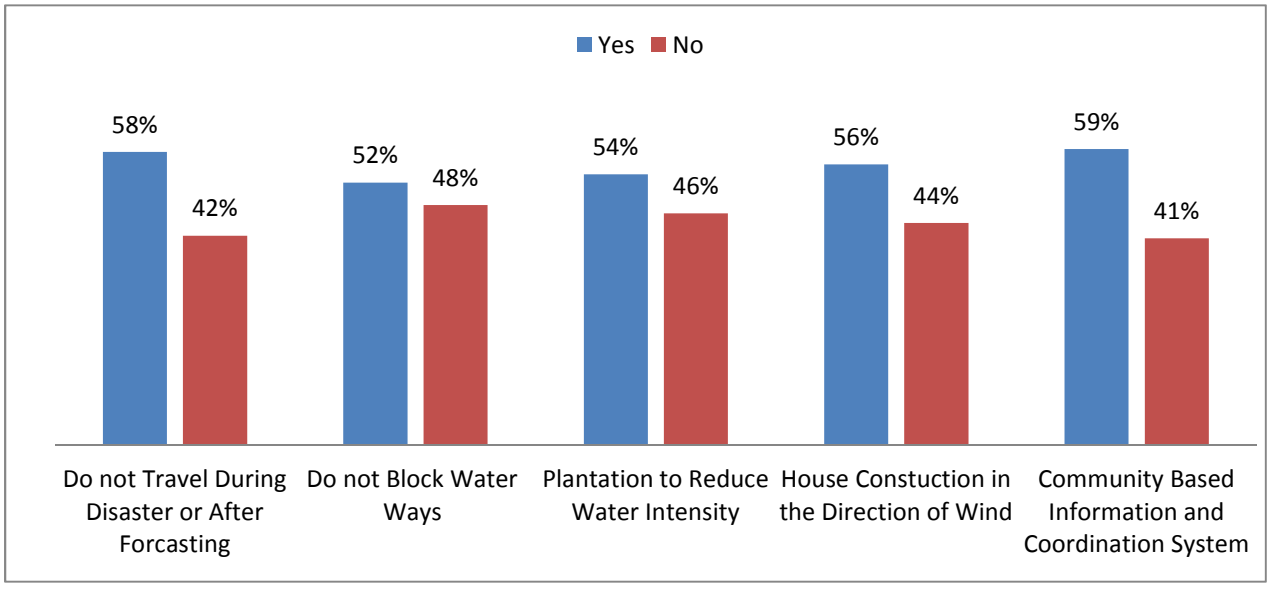
Source: Survey Study 2010.

Both figures 4.2 and 4.3 shows that indigenous people was not focusing on only post disaster activities but they gave special consideration to pre disaster situation also. Following are the points which were inhabited by the Portuguese and shifted in new generation by local wisdom and knowledge and both figures 8.2 and 8.3 shows the percentages of the people of the study area using this knowledge or adopting.

Lesson from Parents for Disaster Mitigation.

- Migrate from the area or develop contingency plans to shift from the area if any disaster occur.
- Construction of safe collective shelter, where local people shift their families in case of any emergency.
- Keep high and strong foundation of the houses to save them from water.
- Build houses in cluster from or group form it reduces the intensity of the water.
- Always use mud and wooden material in home construction because it reduces the life damages if occurred .
- In the case of the disaster announcement or forecasting do not travel in the sea or far away area.
- Repair all weak and damaged parts and corners of houses and shelters before occurrence of any disasters in advance.

Fig 4.3 Traditional Activities Performed by Community for Disaster Mitigation **N= 360**



Source: Survey study 2010

- Do not construct any structural thing in the path or way of water, it damages the area badly.
- Cover the mostly area with small plants and trees it reduce the intensity of cyclone and flood.

- Always remember the direction of wind during the construction of houses, don't construct in the opposite direction.
- Develop a strong communication and information system within the village, with neighboring villages and administrative bodies of the area.

