



RICE GROWERS, HUNTERS AND FISHERMEN PERCEPTION OF HIPPOPOTAMUS ACTIVITIES ACROSS CENTRAL RIVER REGION (CRR) OF THE GAMBIA: IMPLICATION FOR THEIR CONSERVATION

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ABSTRACT

The aim of the study is to investigate the types of damages caused by hippopotamus and control methods adapted by farmers in order to facilitate co-existence between hippopotamus and humans. A cross-sectional survey was conducted in March 2021 to assess the activities of Hippopotami across CRR of The Gambia using 252 standardized questionnaire and two Focal Group Discussions (FGDs). About 96% of respondents reported that they have seen hippos before in their communities and 98% of them also said that hippos have been raiding their communities for food for the past 10 years. Majority of the respondents reported that hippos have affected them before and 93% of them said that there was no help from the government when these animals attacked or destroyed their crops/fishing nets. However, 11% of the respondents reported that, hippos are not important to be conserved. The multinomial logistic regression result shows that, the young active, adult active and respondents from Janjanbureh had a positive belief about the importance of conserving hippos.

Key words: Human-wildlife conflict, Preventive measures, Hippopotamus amphibius, rice field

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INTRODUCTION

The eminent loss of the common hippopotamus *Hippopotamus amphibious* (hippo) is evident due to habitat depletion and hunting. However, both anthropogenic and natural interventions are likely to be occurring simultaneously which can leave devastating effects on the existence of a population (Lewison, 2007). Hippo populations witnessed a steep decline of about 95% in some parts of Sub-Saharan Africa in countries like The Democratic Republic of Congo and Uganda to name a few. This decline in such countries is

attributed to recent civil unrest; and on the entire continent the decline ranges from 7-20% as reported over the last 10 decades (Lewison, 2007, Kendall, 2011). The earth's biodiversity provides a large part of the ecosystem services ideal for human habitation. However, anthropogenic activities interfere with the flow of these services and if the current trends are not checked, will drastically affect most of the planet's remaining natural ecosystems and their numerous biotas in the near future. Worsening the impacts on biodiversity from injurious management

practices is climate variability and change. Recent research concluded that there is adequate evidence to suggest that climate change is likely to inflict huge impacts on biological diversity. The alterations in soil characteristics, water and nutrient cycling, plant productivity, species interactions (competition, predation, parasitism, etc.) and the structure and functions of ecosystems is likely to result in elevated atmospheric CO₂ concentration and temperature and shifts in rainfall regimes (Williams, 2000). Continual elevation in drought spells due to climate change threatens not only hippo species but the entire population of biodiversity as a decrease in grazing land causes both morbidity and mortality and forces Hippos to invade surrounding agricultural landscapes, which may lead to conflict increased, persecution and poaching. In addition, increased alterations of land and hydrological patterns as well as deteriorating water conditions due to anthropogenic activities will reduce available land area for human habitation (Rationale, 2004). Hippos spend much of their day in water in groups or pods of about 10-13 hippos per pod which could amount up to 100 individuals. Most of their nocturnal activity involves foraging for pasture and other vegetation on land. This nightly feeding behaviour of the animals which leads to increased human-hippo conflicts such as crop damage and physical threats, can therefore inflict injurious effects for both hippos and humans (Michez *et al.*, 2013; Fernandez *et al.*, 2020). Hippo foraging results to the literal formation of “hippo lawns” which consist of a greater proportion of protein and soluble carbohydrates (Arsenault & Owen-Smith, 2002; Michez *et al.*, 2013). Grazing lawns existed in many ecosystems supporting various groups of herbivores. Slow-growing, palatable lawn forages can only persist in a system of continuous heavy grazing. This condition can be reverted by reduction of the number of grazing animals which would allow faster and taller species of grasses to dominate the lawn (Archibald, 2008). When it comes to hippos, it is very difficult to relax the grazing pressure in order to allow regrowth because they prefer to

