Multi Hazards Risk in the Imbulpe Divisional Secretariat Division
(Application of Participatory Rural Appraisal Method - PRA)

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Abstract: - **Sri Lanka is a continental island which covers the 65,000 Km² of land. Last few decades denoted an incensement of multi hazards in the country. As a developing country, should be paid an attention on the disaster risk mitigation. This study was focused on identification of multi hazard risk in the selected area of the Imbulpe Divisional Secretariat Division (DSD). Participatory Rural Appraisal (PRA) method was used to analyze disaster risk. The area has risk of landslide, forest fire, animal attack, drought, flood, elephant attack and high wind. Area could be named as a multi hazard risk area and animal attack could be named as the severe hazard condition in the area.**

Key Words: **Disaster Management, Imbulpe DSD, Multi hazards, PRA, Risk**

I. INTRODUCTION

Burton et al. (1978) have defined hazards as characteristics of physical environment that harmful to man and caused by forces extraneous to him. Asian Disaster Preparedness Center (ADPC) (1999), states that "Hazard is a natural event that has potential to cause harm or loss". Hazard can be defined in simply as a dangerous event that may cause harmful impact on the humankind. In the world some countries are being suffered by more than one hazard. According to the "Natural Hazard Hotspots" report which was written by Dilley et al (2005), from the total land area of the Earth 25 million Square kilometers of land area and 3.4 billion people which represent more than half of the world population are relatively highly exposed to at least one hazard and 790 million people are relatively highly exposed to at least two hazards. 105 million people in the world are relatively highly exposed to three or more hazards. Based on those condition the study about multi hazards came to the open debate.

When one area is affected by several hazards in the same time or at different times it is considered as multi hazard situation. According to the research articles (Carpignano et al. 2009; Garcia Aristizabal and Marzocchi 2012a, 2012b) multi hazards are different hazardous events that have an effect on the same exposures at the same time or at the different times. Kappes et al. (2010, 2011) defined multi hazards as hazardous events that occur at the same time or following each other events like a chain in the defined administrative area. According to the Komendantova et al. (2014) the concept of the multi hazards relates to the analysis of different hazards and triggering for them and hazards related effects on the same exposures with or without temporal differences. Multi hazards assessments determine the probability of occurrence of different hazards at the same time or relatively following each other because they are caused by same triggering factors and they are depending on each other or they pay risk at the same elements or same exposures.

Sri Lanka could be considered as multi hazard risk country. According to the book, "Towards Safer Sri Lanka, a Road Map for Disaster Risk Management" which was published by the Disaster Management Center (DMC) in 2005, country is affected by natural hazards like floods, cyclones, landslides and coastal erosion. In addition to those major hazards lightning strikes, epidemics and the effects of environmental pollution are also present within the country. According to the report "Sri Lanka Comprehensive Disaster Management Programme (SLCDMP) 2014-2018" which was published by the DMC of Sri Lanka, 415 lives lost have been reported by the flood hazards between the years of 2003 to 2012. During the 10 years period from 2000 to 2010 because of landslide hazards 351 lives lost have been reported. Approximately 204 lives lost have been reported by lightning within 10 years period from 2002 to 2012. From the cyclones and high wind, approximately 54 lives lost have been reported during the thirteen years period from 2000 to 2013. In addition to those hazards conditions, in 2004 26th December by the Indian Ocean Tsunami, more than 35,000 lives lost have been reported. Human and Elephant Conflict (HEC) can be name as the one of the major hazard conditions in the country. Because of the HEC 341 people have been lost their lives within the 4 years from 2008 to 2012. Not only human life lost and also elephants lives lost have been reported from the human and elephant conflict. According to the data approximately 1,383 elephants have been died because of the human and elephant conflict during the 5 years period from 2008 to 2013. According to the SLCDMP 1,786,890,889 (LKR million) has been expended by the Sri Lanka government as relief

expenditures for victims during the four years period from 2007 to 2011.

As a developing country Sri Lanka has to pay much more attention on disaster management strategies. In the disaster management process identifications of disaster risk could be named as an important stage. Because identification of disaster risk provides a chance for proper implementation of disaster mitigation activities. Thus, this paper pays an attention on application of tools of Participatory Rural Appraisal (PRA) method to identify disaster risk in the selected area of the Imbulpe Divisional Secretariat Division.

