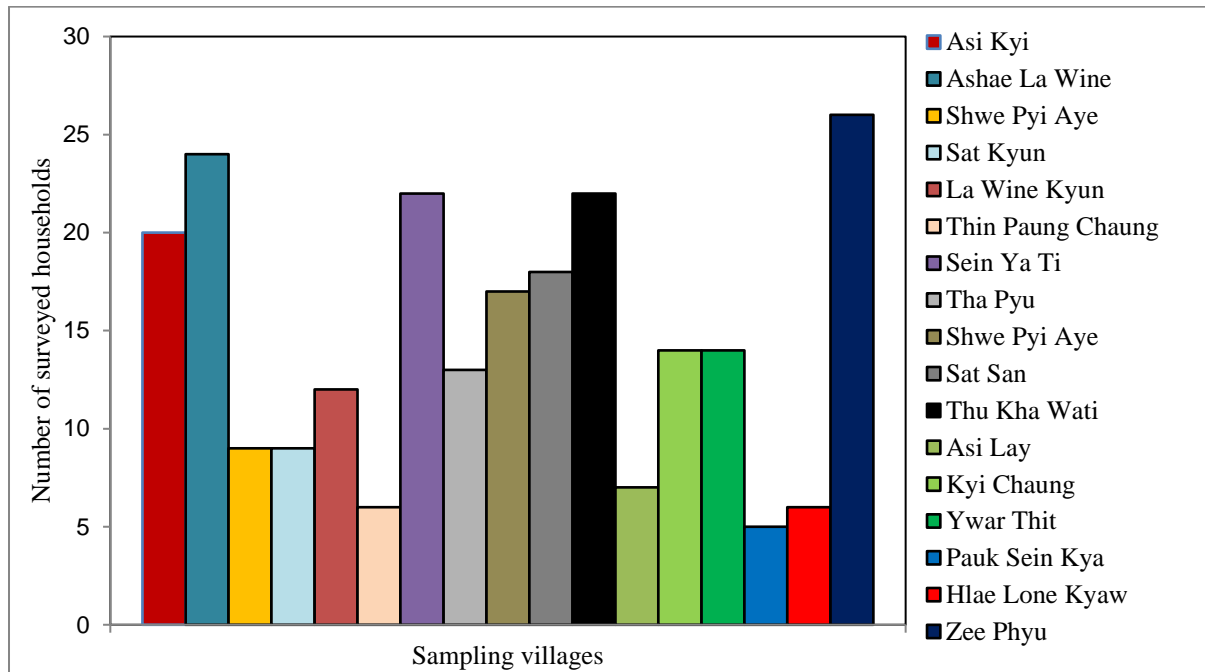


# Integrating local perspectives into conservation to facilitate human–crocodile coexistence in the Ayeyarwady Delta, Myanmar

KAY ZIN THAN, ZAW ZAW and ALICE CATHERINE HUGHES



SUPPLEMENTARY FIG. 1 Number of respondents in each of the surveyed villages.

**Questionnaire Form**

Date of survey:

Interviewer name:

*(Note: This English questionnaire form is translated into the Burmese language for the ease of conducting interviews)*

- 1. Name.....
- 2. Age.....
- 3. Education level.....
- 4. Livelihoods.....
- 5. Gender.....

**Knowledge about the surrounding environment**

- 6. Have you ever noticed that the mangrove areas near your village are decreasing?  
(a) Yes (b) No (c) Don't know
- 7. If yes, what are the factors contributing to the decrease of mangrove forests?

Potential correct answers are given. If the respondents give the answers below, just tick the answers. If the respondents give the answer which is not included in the list, tick the (other) option and please write down the answers in the space provided.