graze on the crops that humans cultivate for consumption. With their big, strong and uniform lips, the hippos feed randomly and not stationary but prefer grasslands containing a certain threshold of palatable species of grass, in which all the species are consumed (Michez *et al.*, 2013). However, urbanization due to human settlements, crop farming and conversion of forest and savannah grasslands to arable lands and pastures for livestock production has contributed to the loss of large populations of wildlife globally (Masese *et al.*, 2020). It appears uncertain that only recently have hippos and other animals become pests to African farmers along the River Gambia (Finley, 1959). Hippos play a dynamic role as ‘keystone species’ and ‘ecosystem engineers’ in maintaining wetland ecosystems and their reputation as notorious ‘crop raiders’. These herbivores have received comparatively scanty attention from the scientific community (Mkanda 1994; Post 2000). In the Gambia, research on hippos is rare. Human-hippo conflicts have rarely been studied even though hippos are frequently accused of killing more people than any other animal in Africa (Raffaele 2006). The aim of the study was to investigate factors influencing rice farmers, hunters and fishermen’s perceptions on human–hippos’ conflict, assess the spatial, ecological and habitat of hippos.

MATERIALS AND METHODS

Ethics statement

This study was approved by the Ethics Committee of the Parks and Wild Life Management, Ministry of Environment, The Gambia. All participants have signed a consent form prior to their participation in the study.

Study area

The study was conducted only in the Central River Region of The Gambia. Three districts in Central River Region-North (CRR-N) and three districts in Central River Region-South (CRR-S), one community from each district were selected for participation in the study.

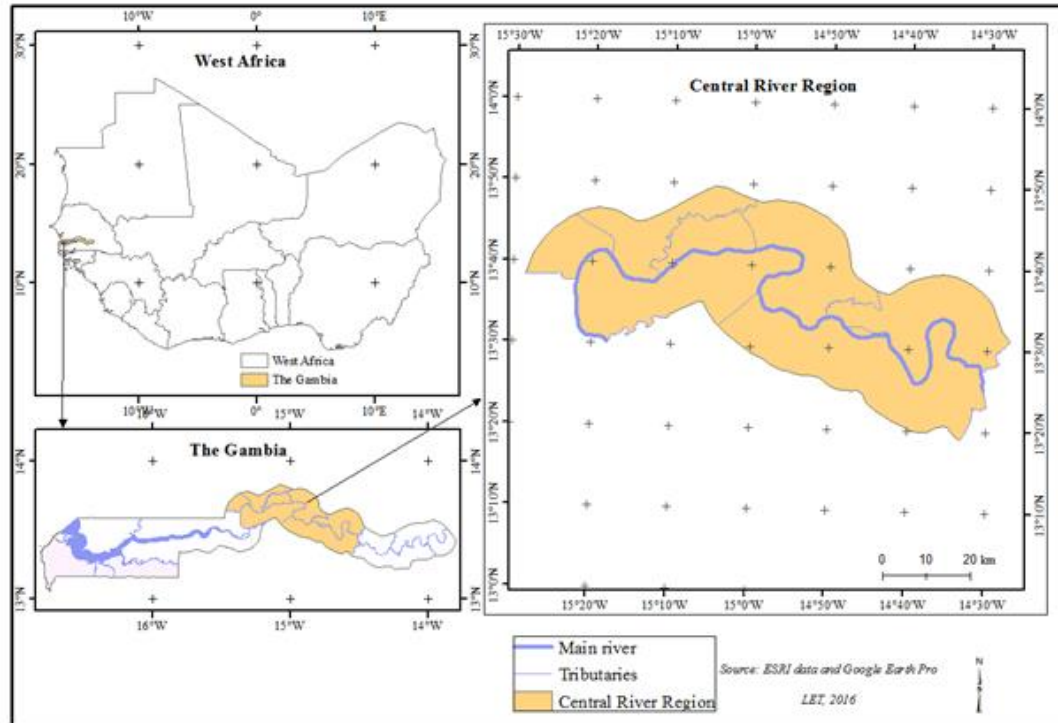


Figure 1: Map of the Gambia showing the location of the study. The figure was generated and modified using ArcGIS 9.

