Australia Awards

Adaptive Strategies of Small-scale Farmers to Cope with Water Shortages due to Climate Change: A Comparative Study between the Tonle Sap Lake and the Mekong River Areas

In cooperation with Royal University of Phnom Penh (RUPP), and Supported by Australian Alumni Association of Cambodia (AAC)

Presented by Ms. Sophorn YANN
Deputy Director
Centre for Governance Innovation and Democracy
Asian Vision Institute

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Contents

Phum Thmei_Trapaeng Chorng_Pursat

Core Research Team

- Ms. Sophorn YANN, Research Lead
- Dr. Serey Sok, Research Advisor
- Mr. Ponleu Thou, Research Assistant, and
- Mrs. Leakhena Thoeun, Research Assistant

Context

Moha Knhoung_Koh Sotin_Kompong Cham

- While **floods** have been annual events since 1999, drought brought even more concern in 2003 and 2004 (Sok et al., 2010, MRC, 2005).
- Climate change has significant impacts on Cambodian rice producers as a result of **variations in rainfall patterns** (Keskinen et al., 2010).
- **Wet season rainfall** has **increased** over time, resulting in more frequent **flood events**. Meanwhile precipitation in the **dry season** has remained stable, or **possibly decreasing** (Nguyen, et al., 2011).
- Sok et al. (2021) confirmed that **drought events** were **more severe** than flood events in terms of their adverse effect on rice production in the Mekong River and at Tonle Sap Lake.

✸ Research Objectives & Questions

Moha Khnoung_Koh Sotin_Kompong Cham

Research aims to:

- Analyze the **effects and causes** of water shortage, **local adaptive capacity**, and support **mechanisms** to reduce the negative impacts of climate change
- To **draw the perception** of affected farmers and key players for better adaptation to and management of water resources

Three Leading Questions:

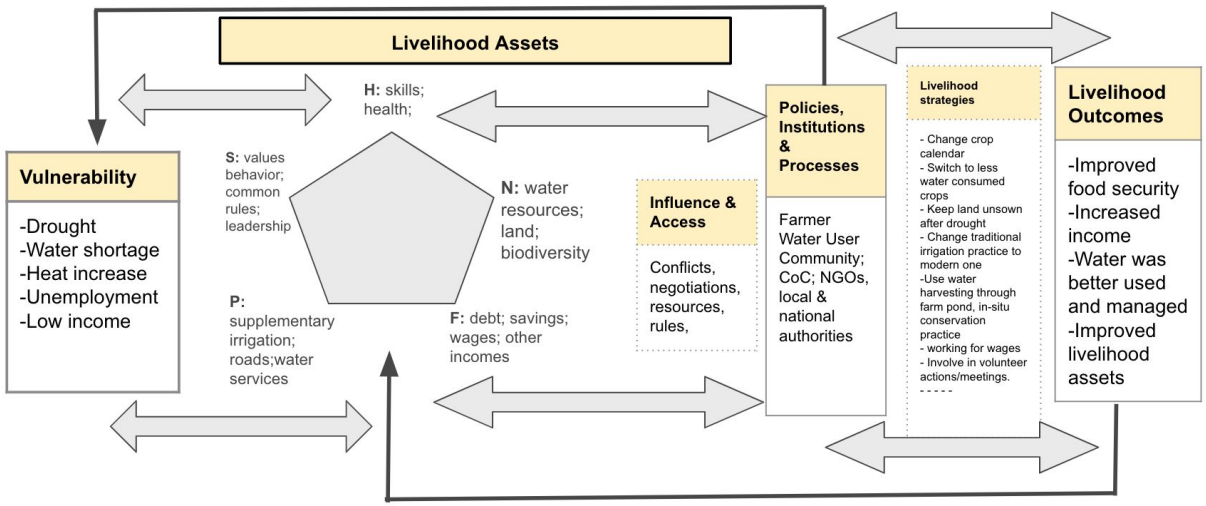
Q1: How are farmers affected by water shortages due to climate change?

Q2: What are farmers doing with water shortages caused by climate change?

Q3: What support is there to help those affected farmers?

Conceptual Framework

Sustainable Livelihoods Framework



Source: Authors' adopted framework based on the context of Cambodia

Sustainable Livelihood Framework

-Chambers and Conway write (1992: 5, and see Chambers, 1995: 174, Scoones, 1998: 5) that a "livelihood in its simplest sense is a means of **gaining a living**."

-A fuller 'working definition':

"A livelihood comprises the **capabilities**, **assets** (stores, resources, claims, and access) and **activities** required for **a means of living**: a **living is sustainable which can cope with and recover from stress and shocks**, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods **at the local and global levels and in the short and long term**."

