ADRRI JOURNAL OF AGRICULTURE AND FOOD SCIENCES
pISSN: 2026-5204 ISSN-L: 2026-5204
VOL. 2, No.2 (1), February, 2015
Published by Africa Development and Resources Research Institute

ADRRI JOURNAL OF AGRICULTURE AND FOOD SCIENCES

*ADRRI JOURNAL (***www.adrri.org***)*

pISSN: 2026-5204 ***ISSN-L***: 2026-5204 VOL. 2, No.2(1), February, 2015

Effects of 2010 Floods on Livelihoods and Households Food Security in Pru District of Ghana.

Frederick Kwame Sakyi[1] and Olivia Agbenyega[2]

[1]Department of Environmental Science, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana. Email: sakyifrederickkwame@yahoo.com

[2]Department of Agroforestry, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana. Email: olivia_agbenyega@yahoo.com

[1]**Correspondence**: sakyifrederickkwame@yahoo.com

Received: 10th February, 2015 **Revised**: 27th February, 2015 **Published Online:** 28th February, 2015

URL: http://www.journals.adrri.org/ http://www.journals.adrri.com

[**Cite as**: Sakyi, F. K. and Agbenyega, O. (2015). **Effects of 2010 Floods on Livelihoods and Households Food Security in Pru District of Ghana**. ADRRI Journal of Agriculture and Food Sciences, Ghana: Vol. 2, No. 2(1), Pp. 1-17, **ISSN**: 2026-5204, 28th February, 2015.]

Abstract

Seasonally communities in Pru District (PD) of Ghana that are within the banks of the Volta River experience flood to the extent that it causes damages to human lives and other properties. The floods of 2010 brought a lot of problems and untold hardships on the affected victims in the District. A mixed methodological approach including field investigation, questionnaire survey, structured and face-to- face interviews were employed in gathering data for the study. The key findings established to be the causes of floods in the study area include torrential rains, spillage of Bagre (in Burkina Faso) and Akosombo Dams (Volta Basin), lack of drainage systems and building / farming on flood plains. Based on the sources and speed of onset of flood; three types of floods were identified in the study area: flash floods due to heavy rains, slow – rise floods due to gradual build-up of water in an area and river floods due to increase in volume of drainage basins by spillage of dams and torrential rains. About 60 hectares of farmland was totally inundated by floods in the year 2010.The study revealed that respondents with single livelihood strategies were adversely affected by floods more than those with multiple livelihood strategies.

Keywords: Pru District of Ghana, floods, affected victims, farmland

INTRODUCTION

Flooding is a serious environmental issue affecting most countries, and with rising sea levels it may become an even greater problem (Rain *et al*., 2011). It is expected that an increased level of cyclonic storms to a great extent and storm surges to a lesser extent will be associated with future climate change and may increase flood occurrence in spatial patterns similar to those of the present. Ghana ranks high amongst African countries most exposed to risks from multiple weather related hazards particularly the natural hazards such as floods and droughts (UNDP / NADMO, 2009). Runoff in the Volta basin in Ghana is similarly sensitive to precipitation (Andreini *et al.,* 2000).

In recent times the possibility of communities within the stretch of the Volta Basin and other water bodies affected by floods cannot be underestimated. Yearly reports from all indications by research institutions, NADMO (National Disaster Management Organization), Environmental Protection Agency and Media houses in Ghana, reveal destructions caused by floods to farms, livestock, houses, schools, roads and other important infrastructure. Nelson and Agbey (2005) reveal that floods can render farms uncultivable for the time it is submerged and even deposit sediments on farms that make cultivation expensive and difficult for a specific period. Floods therefore potentially reduce food production. Such reduction in food production can reduce access to food, lower nutrition standards and encourage rural exodus. Rural exodus potentially causes loss of agricultural labour which further reduces food crop production in a vicious cycle.

But Sagoe (2006) posits that agriculture production is Ghana's main source of employment with over 70% of the population earning its livelihood from this sector. It generates about 75% of the country's export earnings and also a major source of food and government savings on revenues. Economic progress will therefore depend to a large extent on the agriculture sector. Further explanation in a study by Nelson and Agbey (2005) show that majority 60% of the population in Ghana dwell in rural areas where agriculture is the main source of livelihood. They also reveal that rural communities tend to be characterized by: relatively higher incidence and depth of poverty; higher fertility rates; higher biomass usage; lower infrastructure facilities; lower educational status and lower health status. The interplay of these features have made rural communities disproportionately vulnerable since they are most exposed to hazards such as flooding, bush fires and earthquakes, and are certainly least capable of adjusting or coping with such hazards. Thus the poor remain most susceptible to the potential damages and uncertainties inherent in climate change.