Study design and sampling

A cross-sectional survey was conducted in March 2021 to assess and compare the activities of Hippopotami across CRR of The Gambia using a standardized questionnaire and two (2) Focal Group Discussion (FGDs). The sample size was calculated using Topman's sample size formula for unknown population (rice farmers, fisher men and hunters).

$$x = \frac{Z}{2a} \dots [1]$$

Where:

Z = (95%=1.96), P= rate of response from pilot study (80%=0.8), R= non-respondent rate (0.2), e= Margin of error (5% or 0.05). The minimum sample size for this study was 246 totaling to 6 districts and 6 villages. Three districts and one village per district were randomly selected for CRR-N and CRR-S. The names of all the rice growers was collected from the village heads and they were randomly selected. Snow board method was used to obtained participants for fishermen and hunters for this study. Two Focal Group Discussions were evaluated in this study.

Study instruments

A standardized pretested questionnaire was developed. The questionnaire comprised 17 questions which were divided into four categories: (1) socio-demographic characteristics; (2) knowledge on Hippos population and habitat; (3) knowledge on the impact of hippo activities on humans.

Data analysis

Chi-square and Fisher's exact test was used to assess differences in the proportions of individual variables and Binary logistic regression was used to determine association between the explanatory variable with knowledge of hippos. Results were considered significant when $p \leq 0.05$. Data were compiled and analysed by Statistical Package for Social Sciences (SPSS) version 25 (IBM Corp., Armonk, NY, USA) while the Binary logit regression was implemented in R 3.6.3 software.

RESULTS

Respondent demographic background

A total of 252 rice farmers, hunters and fisher forks were interviewed of which 49 (19%) were fishermen, 5(2%) were hunters and rice 198 (79%) were rice farmers and among which 147 (58%) were males, and 105 (42%) were females.

Most of the respondents 86 (34.1 %) were between 36 to 45 years of age. Regarding educational status, the highest number of the respondents 169 (67.06 %) had informal/Madarasa education (Table 1).

Table 1: Demographic characteristics of respondents on Hippo

Characteristics	Frequency	Percentage
District		
Niamina East	42	16.67
Lower Fulladu West		
Janjanbureh	42	16.67
Niani	42	16.67
Lower Saloum	42	16.67
Sami	42	16.67
Gender		
Male	147	58
Female	105	42
Age (Years)		
26-35	60	23.8
36-45	86	34.1
46-55	52	20.6
56-65	24	9.5
Above 65	30	11.9
Ethnic group		
Mandinka	98	39
Fula	110	44
Wolof	8	3
Others	36	14
Occupation		
Fishermen	49	19
Hunters	5	2
Rice farmer	198	79
Marital Status		
Married	233	92
Single	10	4
Widowed	9	4
Household Size		
1-10	69	27
11-20	110	44
More than 20	73	29
Qualification		
Primary	32	12.70
Secondary	32	12.70
Tertiary	4	1.59
Informal/Madarasa	169	67.06
None	15	5.95

Respondent's knowledge on hippos Populations, feeding patterns and habitat

The incidence of hippos' crop raids per year was reported to be high. About 96% of interviewees reported that they have seen hippos before in their community and 98% also said that hippos have been in their communities for the past 10 years. The majority of the respondents reported that hippos have affect them before and 93% reported receiving no help from the government when the

animals attacked or destroyed their crops/ fishing nets and other equipment. However, 11% of the respondents reported that, hippo conservation is not important (table 2). More than a quarter of the respondents 27% reported seeing more than 30 different hippos in 2021 while another 27% reported that, they have never seen hippos before but they have heard the sound of a hippo before (figure 2)