Study Areas

1. **Bakan** district of Pursat Province was selected as the riverine communities in the **Tonle Sap**

2. **Koh Sotin** district and Kampong Cham Province were recruited as in the **Mekong River**.

3. **Respondents** are rice farmers (as their primary job)

Methodology:

- Data: Secondary & Primary data; Qual & Quant; Adopted social and participatory tools
- Sampling: Purposive, systematic and stratified sampling design and procedure were applied to each household
- Sample: equally recruited male and female household representatives
- Survey: Structured questionnaire
- Data Analysis: Statistical Package for Social Science (SPSS) software for quantitative data analysis; they included Weighted Average Index (WAI), t-test, and Chi-Square.

Demographic Data

Table 1. Gender and marital status of respondents by location.

Indicator	Tonle Sap Lake		Mekong River		Overall	
	n=150		n=150		n=300	
	f	%	F	%	f	%
Gender						
Female	74	49.3	73	48.7	147	**49.0**
Male	76	50.7	77	51.3	153	**51.0**
Overall	150	100.0	150	100.0	300	100.0
Marital status						
Single	4	2.7	3	2.0	7	2.3
Married	**137**	**91.3**	**136**	**90.7**	**273**	**91.0**
Divorced	2	1.3	0	0.0	2	0.7
Widow/Widower	7	4.7	11	7.3	18	6.0
Overall	150	100.0	150	100.0	300	100.0

Demographic Data

Table 2. Demographic characteristics of respondents by location.

Indicator	Tonle Sap Lake	Mekong River	Overall	P-value
	n=150	n=150	n=300	
Age	46.3	**53.6**	49.9	***0.000****
Education	5.5	5.1	5.3	0.250
Family member	4.5	**4.9**	4.7	**0.042***
Dependent member	4.3	4.7	4.5	0.051
Land size for resettlement (meter square)	**1,785.3**	**642.2**	1,213.8	***0.000****
Land size for agriculture (meter square)	**33,336.7**	**11,849.3**	22,593.0	***0.000****
Number of secondary occupations	1.3	**1.7**	1.5	***0.000****

Demographic Data

Table 3. Types of secondary jobs by geographical location.

Indicator	Tonle Sap Lake		Mekong River		Overall	
	n=150		n=150		n=300	
	f	%	f	%	f	%
Gardener	13	8.7	84	56.0	97	**32.3**
Fisherfolk	3	2.0	2	1.3	5	1.7
Livestock raiser	80	53.3	65	43.3	145	**48.3**
Self-employed worker	27	18.0	30	20.0	57	19.0
Employed worker	30	20.0	34	22.7	64	21.3
Self-employed businessmen	19	12.7	15	10.0	34	11.3
Employees (i.e., Private, Public, and NGOs)	20	13.3	18	12.0	38	12.7
Other	0	0.0	0	0.0	0	0.0
Overall	**132**	**88.0**	**146**	**97.3**	**278**	**92.7**
Number of secondary occupations	**1.3**		**1.7**		**1.5**[a]	