Nelson and Agbey (2005) again explain that the country's agriculture is rain fed and this constitutes the mainstay of the economy. They further indicated that, the sector employs 49.2% of the economically active population and about 85% of the rural population in Ghana's livelihood is dependent on agriculture, thus a reduction or excess rainfall will affect valuable crops like rice, cocoa, yam, maize, millet and many others, which has the possibility of causing and exacerbating hunger among the rural poor. Their study is consistent with a report by IPCC (1996) which lays emphasis on the fact that the world's poorest people are at risk of increased hunger, particularly those in the tropical and sub tropical areas in the face of climatic change effect on Agriculture.

ZVAC (2007) suggests that, within the agricultural sector floods and water logging impact adversely on staple crops followed by livestock, cash crops, aquaculture and wildlife. Crop losses are mainly through rotting of root crops and leaching of fertilizers from the late planted fields. Both staple food crops (maize, millet, sorghum and cassava) and cash crops such as rice, soya-beans and groundnuts are severely affected. The damages cause by floods on roads and bridges also affect the delivery of agricultural inputs such as fertilizers of which Pru District in the Brong Ahafo Region of Ghana is of no exception.

Relevant research conducted in Pru District and its environs have been on water resources management (Dei, 2011) and sustainable rural development (Abonkrah, 2004; Gordon and Amatekpor, 1999). There is a short fall in depth and direction of research that would provide a basis for climate mitigation in Pru District. There is inadequate information to use to develop strategies for the vulnerable to cope with the impacts of climate change by themselves. There is also not enough information on the effects of flood on livelihood and food security in the light of increasing climate variability, deforestation, floods and urbanization. Moreover, there is inadequate information on the causes of flooding, types of flooding, frequency of flood occurrence and major agricultural activities affected by floods in the District. In order to understand the link between food security and the incidence of flooding, there is the need to know the nature of flood, causes of flood, livelihood strategies of the people and the kind of damages cause to certain aspects of agriculture due flooding especially in Pru District. This paper is therefore an attempt to provide relevant information to serve as a basis to address issues of flooding and food security in Pru District.

Pru District, with one hundred and forty-six communities, is characterized by low level of education, poor infrastructure, poor housing facilities, high level of unemployment, poor road network and limited access to good health delivery system (MOFA, 2011). Seasonally, the District especially communities within the banks of River Volta are flooded to the extent that damages are caused to human lives and other properties. In 2010, certain portions of the settlements in Pru District were flooded after torrential rains. During this period about 48 residential buildings got inundated by floods at Kobre town, with another 360 houses being washed away and over 1000 residents displaced at Fante Akura (NADMO, 2011). Also, the lives of people living on some of the islands are severely threatened as almost all or majority of the island communities are being inundated by the overflowing Volta Lake and also from intense rainfalls. Cherepo, Parambo / Sawaba and Makpe in the District were also affected by intense rainfall resulting in flash floods.

Provision of relief items during these seasonal floods has not been successful in solving the problems of floods. This research therefore assumes that there are two path ways available to the people of Pru District in the management of flooding: (i) to continue with the usual livelihood pattern and the wait-for-flood incidence to provide relief items or (ii) Encourage the adoption of sustainable or diversified livelihood pattern which this study seeks to investigate.

In this case the later will lead to continuity in business since not every aspect of respondents' multiple livelihoods pattern would be adversely affected including a reduction in adverse flood effects. While the usual livelihood pattern and the wait-for-flood

incidence to provide relief items will result in a vicious and worsening economic situation of the affected people leading to food insecurity. This is because with the increasing trend of climate change couple with urbanization and environmental degradation, the Government of Ghana and hence the Pru District Assembly will continually have to expand their financial and material resources in providing relief items to the potentially increasing number of people that are likely to be affected by these seasonal floods in the future.

This research article is therefore based on the theory that any form of climate interruption (especially flood) on food crop cultivation, storage or on general household could possibly result in households and even a greater majority of communities facing food insecurity. It is against this background that the present study seeks to examine the effects of the 2010 flood on the livelihood and food security of affected households in Pru District of Ghana.

METHODOLOGY

Pru District is located at the North – Eastern portion of the Brong Ahafo Region of Ghana. It lies between latitudes 7° 50' N and 8° 22' N and longitudes 0° 30' W and 1° 26' W. The district capital is Yeji which has the second largest market centre after Techiman market in the Brong Ahafo Region of Ghana with its adjoining Districts being East Gonja District to the North, Sene District to the East, Nkoranza and Atebubu – Amanten to the South and Kintampo North and Kintampo South to the West (MOFA, 2011). Major towns in the District include: Yeji, Parambo / Sawaba, Prang, Abease and Zabrama (Figure 1). Yeji and its surrounding communities fall within the Volta basin and drained by the Volta Lake, Pru River, Nyomo, Tanfi and Nwansi. The Volta Lake and Pru River are the two largest water bodies in Pru District which extend even beyond the District to other parts of the country.