- (a) Exploitation of wood
- (b) Subsistence use
- (c) Illegal extraction for business
- (d) Clearance for agriculture extension
- (e) Natural disasters (Typhoon)
- (f) Others
- (g) Don't know

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- 8. Do you think that the mangrove forests are important for local people?  
(a) Yes (b) No (c) Don't know
- 9. If yes, why mangrove forests are important for local people? (Benefits of mangroves for local people)

Potential correct answers are given. If the respondents give the answers below, just tick the answers. If the respondents give the answer which is not included in the list, tick the (other) option and please write down the answers in the space provided.

- (a) Small- scale business from extraction of non-timber forest products
- (b) Subsistence use
- (c) Protection of natural disaster
- (d) Others benefits
- (e) Don't know

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10. Do you think the mangrove areas are also important for wildlife?

- (a) Yes (b) No (c) Don't know

11. If yes, why mangrove forests are important for wildlife? (Benefits of mangroves for wildlife)

Potential correct answers are given. If the respondents give the answers below, just tick the answers. If the respondents give the answer which is not included in the list, tick the (other) option and please write down the answers in the space provided.

- (a) Provide shelter
- (b) Provide food
- (c) Provide breeding ground
- (d) Others
- (e) Don't know

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12. Do you think the mangrove forests should be conserved?

- (a) Yes (b) No (c) Don't know

**Knowledge about saltwater crocodiles and their habitats**

13. Have you ever seen the crocodiles in this area?

- (a) Yes (b) No (c) Don't know

14. If yes, how many times and where you have ever seen crocodiles?

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- 15. Have you ever seen the crocodile nests in this area?  
(a) Yes (b) No (c) Don't know
- 16. Do you think that the population of crocodiles are decreasing?  
(a) Yes (b) No (c) Don't know
- 17. Do you think the mangrove forests are important for the crocodiles?  
(a) Yes (b) No (c) Don't know
- 18. If yes, why? (Benefits of mangrove for crocodiles)

Potential correct answers are given. If the respondents give the answers below, just tick the answers. If the respondents give the answer which is not included in the list, tick the (other) option and please write down the answers in the space provided.

- (a) Provide shelter
- (b) Provide food
- (c) Provide breeding ground
- (d) Others
- (e) Don't know

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- 19. How do you think why Meinmahlakyun wildlife sanctuary was established for?

Potential correct answers are given. If the respondents give the answers below, just tick the answers. If the respondents give the answer which is not included in the list, tick the (other) option and please write down the answers in the space provided.

- (a) Protect and conserve the trees
- (b) Protect and conserve the animals
- (c) Protect both trees and animals
- (d) Others
- (e) Don't know

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**Knowledge about threats to crocodiles**

- 20. Do you think the existence of the crocodile is highly threatened by hunting in this area?  
(a) Yes (b) No (c) Don't know
- 21. If hunting is not the main threat, are there any other threats to crocodiles?  
(a) Yes (b) No (c) Don't know
- 22. Do you think crocodile poaching might happen in the future?  
(a) Yes (b) No (c) Don't know
- 23. And why?

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**Awareness about Human-Crocodiles conflicts**

- 24. How many times have you ever heard about crocodile attacks on people?

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**Perceptions on benefits from conservation of saltwater crocodiles in Meinmahlakyun**

- 25. Do you think what kinds of benefits are received by the local people from the conservation program of saltwater crocodiles?

Potential correct answers are given. If the respondents give the answers below, just tick the answers. If the respondents give the answer which is not included in the list, tick the (other) option and please write down the answers in the space provided.

- (a) No benefits
- (b) Only get disadvantages
- (c) Environmental benefits
- (d) Non-financial benefits
- (e) Financial benefits
- (f) Other benefits
- (g) Don't know

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**Perceptions on the impacts of saltwater crocodiles' conservation**

26. Do you think the conservation of saltwater crocodiles in the Meinmahlakyun wildlife sanctuary impacted local people?

Potential correct answers are given. If the respondents give the answers below, just tick the answers. If the respondents give the answer which is not included in the list, tick the (other) option and please write down the answers in the space provided.