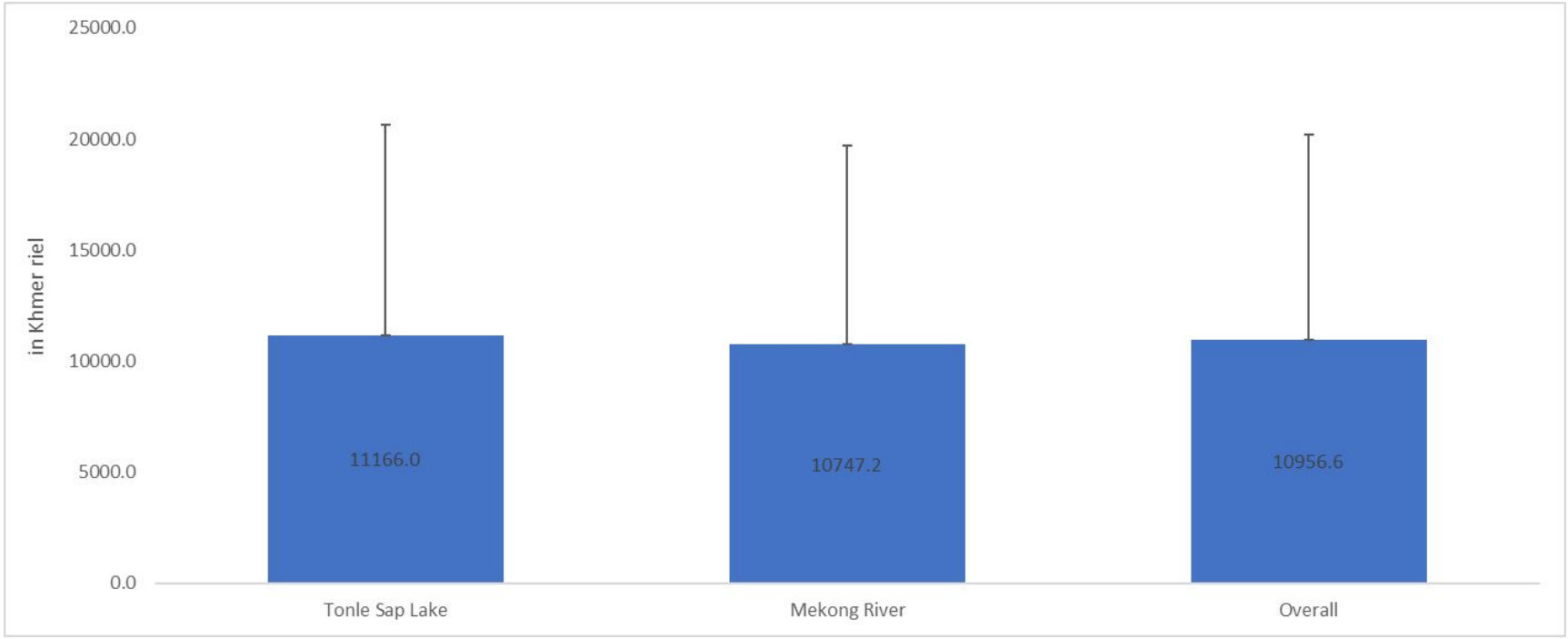
Demographic Data

Table 4. Primary job in the next decade by geographical location.

Indicator	Tonle Sap Lake		Mekong River		Overall	
	n=150		n=150		n=300	
	f	%	f	%	F	%
Rice Farmer	135	90.0	147	98.0	282	**94.0**
Gardener	0	0.0	0	0.0	0	0.0
Fishman	1	0.7	0	0.0	1	0.3
Animal Raising	0	0.0	0	0.0	0	0.0
Self Employed Worker	2	1.3	2	1.3	4	1.3
Employee	1	0.7	0	0.0	1	0.3
Business Owner	9	6.0	1	0.7	10	3.3
Staff (i.e., Private, Public, and NGOs)	2	1.3	0	0.0	2	0.7
Other	0	0.00	0	0.0	0	0.0
Overall	150	100.0	150	100.0	300	100.0

Income & Poverty

Figure 1. Income per capita by geographical location.