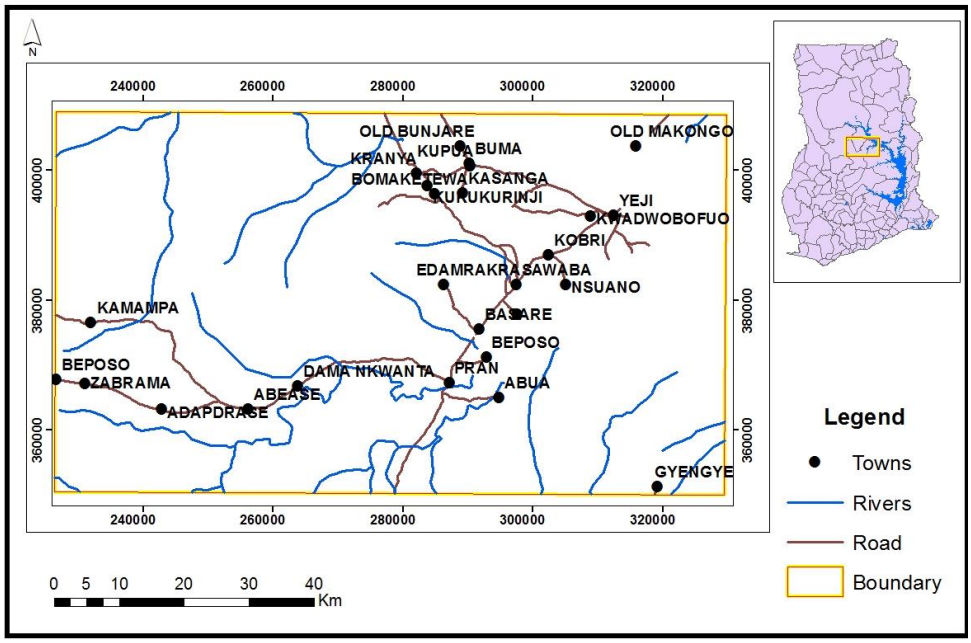

Figure 1: Map of Pru District in Brong Ahafo Region of Ghana

The topography of the district shows that it lies in between the northern part of the central uplands of the Brong Ahafo Region dominated by plains with rolling and undulating land surface with land elevation between 60 m to 300 m above sea level. The District experiences the tropical continental or interior savannah type of climate which is a modified form of the tropical continental or Wet Semi-Equatorial type. The regime in the area is double maxima type, the first from April to June and the second from July to October. Annual rainfall amounts ranges between 1400 mm – 1800 mm. Dry season occurs from November to March. The mean annual temperature ranges between 26.5 °C and 27.2 °C and mean monthly temperature ranges from 24 °C to 30 °C. Climatic conditions are unstable in the District. January to April constitutes the hottest months while December has the lowest temperatures. The highest relative humidity is 75% - 80% in wet seasons; and the lowest relative humidity is 70% - 72% in dry season (MOFA, 2011).

Questionnaires were designed for household heads in some of the flood affected communities in Pru District to determine what they go through in times of flood. Another set of questionnaire was designed for officials of the National Disaster Management Organization (NADMO) and District Agricultural Development Unit (DADU) in the District. Secondary data on agriculture and flood related issues were taken from NADMO and DADU to ascertain flood related issues of the District. Interviews were held with some Sub - Chiefs and Elders of the following communities; Cherepo, Kobre, Banyawaya and Parambo in the District and these were done through the use of questionnaires.

Social survey is an objective and quantitative approach to the study of social processes within a well – defined area at a given time through one or more institutions, by means of a schedule, or a questionnaire and the data thus obtained related statistically (Kumekpor, 2002). It is therefore a method of collecting facts by putting questions to people. Social survey can equally be considered as an exploration or investigation into the current or existing social, political, economic and environmental conditions of a place or people (Kumekpor, 2002).

The study employed Slovin's sampling formula to determine the sample size: $n = \frac{N}{1 + N\,(\alpha)^2}$ (Guildford and Fruchter, 1973).Where **n**= sample size, **N** = sample frame **(2,172)** and $\boldsymbol{\alpha}$ represents the margin of error of **0.063** with confidence level of **93.7%.** By substituting 2, 172 and 0.063 into the formula: $n = \frac{2{,}172}{1 + 2{,}172\,(0.063)^2}$, $n = \frac{2{,}172}{9.620668}$**, n = 225.76 ≈ 226,** hence **n = 226**

Therefore the sample size for the community household survey was 226.The researchers used this specific margin of error to select 226 respondents (Table 1) in 15 flood affected communities to ensure a large sample for more representation. The target population for the study were the households with household heads as the sampling units of the study.

Table 1: Population and Sample Size of Flood Affected Communities in Pru District.