- (a) No impact
- (b) Emotional impact
- (c) Financial impact
- (d) Physical impact
- (e) Other impacts

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**Attitudes on the conservation of saltwater crocodiles**

27. Do you think saltwater crocodile should be conserved and protected in Ayeyarwady delta?

- (a) Yes
- (b) No
- (c) Don't know

**Suggestions for co-existence**

28. What kinds of interventions or activities should be taken to get co-existence between local people and saltwater crocodiles in Ayeyarwady delta? And, why do you suggest that intervention?

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SUPPLEMENTARY TABLE 1 Questions and response types of the 11 variables: environmental knowledge, knowledge about saltwater crocodiles, perceptions of threats to saltwater crocodiles, human-crocodile conflict awareness, perceptions of impacts and benefits of saltwater crocodiles, conservation attitudes of local people, age, education, gender and livelihoods

Sr.	Variables	Questions	Responses
1.	ENVA (Knowledge about the surrounding environment)	1.1 Have you ever noticed that the mangrove areas near your village are decreasing? 1.2 If yes, what are the factors contributing to the decrease of mangrove forests? (Factors decreasing mangroves) 1.3 Do you think that the mangrove forests are important for local people? 1.4 If yes, why mangrove forests are important for local people? (Benefits of mangroves for local people) 1.5 Do you think the mangrove areas are also important for wildlife? 1.6 If yes, why mangrove forests are important for wildlife? (Benefits of mangroves for wildlife) 1.7 Do you think the mangrove forests should be conserved?	Yes/No/Don't know Open Yes/No/Don't know Open Yes/No/ Don't know Open Yes/No/ Don't know
2.	CROCK (Knowledge about saltwater crocodiles and their habitats)	2.1 Have you ever seen the crocodile nests in this area? 2.2 Have you ever seen the crocodiles in this area? 2.3 Do you think that the population of crocodiles are decreasing? 2.4 Do you think the mangrove forests are important for the crocodiles? 2.5 If yes, why? (Benefits of mangrove for crocodiles) 2.6 How do you think why Meinmahlakyun wildlife sanctuary was established for? (intention for the establishment of Meinmahlakyun Sanctuary)	Yes/No/ Don't know Yes/No/ Don't know Yes/No/ Don't know Yes/No/ Don't know Open Open
3.	TP (Knowledge about threats to saltwater crocodiles)	3.1 Do you think the existence of the crocodile is highly threatened by hunting in this area? 3.2 If hunting is not the main threat, are there any other threats to crocodiles? 3.3 Do you think crocodile poaching might happen in the future (possibility of future hunting threats)?	Yes/No/ Don't know Yes/No/ Don't know Yes/No/ Don't know
4.	CFA (Awareness about Human-Crocodile Conflicts)	4.1 How many times have you ever heard about crocodile attacks on people?	Open
5.	PERB <i>Benefit Perceptions</i>	5.1 Do you think what kinds of benefits are received by the local people from the conservation program of saltwater crocodiles in Meinmahlakyun	Open

6.	PERI (Impact Perceptions)	6.1 Do you think the conservation of saltwater crocodiles in Meinmahlakyun impacts on local people?	Open
7.	CA (Conservation Attitudes)	7.1 Do you think saltwater crocodile should be conserved and protected in Ayeyarwady delta?	Yes/No/ Don't know
8.	AGE	8.1 Age of the respondents	Open
9.	GEN	9.1 Gender of the respondents	Open
10.	LIV	10.1 Main livelihoods of the respondents	Open
11.	EDU	11.1 Educational level of the respondents	Open

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SUPPLEMENTARY TABLE 2 Weights of the questions under the 11 variables: environmental knowledge (ENVK), knowledge about saltwater crocodiles (CROCK), perceptions of threats to saltwater crocodiles (TP), human-crocodile conflict awareness (CFA), perceptions of impacts (PERI) and benefits (PERB) of saltwater crocodiles, conservation attitudes of local people (CA), age (AGE), education (EDU), gender (GEN) and livelihoods (LIV).