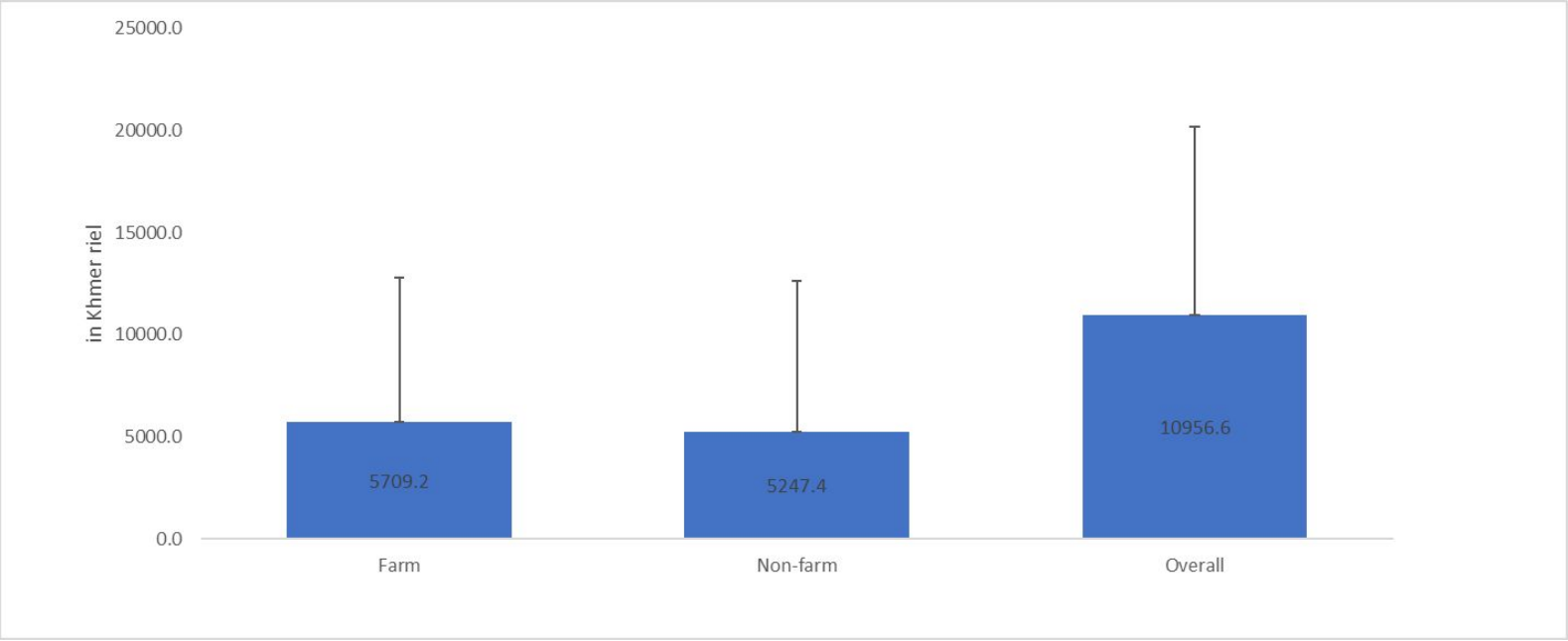


P-*value*: 0.695.

Research Findings

Income & Poverty

Figure 2. Incomer per capita by farm and non-farm.



P-*value*=0.474.

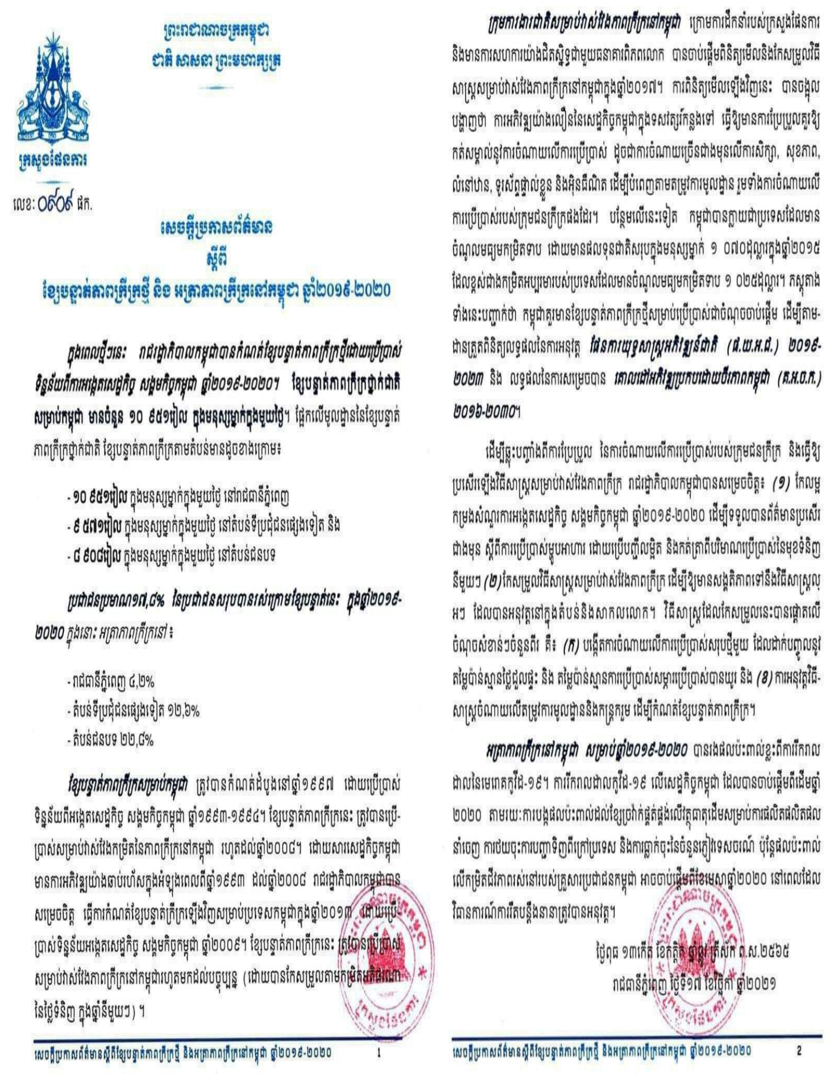
✸ Research Findings

Income & ID Poor

Indicator	Tonle Sap Lake		Mekong River		Overall	
	n=150		n=150		n=300	
	f	%	f	%	f	%
Holding ID Poor						
Yes	12	8.0	14	9.3	26	8.7
No	138	**92.0**	136	90.7	274	**91.3**
Overall	150	100.0	150	100.0	300	100.0
Types of ID Poor						
ID Poor I	2	16.7	2	14.3	4	15.4
ID Poor II	10	**83.3**	12	**85.7**	22	**84.6**
Overall	12	100.0	14	100.0	26	100.0

Table 1. Average monthly household and per capita consumption, 2019/20 and 2021. In thousand riels.