Table 2: Respondent's knowledge on Hippo in The Gambia

Questions	Frequency	
	Yes	No
Have you seen Hippos before in your community	242(96%)	10 (4%)
Do you know if Hippos where in your community 10 years ago	248 (98%)	4 (2%)
Have Hippos ever affect you or a relative in the past	248 (98%)	4 (2%)
Did the government or NGO supported you when these animals affect you	17(7%)	235 (93%)
Do you think that Hippos are important to conserve	241 (96%)	11 (4%)
Do you know what Hippos feed on	250 (99%)	2 (1%)
Do you know if they have changed their feeding habit	79 (31%)	173 (69%)
Do you know where Hippos can be found	252 (100%)	-
Why do you think Hippos are invading your community now	252 (100%)	-

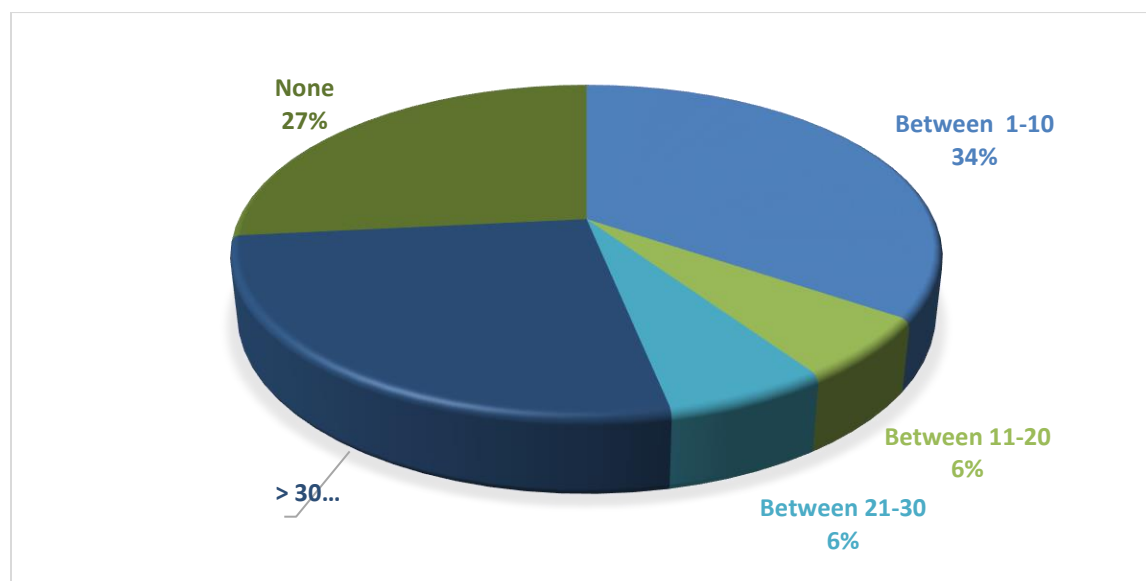


Figure 2: Number of hippos seen in 2021.

Economic impact of hippo activity on the livelihood of respondents

Forty Seven percent (47%) of participants in the study reported that, hippos do destroy their farms by walking through their farms every year and 38% of also reported that hippos do eat their farm produce every year as well. Fifteen Percent (15%) reported that hippos do attack their fishing nets and they have physically attacked them in the past. when asked about the cost of the destruction of one hippo, 95% of the respondents replied that, the cost is usually more than D12,750 (\$250).

Respondents' perception of the presence of hippos and their implications on their livelihoods

The chi-square results show that, gender ($\chi = 6.296$, $p = 0.012$); marital status ($\chi = 8.458$, $p = 0.015$), house hold size ($\chi = 9.536$, $p = 0.008$) and qualification ($\chi = 20.137$, $p < 0.001$), where the only factors significantly influencing respondents perception of seeing hippos before in their community. However, gender ($\chi = 0.781$, $p = 0.012$); ethnic group ($\chi = 11.06$, $p = 0.01$) and qualification ($\chi = 20.137$, $p < 0.001$) where again the only demographic variables which were statistically significant with the respondent's perception of hippos in their community (table 3)

It appears that all the demographic variables were significantly associated with the respondents' perception of hippos' activities on their livelihood except the respondents' age and their house hold size (table 3).