Community	Number of household heads interviewed	Total number in households	Mean household Size
Cherepo	20	122	6
Banyawaya	14	66	5
Fante Akura	16	72	5
Yeji Nsuano	11	41	4
Jaklai	8	23	3
Kwaease	23	132	6
Kobre	28	126	5
Parambo/ Sawaba	13	46	4
Labun	7	29	4
Prang	21	112	5
Adjantrewa	18	98	5
Kadua	10	49	5
Vutideke	17	89	5
Accra town	5	38	8
Kade	15	103	7
Total	**226**	**1,146**	**MH* = 5**

MH* is the mean household size of the entire communities under study, **n = 226** respondents. Source (Field Survey, 2012)

RESULTS AND DISCUSSIONS

The study shows that out of 226 respondents, majority (87.6%) of households are headed by males whiles few 12.4% are headed by females. This supports the general assertion that in rural communities in Ghana, households are predominantly headed by men except in some few cases where household heads are women.

Nature of Floods

On the occurrence of floods in the study area, six parameters including the knowledge of respondents on floods, causes of floods, frequency of occurrence, month of occurrence, duration of the flood and the worst hit year in the study area was examined. The causes of floods in the study area as suggested by respondents are indicated in Figure 2.

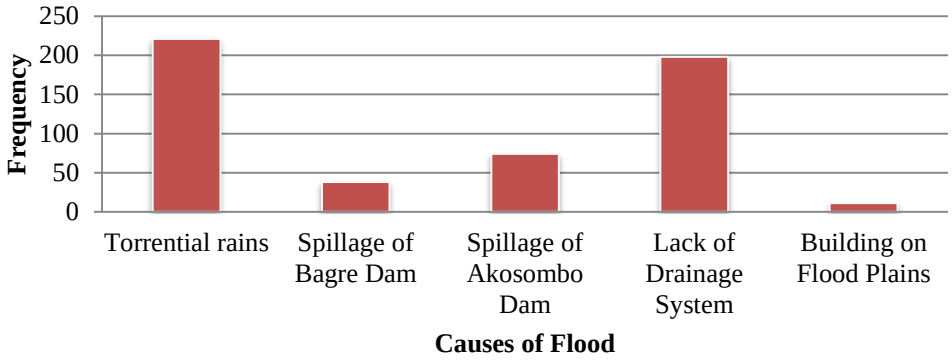

Figure 2: Causes of Floods in Pru District as Suggested by Respondents

Majority 221 of Respondents attributed floods in the study area to torrential rains which usually occur between the months of June to September while a few 4.87% of respondents rather suggested buildings on flood plains. In recent times, Metropolitan Municipal and District Assemblies as well as other related building and research organisations have been educating the general public to avoid the acquisition of land and putting up of permanent structures on flood plains. For that reason some of the respondents (4.87%) who had buildings on flood plains that got inundated were not ready to admit to the fact that they were violating the building codes of Ghana. This could account for the low percentage of response suggesting buildings on flood plains as cause of floods. Therefore, building on flood plains has to do more with attitudes of residential occupants not willing to relocate to areas outside the flood zone than being ignorant of the flood disaster that could potentially affect them.

Nevertheless, floods caused by spillage of Bagre and Akosombo dams in the coastal communities (such as Fante Akura, Banyawaya, Yeji Nsuano and Adjantrewa) although disastrous yet were less risky and damaging to human lives and properties since such floods are slow rise types, providing enough time for occupants to evacuate. Most 97.79% of the respondents indicated that the flood peaks in the month of October and last for about 2 – 4 months. The reason is linked to the fact that, the study area records its maximum rainfall intensity during that period. This then results in volume changes of water basins such as River Volta, Pru River and other minor streams in the study area.

About 8.85% and 12.39% of respondents in Cherepo and Kobre respectively indicated that the slightest rain in a raining season can potentially flood their communities attributing the situation to inadequate drainage systems which was mentioned by 87.61% of respondents in the study area. In the light of identifying the causes of floods in the study area, the sources and speed of onset of flooding were taken into consideration. Based on this, three types of floods were identified: flash floods due to heavy rains, slow – rise floods due to gradual build-up of water in an area and river floods due to increase in volume of drainage basins by spillage of dams and torrential rains. These types of floods as identified in the study area are in agreement with similar findings reported by Jha *et al.* (2012), outlining that

floods usually result from a combination of meteorological and hydrological extremes, such as extreme precipitation and flows.

Livelihood Strategies of Respondents

The study revealed that there were multiple livelihood options adopted by some of the respondents. These livelihood options were ranked as the top 5 sources of livelihood, hence the primary means of income generation for respondents. These are; crop production, trading, farm animal production, fishing and charcoal burning (Table 2) in a descending order of adoption. Majority 61.95% of the respondents are food crop producers with trading as the second most important livelihood suggested by 38.05% of respondents while few 18.56% of the respondents are charcoal burners (Table 2). This suggests that the study area has farmer – dominated household heads. The study therefore supports the assertion that, Pru District has the second largest market centre after Techiman Market in the Brong Ahafo Region of Ghana and hence noted for the convergence of business men and women, traders and other professionals.