Domain	Per household		Per capita	
	2019/20	2021	2019/20	2021
Cambodia	2,278	1,838	527	425
Phnom Penh	3,825	2,546	926	598
Other urban	2,534	2,038	577	470
Other rural	1,819	1,598	410	366



Research Findings

Income & Poverty

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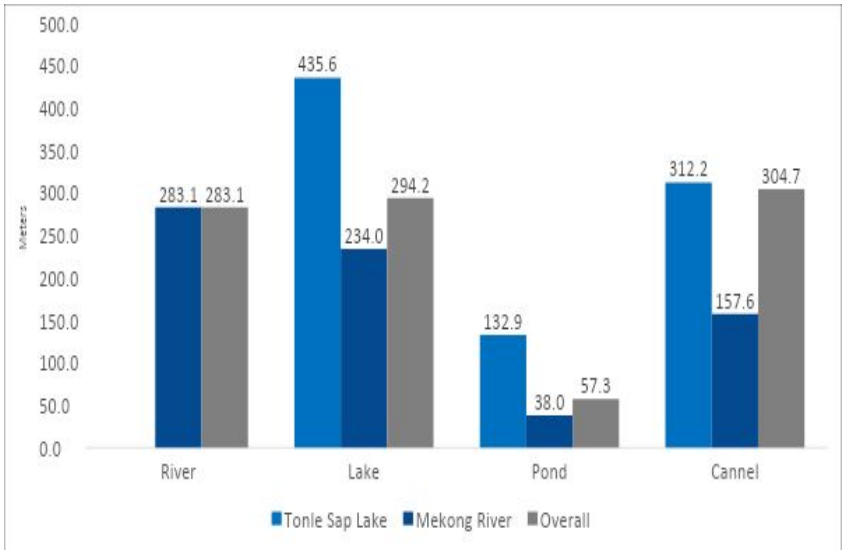
- In average, income per capita was 10,956.6 Riels derived from **11,166.0 Riels in Tonle Sap Lake** and **10, 747.2 Riels in Mekong River**.
- **Average income per capita** in **Tonle Sap Lake** was **higher than** those in **the Mekong River** (P-value=0.030).
- **Average income per capita from farm and non-farm was not significantly different** (P-value=0.422).
- Monthly **income per capita** was 328,498 Riels which was **significantly lower than** national data of Ministry of Planning (P-value=0.019).
- Monthly **household** income was 1,473,139 Riels which was **not significantly different** from national data of Ministry of Planning (P-value=0.114).

Access to water for consumption

Indicator	Tonle Sap Lake		Mekong River		Overall		P-value
	n=150		n=150		n=300		
	WAI	OA	WAI	OA	WAI	OA	
Accessible to water for bathing	0.71	H	0.79	H	0.75	H	***0.000****
Accessible to water for drinking	0.71	H	0.78	H	0.74	H	***0.000****
Accessible to water for cooking	0.71	H	0.78	H	0.74	H	***0.000****
Accessible to water for washing	0.70	H	0.78	H	0.74	H	***0.000****
Accessible to water for rice cultivation	**0.52**	**M**	**0.50**	**M**	**0.51**	**M**	0.066
Accessible to water for crop cultivation	**0.53**	**M**	**0.47**	**M**	**0.50**	**M**	***0.002****
Overall	0.65	H	0.68	H	0.66	H	***0.000****

Access to water for consumption



Sources to access to water

Indicator	Tonle Sap Lake		Mekong River		Overall	
	n=150		n=150		n=300	
	f	%	f	%	f	%
Rainy season	21	14.0	90	**60.0**	111	**37.0**
Dry season	1	0.7	0	0.0	1	0.3
Both	128	**85.3**	60	**40.0**	188	**62.7**
Overall	150	100.0	150	100.0	300	100.0

Season to grow rice

Cropping Periods

Indicator	Tonle Sap Lake	Mekong River	Overall
January	0.7	0.0	0.3
April	10.7	5.3	8.0
May	68.0	1.3	34.7
June	17.3	4.7	11.0
July	2.7	7.3	5.0
August	0.7	4.0	2.3
September	0.0	66.7	33.3
October	0.0	6.7	3.3
November	0.0	3.3	1.7
December	0.0	0.7	0.3

The start of first crop

Indicator	Tonle Sap Lake	Mekong River	Overall
February	0.0	9.3	4.7
March	0.0	2.7	1.3
June	0.7	0.7	0.7
July	0.7	0.0	0.3
August	0.0	4.7	2.3
September	3.3	1.3	2.3
October	25.3	8.0	16.7
November	48.7	3.3	26.0
December	20.7	11.3	16.0

The end of first crop

Indicator	Tonle Sap Lake	Mekong River	Overall
Not involved	13.3	59.3	36.3
January	0.7	4.0	2.3
February	0.0	2.7	1.3
March	0.0	0.7	0.3
April	0.0	4.0	2.0
May	0.7	14.0	7.3
June	0.0	0.7	0.3
September	0.0	6.7	3.3
October	9.3	4.0	6.7
November	67.3	4.0	35.7
December	8.7	0.0	4.3