Variables	Questions	Weights
ENVK	Have you ever noticed that the mangrove areas near your village are decreasing?	0.14
	If yes, what are the factors contributing to the decrease of mangrove forests?	0.29
	Do you think that the mangrove forests are important for local people?	0.43
	If yes, why mangrove forests are important for local people?	0.57
	Do you think the mangrove areas are also important for wildlife?	0.72
	If yes, why mangrove forests are important for wildlife?	0.86
	Do you think the mangrove forests should be conserved?	1.00
CROCK	Have you ever seen the crocodile nests in this area?	0.17
	Have you ever seen the crocodiles in this area?	0.33
	Do you think that the population of crocodiles are decreasing?	0.50
	Do you think the mangrove forests are important for the crocodiles?	0.67
	If yes, why? (Benefits of mangrove for crocodiles)	0.83
	How do you think why Meinmahlakyun wildlife sanctuary was established for? (intention for the establishment of Meinmahlakyun Sanctuary)	1.00
TP	Do you think the existence of the crocodile is highly threatened by hunting in this area?	0.33
	If hunting is not the main threat, are there any other threats to crocodiles?	0.67
	Do you think crocodile poaching might happen in the future (possibility of future hunting threats)?	1.00
CFA	How many times have you ever heard about crocodile attacks on people?	1.00
PERBI	Do you think what kinds of benefits are received by the local people from the conservation program of saltwater crocodiles in Meinmahlakhyun?	1.00
CA	Do you think saltwater crocodile should be conserved and protected in Ayeyarwady delta?	1.00
Age	Age of the respondents	1.00
GEN	Gender of the respondents	1.00
LIV	Main livelihoods followed by the respondents	1.00
EDU	Educational level of the respondents	1.00

SUPPLEMENTARY TABLE 3 Respondents' demographic characterization.

Variables/ Factors	Answers Groups	Counts	Total (%)
<i>Gender (GEN)</i>	Female	64	26.2
	Male	180	73.8
<i>Age (AGE)</i>	> 18 ≤ 20 yrs	8	3.3
	> 20 ≤ 40 yrs	94	38.5
	> 40 ≤ 60 yrs	112	45.9
	> 60 years	30	12.3
<i>Education (EDU)</i>	Primary (Grade 1 to Grade 4)	165	67.6
	Secondary (Grade 5 to Grade 8)	68	27.9
	High (Grade 9 to Grade 10)	11	4.5
<i>Livelihoods (LIV)</i>	Farm	66	27.0
	Livestock	3	1.2
	Fishery	56	23.3
	Seasonal jobs	100	41
	Business	11	4.5
	Others	8	3.3

SUPPLEMENTARY TABLE 4 Respondents' knowledge characterization.

Questions under the variables	Answers Groups	Counts	Total (%)
<i>Environmental Knowledge (ENVK)</i>			
Have you ever noticed that the mangrove areas near your village are decreasing?	Yes	230	94.3
	No	8	3.3
	Don't know	6	2.5
If yes, what are the factors contributing to the decrease of mangrove forests? (Factors Decreasing Mangroves)	Exploitation of wood	79	32.4
	Subsistence use	46	18.9
	Business/illegal extraction	54	22.1
	Agricultural extension	25	10.2
	Natural disaster (typhoon)	12	4.9
	Others	9	3.7
	Don't know	19	7.8
Do you think that the mangrove forests are important for local people?	Yes	240	98.4
	No	4	1.6
If yes, why mangrove forests are important for local people? (Benefits of mangroves for local people)	Small scale business	66	27.0
	Subsistence use	55	22.5
	Protection of natural disaster	94	38.5
	Other benefits	18	7.4
	Don't know	11	4.5
Do you think the mangrove areas are also important for wildlife?	Yes	235	96.3
	No	9	3.7
If yes, why mangrove forests are important for wildlife? (Benefits of mangroves for wildlife)	Provide shelter	78	32.0
	Provide food	13	5.3
	Provide breeding/ nesting sites	4	1.6
	Provide suitable habitats	120	49.2
	Others	5	2
	Don't know	24	9.8
Do you think the mangrove forests should be conserved?	No	7	2.9
	Yes	227	93.0
	Don't know	10	4.1
<i>Knowledge about saltwater crocodiles (CROCK)</i>			
Have you ever seen the crocodiles in this area?	Never	32	13.1