Fishing is another major source of livelihood among the communities which was indicated by 31.86% of the respondents. The fish are sold to market women, who smoke and trade these in the Market. The study area is noted for its supply of fish to Kumasi, Accra, Sunyani and other parts of the Country. Some of the respondents fish on subsistence basis which Buitelaar *et al.* (2007) explain provides sources of protein for the household, and further point out that, the use of very basic techniques for subsistence mean that the full potential of fishing is probably not being exploited. Their main livelihood sources and income in Pru District are also supplemented by other sources of income including farm labour and harvesting of forest products such as fire wood, fruits and medicine.

Table 2: **Main Livelihood pattern of respondents in Pru District**

Livelihood Pattern	Frequency	Percentage
Crop Production	140	61.95
Trading	86	38.05
Farm Animal Production	78	34.51
Fishing	72	31.86
Charcoal Burning	42	18.58
Others*	59	26.11

n = 226 respondents, others* refer to supplementary livelihood sources,

Moreover the crop producers are mostly staple crop farmers and have various farm sizes ranging from 0.8 hectares to 23.5 hectares. Respondents (Crop Farmers) with large farm sizes (8.1 – 23.5 hectares) are corporate entities under the Block Farming Programme initiated by Ghana's Ministry of Food and Agriculture and supervised by the District Agricultural Development Unit (DADU) in the District. This was initiated in 2009 to enable farmers in groups (10 – 50 members) under the Block Farming Concept to have easy access to credit, subsidized farm inputs such as fertilizers and extension services from the DADU.

This initiative became necessary as individual farmer accessibility to credit and other agricultural services was becoming problematic.

With the exception of Accra Town where none of the respondents reared livestock, all the 15 communities in the study area had a number of respondents who either farm staple food crops or rear livestock (Table 3) in the District. Majority 16.43% of staple crop farmers are in Kobre with few a (1.43%) of the staple crop farmers in Yeji Nsuano and Accra town. Majority 15.39% of the respondents in Kwaease are livestock rearers with Jaklai recording the least (1.28%).

Pru District falls in a geographical region of Ghana known as ''the food basket of Ghana''. All the 140 household heads who indicated they are into farming, cultivate maize. The study revealed that respondents cultivate more than one type of staple food crop on a piece of land including rice, yam, cassava, tomato, pepper, beans, garden egg, ground nut, okra and guinea corn (Table 4). This suggests that farmers in Pru District practice mixed cropping which involves the cultivation of more than one type of food crop on a piece of land from year to year. Besides growing of staple crops, about 78 out of the 140 farmers rear livestock. Respondents raise a combination of two or more of the following livestock; goats, sheep, cattle, chicken, duck, pig, guinea fowl and turkey (Table 5) at home. About 20.51% of the respondents that rear farm animals keep cattle with Cattle Herdsmen in other villages. A similar study by Buitelaar *et al.* (2007) in the Caribbean suggests that crop production is supplemented by some rearing of farm animals, which to a certain extent runs counter with findings from Pru District where 34.51% of respondents suggest livestock keeping as their main source of livelihood.

What these farmers failed to do was to integrate some of these livestock rearing into the food crop production system in order to improve the soil fertility of farmlands. On the contrary, Majority 98.57% of respondents indicated that such practices are not carried out because it is difficult to ensure the safety of the livestock that are far from their homes. The remaining 1.43% of the respondents indicated that keeping farm animals on the same piece of land as the crops would result in damage to food crops as some of the farm animals would trample and browse on the food crops. To prevent this, the animals should be put in pens and monitored which would be costly and unaffordable.

Table 3: Proportion of respondents (farmers) in various communities in Pru District

Community	Staple crop farmers (Frequency)	Per cent of Staple Crop Farmers	Livestock Rearers (Frequency)	Per cent of Livestock Rearers
Cherepo	12	8.57	7	8.97
Banyawaya	8	5.71	5	6.41
Fante Akura	7	5	4	5.13
Yeji Nsuano	2	1.43	2	2.56
Jaklai	3	2.14	1	1.28
Kwaease	16	11.43	12	15.39
Kobre	23	16.43	9	11.54

Parambo/ Sawaba	8	5.71	3	3.85
Labun	5	3.57	4	5.13
Prang	16	11.43	10	12.82
Adjantrewa	15	10.71	8	10.26
Kadua	9	6.44	4	5.13
Vutideke	6	4.29	3	3.84
Accra town	2	1.43	-	
Kade	8	5.71	6	7.69
Total	**140**	**100**	**78**	**100**

n = 140 respondents and n = 78 respondents for crop and animal producers respectively