The start of second crop

Indicator	Tonle Sap Lake	Mekong River	Overall
Not involved	13.3	59.3	36.3
January	11.3	0.7	6.0
February	38.0	4.0	21.0
March	34.7	2.0	18.3
April	1.3	5.3	3.3
May	0.0	1.3	0.7
June	0.0	0.7	0.3
September	0.0	3.3	1.7
October	0.7	13.3	7.0
November	0.0	2.0	1.0
December	0.0	0.7	0.3

The end of second crop

Cropping Periods

Indicator	Tonle Sap Lake	Mekong River	Overall
Not involved	100	98	99
January	0	0.7	0.3
February	0	0.7	0.3
March	0	0.7	0.3

The start of third crop

Indicator	Tonle Sap Lake	Mekong River	Overall
Not involved	100.0	98.0	99.0
January	0.0	0.7	0.3
February	0.0	1.3	0.7

The end of third crop

Indicator	Tonle Sap Lake	Mekong River	Overall	P-value
	n=150	n=150	n=300	
Number of times to grow crop per year	1.87	1.43	1.65	***0.000****
Number of months to grow crop per year	9.23	5.59	7.41	***0.000****

Number of times and months to grow crop per year

Access to Livelihood Assets

Indicator	Tonle Sap Lake n=150		Mekong River n=150		Overall n=300		P-value
	WAI	OA	WAI	OA	WAI	OA	
Water	**0.62**	**H**	**0.58**	**M**	**0.60**	**M**	***0.044****
Fishery	0.37	L	0.34	L	0.36	L	0.100
Aquaculture	0.29	L	0.27	L	0.28	L	0.137
Forest	0.30	L	0.31	L	0.30	L	0.679
Wildlife	0.26	L	0.25	L	0.26	L	0.620
Bird	0.26	L	0.25	L	0.26	L	0.352
Overall	0.35	L	0.33	L	0.34	L	0.134

Access to natural assets

Indicator	Tonle Sap Lake n=150		Mekong River n=150		Overall n=300		P-value
	WAI	OA	WAI	OA	WAI	OA	
Rice farming	0.45	M	0.39	L	0.42	M	***0.001****
Chamkar (i.e., vegetable and fruit)	0.36	L	0.40	L	0.38	L	***0.013*****
Small and medium business	0.29	L	0.30	L	0.30	L	0.782
Construction	0.30	L	0.29	L	0.30	L	0.844
Driving	0.33	L	0.32	L	0.33	L	0.347
Overall	0.35	L	0.34	L	0.34	L	0.615

Access to human assets

Indicator	Tonle Sap Lake n=150		Mekong River n=150		Overall n=300		P-value
	WAI	OA	WAI	OA	WAI	OA	
Road	0.68	H	0.70	H	0.69	H	0.244
Bridge	0.58	M	0.58	M	0.58	M	0.786
Irrigation	**0.61**	**H**	**0.51**	**M**	**0.56**	**M**	***0.000*****
Local market	0.61	H	0.63	H	0.62	H	0.255
Health facilities	**0.71**	**H**	**0.68**	**H**	**0.69**	**H**	***0.042****
School facilities for children	0.71	H	0.72	H	0.72	H	0.658
Transportation	0.66	H	0.67	H	0.67	H	0.329
Physical Asset (Overall)	0.68	H	0.70	H	0.69	H	0.244

Access to physical assets

Indicator	Tonle Sap Lake n=150		Mekong River n=150		Overall n=300		P-value
	WAI	OA	WAI	OA	WAI	OA	
Raised concerns about community development	0.46	M	0.43	M	0.45	M	0.207
Participate in activities of NGOs	**0.41**	**M**	**0.35**	**L**	**0.38**	**L**	***0.008*****
Participate in activities of Commune Council	0.55	M	0.54	M	0.55	M	0.574
Participate in activities of government offices	**0.39**	**L**	**0.34**	**L**	**0.36**	**L**	***0.020****
Involve in community decision making	0.45	M	0.41	M	0.43	M	0.051
Overall	0.45	M	0.42	M	0.43	M	***0.026****

Access to social assets

Access to livelihood Assets

Indicator	Tonle Sap Lake		Mekong River		Overall		P-value
	n=150		n=150		n=300		
	WAI	OA	WAI	OA	WAI	OA	
Access to microfinance for loan	0.61	H	0.58	M	0.60	M	***0.044****
Access to commercial bank for loan	0.52	M	0.45	M	0.49	M	***0.000****
Access to local lender for loans	0.59	M	0.56	M	0.57	M	***0.048****
Participate in saving group	0.48	M	0.46	M	0.47	M	0.328
Access to income generation activities	0.46	M	0.46	M	0.46	M	0.948
Financial Asset (Overall)	0.53	M	0.50	M	0.52	M	***0.041****