Binary and multinomial logistic regression result (respondents' perception of hippo's activity on their)

Table 4 shows Binary logistic regressions indicated that, respondent's in age group 26–35 years (OR: 0.235; 95% CL: 0.838, 0.066; $P = 0.026$) and age group 36-45 years (OR: 0.22; CL: 0.692, $P = 0.01$), house hold size of 1-10 individuals (OR: 0.23; CL: 0.559, 0.094; $P = 0.001$) and Janjanbureh district (OR: 0.654, CL: 0.725, 0.051; $P = 0.015$) were the demographic variables which had a significant influence on respondents belief when asked whether hippos are important or not.

Age (OR: 2.462, CL: 5.613, 1.08, $P = 0.032$), house hold size (OR: 4.675, CL: 15.764, $P = 0.013$) and district (OR: 0.261, CL: 0.491, 0.139, $P < 0.001$) are the socio-demographic characteristics which significantly ($P < 0.05$) influenced the overall knowledge about the importance of hippo at multivariable analysis (table 5).

Table 3: Respondents' perception of the presence of hippos and their implications on their livelihoods

Item	Factors	DF	X² Value	P – Value
Have you seen Hippo before	D	5	3.332	0.649
	G	1	6.296	0.012*
	A	4	5.285	0.259
	T	3	0.827	0.843
	O	2	2.840	0.242
	MS	2	8.458	0.015*
	HS	2	9.536	0.008*
	Q	4	23.167	<0.001*
Was Hippos in your community before	D	5	3.036	0.694
	G	1	0.781	0.012*
	A	4	4.328	0.363
	T	3	11.060	0.011*
	O	2	0.828	0.661
	MS	2	0.248	0.884
	HS	2	2.395	0.302
	Q	4	20.137	<0.001*
Have Hippos ever affected you	D	5	6.025	0.304
	G	1	0.710	0.400
	A	4	6.549	0.162
	T	3	3.611	0.307
	O	2	1.964	0.375
	MS	2	2.224	0.329
	HS	2	2.751	0.253
	Q	4	1.089	0.896
Implication of Hippos on Livelihood	D	15	65.654	<0.001*
	G	3	19.310	<0.001*
	A	12	18.754	0.095
	T	9	41.752	<0.001*
	O	6	119.804	<0.001*
	MS	6	35.515	<0.001*
	HS	6	9.223	0.161
	Q	4	23.167	<0.001*

Note: D (district), G (gender), A (age), T (tribe), O (occupation), MS (Marital status), HS (house hold size) and Q (qualification). Statistically significant*

Table 4: The socio-cultural activities of pastoralists that influence respondent’s knowledge on whether hippos are important in The Gambia.

	S.E.	Df	Sig.	Odd Ratio	95% C. I	
					Lower	Upper
Sex						
Male	0.350	1	0.192 ^{ns}	0.633	0.319	1.257
Female						Ref
Age						
26-35	0.649	1	0.026*	0.235	0.066	0.838
36-45	0.585	1	0.010*	0.220	0.070	0.692
46-55	0.597	1	0.624 ^{ns}	0.746	0.232	2.404
56-65	0.716	1	0.741 ^{ns}	1.267	0.311	5.151
> 65						Ref
Tribe						
Mandinka	0.616	1	0.549 ^{ns}	1.446	0.432	4.841
Fula	0.616	1	0.210 ^{ns}	0.462	0.138	1.544
Wolof	1.161	1	0.710 ^{ns}	0.649	0.067	6.319
Others						Ref
Marital Status						
Married	0.948	1	0.141 ^{ns}	0.248	0.039	1.588
Single	1200.3	1	0.999 ^{ns}	0.000	0.000	-.
Widowed						Ref
Household size						
1-10	0.454	1	0.001*	0.230	0.094	0.559
11-20	0.380	1	0.131 ^{ns}	0.563	0.268	1.186
>20						Ref
Qualification						
Primary	0.845	1	0.526 ^{ns}	0.585	0.112	3.065
Secondary	0.920	1	0.660 ^{ns}	0.667	0.110	4.049
Tertiary	17953.4	1	0.999 ^{ns}	8232.901	0.000	-.
Informal	0.737	1	0.868 ^{ns}	0.884	0.209	3.750
None						Ref
District						
Niamina east	.641	1	0.089 ^{ns}	0.336	0.096	1.181
Lower fulladu west	.647	1	0.512 ^{ns}	0.654	0.184	2.326
Janjanbureh	.675	1	0.015*	0.193	0.051	0.725
Niani	.560	1	0.642 ^{ns}	1.298	0.433	3.891
Lower Saloum	.636	1	0.090 ^{ns}	0.340	0.098	1.183
Sami						Ref

