

1 **Sustainability of the rice-crayfish farming model in waterlogged land: A case study in**
2 **Qianjiang County, Hubei Province¹**

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11 Appendix A. Brief introduction of survey locations

Sites	Latitude and longitude	Brief introduction
Jiyukou	N30°27' 4.95" , E112°35' 41.90"	The earliest place where crayfish farming was carried out in paddy fields in Qianjiang can be traced back to the 1990s. This place belongs to a small
Gucheng	N30°25' 14.14" , E112°33' 1.28"	hilly terrain, and most of the low-lying areas was cold flood fields. Local farmers began to explore a new planting mode -- rice-crayfish farming

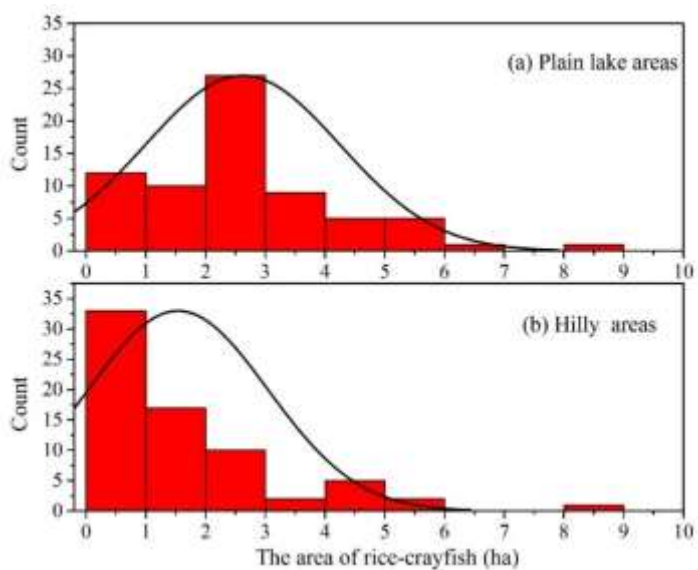
Baowan	N30 24' 50.78" , E112 32' 20.90"	mode. Due to the limited topography, the rice-crayfish here is mainly dominated by small farmers, with an area of 0.3-2 hectares.
aokou	N30 23' 8.00" , E112 38' 48.56"	In the water network area, the Xijing river, Changhu lake and Tianguan river flow through this area, and the terrain is relatively flat. Crayfish farming in rice fields has developed rapidly in recent years, which can be traced back to around 2003 at the earliest.
Houhu	N30 23' 59.70" , E112 43' 11.77"	Flat terrain, located in the central Qianjiang river. The source of water mainly comes from Tianguan river. The area of rice-crayfish has expanded rapidly in the past two years. The earliest rice-crayfish field can be traced back to about 2006.
Longwan	N30 13' 54.17" , E112 42' 34.89"	In the hinterland of the submerged river network, the river is rich in lakes and other lakes, and the water resources are abundant. In April 2016, the amount of crayfish in the paddy field is 2,200 ha. After 2010, it is just began to develop rapidly.
Huangqiao	N30 18' 23.13" , E112 44' 19.81"	Located in the southeast of Qianjiang river and flat, it is the main interweaving point of water network in the Sihu region. In recent years, the development of rice-crayfish mode is also rapidly, most of which developed around 2010. There are about 133.3 ha of rice-crayfish the paddy field.
Guanshan	N30 10' 24.98" , E112 42' 58.02"	The water source here mainly comes from the Longhu river and Egret lake. The area is located in the lake district, flat terrain, rich in water resources. 95% the paddy fields were converted into rice-crayfish mode fields. There are about 267 ha of rice-crayfish in this area. Rice-crayfish dates back to around 2006.