4.4 Limitations of local knowledge

Regardless of lots of benefits related to local knowledge, there are many precincts too, which should be reflected while using or working with local knowledge. As local knowledge developed through verbal awareness and annotations so it lacks evidence, therefore it becomes tough to integrate local knowledge with scientific knowledge. Moreover this, as local knowledge conveyed to peers verbally therefore, it might not convey in its original shape or may not adopt by new generations in actual shape. Therefore, there is a small chance of getting original practices of some local knowledge. However, many people receive local knowledge uncritically because of sophisticated ideas that whatever local people do is naturally in congruence with the environment. However, local people have also committed environmental sins through over-grazing, over-hunting, or over-cultivation of the land. Furthermore, most of local knowledge is contingent on stereotypes and have no practical representation. Therefore it is deceptive to think local knowledge as always good, right of sustainable. (Langill, 2010)

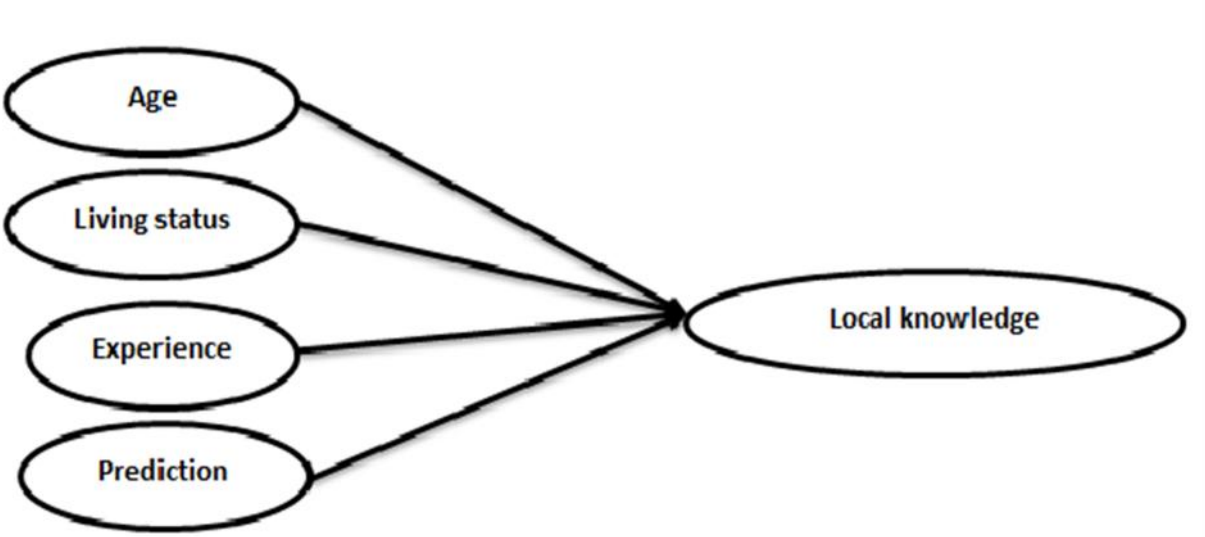
With the increasing socioeconomic changes in this global village, local knowledge is worn away unremittingly and having no severe to sightsee. New peers are accepting new ways of life and grownup groups reminisce very less. At most times, older people misguide researchers, by telling them self-made success stories of their local knowledge. Therefore, researchers should be careful and document stories and implementation practices of local knowledge after solid evidences.

Furthermore, the area of local knowledge is narrow. Sometimes, local knowledge modified in any environment is not appropriate in any other environment, also with the changing environmental conditions, many local knowledge utilized historically are now on the dole. Henceforth it is suitable to measure ecological conditions existing around certain local knowledge and assess whether it is valid now or not. In the local communities, knowledge is considered as power and therefore individuals are now keen to share knowledge among themselves or with foreigners. For them knowledge is a basis of status and income. Local knowledge is not spread homogeneously, individuals vary in their abilities for learning, storing and generating knowledge.