II.   RESEARCH PROBLEM

As a country, Sri Lanka has to face various kinds of hazards. Some provinces like Sabaragamuwa Province, Southern Province and Central Province could be considered as highly vulnerable provinces for the natural hazards. In 2017, because of the multi hazards conditions 210 deaths and 76 missing individuals were recorded from the Sabaragamuwa Province (UNISDR, 2017). Rathnapura district could be named as highly vulnerable district for the multi hazards conditions in the Sabaragamuwa Province. The district is affected by the natural hazards like flood, drought, forest fire, landslide and animal attack. Imbulpe Divisional Secretariat Division (DSD) is located in the Rathnapura district and it is affected by several severe hazards conditions. Majority of the residents in the area are engaging in primary economic activities. Because of the natural setting of the Imbulpe DSD, it is popular destination among tourists. Then it is very crucial to identify spatial distribution of the multi hazards conditions in the Imbulpe DSD for future social and economic development of the area.

III.   OBJECTIVE

Identification of multi hazards risk in the Imbulpe Divisional Secretariat Division is the main objective of the study

IV.   METHODOLOGICAL REVIEW

A.   Participatory Rural Appraisal Method (PRA)

Participatory rural appraisal method can introduce as a very popular data collection and analyzing method among social scientists and other various kinds of researchers and planners. According to the Chambers in 1994, it is a group of methods that enable rural people to share their ideas and capable them for future planning. Within this method include mapping and modelling, transect, walk, matrix scoring, seasonal calendars, trend and change analysis, wellbeing and wealth ranking and grouping and analytical diagramming.

When looking at the history of PRA model it is a development of Rapid Rural Appraisal (RRA) model. In 1980 RRA mostly used in universities and other organizations for their investigations. Then 1990 PRA came forward as further development of the RRA model. According to the Whyte (1977), Pelto and Pelto (1978) and Rhoades (1992), PRA has several sources. It has evolved depending on several

traditions. Then some of methods that using in the PRA appear as novel ones. But some of those models are rediscoveries.

According to the chambers (1994), there are five other streams, which worked as background sources for the PRA model. They are namely,

- Activist participatory research
- Agro ecosystem analysis
- Applied anthropology
- Field research on farming system
- Rapid rural appraisal

Furthermore, Chambers says the word 'Participation' and 'Participatory' entered the RRA vocabulary in 1980.

"It was at the 1985 KhonKaen International conference that the word participatory began albeit modestly, to be used in connection with the RRA. Discussion at the conference generated a typology of seven types of RRA (KKU, 1987, P.17)".

"Participatory RRA" was ones of the above methods. Its domain purpose is understanding community awareness as an outsider. According to the Mc Cracken (1988), Jennifer Mc Cracken carried out participatory rural appraisal method in the villages of Gujarat in September and October at 1988 with the cooperation of Aga Khan Rural Support Programme (AKRSP) staff. The first book about PRA was written by 'Neela Mukherjee'. She worked at National Academy of Administration in India and that book was published in 1993. Furthermore, Chamber saying, "PRA methods spread from India to Nepal on the initiative of Winrock International and to Sri Lanka on the initiative of inter cooperation".

Chambers (1994), "RRA and PRA for combination and fluxes of activities which are dynamic and evolving and which take different forms in different places, labels can help to define what belongs where, There can then be a distinction between "RRA" and "PRA". Outsider intends the "RRA" for learning. The "PRA" is intended to enable local people to conduct their own analysis and often to plan take action".

When PRA become popular, some researchers used PRA label for RRA methods without changing their behavior and attitudes on the method. RRA methods are more verbal within those methods outsiders are more active. However, PRA methods are more visual and local people active with the methods. The major different between RRA and PRA is the data collection methods. Within the RRA data collect by the outsider. In the RRA data collect by the insider through investigation, planning and evaluating by themselves. Within the PRA, the knowledge share by the local people. For that they are using mapping or modelling on ground or paper, estimating scoring and ranking with seeds, stone or sticks and vendiagramming.

B. PRA model in disaster management.

When looking at the practices of PRA in disaster management many countries and organizations have used the tools of PRA for disaster management purposes. However, the model name has been changed. In the some counties it is known as, PVA 'Participatory Vulnerability Analysis' method. Some it is known as, PCVA 'Participatory Capacity and Vulnerability Analysis' method. However, both models are using the same tools in disaster management and analysis.

By Ahmed et al (2012), define PCVA as a toolkit or process that people are willingly engaging to analyze their capacity and vulnerability regarding to the climate change and disasters. Furthermore, they are saying, "PCVA is a systematic way of understanding and analyzing the capacity and vulnerability of communities and distinct groups within a community to climate change and disaster risk". In their publication, they discuss about nine stages of the participatory capacity and vulnerability analysis method. They are orderly, Stage 1 - Preparing for PCVA, Stage 2 - Collecting secondary data, Stage 3 - Generating a community view, Stage 4 - Understanding vulnerability to hazard and stress, Stage 5 - Livelihood analysis, Stage 6 - Analysis future uncertainty, Stage 7 - Governance analysis, Stage 8 - Prioritizing and action plan and Stage 9 - Finalizing the PCVA. These steps have divided into two parts as 'Re-facilitation stage' and 'Facilitation stage'. The first two stages are belong to re-facilitation stage.