	Often	212	86.9
	Don't know	0	0
Locations of saltwater crocodile sight	Near villages	40	16.4
	Inside Meinmahlakyun	145	59.4
	Both places	42	17.2
	Don't know/ remember	17	7.0
Have you ever seen the crocodile nests in this area?	Never	182	74.6
	Often	42	25.4
	Don't know	0	0
Do you think that the population of crocodiles are decreasing?	Yes	9	3.7
	No	213	87.3
	Don't know	22	9.0
Do you think the mangrove forests are important for the crocodiles?	Yes	207	84.8
	No	22	9.0
	Don't know	15	6.1
If yes, why? (Benefits of mangrove for crocodiles)	Provide shelter	31	12.7
	Provide food	14	5.7
	Provide breeding/ nesting sites	26	10.7
	Provide suitable habitats	113	46.3
	Others	1	0.4
	Don't know	59	24.2
How do you think why Meinmahlakyun wildlife sanctuary was established for? (intention for the establishment of Meinmahlakyun Sanctuary)	Protect and conserve mangroves	14	5.7
	Protect and conserve wildlife	16	6.6
	Protect both	19	7.8
	Others	9	3.7
	Don't know	186	76.2
<i>Knowledge about threats (TP)</i>			
Do you think the existence of the crocodile is highly threatened by hunting in this area?	Yes	0	0
	No	237	97.1
	Don't know	7	2.9
If hunting is not the main threat, are there any other threats to crocodiles?	Yes	27	11.1
	No	211	86.5
	Don't know	6	2.5
Do you think crocodile poaching might happen in the future (possibility of future			

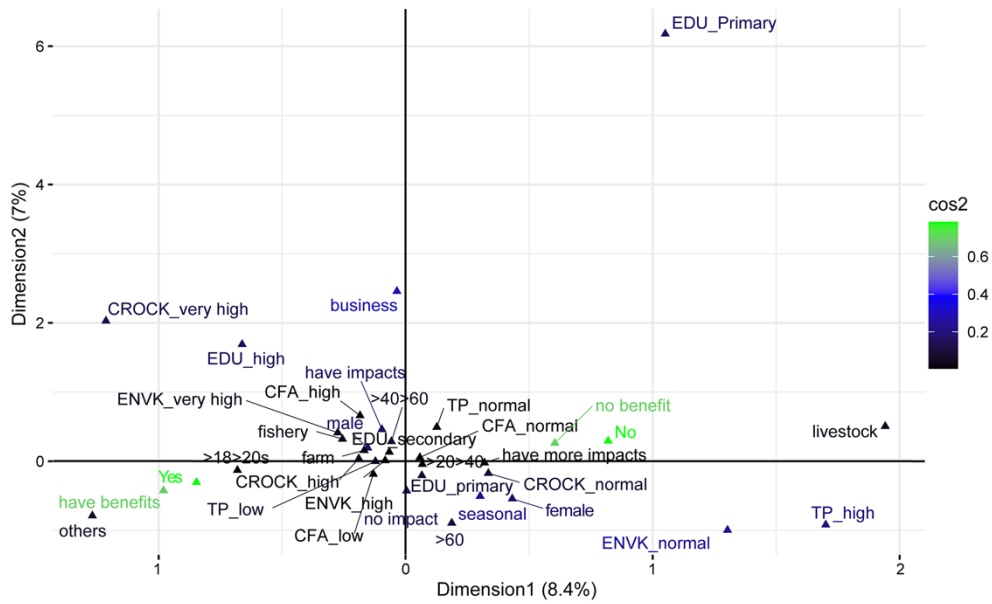
hunting threats)?  
And why?