*Note: ^{ns} Not significant and * significant*

Table 5: The association between socio-demographic characteristics of the respondents and action to be taken to protect hippos from invading their community.

Characteristics	Std. Error	Df	Sig.	Exp(B)	95% Confidence Interval	
					Lower Bound	Upper Bound
Gender	0.959	1	0.111 ^{ns}	4.617	0.705	30.257
Age	0.421	1	0.032*	2.462	1.080	5.613
Marital Status	0.742	1	0.552 ^{ns}	0.643	0.150	2.756
Occupation	0.529	1	0.319 ^{ns}	1.693	0.600	4.776
Qualification	0.358	1	0.139 ^{ns}	1.698	0.843	3.423
Tribe	0.393	1	0.583 ^{ns}	0.806	0.373	1.742
House size	0.620	1	0.013*	4.675	1.386	15.764
District	0.322	1	<0.001*	0.261	0.139	0.491

Note: ^{ns} Not significant and * significant

DISCUSSION

Respondents' perception of hippo human conflict

In this study, 96% of the respondents have seen hippos in their community and 98% confirmed that hippos have been raiding their communities for the past 10 years. Detecting the distribution and agricultural risk factors for human-wildlife conflict is indispensable for its mitigation (Kendall 2011). Studies of hippos' behavior have discovered that they leave and enter waterways each night, following specific pathways (Eltringham, 1999; Kendall 2011). Thus, it is not surprising to find that the majority of reported crop raiding by hippos occurs at night on farms that border the river. All the respondents in this study reported that, hippos are mainly found in islands along The River Gambia and they also said that hippos do not have enough food that is why they usually invade their communities. Almost all the respondents 248 (98%) in this study reported that, hippos have either affected them or a close relative of theirs before. Ninety-nine percent (99%) of the respondents reported knowing what hippos usually feed on. This study shows that the major damages and losses caused by hippos in The Gambia is by raiding crops in the field and destruction of fishing nets to some extent as the source of human-hippo conflicts. Furthermore, this study is in agreement with the Previous studies performed on Adjame community reserve in south-eastern Benin and in

Ouémé River area in central Benin Republic, where it was reported that the main human hippos conflicts are linked to crops raided by hippos in Benin (Sogbohossou *et al.*, 2017; Dossou *et al.*, 2019) and In Kenya, (Kanga *et al.*, 2012) reported that majority of the hippo-human conflict incidences occurs as a result of agricultural and physical threats. In FGDs one of the rice growers reported that “since rice appears to be like normal grass to these animals, but rice is more palatable than other grasses to the hippo and because of this, *an adult hippo is capable of eating about 55 bags of rice a night*”. Additionally, the results of this study are also similar with the finding of González *et al.*, 2017, in Guinea Bissau and Sogbohossou *et al.*, 2017 conducted where also reported that, in addition to crop destruction, attacks on fishermen and loss of life are considered an important factor contributing to the persistence of human-hippos' conflicts. The seasonal atrocities cause by hippos can be estimated at \$250 per raid in a rice farm. However, 235 (93%) of the participants in this study said that neither government nor any non-governmental organization has ever supported them before when hippos affect them. Generally, the main course of this conflict is as a result of the conversion of swamp and wet lands which were once used by the hippos or which are supposed to be use a rest place or corridors for hippos into agricultural land. “*in fact, the dry season is the period when we see them the most searching for*