Chiwaka and Yates (nd), in the book that published by "Actionaid International" define PVA as "systematic process that involves communities and other stakeholders in an in-depth examination of their vulnerability, and at the same time empower or motivate them to take appropriate actions". PVA is a qualitative way of analysis, which enable people to understand their vulnerability and what are the actions that have to make by themselves to reduce their vulnerability.

In the PVA likes in PCVA, we can see three phases. Namely, Preparation, Analytical framework and Multi level analysis. Within the PVA, the preparation phase is very important. Because the entire PVA depends on the preparation phase. Within the preparation, country level awareness raising, defining purpose, stakeholder analysis and PVA team preparation very important. In the analysis framework can see, situation analysis, analyzing causes, analyzing community action and drawing action from analysis. Within the third phase focus on, community level analysis, district level analysis, national level analysis and international level analysis.

By Paul Venton and Cabot Venton (2005), have done the study on, "Community based disaster risk reduction in the Indian state of Bihar". In that study, they have used PRA methods such as 'hazard mapping' and 'seasonal charts'. Study mainly focused on flood hazard, its impact on the community and the vulnerabilities and capacities of the villagers. Through this study identified that the development

activities need to integrate with disaster risk reduction activities. Capacity building, skill training and establishment of village development communities have proposed as strategies to integrate development activities with the activities of disaster risk reduction. Importance of study about the root causes of vulnerability discuss as a finding result of the study. Through the study, they have identified that the linking of government level policies with the 'bottom-up' approaches of community base NGO may very helpful to address the root causes of vulnerability.

Sagala.S and Okada.N (2007) have done a research on "Managing early warning system for tsunami prone communities: Preliminary analysis of needs for the participatory approach (PRA)". In the research, mainly discuss about the use of PRA methods to implement an early warning system. This research discusses about the importance of six characteristics which introduced by Chambers (1994) on an early warning system. Those characteristics are, etic to emic, individual to group, verbal to visual, measuring to comparing, reserve to report and extracting to empowering. Those characteristic known as distinguished characteristic of the PRA by the Chambers in 1994.

There is no much research on the application of PRA in disaster management. Cronin et al (2004) has used PRA method to produce hazard maps, evacuation plans and warring systems in the Solomon Islands and Lolovange, Republic of Vanuatu Island. By the publication of the International Federation of Red Cross and Red Crescent Societies have introduced the importance of community base disaster management system in disaster management. In there they have presented the implementation of PRA within the disaster management. According to that, PRA and SWOT analysis have used by the Nepal Red Cross (NRC) to identify capacity and vulnerability in their communities. Through the application of PRA method NRC has realized that the vulnerability have interrelated with the factors of food production, seasonal migration, landlessness, literacy and access to safe water. Through the study, they identified and they were capable to motivate communities to develop group to address their own core problems through self-initiate projects.

In this study used PRA tools which named as hazard map, risk quadrant and historical timeline to analyze the multi hazards risk in the Imbulpe Divisional Secretariat Division (DSD).

V. METHODOLOGY

C. Study Area

The study area (Fig.1) covers seven GN divisions of Imbulpe DSD division in Rathnapura District, Sri Lanka. It is located in between 6^0 75' – 6^0 78' North Latitude and 80^0 71' – 80^0 80' East longitudes values. The study region belongs to the intermediate climatic zone of the country with a mean annual rainfall of 1,400 mm to 2,000 mm. The area received high rainfall within the North East Monsoon period (September to

May). However, rainfall records decrease in South Western Monsoon season (May to September). There are 8,819 population (Sampath pethikada, 2017) live within the selected 7 GN divisions. Most residents are engaging with primary economic activities like mining and cultivation. addy, tea, sorghum, pepper and vegetable cultivation could be identified as major cultivations. In addition to that natural beauty of the area is providing opportunities and resources for the tourism industry. Thusin the area can identify number of hotels and adventure parks.

D. Sample

The application of the PRA method was done with the active participants. "Samurdhi" societies of the selected GN divisions had been used to select them, because majority villagers are having the membership of that society. Before conducting the PRA method a lecture had been delivered to provide a better awareness about the PRA procedure and the importance of the study. After that all the members were encouraged toparticipate application ofthePRA method. All the necessary color pens and papers were provided. From the each society 10 to 15 members were participated to conduct the PRA methods for their GN divisions.