Yes (with no reasons)	7	2.9
No (because of the law prohibiting poaching to saltwater crocodiles)	230	94.3
Don't know	7	2.9

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SUPPLEMENTARY TABLE 5 Respondents' awareness and perception characterization.

Variables/ Factors	Answers Groups	Frequency	Total (%)
<i>Conflicts Awareness (CFA)</i>			
How many times you have ever heard about crocodile attacks on people?			
	Low (0)	68	27.9
	Normal (1 to 6)	171	70.1
	High (7 and above)	5	2
<i>Benefit Perception (PERB)</i>			
Do you think what kinds of benefits are received by the local people from the conservation program of saltwater crocodiles in Meinmahlakyun			
	No Benefit	151	61.9
	Rare species	5	2.0
	Disadvantages	7	2.9
	Ecological values	26	10.7
	Others	55	22.5
<i>Impact perception (PERI)</i>			
Do you think the conservation of saltwater crocodiles in Meinmahlakyun impacts on local people?			
	No impact	110	45.1
	Emotional impact	98	40.2
	Financial impact	13	5.3
	Physical impact	15	6.1
	Others	8	3.3



SUPPLEMENTARY FIG. 2 Multiple correspondence analysis plot showing amount of contribution (squared correlation  $\cos^2$  values) and discrimination of the 11 variables' levels on the two dimensions (Dim 1 and Dim 2), 11 variables: environmental knowledge (ENVK), knowledge about saltwater crocodiles (CROCK), perceptions of threats to saltwater crocodiles (TP), human-crocodile conflict awareness (CFA), perceptions of impacts (PERI) and benefits (PERB) of saltwater crocodiles, conservation attitudes of local people (CA), age (AGE), education (EDU), gender (GEN) and livelihoods (LIV).

SUPPLEMENTARY MATERIAL 2 Saturated model and simplified model with significant main and interaction characteristics.

Model 1:

ENVK\*CROCK\*TP\*CFA\*PERB\*PERI\*GEN\*AGE\*LIV\*EDU(Saturated model)

Model 2: CROCK + CFA + TP + PERI + PERB + CROCK:CFA +

CROCK:PERI + PERI:PERB + GEN+ LIV + AGE+ GEN:AGE +

LIV:AGE (Simplified model with main and interaction effects)



SUPPLEMENTARY TABLE 6 Retained significant interaction and main variables: knowledge about saltwater crocodiles (CROCK), human-crocodile conflict awareness (CFA), perceptions of impacts of saltwater crocodiles (PERI), age (AGE), gender (GEN) and livelihoods (LIV), from the simplified model with residual deviance chi-squared p-values.

Variables	Resid. Dev	<i>Pr</i> (> Chi)
CROCK:CFA	150.11	0.03088 *
CROCK:PERI	150.15	0.03047 *
TP	149.20	0.007701 **
GEN:AGE	299.36	0.0003584 ***
LIV:AGE	304.49	0.005051 **

Significant codes: '\*\*\*' 0.001, '\*\*' 0.01, '\*' 0.05, '.' 0.1

SUPPLEMENTARY TABLE 7 Binomial logistic regression with retained interaction and main variables' levels: knowledge about saltwater crocodiles (CROCK), human-crocodile conflict awareness (CFA), perceptions of impacts of saltwater crocodiles (PERI), age (AGE), gender (GEN) and livelihoods (LIV), on the conservation willingness.

