

Statistical analysis to test differences between the Socio-hydrological spaces (SHS)

1. Source of flooding

H₀: Is there a significant difference in sources of flooding by the socio-hydrological spaces?

To test the above hypothesis, we performed Chi-square tests. We find that there is a statistically significant difference in sources of flooding between the different socio-hydrological spaces. SHS1 is significantly more often flooded from other rivers and excessive rainfall than SHS2, while SHS2 is significantly more often flooded from the Jamuna River. SHS3 is significantly more often flooded from other rivers than SHS2, while SHS2 is significantly more often flooded from the Jamuna River. SHS1 is significantly more often flooded from excessive rainfall than SHS3, while SHS3 is significantly more often flooded from the Jamuna River. Detail analysis are shown below.

Observed	Socio-hydrological spaces		
Sources	SHS1	SHS2	Total
Jamuna	233	298	531
Non-Jamuna	53	0	53
Total	286	298	584
Expected	Socio-hydrological spaces		
Sources	SHS1	SHS2	Total
Jamuna	260.04	270.96	531
Non-Jamuna	25.96	27.04	53
Total	286	298	584
p =		6.53E-15	

Observed	Socio-hydrological spaces		
Sources	SHS1	SHS3	Total
Jamuna	233	267	500
Non-Jamuna	53	12	65
Total	286	279	565
Expected	Socio-hydrological spaces		
Sources	SHS1	SHS3	Total
Jamuna	253.10	246.90	500
Non-Jamuna	32.90	32.10	65
Total	286	279	565
p =		1.16E-07	

Observed	Socio-hydrological spaces		
Sources	SHS2	SHS3	Total
Jamuna	298	267	565
Non-Jamuna	0	12	12
Total	298	279	577
Expected	Socio-hydrological spaces		
Sources	SHS2	SHS3	Total
Jamuna	291.80	273.20	565
Non-Jamuna	6.20	5.80	12
Total	298	279	577
p =		2.97E-04	

Observed	Socio-hydrological spaces		
Sources	SHS1	SHS2	Total
Excessive rainfall	28	0	28
Non-Excessive rainfall	258	298	556
Total	286	298	584
Expected	Socio-hydrological spaces		
Sources	SHS1	SHS2	Total
Excessive rainfall	13.71	14.29	28
Non-Excessive rainfall	272.29	283.71	556
Total	286	298	584
p =		3.10E-08	

Observed	Socio-hydrological spaces		
Sources	SHS1	SHS3	Total
Excessive rainfall	28	2	30
Non-Excessive rainfall	258	277	535
Total	286	279	565
Expected	Socio-hydrological spaces		
Sources	SHS1	SHS3	Total
Excessive rainfall	15.19	14.81	30
Non-Excessive rainfall	270.81	264.19	535
Total	286	279	565
p =		1.52E-06	

Observed	Socio-hydrological spaces		
Sources	SHS2	SHS3	Total
Excessive rainfall	0	2	2
Non-Excessive rainfall	298	277	575
Total	298	279	577
Expected			
Sources	SHS2	SHS3	Total
Excessive rainfall	1.03	0.97	2
Non-Excessive rainfall	296.97	278.03	575
Total	298	279	577
p =	0.14316		

Observed	Socio-hydrological spaces		
Sources	SHS1	SHS2	Total
Other rivers	120	0	120
Non-other rivers	166	298	464
Total	286	298	584
Expected			
Sources	SHS1	SHS2	Total
Other rivers	58.77	61.23	120
Non-other rivers	227.23	236.77	464
Total	286	298	584
p =	4.25E-36		

Observed	Socio-hydrological spaces		
Sources	SHS2	SHS3	Total
Other rivers	0	106	106
Non-other rivers	298	173	471
Total	298	279	577
Expected			
Sources	SHS2	SHS3	Total
Other rivers	54.75	51.25	106
Non-other rivers	243.25	227.75	471
Total	298	279	577
p =	5.13E-32		

Observed	Socio-hydrological spaces		
Sources	SHS1	SHS3	Total
Other rivers	120	106	226
Non-other rivers	166	173	339
Total	286	279	565
Expected			
Sources	SHS1	SHS3	Total
Other rivers	114.40	111.60	226
Non-other rivers	171.60	167.40	339
Total	286	279	565
p =	0.33611		

2. Flood occurrence

H₀: Is there a significant difference in flood occurrences between the socio-hydrological spaces?