E. PRA tools used for the study.

The study was focused on multi hazard risk of the selected seven GN divisions. Hence, PRA tools that are known as hazard map (Fig.2), risk quadrant (Fig.3) and historical timeline (Fig.4) were used to collect data and analyze hazard risk of the each GN divisions.
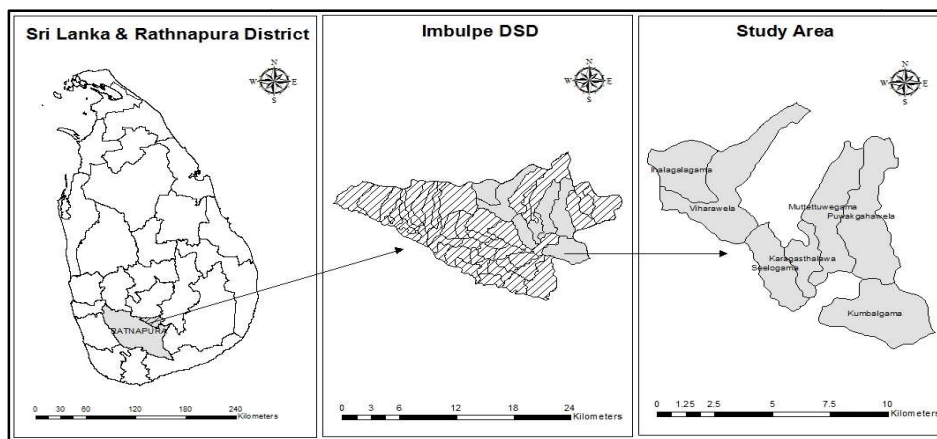

Fig. 1 Study area
Source: Digital data of Survey General Department of Sri Lanka (2007)

1) Hazards Map:

Participants had to draw major land use activities of their GN division within the map. This must done through the group discussions. After drew major land use activities of the area, participants had to mark hazard situations which they have to face on the map. They had chance to use any symbol to present hazards on the map. Through this can get better idea about spatial distribution of the hazards in the GN divisions.
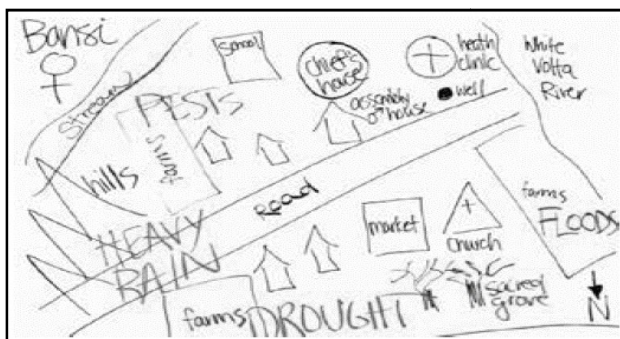

Fig. 2 Example of a Hazard Map in a village in Ghana

Source: Daze et al. (2009)

2) Risk Quadrant

The preparation of hazards map (Fig.2) gave better knowledge for participants about hazards situations that they have to face. Then they had to arrange hazard situation within the "Risk Quadrant" according to their probability of occurrences and impacts on them. Participants had to arrange hazards under four categories.

- Category of low probability of occurrence (LP) and low impact (LI) (bottom left box of the quadrant)
- Category of low probability of occurrence (LP) and high impact (HI) (top left box of the quadrant)
- Category of high probability of occurrence (HP) and low impact (LI) (bottom right box of the quadrant)
- Category of high probability of occurrence (HP) and high impact (HI) (top right box of the quadrant).
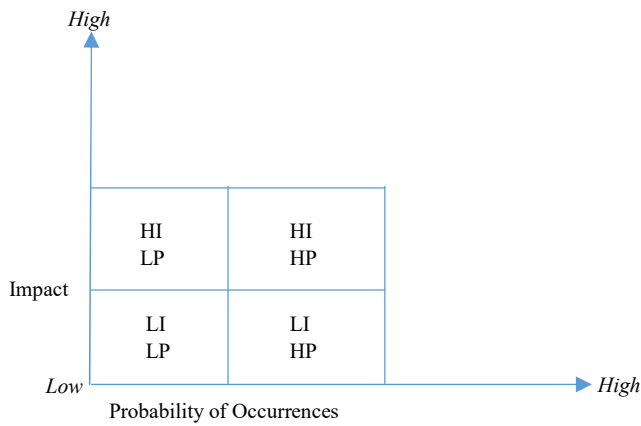
Fig. 3 Risk quadrant

3) Historical Timeline

Participants had to mention severe hazards situations and their impacts within a table. Those hazards had been arranged according to the date that they have been occurred. This known as historical timeline (Fig.4). Historical timeline was prepared by the participants which have faced sever hazard condition in frequently. Through the historical timeline can identify most severe hazards situations faced by the villagers and severity of those hazards.