Access to financial assets

Effect of Water Shortage on Rice

Indicator	Tonle Sap Lake n=150		Mekong River n=150		Overall n=300		P-value
	WAI	OA	WAI	OA	WAI	OA	
Flood	0.48	M	0.36	L	0.42	M	***0.000***
Droughts	**0.68**	**H**	**0.69**	**H**	**0.69**	**H**	**0.616**
Storms	0.39	L	0.35	L	0.37	L	***0.019****
Overall	0.52	M	0.47	M	0.49	M	***0.000***

Hazards which are affecting crops

Indicator	Tonle Sap Lake n=150		Mekong River n=150		Overall n=300	
	f	%	f	%	f	%
Which season has the **sufficient** water for your crop?						
Wet season	**150**	**100.00**	**148**	**98.67**	**298**	**99.33**
Dry season	0	0.00	2	1.33	2	0.67
Which season has **insufficient** water for your crop?						
Wet season	2	1.3	24	16.0	26	8.7
Dry season	**148**	**98.7**	**126**	**84.0**	**274**	**91.3**
Which season are the **most affecting** on your crop?						
Wet season	58	38.7	**109**	**72.7**	167	**55.7**
Dry season	92	61.3	41	27.3	133	**44.3**

Sufficiency of water by season

Impacts of Water Shortage

Indicator	Tonle Sap Lake n=150		Mekong River n=150		Overall n=300		P-value
	WAI	OA	WAI	OA	WAI	OA	
Water shortage threatened household food scarcity	**0.86**	**SA**	**0.89**	**SA**	**0.87**	**SA**	***0.033****
Water shortage caused conflicts for water in scarcity	**0.91**	**SA**	**0.85**	**SA**	**0.88**	**SA**	***0.000****
Water shortage caused no choice in food preference	0.80	A	0.78	A	0.79	A	0.275
Water shortage affected on health	0.87	SA	0.88	SA	0.88	SA	0.670
Water shortage caused malnutrition	0.83	SA	0.81	SA	0.82	SA	0.106
Water shortage affected schooling of children	0.76	A	0.77	A	0.76	A	0.756
Water shortage caused population migration	**0.83**	**SA**	**0.79**	**A**	**0.81**	**SA**	***0.002****
Water shortage caused debts	0.81	SA	0.80	A	0.81	SA	0.346
Water shortage caused unemployment	0.79	A	0.78	A	0.78	A	0.647
Water shortage caused in spending on festivals	0.83	SA	0.84	SA	0.84	SA	0.398
Overall	0.83	SA	0.82	SA	0.82	SA	0.199

Impacts of Water Shortage

Indicator	Tonle Sap Lake		Mekong River		Overall	
	n=150		n=150		n=300	
	f	%	f	%	F	%
What are the negative impacts from water shortage?						
Reduce production	83	55.33	90	60.00	173	57.67
Delay to crop harvest	79	52.67	83	55.33	162	54.00
Disease attack	**93**	**62.00**	**140**	**93.33**	**233**	**77.67**
Unable to agriculture/farm	**97**	**64.67**	**83**	**55.33**	**180**	**60.00**
Hamper rice production	75	50.00	85	56.67	160	53.33
What are the negative impacts from water shortage on health?						
Diarrhea	51	34.00	30	20.00	81	27.00
Typhoid	9	6.00	2	1.33	11	3.67
Skin Problems	**133**	**88.67**	**146**	**97.33**	**279**	**93.00**
Dysentery	53	35.33	79	52.67	132	44.00
Fever	**135**	**90.00**	**103**	**68.67**	**238**	**79.33**

Adaptive Capacity to Water Shortage

Indicator	Tonle Sap Lake		Mekong River		Overall		P-value
	n=150		n=150		n=300		
	WAI	OA	WAI	OA	WAI	OA	
Change crop calendar	0.57	M	0.56	M	0.57	M	0.425
Change to less water consuming crop	0.61	H	0.60	M	0.60	M	0.714
Keep using unsown after possibility of drought	**0.51**	**M**	**0.56**	**M**	**0.53**	**M**	***0.004****
Change traditional irrigation practice to modern one (i.e., sprinkler, drip irrigation etc.)	**0.55**	**M**	**0.50**	**M**	**0.53**	**M**	***0.005****
Use water harvesting through farm pond, in-situ conservation practice	**0.49**	**M**	**0.61**	**M**	**0.55**	**M**	***0.000****
Overall	0.55	M	0.56	M	0.56	M	0.135