Table 4:Staple Crop Farmers among affected flood victims in the Study Area

Crop	Frequency	Per cent
Pepper	94	67.14
Rice	108	77.14
Guinea Corn	90	64.29
Maize	140	100
Tomato	94	67.14
Cassava	136	97.14
Yam	134	95.71
Groundnut	98	70
Bean	82	58.57
Garden egg	63	45
Okro	59	42.14

n = 140 respondents

Table 5: Respondents raising various farm animals in the Study Area

Farm Animal	Frequency	Per cent
Goats	75	96.15
Sheep	72	92.31
Cattle	16	20.51
Duck	43	55.13
Pig	19	24.36
Chicken	78	100
Guinea fowl	64	82.05
Turkey	9	11.53

n = 78 respondents

Effects of flood on Livelihood and Food Security

Reports from the District Agricultural Development Unit under the Ministry of Food and Agriculture suggest that floods adversely affected over 60 hectares of farmlands on which

food crops such as rice, maize, yam, cassava, groundnut and pepper were planted (Table 6). Adjantrewa community was the worst hit by the 2010 floods with a total of 15.4 acres of farmland size completely submerged followed by Parambo 27 acres, Kadua 25 hectares, Kade 8.9 hectares, Vutideke 8.5 hectares while Kobre recorded the least (6.1 hectares) farmland size inundated by the 2010 floods. A possible explanation is that these farms are located on flood plains and some along river banks. Majority 98.57% of the respondents received subsidized farm inputs from the Ghana Government which they are supposed to pay back and that has become an issue of concern.

Information from DADU in Pru indicated that farmers were given over 3,060 kg bags of NPK, 1500 kg bags of sulphate of ammonia, 120 mini bags of seed maize (45 kg each), 930 kg of seed rice and 894 litres of orizoplus weedicide from June – August 2010. Inspite of the losses from the floods farmers still have to pay back the farm inputs supplied to them by the Ghana Government. It is only when they pay back that the Government will have resources to provide them with subsidized farm inputs for the next farming season (MOFA, 2011).

Table 6: Flood effects on Block farmers in 2010 in Pru District (PD)

Community	Crops affected by flood	Size of Farmlands Inundated by Floods (hectares)
Vutideke	Maize, Rice, Pepper	8.5
Kobre	Rice, Pepper, Cassava	6.1
Adjantrewa	Yam, Rice, Guinea corn	15.4
Kade	Rice, Pepper, Cassava	8.9
Kadua	Cassava, Rice, Maize	10.1
Parambo	Groundnut, Rice,Tomato	11
Total		**60.0**

Source: (Pru - MOFA, 2010).

Mostly, rice farmers were adversely affected by the 2010 floods and they had to move through the flood water which was at various depths with 4.29% of them experiencing snake bites (Plate 1). Majority 68.53% of respondents into staple crop production complained of; food losses and loss of income. The study could not establish empirically the food losses and loss of income as respondents did not keep accurate records of losses caused by floods.

Plate 1: Cases of 2010 floods inundating rice farms in Pru District

Majority 100 of respondents who produce only staple crops suggested that flood effects were high, 2 claim it was moderate and 10 of the respondents suggested it was low (Table 7). These suggestions were based on the following parameters; 1) total loss of food crops due to flood, 2) food crops got rotten due to flood, 3) quality of planting materials reduced and 4) harvested crops on farm affected by flood. Food crops including; yam, cassava, maize, groundnut, guinea corn, pepper, tomato, beans and okra (Table 4) were seriously affected.

Sagoe (2006) explains that, Cassava and other root crops are affected by root rot and high levels of spoilage as a result of flood water remaining on farmland for a fairly long period. But in the case of other crops such as maize, rice and tomato, poor aeration and drainage due to prolong water within the roots and shoots of plants resulted in crop failure. Some of the crops were completely swept away by the floods. This affected their food availability for a short period of time as indicated by 71.43% of the respondents. About 53.24% of the respondents claimed they were able to survive the disaster months after because they had food supplies from friends who had their farms and storage on high grounds while a few 12.57% of respondents complained of going through famine for only a short period. This was not widespread to raise a national alert although the National Disaster Management Organization came to assist them with some relief items.

Twenty one percent of respondents who trade in Pru District within the stretch of Lake Volta lost their structures and had to relocate, which came at a cost with difficulties in maintaining customers. Based on these, they suggested the flood effects on trading was high while ten of the respondents claim there was low effect of flood on trading. About 38 of livestock rearers were also affected by the floods with a few 12 of the respondents suggesting flood effects on animal production as minimal (Table 7). The flood effect on farm animal production was rated high by respondents because: 1) pens or animal houses were destroyed by flood (16.81% of respondents); 2) death of farm animals due to flood (7.97% of respondents); 3) farm animals got lost during the period of flood (11.95% of respondents); and 4) the cost involved in renovating or putting up new structures to house farm animals (16.81% of respondents).

The effect of flood on fishing was also enumerated by 36 of respondents to be high with a few 8 respondents suggesting it as low. The explanations given by respondents were that: 1)

volume of water increased in the water basin which increased harvest (13.89% of respondents); 2) income generation was high during flood since fish catch was high (15.93% of respondents). Nonetheless the adverse effects of flood on fishing were also mentioned by the respondents as: 1) canoes at river banks were carried away from the shore with some being damaged (13.72% of respondents); 2) submerged tree stumps by the flood caused accidents as some canoes capsized; and 3) human lives endangered when water level rises as they go out fishing (9.74% of respondents).