Year	Hazard
1960-1965	• Landslide near to the "Hiraluwa oya" stream. ○ One life lost ○ Heavy damages to the school buildings
2002	• Landslide near to the "Polgaha ara" stream. ○ Five life lost have been reported ○ Property damages
2014	• High wind ○ Property damages

Fig. 4 Historical timeline

Source: Prepared depending on PRA field data (2018)

VI. RESULTS AND DISCUSSIONS

PRA tools were applied to the seven GramaNiladhari (GN) divisions of the study area. According to the gathered data,

A. Ihalagalagama GN Division

Hazard map and risk quadrant were conducted for the Ihalagalagama GN division. Depending on the study Ihalagalagama GN division could be named as a disaster prone area for the disasters like, landslide, forest fire, drought, high wind and animal attack. Those hazards have been categorized by the participants in the risk quadrant according to the impact and frequently of their occurrence. Animal attack has been mentioned within the top – right box of the quadrant (Fig.6). Hence, from the animal attack villagers are having high impact. Majority of the villagers in the area engaging with cultivation activities and their cultivations are

affected by the wild animals like wild bow, chip monk and peacock. Forest fire has been mentioned within the bottom right box of the quadrant which is representing the hazards that are having high probability of occurrence and low impact. According to that arrangement, from the forest fire, people are not having high impact. Forest fire are recording near to the forest plantation and natural forest according to the hazard map. Near to the forest there are no settlement distribution. Then people are no having high impact from the forest fire hazard.
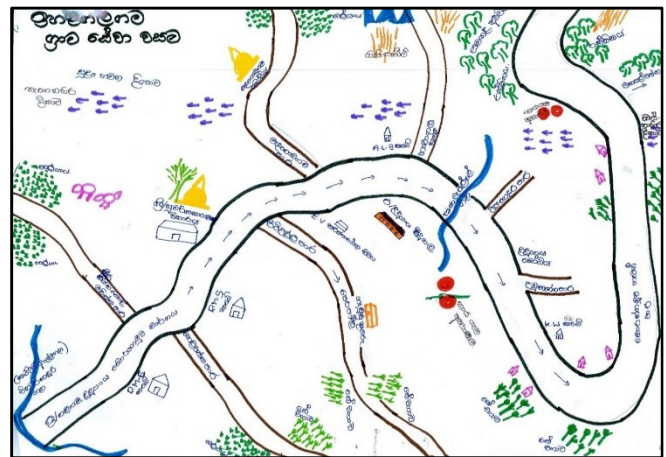

Fig. 5 PRA hazard map of Ihalagalagama GN Division

Source: - Prepared by the participants of Ihalagalagama GN Division (2018)
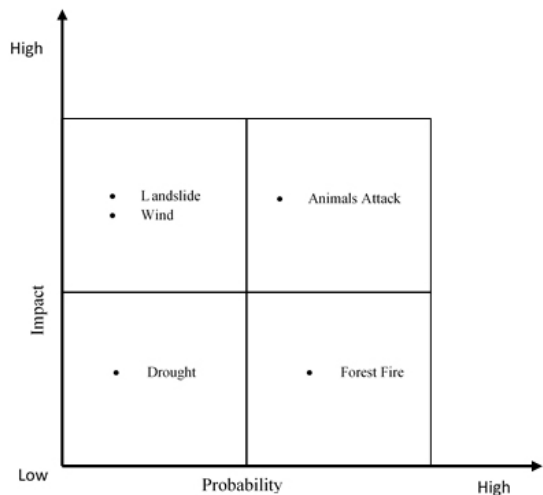

Fig. 6 Risk quadrant of Ihalagalagama GN Division

Source: - Prepared depending on PRA field data (2018)

B. Puwakgahawela GN Division

Hazard map (Fig.7), risk quadrant (Fig.8) and historical time line were conducted for the Puwakgahawela GN division. According to the hazard map, the GN division is affected by several hazard conditions such as landslide, high wind, animal attack, forest fire and drought. After preparing the hazard map, participants had to arrange hazards within the risk quadrant according to the impact and probability of their

occurrence. Animal attack, landslide, high wind and drought had been mentioned within the top right box of the risk quadrant which represent the hazard that are having high impact and high probability of occurrence. The prepared historical time line reveals that the area had been affected by severe landslide hazards. In between the years of 1960 to 1965 (year not clearly defined) area had been affected by the landslide hazard. That landslide hazard had been occurred near to the main stream of the area which well known as "Hiraluwaoya". One life lost and property damage had been reported from that landslide hazard. In 2002, another landslide hazard had been occurred within the GN division near to the stream which known as the "Polgahaaara". From that land slide five people were killed and severe property damage had been reported. In 2014 due to high wind condition the number of houses were damaged. Thus, depending on the study Puwakgahawela GN division could be named as a GN division which has multi hazard risk.