Appendix B. Lodging survey in rice-crayfish farmers field in 2017

Sites	Number	Lodging ratio (%)				Rice yield (kg/667m ²)		Yield reduction	The reasons of rice lodging
		Upright	Upright	Incline	Lodging	2017	2016		
Houhu	1	50	50	0	50	400	500	20.0%	Over-application of N fertilizer
	2	66	66	17	17	600	650	7.7%	Over-application of N fertilizer, overcast and rainy
	3	27	17	50	33	600	650	7.7%	Over-application of N fertilizer, overcast and rainy
	4	100	100	0	0	650	650	0.0%	the least fertilizer
	5	90	90	10	0	600	650	7.7%	overcast and rainy
	6	100	100	0	0	650	650	0.0%	the least fertilizer
	7	70	70	0	30	600	650	7.7%	Over-application of N fertilizer
	8	0	0	6	94	400	650	38.5%	low lying, overcast, and rainy
	9	75	75	25	0	625	700	10.7%	Higher stalks, Over-application of N fertilizer
Mean		64	63	12	25	566	639	0.11	
Guanshan	1	50	50	50	0	637.5	650	1.9%	low lying, overcast and rainy
	2	50	50	40	10	637.5	650	1.9%	low lying
	3	25	25	5	70	550	650	15.4%	Rice blast
	4	50	50	50	0	550	650	15.4%	Rice blast
	5	0	0	0	100	300	500	40.0%	overcast and rainy, windy
	6	0	0	0	100	300	500	40.0%	wind and rainy, Over-application of N fertilizer
	7	100	100	0	0	400	600	33.3%	wind and rainy, Over-application of N fertilizer
	8	50	50	0	50	350	550	36.4%	wind and rainy, Over-application of N fertilizer
	9	90	90	0	10	300	600	50.0%	wind and rainy, Over-application of N fertilizer
Mean		46	46	16	38	447	594	24.8%	
Jiyukou	1	60	60	10	30	550	650	15.4%	Over-application of N fertilizer, insect pest
	2	0	0	0	100	300	650	53.8%	overcast and rainy, Higher stalks
	3	100	100	0	0	625	625	0.0%	the least fertilizer
	4	91	91	0	9	700	700	0.0%	the least fertilizer
	5	100	100	0	0	700	700	0.0%	Good drainage system
	6	100	100	0	0	665	665	0.0%	the least fertilizer
	7	100	100	0	0	665	600	-10.8%	Avoid rainy weather early in the harvest
	8	80	80	0	20	665	665	0.0%	wind and rainy, Over-application of N fertilizer
	9	100	100	0	0	500	600	16.7%	direct-planting rice
	10	100	100	0	0	700	650	-7.7%	Avoid rainy weather early in the harvest

	11	100	100	0	0	575	650	11.5%	wind and rainy, Over-application of N fertilizer
	12	50	50	50	0	675	750	10.0%	rice varieties, Over-application of N fertilizer, climate
	13	50	50	50	0	550	665	17.3%	overcast and rainy
Mean		79	79	8	12	605	659	8.2%	
	1	50	50	0	50	500	700	28.6%	rice varieties, Over-application of N fertilizer, climate
	3	0	0	0	100	550	625	12.0%	rice varieties
	5	0	0	10	90	500	650	23.1%	Over-application of N fertilizer, rainy
	6	30	30	40	30	550	625	12.0%	overcast and rainy
	7	6	6	0	94	575	650	11.5%	overcast and rainy
	8	0	0	0	100	600	700	14.3%	rice varieties, overcast and rainy
	9	0	0	0	100	550	650	15.4%	wind and rainy, Over-application of N fertilizer
	10	100	100	0	0	650	725	10.3%	overcast and rainy
	11	30	30	0	70	500	650	23.1%	overcast and rainy,
	12	0	0	0	100	500	700	28.6%	overcast and rainy
	13	42	42	0	58	500	700	28.6%	overcast and rainy
Haokou	14	20	20	0	80	600	725	17.2%	wind and rainy, Over-application of N fertilizer
	16	30	30	0	70	500	650	23.1%	wind and rainy, Over-application of N fertilizer
	17	0	0	0	100	450	700	35.7%	overcast and rainy
	18	0	0	0	100	300	650	53.8%	climate
	19	0	0	0	100	375	650	42.3%	overcast and rainy, windy
	21	15	15	5	80	400	600	33.3%	overcast and rainy, Over-application of N fertilizer
	22	0	0	0	100	425	650	34.6%	Over-application of N fertilizer, overcast and rainy, Uneven terrain
	23	76	76	0	24	625	650	3.8%	overcast and rainy
	24	30	30	0	70	225	650	65.4%	overcast and rainy
	25	35	35	25	40	500	650	23.1%	rice varieties, overcast and rainy
	26	0	0	10	90	200	650	69.2%	overcast and rainy
	27	0	0	0	100	450	675	33.3%	overcast and rainy
Mean		20	20	4	76	479	664	27.8%	
	1	50	50	0	50	500	600	16.7%	wind and rainy, Over-application of N fertilizer
Baowan	2	50	50	0	50	600	600	0.0%	overcast and rainy, rice varieties
	3	90	90	0	10	525	600	12.5%	overcast and rainy
	4	100	100	0	0	650	650	0.0%	Good drainage system
	5	40	40	50	10	475	600	20.8%	windy