Practice to Reduce Water Shortage

Indicator	Tonle Sap Lake		Mekong River		Overall		P-value
	n=150		n=150		n=300		
	WAI	OA	WAI	OA	WAI	OA	
Reduce cultivation area	0.51	M	0.54	M	0.52	M	0.164
Change crops	0.63	H	0.63	H	0.63	H	0.847
Diversify crops	0.39	L	0.48	M	0.43	M	***0.000******
Improve cultivation	0.52	M	0.58	M	0.55	M	***0.000******
Advance technique	0.51	M	0.54	M	0.52	M	0.154
Improve cultivation facilities	0.45	M	0.52	M	0.49	M	***0.001****
Improve amount of herbicides and pesticides	**0.66**	**H**	**0.63**	**H**	**0.64**	**H**	***0.032****
Increase amount of fertilizer	0.65	H	0.63	H	0.64	H	0.297
Improve irrigation system	0.49	M	0.50	M	0.50	M	0.545
Buy agricultural insurance	0.38	L	0.38	L	0.38	L	0.849
Practice related to reduce water shortage impacts (Overall)	0.52	M	0.54	M	0.53	M	0.068

Equipments' Used

Indicator	Tonle Sap Lake		Mekong River		Overall	
	n=150		n=150		n=300	
	f	%	f	%	f	%
Irrigation method	1	0.7	0	0.0	1	0.3
Electric motor	4	2.7	0	0.0	4	1.3
Diesel machine	**128**	**85.3**	**134**	**89.3**	**262**	**87.3**
Hand pump	**106**	**70.7**	**73**	**48.7**	**179**	**59.7**
Well	5	3.3	**89**	**59.3**	**94**	**31.3**
No equipment or facilities at all	3	2.0	4	2.7	7	2.3
Overall	150	100.0	150	100.0	300	100.0

Water Management

Indicator	Tonle Sap Lake n=79		Mekong River n=118		Overall n=197	
	f	%				
Not being invited	**59**	**74.68**	**115**	**97.46**	**174**	**88.32**
Time is not allowed	20	25.32	3	2.54	23	11.68
Overall	79	100.00	118	100.00	197	100.00

Indicator	Tonle Sap Lake n=71		Mekong River n=32		Overall n=103	
	f	%	f	%	f	%
How did you participate in an event/activity regarding natural resources management?						
Household representative	**67**	**94.37**	**32**	**100.00**	**99**	**96.12**
Community representative	15	21.13	11	34.38	26	25.24
Which organization have you participated in the activity or event with?						
Central government	6	8.45	1	3.13	7	6.80
Provincial office	15	21.13	1	3.13	16	15.53
District office	11	15.49	2	6.25	13	12.62
Commune Council	**69**	**97.18**	**32**	**100.00**	**101**	**98.06**
NGOs	5	7.04	1	3.13	6	5.83
What are your main roles in the above involvement?						
Decision maker	9	12.68	5	15.63	14	13.59
Discussant	39	54.93	8	25.00	47	45.63
Listening	**68**	**95.77**	**31**	**96.88**	**99**	**96.12**

Summary

- Farmers in the Tonle Sap Lake and the Mekong River **have sought ways to cope with** the impact of water shortage.

- However, their **local adaptation was insufficiently** addressed to mitigate **their risks and vulnerabilities.**

    - The residents have a **moderate adaptive capacity** but face risks and vulnerabilities when extreme climatic events occur (eg.drought, floods).

    - The farmers remain **highly dependent on water resources from the Tonle Sap Lake and the Mekong River for their cultivation**. Farmers also have other alternative sources of consumption and other income from non-farm activities; but farm income is always significant.

    - The farmers **were challenged to access the five assets** for their livelihood development, especially with human assets.

    - **Support mechanisms for water management** were insufficient. While the residents had opportunities to participate in various events and activities carried out at the commune level, they were not involved much in the decision-making process.

Suggestions

- The research calls for support from government and non-governmental agencies to promote access to the five livelihood assets, especially **human assets**.

- Access to the five **livelihood assets** proves significantly to increase the adaptive strategies of rice farmers in the Tonle Sap Lake and the Mekong River to cope with water shortage in the face of climate change.

  - Should increase the annual budget for CIP implementation, and the commune councils can allocate the annual funds for other activities to **promote water resource management**.

  - Should mobilize resources from the national budgets and bilateral and multilateral donors to **construct and improve irrigation systems**.

  - Should establish the **local adaptive capacity** to withstand water change by working closely with the district office and commune councils through the provincial office (eg. saving groups, water management groups, trainings, market support..).

  - Should **continue** the work to support the rice farmers to participate in community meetings to identify their needs and raise their concerns to improve their rice productivity and to participate in decision-making for their sustainable livelihoods.

✸ Q & A

Moha Khnoung_Koh Sotin_Kompong Cham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