Model for local Knowledge

On the basis of previous literature and ground realities the local knowledge is directly related with age, living status, experience and prediction. Aged people, living in the same area from long time, experience in the term, number of disasters a person has faced in his/ her life and correct percentage in predicting disaster by using local knowledge. Hence age, living status, experience and prediction are independent variables that impact the dependent variable "Local knowledge". These independent variables have positive direct impact on independent variables. The existence of local knowledge in any community could be determined using this model. The graphical representation of this model is shown in figure below

ARK & Pathan Local knowledge Model



This model could be tested by multi-linear regression model. The equation for multi-linear regression model of local knowledge is;

Local knowledge=α+ $\beta_1$age +β_2 living status+β_3 experience+β_4 prediction---------- eq1

In the present study these variables assessed through determinant-choice questions that provide various alternative answers to choose only one. For each variable there was only one question with four alternatives. Age as also asked using alternatives because most of old aged people could not figure out their age exactly. Besides this for the homogeneity of data all questions kept of same type. By applying the statistics of this model to present study, following table shows results

Table #1: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.252[a]	.064	.053	1.809

a. Predictors: (Constant), How much your prediction were right regarding disasters, How many disaster you have faced (Experience), How long you have been living here, Age

Table#2: ANOVA[b]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	79.019	4	19.755	6.038	.000[a]
	Residual	1161.381	355	3.271		
	Total	1240.400	359			

a. Predictors: (Constant), How much your prediction were right regarding disasters, How many disaster you have faced (Experience), How long you have been living here, Age

b. Dependent Variable: traditional knowledge

a. Dependent variable: traditional knowledge

In the above regression model statistics the model summary in table 1 shows that there is 64% variance in dependent and independent variables as $R^2$is equal to 0.64. In the table 2 the whole regression model has shown as significant as the significance value is "000". In the last table of coefficients first three variables are significant as significance value in last table is less than 0.05 whereas last variable become insignificant. However, the model as a whole is significant on the basis of ANOVA. Hence by using model shown in equation 1;

α=12.289

β_1=0.33 age

β_2 =0.325 living status=How long you have been living here

β_3 =0.307 experience=How many disaster you have faced

β_4 =0.172 prediction=How much your prediction were right regarding disasters

Local knowledge=12.289+0.33age+0.325living status+0.307experince+0.172prediction

The impact of variable "prediction" is least and insignificant as well because majority of the people are avoiding to use it because of lack of resources, trust of other people and influence of government modern machinery. However overall model is significant according to ANOVA, hence the variable predication could not be ignored.

In this model the education of people do not considered although lot of literature suggests that less educated people prefer to use local knowledge. The advent of local knowledge in this era of modernization rejected this phenomenon. Because if local knowledge is now adopted by educated as well and most of scientists induce local knowledge in different fields because of its cost and environmental benefits. Hence current trends could revolve the local knowledge from its roots with education. However, aged people are precious source of evolving local knowledge