Interaction or main variables	Variable levels in the equation				Final binomial logistic model			
	B	s.e	z value	p value	Exp (B)	p value	AIC	
CROCK:CFA	CROCK_low	-15.57	1029.12	0.015	0.986	-15.57	0.988	339.1
	CROCK_normal	31.13	1782.49	0.017	0.986			
	CFA_low	15.92	1029.12	0.015	0.988			
	CFA_normal	16.02	1029.12	0.016	0.988			
	CROCK_Low: CFA_low	-16.21	1029.12	-0.016	0.987			
	CROCK_normal : CFA_low	-31.22	1782.49	-0.018	0.986			
	CROCK_low : CFA_normal	-17.46	1029.12	-0.017	0.986			
	CROCK_normal : CFA_normal	-31.67	1782.49	-0.018	0.986			
CROCK:PERI	CROCK_low	-1.505	0.737	-2.057	0.040*	0.118	0.732	334.8 6
	CROCK_normal	-0.081	0.437	-0.186	0.852			
	PERI_have more impacts	1.492	1.148	-1.734	0.194			
	PERI_no impacts	0.313	0.495	0.632	0.527			
	CROCK_low : PERI_have more impacts	-16.671	979.611	-0.017	0.986			
	CROCK_normal : PERI_have more impacts	-2.221	1.281	-1.734	0.083.			
	CROCK_low: PERI_no impacts	0.986	0.914	1.079	0.281			
	CROCK_normal : PERI_no impacts	-0.126	0.627	-0.201	0.840			
TP	TP_low	1.661	1.103	1.505	0.132	-1.609	0.142	335.6 5

	TP_normal	-13.957	727.7	-0.019	0.985			
GEN:AGE	GEN_female: AGE_(> 18 ≤ 20 yrs)	-0.560	1.309	-0.427	0.669	-0.693	0.571	329.47
	GEN_male: AGE_(> 18 ≤ 20 yrs)	0.843	1.249	0.675	0.500			
	GEN_female: AGE_(> 40 ≤ 60 yrs)	0.526	1.291	0.407	0.684			
	GEN_male: AGE_(> 40 ≤ 60 yrs)	0.830	1.243	0.667	0.505			
	GEN_female: AGE_(> 60 yrs)	17.259	848.368	0.020	0.984			
	GEN_male: AGE_(> 60 yrs)	0.133	1.303	0.103	0.918			
	GEN_female: AGE_(> 18 ≤ 20 yrs)	2.079	1.658	1.254	0.210			
LIV:AGE	LIV_fishery	-2.035	0.662	-3.070	0.002**	0.810	0.056	335.79
	LIV_livestock	-18.377	2284.102	-0.008	0.994			
	LIV_others	0.575	1.196	0.481	0.630			
	LIV_business	16.755	3956.180	0.004	0.996			
	LIV_seasonal jobs	-1.307	0.544	2.40	0.016 *			
				5				
	AGE_(> 40 ≤ 60 yrs)	-0.875	0.556	-1.573	0.116			
	AGE_(> 60 yrs)	-1.034	0.794	-1.302	0.193			
	AGE_(> 18 ≤ 20 yrs)	0.091	0.974	0.093	0.926			
	LIV_fishery: AGE_(> 40 ≤ 60 yrs)	2.474	0.850	2.912	0.004**			
	LIV_others: AGE_(> 40 ≤ 60 yrs)	17.055	3956.18	0.004	0.997			
	LIV_seasonal jobs: AGE_(> 40 ≤ 60 yrs)	-17.384	3956.18	-0.004	0.997			
	LIV_seasonal jobs: AGE_(> 40 ≤ 60 yrs)	1.463	0.718	2.037	0.042 *			
	LIV_fishery: AGE_(> 60 yrs)	19.824	1978.09	0.010	0.992			
	LIV_others: AGE_(> 60 yrs)	17.214	2797.442	0.006	0.995			
	LIV_business: AGE_(> 60 yrs)	-34.098	5594.884	-0.006	0.995			

LIV_seasonal jobs: AGE _(> 60 yrs)	1.243	1.018	1.220	0.222
LIV_fishery: AGE _(> 18 ≤ 20 yrs)	18.699	2284.102	0.008	0.993

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Significant codes: '\*\*\*\*' 0.001, '\*\*' 0.01, '\*' 0.05, '.' 0.1