Adverse Flood Effects on Main Livelihood Pattern of Respondents

Respondents who had only one form of livelihood pattern complained the most of high flood effects (Table 7). These include respondents who engage in crop production (CP) only, trading (T) only, fishing only (F), farm animal production (FAP) only or charcoal burning (CB) only. CP only, T only, FAP only, F only and CB only recorded 44.25%, 21.24%, 13.72%, 15.04% and 3.98% responses respectively from respondents as high adverse flood effects on the single livelihood patterns. But responses from individuals who engage in two or more of the livelihood options at a time run counter with the responses of individuals into single livelihood option in terms of the percentage effects for the three categories (high, medium and low adverse flood effects). For instance, the multiple livelihoods pattern of respondents such as CP and T only, CP, T and FAP only, CP, T, FAP and F only, and CP, T, FAP, F and CB only recorded low suggestions (15.04%, 5.31%, 4.43% and 1.77% respectively) for high adverse flood effect category compared to high suggestions (16.81%, 7.97%, 7.52% and 6.64% respectively) for low adverse flood effects. That is, the impact of flooding on respondents' livelihood decreased with increase in livelihood patterns. Suggestions from respondents who engage in all the 5 main livelihoods pattern (CP, T, FAP, F and CB) is a clear indication of reduced vulnerability to adverse flood effects because only few 1.77% of respondents rated the adverse effects on their multiple livelihood sources as high with majority 6.64% of respondents ranking it as low. As a result of the adverse flood effects, respondents who were engaged in single livelihood pattern lost their means of livelihood while those engaged in multiple livelihoods pattern suggested they had other means of livelihood to earn their incomes although one or two of the livelihoods got affected adversely by the 2010 floods.

Table 7: Adverse Effects of flood on Livelihoods as suggested by Respondents in Pru District

Livelihood	Adverse Flood Effects on Livelihood		
	High (%)	Moderate (%)	Low (%)
Crop production (CP) only	44.25	0.89	4.43
Trading (T) only	21.24	3.54	4.43
Farm animal production (FAP) only	13.72	3.10	5.31
Fishing (F)* only	15.93	0	3.54
Charcoal burning (CB) only	3.98	1.33	0.89
CP and T only	15.04	2.21	16.81
CP, T, and FAP	5.31	7.08	7.97
CP, T, FAP and F	4.43	6.20	7.52
CP, T, FAP, F and CB	1.77	3.98	6.64

Fishing* was the only livelihood that recorded major positive effects of flood, n = 226 respondents.

The study therefore revealed that respondents with one livelihood source in Rural Pru District suffer the most when affected negatively by floods while respondents with multiple livelihood sources practice diversification and have reduced vulnerability to floods with decreased adverse effects on their livelihoods. In which case, household food security may not be compromised. This is consistent with a study by Ellis (2000) who reveals that diversification of livelihoods are very strong and necessary economic strategy which increase resilience to stress during flood disaster. Again Chigwada (2005) also argues that agricultural intensification; for example based on increased livestock and crop densities can be a useful mechanism against adverse flood effects.

CONCLUSIONS AND RECOMMENDATIONS

Torrential rains, lack of drainage basins, spillage from dams and building on flood plains are the main causes of flooding. However flash floods due to heavy rains, slow – rise floods due to gradual build-up of water in an area and river floods due to increase in volume of drainage basins by spillage of dams and torrential rains are the types of flooding identified in the District. Crop production and livestock keeping are the main agricultural activities adopted by households in the District whereas trading is one of the major sources of livelihood income. Flooding has been a yearly occurrence in the District; however the 2010 floods adversely affected agricultural farmlands which had consequent effects on livelihood and food security among households. The study concluded that the destruction of crops by the yearly floods makes it imperative for the community members to shift dependence on solely agriculture income to the integration of non-agriculture income with other diversified agricultural income sources.

Measures for flood risk management are few except provisions of relief items by National Disaster Management Organisation (NADMO) and other benevolent individuals and organisations which only serve as temporary measures. Therefore regular stakeholder meeting on adoption of integrated flood risk management approach should be encouraged.

There is a need to establish agricultural flood insurance policy for farmers but first, farmers' and farm locations should be documented. This requires the combine effort of the Ministry of Food and Agriculture (on behalf of the Government of Ghana) and the Insurance Companies in Ghana. The study identified that the NADMO office is extremely under resourced in terms of infrastructure, personnel and other logistics. There is therefore a need for adequate resourcing in terms of facilities and staff for better services and information to the general public.