Table #3: Coefficients

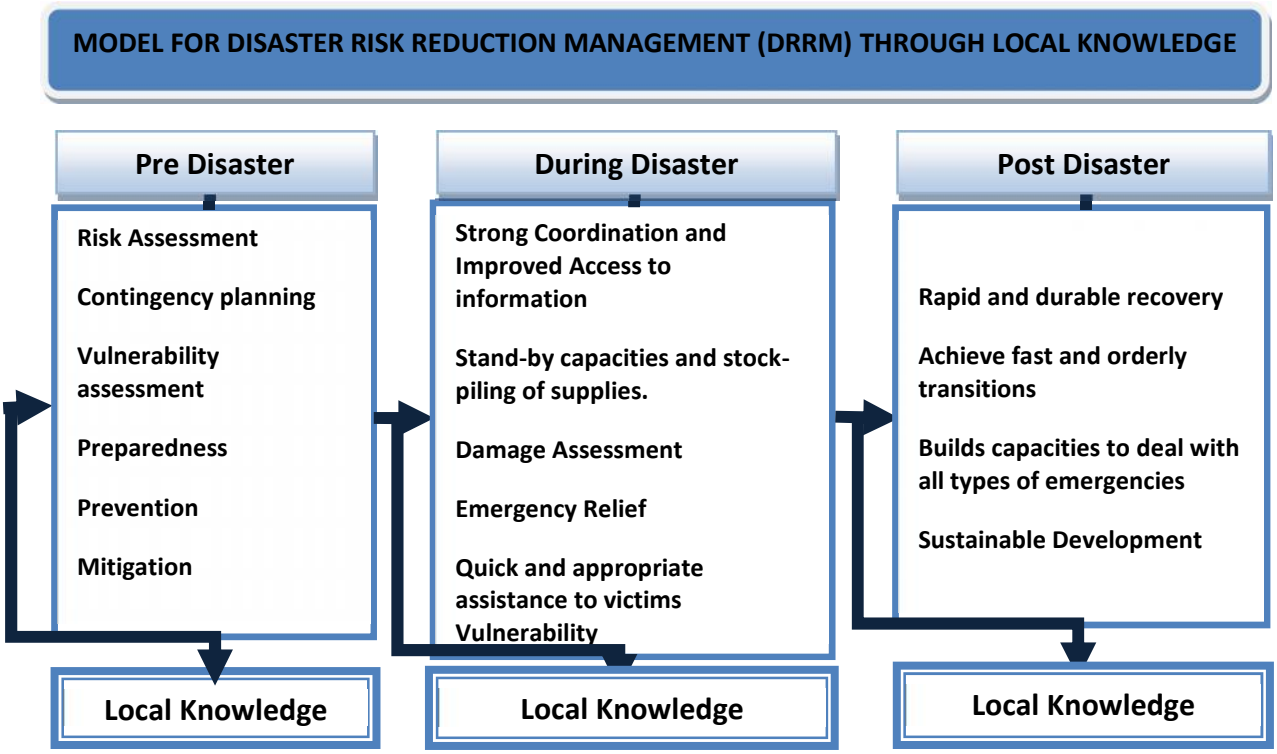
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	12.289	.987		12.448	.000
	Age	.330	.158	.120	2.084	.038
	How long you have been living here	.325	.161	.105	2.011	.045
	How many disaster you have faced (Experience)	.307	.147	.121	2.087	.038
	How much your prediction were right regarding disasters	.172	.137	.065	1.255	.210

because they are banks of local knowledge. Their knowledge depends on whether they live in particular community for a long time or not. All old aged people could not provide local knowledge because if they displaced or migrated from their place to any other then they could not have expert knowledge although if the environmental, cultural, geological conditions of areas migrated are same then they could share useful knowledge. Besides being habitant of community one could have local knowledge if he experience numbered of events and again and again got an opportunity to use their knowledge and hence make them expert. But any person will continue to

use his experiences if become successful in maximum attempts i.e. his prediction become successful numbered of time. This whole builds foundation for local knowledge and keeps the local knowledge alive for years. Local knowledge that are no more alive were basically unsuccessful. In the present study area 58% of population is using local knowledge and 42% do not and study reveals that they could not use mostly because of lack of resources. Hence in the present study area local knowledge have wide space and it could be further utilized for disaster management as shown in further model.

As discussed earlier disasters and their destruction is not new for any local community, the relation between these indigenous people and nature is from the very beginning, they or their forefathers are old victims of these natural disasters. Obviously, these local people were used to, to tackle these situations through their knowledge, skills and wisdom. This model tells us that by including local knowledge in every stage of disaster management we could have effective disaster management and planning system. This model supports participatory approach. The local people should be involved in disaster management. This will ultimately reduce vulnerability of the people and their risk of disaster.