food in our community” FGDs. Overall, swamps and wet land conversions into agricultural lands result in loss of hippos grazing areas and migratory corridors; leading to conflicts between humans and wildlife (Kendall *et al.*, 2011).

Prevention of human hippo conflict

The destruction cause by these animals to the farming communities in CRR is unbelievable “*Hippo’s population have been left uncontrolled, resulting into their overpopulation. Because of their destructive nature, most of us have abandoned rice farming because no one supports us when they destroy our rice, and the government also prevents us from killing them*” FGDs. In order to co-exist, some rice growers have adopted and use different methods depending on the history of hippopotamus attacked in their farm. Respondents reported in FGDs includes “*Preventive measures we have adopted includes fencing of farm land (Kuntaur community rice farm by the Government of The Gambia and the National Agricultural Research Institution rice fields at Sapu by the Republic of China), putting of scare crew on the farm and lighting of fire at night*”. The use of cemented fence to prevent hippos from entering rice fields is less effective, because in the in Kuntaur a hippo destroyed the fence and force itself through the rice field. This result concurs with those of (Sogbohossou *et al.*, 2017; Dossou *et al.*, 2019) who also reported that, respondent reported that, they of pole barriers, barbed wire fences, shouting, drumming and fires used to repel wildlife from the farm. Respondents in FGDs also said that despite all the above control measures, “*we would also appreciate it if the department of parks and wild services workers can help us by patrolling along the river Gambia to prevent hippo from entering our farms since most of the hippo’s destruction occurs during the night when we are all asleep*”. Additionally, others respondents said that, “*the government of The Gambia should ensure that all the major rice field in CRR of The Gambia should be fenced with iron rods like the type the Republic of China technical mission did at Sapu*”. This use of physical barrier to prevent hippo-human conflict can be very effective even though it requires important investment (Hoare 2012).

Some of the respondents 11 (4%) believe that, it’s of no use to conserve hippos because they are of no importance since, they only cause destruction. For a balanced cohabitation between hippopotamus and human, we suggest optimal demarcation of hippopotamus habitat in the study area which will be erected as community reserve where human activities which can compete with hippopotamus habitat will be locally prohibited. Furthermore, 100% of the respondents suggested that “*fata woro or Baboon Islands on the river Gambia is an ideal place where hippos can be conserved by fencing the entire rivers body around these island*”. The multinomial logistic regression results show that, the young active and adult active respondents had a positive belief about the importance of conserving hippos. This result is in agreement with the findings of (Megaze *et al.*, 2017), who also reported that, Youngsters displayed more positive attitudes for conservation than adults and elders. Similar results were reported for older residents in five protected areas in Tanzania, who supported the elimination of protected areas for hippos (Newmark *et al.* 1993). The Respondents from Janjabureh also showed a positive belief on the economic importance of hippos, this could have been as a result of the level of awareness of the respondents from this region since it serves as the regional headquarters.

CONCLUSION

Crop destruction in the rice farms and destruction of fishing nets is the major damage caused by wild hippos in the study area. Rice, potatoes, cassava and various vegetable crops were the most commonly attacked crops by the hippos. Rice growers use traditional mitigation measures as scare crows, fence barriers, crop guarding farm and fire to prevent crop damage caused by hippos in their farms. Farmland closeness to the river Gambia was the most important factor increasing human-hippos’ conflicts in the study area. It is recommended that, the Government of The Gambia and other Non- governmental agencies should help farmers to construct strong electrified iron bar fence, provide patrol guards along the river Gambia and also provide pole lights in rice fields.

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