Acknowledgements

Profound thanks go to the entire staff at National Disaster Management Organization Department of Pru District, Pru District Assembly, Nana S.Y. Adankwah Sub-Chief of Akuamuhene, Mr. Collins Esiape and Alfred Akangaba of the District Agricultural Development Unit for their immense contributions towards this article. Kudos to Samuel Yaw Sakyi, Emmanuel Owusu and Asare Prosper for the logistics they offered throughout the period of research in Pru District as well as the households in the various communities whose cooperation and support made the fieldwork a success.

REFERENCE

Abonkrah, C.K., (2004). Environmental and Natural Resources Management and Sustainable Rural Development in Atebubu District. MSc Thesis submitted to Ohio University. 1-81.

Andreini, M., Van de Giessen, N.C., Van Edig, A., Fosu, M., and Andah, W., (2000). Volta Basin water balance, ZEF-Discussion Papers on Development Policy, Number 21, Centre for Development Research, ZEF, Bonn, Germany. 52-62.

Buitelaar, R., Kambon, A., Hendrickson, M., and Blommestein, E., (2007). Studies and Perspective: Suriname; the impact of the May 2006 floods on sustainable livelihoods. United Nations Publications, the Caribbean No.3. 5 – 52.

Chigwada, J., (2005). Climate proofing infrastructure and diversifying livelihoods in Zimbabwe. IDS Bull., 36, S103-S116. *In:* Boko, M., Niang, I., Nyong, A., Vogel, C., Githeko, A., Medany, M., Osman-Elasha, B., Tabo, R., and Yanda, P., (2007): Africa. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge UK. 433-467.

Dei, D., (2001). Water Resources Management for socio-economic development: A study of Pru and Atebubu – Amanten districts, Ghana. A Postgraduate Thesis submitted to Kwame Nkrumah University of Science and Technology. 1- 64

Ellis, F., (2000). Rural Livelihoods and Diversity in Developing Countries. Oxford University Press, Oxford. *In:* Boko, M., Niang, I., Nyong, A., Vogel, C., Githeko, A., Medany, M., Osman-Elasha, B., Tabo, R., and Yanda, P., (2007): Africa. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge UK. 433-467.

Gordon, C., and Amatekpor, J.K., (1999). The Sustainable Integrated Development of the Volta Basin in Ghana. Volta Basin Research Project, University of Ghana.

Guidford, J.P., and Fruchter, B., (1973). Fundamental Statistics in Psychology and Education, 5th edition, McGraw – Hill, New York.

IPCC, (1990). Intergovernmental Panel on Climate Change, WMO and UNEP, Geneva, Switzerland. State of the global agriculture In: Climate Change 2001_Impacts, adaptation and vulnerability.

Jha, A. K., Bloch R., and Lamond, J., (2012). Cities and Flooding: A Guide to Integrated Urban Flood Risk Management for the 21st Century, the World Bank 1818 H Street NW Washington DC 20433, Clearance Center Inc., 222 Rosewood Drive, Danvers, MA 01923, USA. 21 – 591.

Kumekpor, T.B.K., (2002). Research Methods and Techniques of Social Research. SonLife Printing Press and Services, Adenta, Ghana.117 – 118.

MOFA (Ministry of Food and Agriculture), (2011). Pru District Assembly and its Agricultural Activities. (Accessed, 11th June, 2012) http://.mofa.gov.gh/site.

NADMO (National Disaster Management Organization), (2010). News Report No. 1 Volume 4 January - June 2010. 4-16.

NADMO (National Disaster Management Organization), (2011). Technical Report for Pru District.

Nelson, W., and Agbey, S.N.D., (2005). Linkages between Poverty and Climate Change: Adaptation of Livelihood for the Poor in Ghana. Technical Paper. 1 – 71.

Rain, D.R., Ryan, E., Ludlow, C., and Antos, S., (2011). Accra Ghana: A City Vulnerable to Flooding and Drought-Induced Migration, Case study prepared for Cities and

Climate Change: Global Report on Human Settlements, Published. Web: http://www.unhabitat.org/grhs/2011(Accessed on July 7, 2012). 18-34.

Sagoe, R., (2006). Climate Change and Root Crop Production in Ghana. A Report Prepared for Environmental Protection Agency, Accra Ghana. Crops Research Institute, Kumasi.

UNDP / NADMO (United Nation Development Program / National Disaster Management Organisation) (2009). Enhancing National Strategies for Effective Disaster Risk Reduction in Ghana. United Nations Development Programme. Web: http://www.undp.org/disaster/Ghana (Accessed, June 23, 2012).

ZVAC (The Zambia Vulnerability Assessment Committee) (2007). Rapid Flood Impact Assessment Report in Zambia. www.google.com (Accessed, June 23, 2012). 15 – 17.

This academic research paper was published by the Africa Development and Resources Research Institute's Journal of Agriculture and Food Sciences. ***ADRRI JOURNALS*** are double blinded, peer reviewed, open access and international journals that aim to inspire Africa development through quality applied research.

For more information about *ADRRI JOURNALS* homepage, follow:
http://journal.adrri.org/aj

CALL FOR PAPERS