	6	65	65	5	30	500	625	20.0%	windy and rainy
	7	0	0	0	100	500	650	23.1%	overcast and rainy, High - stalk rice varieties
	8	10	10	0	90	500	650	23.1%	climate
	9	20	20	0	80	350	550	36.4%	overcast and rainy
	10	80	80	0	20	575	700	17.9%	overcast and rainy, rice varieties
	11	0	0	0	100	400	600	33.3%	overcast and rainy
	12	50	50	45	5	675	675	0.0%	Avoid rainy weather early in the harvest
	13	30	30	0	70	550	625	12.0%	overcast and rainy
	14	40	40	0	60	333.5	600	44.4%	overcast and rainy
	15	50	50	0	50	333.5	600	44.4%	overcast and rainy
Mean		45	45	7	48	498	622	19.9%	
	1	20	20	0	80	435	585	25.6%	overcast and rainy
	2	100	100	0	0	635	500	-27.0%	Avoid rainy weather early in the harvest
	3	100	100	0	0	550	550	0.0%	Avoid rainy weather early in the harvest
Zhishu	4	100	100	0	0	500	550	9.1%	Over-application of N fertilizer
	5	100	100	0	0	550	650	15.4%	wind and rainy, Over-application of N fertilizer
	6	40	40	60	0	500	650	23.1%	overcast and rainy
	7	70	70	20	10	500	650	23.1%	overcast and rainy
Mean		76	76	11	13	524	591	11.2%	
Total	80	49	49	8	43	515	637	0.19	

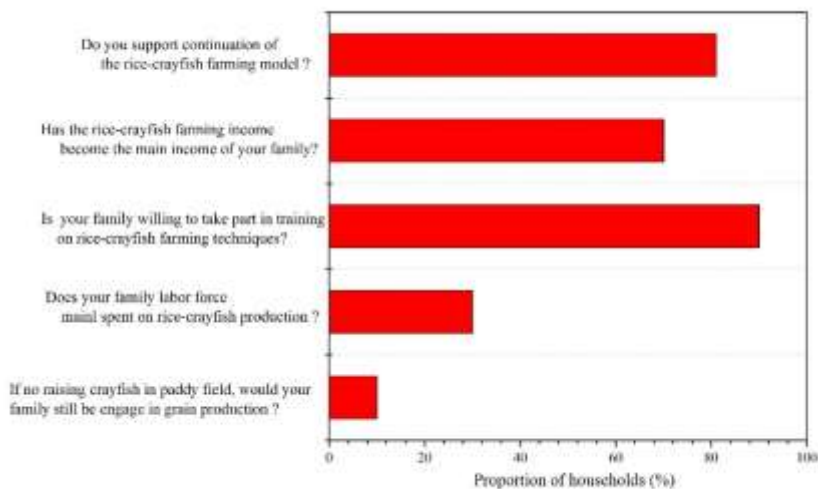


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16 Appendix C. Histogram of the area distribution frequency of rice-crayfish fields of farmers in
17 different geographical environments: (a) Plain-lake areas; (b) Hilly areas.

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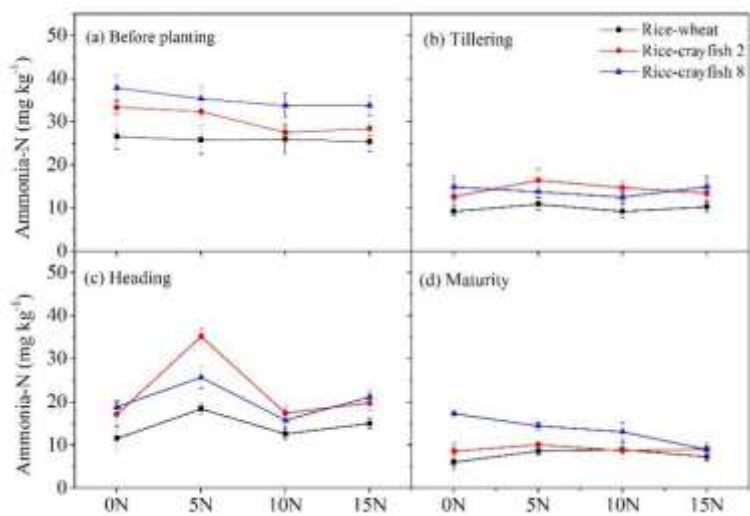


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Appendix D. Percentage of participating households that answered “yes” ($n = 100$)

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Appendix E. Nitrate and ammonium nitrogen contents in the soil during the rice-growing period with different nitrogen fertilizers in 2017

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