Fig 4.4 Model suggested for DRRRM through Local Knowledge



This model developed on the basis of equations

$$\text{Risk} = \text{Hazard} + \text{vulnerability}$$

$$\text{Disaster} = \text{Hazards} * \text{Vulnerability}$$

By dealing with hazard effectively and reducing vulnerability we could have low risk and reduce the scale of disaster destruction.

For the implementation of such model there is need of decentralized institutional structure with strong checks and control. The following institutional structure will guide disaster managers that how a participatory approach should be adopted for implementation of the model discussed.

4.11 Conclusion and Recommendations

The whole literature on local knowledge shows that now it is of greater importance in the developmental work. There is a need to understand and involve local knowledge in the developmental process to attain locals' trust and for effective implementation of projects. Besides this local knowledge have certain features which are valuable for sustainable development. Likewise, due to its cost effectiveness it is good for developing countries to empower their aloof communities. While local knowledge has various limitations and with the passage of time it had also become extinct, therefore there is a problem in collecting real local knowledge, despite this effective research and observations could help to search practices and uses of local knowledge.

1. Local people should be taking on trust to use their local knowledge to forecast disaster and adopt preventive measures to have least losses.
2. There should be disaster management units within the villages of local people that force people to save themselves and to adopt long term indigenous preventive measures that they know from their parentages.
3. Incorporate local knowledge in disaster management
4. local knowledge practices should be used because of their cost effectiveness and to build local trust that ultimately could help in motivating local communities
5. Sustainable measures could be develop to predict disasters using their ability to identify and interpret early warning signals of cyclone based on environmental indicators, weather interpretations/ predictions, smells, sounds, direction and types of wind, unusual appearance and movements of wildlife etc.
6. Ability of local population to interpret the landscape and indicators of past cyclones such as the location of past cyclones by looking at the shape, direction, and nature of the wind, sea waves, geology, morphology, etc. could help in forecasting disasters.

Development Institute (2009). Disasters Management: *Blackwell Publisher.* 9600 Garsington Road, Oxford, Pp., 33(1): 152−169.

DFID (2005), "Natural disasters and disaster risk reduction measures", A Desk Review of Costs and Benefits – Draft Final Report, DFID, London.

EM- DAT EMERGENCY DISASTER DATABASE. (2006). Glossary from: International Agreed Glossary of Basic Terms Related to Disaster Management [online]. Brussels, CRED. Available from: http://www.em-dat.net/glossary .htm [Accessed 25 April 2009]

FEMA. (2006, October 6). *Federal Emergency Management Agency (FEMA)*. Retrieved August 2011, 15, from FEMA web site: http://www.fema.gov/about/history.shtm

Khan, H., & Khan, A. (2008, April 12). *Natural hazards and disaster Management in Pakistan*. Retrieved October 5, 2010, from http://mpra.ub.uni-muenchen.de/: http://mpra.ub.uni-muenchen.de/11052/1/MPRA_paper_11052.pdf

Khan, T. M., & Rabbani, M. M. (2000). *SEA LEVEL MONITORING AND STUDY OF SEA LEVEL VARIATIONS ALONG PAKISTAN COAST: A COMPONENT OF INTEGRATED COASTAL ZONE MANAGEMENT.* Karachi, Pakistan: National Institute of Oceanography .

Kumar, A. (2008). *Global Disaster Prepardness.* Dehli, New Dehli, India: Sbs Publishers & Distributors Pvt Ltd.

Langill, S. 1999. Indigenous Knowledge: A Resourcee Kit for Sustainable Development Researchers in Dryland Africa. Internet. www. Irdc,ca/plaw/_e-IK.html

Schnieder, P. J., & Shauer, B. A. ((2006)). HAZUS-its development and future. *Natural Hazards Review (7)(2)*, 40-44.

SEEDS. (2008). *Reducing Vulnerability of School Children to Earthquake in Asia aPacific Region-Shimla, India.* Sustainable Environment and Ecological Development Society. New Delhi: Panchsheel Enclave.