Fig. 7PRA hazard map of Puwakgahawela GN Division

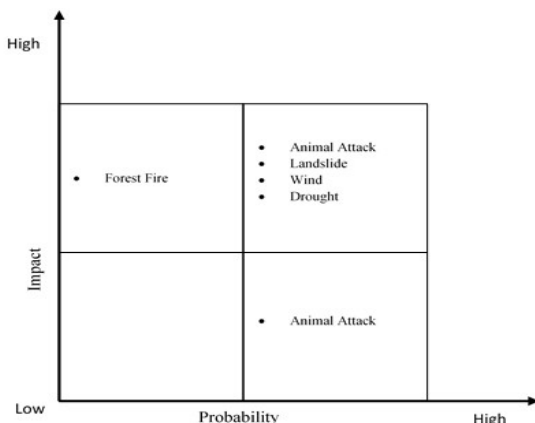Source: - Prepared by the participants of Puwakgahawela GN Division (2018)

Fig. 8 Risk quadrant of the Puwakgahawela GN Division

Source: - Prepared depending on PRA field data (2018)

C. *Muththettuwegama GN Division*

Hazard map, risk quadrant and historical timeline were created by the PRA participants of the GN division. According to the prepared hazard map (Fig.9) the GN division is affected by the hazard like landslide, animal attack, high wind and forest fire. The participants have mentioned animal attack within the top right box of the quadrant. Hence, animal attack could be named as the most severe hazard condition that is faced by the villagers. Forest fire has been put in to the bottom right box of the quadrant that is representing hazards which are having low impact and high probability of occurrence. They have mentioned landslide hazard and heavy wind hazard within the top left box of the quadrant. In the historical timeline the participants have mentioned that the area has affected by heavy wind condition in the years of 2016 and 2017. In 2017 a severe landslide hazard had been reported from the GN division and from that landslide a temple was destroyed and one person was killed. Depending on the study the area could be named as the GN division that is having the risk of multi hazards.
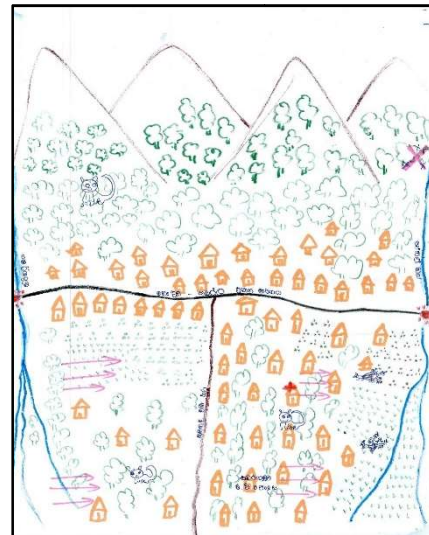

Fig. 9 PRA hazard map of Muththettuwegama GN Division

Source: - Prepared by the participants of Muththettuwegama GN Division (2018)

D. *Kumbalgama GN Division*

Participants of the Kumbalgama GN division prepared hazard map and risk quadrant for their GN division. According to the hazard map (Fig.10) the GN division is affected by drought and animal attack. Animal attack has been mentioned within the top right box of the quadrant (Fig.11) by the participants. Depending on that animal attack could be named as severe hazard condition that face by the villagers. This is the only one GN division that has affect from the elephant attack. Elephant attack has been mentioned in the top left box of the quadrant that is representing the hazard which are having high impact and law probability of occurrence. Wind and drought hazard have been mentioned within the top left box by the participants along with the elephant attack.
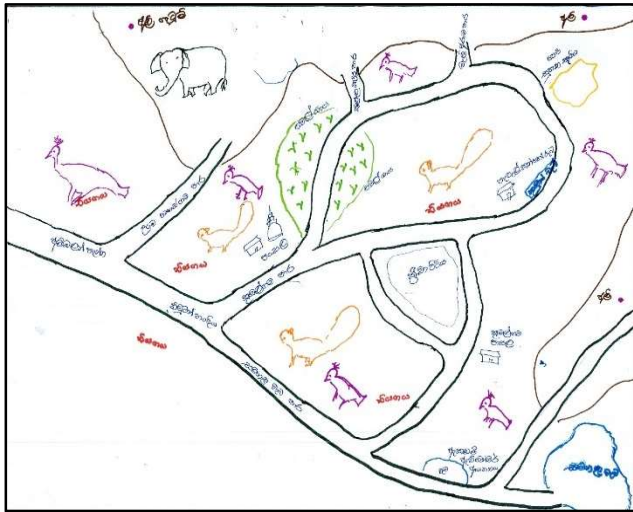
Fig. 10PRA hazard map of Kumbalgama GN Division