To test the above hypothesis, we performed Chi-square tests. We find that there is a statistically significant difference in number of floods between the socio-hydrological spaces. There is no significant difference in number of floods between SHS1 and SHS3. Detail analysis are shown below.

Observed	Socio-hydrological spaces		
Occurrences	SHS1	SHS2	Total
Flooded	33	54	87
Non-flooded	21	0	21
Total	54	54	108
Expected	Socio-hydrological spaces		
Sources	SHS1	SHS2	Total
Flooded	43.50	43.50	87
Non-flooded	10.50	10.50	21
Total	54	54	108
p = 3.29E-07			

Observed	Socio-hydrological spaces		
Occurrences	SHS1	SHS3	Total
Flooded	33	30	63
Non-flooded	21	24	45
Total	54	54	108
Expected	Socio-hydrological spaces		
Sources	SHS1	SHS3	Total
Flooded	31.50	31.50	63
Non-flooded	22.50	22.50	45
Total	54	54	108
p = 0.558185			

Observed	Socio-hydrological spaces		
Occurrences	SHS2	SHS3	Total
Flooded	54	30	84
Non-flooded	0	24	24
Total	54	54	108
Expected	Socio-hydrological spaces		
Sources	SHS2	SHS3	Total
Flooded	42.00	42.00	84
Non-flooded	12.00	12.00	24
Total	54	54	108
p = 2.78E-08			

3. Average flood damage

H₀: Is there a significant difference in average flood damages between the hydrological spaces?

To test the above hypothesis, we use a single-factor analysis of variance (ANOVA). We find that there is no statistically significant difference in average flood damages between the socio-hydrological spaces (with $\alpha=0.05$). Detail analysis is shown below.

Anova: Single Factor						
SUMMARY						
Groups	Count	Sum	Average	Variance		
SHS1	286	165244.7	577.7786	432246.2		
SHS2	298	172707.1	579.554	432091		
SHS3	279	140711	504.3406	475834.1		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1043972	2	521986	1.169631	0.310975	3.006192
Within Groups	3.84E+08	860	446282.6			
Total	3.85E+08	862				

4. Experienced with river bank erosion

H₀: Is there a significant difference in experience with river bank erosion between the Socio-hydrological spaces?

To test the above hypothesis, we performed Chi-square tests. We find that there is a statistically significant difference in experience with river bank erosion between the socio-hydrological spaces. Detail analysis are shown below.

Observed	Socio-hydrological spaces		
Erosion	SHS1	SHS2	Total
Eroded	44	243	287
Non-eroded	242	55	297
Total	286	298	584
Expected	Socio-hydrological spaces		
Erosion	SHS1	SHS2	Total
Eroded	140.55	146.45	287
Non-eroded	145.45	151.55	297
Total	286	298	584
p = 1.57E-57			

Observed	Socio-hydrological spaces		
Erosion	SHS1	SHS3	Total
Eroded	44	142	186
Non-eroded	242	137	379
Total	286	279	565
Expected	Socio-hydrological spaces		
Erosion	SHS1	SHS3	Total
Eroded	94.15	91.85	186
Non-eroded	191.85	187.15	379
Total	286	279	565
p = 2.69E-19			

Observed	Socio-hydrological spaces		
Erosion	SHS2	SHS3	Total
Eroded	243	142	385
Non-eroded	55	137	192
Total	298	279	577
Expected	Socio-hydrological spaces		
Erosion	SHS2	SHS3	Total
Eroded	198.84	186.16	385
Non-eroded	99.16	92.84	192
Total	298	279	577
p = 5.83E-15			

5. Average total wealth and income

H₀: Is there a significant difference in average total wealth between the socio-hydrological spaces?

To test the above hypothesis, we use a single-factor analysis of variance (ANOVA). We find that there exists a statistically significant difference in average total wealth between the socio-hydrological spaces (with $\alpha=0.05$). Detail analysis is shown below.

Anova: Single Factor

SUMMARY

Groups	Count	Sum	Average	Variance
SHS1	286	9863089	34486.32	2.05E+09
SHS2	298	1782068	5980.095	98264341
SHS3	279	4923220	17645.95	6.4E+08

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.19584E+11	2	5.98E+10	64.99275	5.18E-27	3.006192
Within Groups	7.91183E+11	860	9.2E+08			
Total	9.10767E+11	862				

H₀: Is there a significant difference in average annual income in between the socio-hydrological spaces?