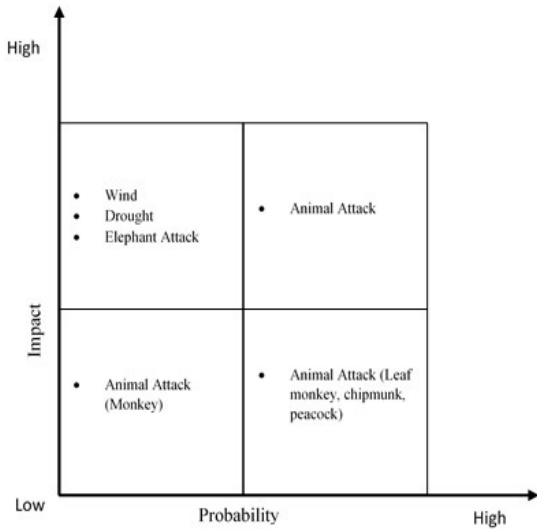Source: - Prepared by participants of Kumbalgama GN Division (2018)

Fig. 11 Risk quadrant of Kumbalgama GN Division

Source: - Prepared depending on PRA field data (2018)

E.   Viharawela GN Division

Hazard map and risk quadrant were prepared by the participants of the Viharawela GN division. According to the hazard map (Fig.12), GN division is affected by the hazards like forest fire, landslide, animal attack and high wind condition. After hazard map has been prepared hazard were categorized within the risk quadrant (Fig.13). In the risk quadrant animal attack has been mentioned within the top right box of the quadrant which is representing the hazards that are having high impact and high probability of occurrence. High wind and forest fire have been mentioned with in the top left box of the quadrant which is representing the hazards that are having high impact and law probability of occurrence. GN division also has risk of the landslide hazard.

But the impact and probability of the occurrence of the landslide hazard at a law level. Then participants have mentioned it with in the bottom left box of the quadrant. Depending on the study Viharawela GN division could be named as a GN division that has risk of multi hazard.

Fig. 12 PRA hazard map of Viharawela GN Division

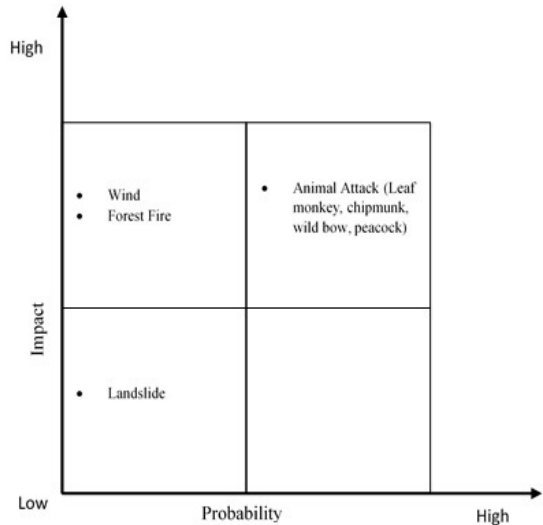Source: - Prepared by the participants of Viharawela GNDivision (2018)

Fig. 13 Risk quadrant of Viharawela GN Division

Source: - Prepared depending on PRA field data (2018)

F.   Karagasthalawa GN Division

Hazard map was prepared by the participants of Karagasthalawa GN division. According to that map (Fig.14) the GN division is only affected by the animal attack. Thus animal attack could be named as the severe hazard condition that face by the villagers.
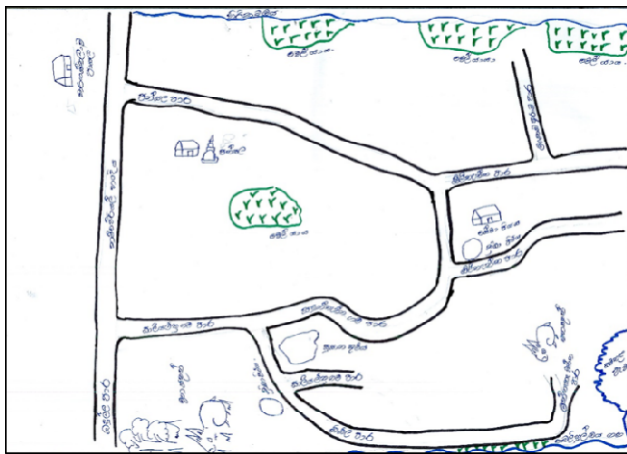
Fig. 14 PRA hazard map in Karagasthalawa GN Division
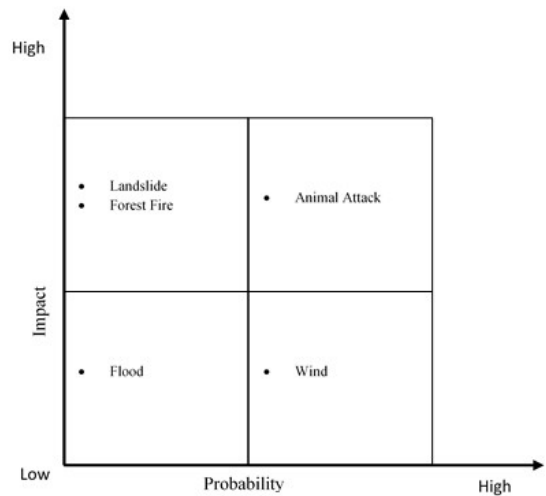
Source: - Prepared depending on PRA field data (2018)

G. Seelogama GN Division

Risk quadrant and hazard map were prepared by the participants of Seelogama GN division. According to the hazard map (Fig.15), the GN division is affected by landslide, high wind, forest fire, animal attack and flood. This is the only one GN division within the study area that is affected by the flood hazard. It is only have impact on the paddy cultivation. Depending on the arrangement of the risk quadrant (Fig.16), animal attack could be named as the severe hazard condition that face by the villagers. Because it has mentioned within the top right box of the risk quadrant. Flood hazard has been put in to the bottom left box of the quadrant that represent law impact and law probability of occurrence. Land slide and forest fire have been put in to the top left box of the quadrant that represent the hazards which are having high impact and law probability of occurrence. Depending on the study GN division could be named as multi hazard risk area and animal attack could be named as the severe hazard condition that faced by the villagers.

Fig. 15 PRA hazard map of Seelogama GN Division

Source: - Prepared by the participants of Seelogama GN Division (2018)

Fig. 16 Risk quadrant of Seelogama GN Division

Source: -Prepared depending on PRA field data (2018)

The gathered PRA data of the each GN divisions could be summarized as following table.

TABLE I

SUMMARY OF FINDINGS

GN division Name	Disasters	Severe disasters (Impact and probability of occurrence is high)
Ihalagalagama	Landslide, Forest fire, Wind, Animals attack, Drought	Animal attack
Puwakgahawela	Forest fire, Landslide, Drought, Animals attack, Wind	Animals attack, Wind, Landslide, Drought
Muththettuwegama	Landslide, Animals attack, Wind, Drought	Animals attack
Kumbalgama	Wind, Animals attack, Drought, **Elephants attack**	Animals attack
Viharawela	Wind, Forest fire, Landslide, Animals attack	Animals attack
Karagasthalawa	Animal attack	Animal attack
Seelogama	Landslide, Forest fire, Animals attack, Wind, **Flood**	Animal attack

VII.   CONCLUSION

The study area affected by multi hazards. According to the participants of PRA method the animals attack is the most severe hazard face by the residents in the study area. All the GN divisions are having high risk of animal attack. Most of the residents are engaging with agricultural activitiesin the

study area. From the animals like peacocks, wild bows, elephants, and leaf monkeys cultivations have big impacts. Some time it cause for high economic lost. Not only animal attack the study area also affected by landslide, heavy wind, drought and forest fire risk. However the forest fire in the study area not a natural event, it is a human induce hazard. Among the local people of the area, there is a mythical beliefwhich is "by letting fire to the forest during the dry season can get early rain". This mythical belief lead people to fire forest. Following recommendations are proposed to reduce multi hazards risk in the study area,

- Establishment of community base hazard management societies which societies will be helpful to implement hazard mitigation activities in the area.
- Conducting training camps, through those camps can make people more aware of environment and that will erase mythical believes of people.
- Replanting mountaintops with native fruit species, if able to grow natural forest in the bare mountaintops, it will be reduced the impacts of the animals like leaf monkeys and chipmunks by providing habitats for them.
- Planting tree boundaries against the wind direction will be helpful in reduce wind speed.
- Introducing crop insurance system will be helpful to reduce risk of droughts and animals' attack in agricultural field.
- Arraigning strong and efficient mitigation and recovery system for hazards with the cooperation of local societies.

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