To test the above hypothesis, we use a single-factor analysis of variance (ANOVA). We find that there exists a statistically significant difference in average annual income between the socio-hydrological spaces (with $\alpha=0.05$). Detail analysis is shown below.

Anova: Single Factor						
SUMMARY						
Groups	Count	Sum	Average	Variance		
SHS1	286	361806.3	1265.057	539348.3		
SHS2	298	289100	970.1342	345594.9		
SHS3	279	345125	1237.007	3666301		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	15524131	2	7762066	5.233178	0.005508	3.006192
Within Groups	1.28E+09	860	1483241			
Total	1.29E+09	862				

6. Migration

H₀: Is there a significant difference in migration/relocation between the socio-hydrological spaces?

To test the above hypothesis, we performed Chi-square tests. We find that there is a statistically significant difference in migration/relocation between the socio-hydrological spaces. Detail analysis are shown below.

Observed	Socio-hydrological spaces		
Migration	SHS1	SHS2	Total
Migrated	71	238	309
Non-migrated	215	60	275
Total	286	298	584
Expected	Socio-hydrological spaces		
Erosion	SHS1	SHS2	Total
Eroded	151.33	157.67	309
Non-eroded	134.67	140.33	275
Total	286	298	584
p = 1.75E-40			

Observed	Socio-hydrological spaces		
Migration	SHS1	SHS3	Total
Migrated	71	116	187
Non-migrated	215	163	378
Total	286	279	565
Expected	Socio-hydrological spaces		
Erosion	SHS1	SHS3	Total
Eroded	94.66	92.34	187
Non-eroded	191.34	186.66	378
Total	286	279	565
p = 2.33E-05			

Observed	Socio-hydrological spaces		
Migration	SHS2	SHS3	Total
Migrated	238	116	354
Non-migrated	60	163	223
Total	298	279	577
Expected	Socio-hydrological spaces		
Erosion	SHS2	SHS3	Total
Eroded	182.83	171.17	354
Non-eroded	115.17	107.83	223
Total	298	279	577
p = 3.77E-21			

7. Homestead types

H₀: Is there a significant difference between the homestead types?

To test the above hypothesis, we performed Chi-square tests. We find that there are significantly more houses made of brick and tin and well-constructed buildings using modern masonry materials in SHS1, than the two other spaces. SHS2 has significantly more houses made of straw, while SHS3 has significantly less houses made of earthen floor, wood, paddy straw and bamboo mats. Detail analysis are shown below.

Observed	Socio-hydrological spaces		
Homestead types	SHS1	SHS2	Total
Earthen	219	226	445
Non-earthen	67	72	139
Total	286	298	584
Expected	Socio-hydrological spaces		
Homestead types	SHS1	SHS2	Total
Earthen	217.93	227.07	445
Non-earthen	68.07	70.93	139
Total	286	298	584
p = 0.834952			

Observed	Socio-hydrological spaces		
Homestead types	SHS1	SHS3	Total
Earthen	219	247	466
Non-earthen	67	32	99
Total	286	279	565
Expected	Socio-hydrological spaces		
Homestead types	SHS1	SHS3	Total
Earthen	235.89	230.11	466
Non-earthen	50.11	48.89	99
Total	286	279	565
p = 0.000186			

Observed	Socio-hydrological spaces		
Homestead types	SHS2	SHS3	Total
Earthen	226	247	473
Non-earthen	72	32	104
Total	298	279	577
Expected	Socio-hydrological spaces		
Homestead types	SHS2	SHS3	Total
Earthen	244.29	228.71	473
Non-earthen	53.71	50.29	104
Total	298	279	577
p = 7.39E-05			

Observed	Socio-hydrological spaces		
Homestead types	SHS1	SHS2	Total
Well-constructed	7	0	7
Non-well-constructed	279	298	577
Total	286	298	584
Expected	Socio-hydrological spaces		
Homestead types	SHS1	SHS2	Total
Well-constructed	3.43	3.57	7
Non-well-constructed	282.57	294.43	577
Total	286	298	584
p = 0.006587			

Observed	Socio-hydrological spaces		
Homestead types	SHS1	SHS3	Total
Well-constructed	7	1	8
Non-well-constructed	279	278	557
Total	286	279	565
Expected	Socio-hydrological spaces		
Homestead types	SHS1	SHS3	Total
Well-constructed	4.05	3.95	8
Non-well-constructed	281.95	275.05	557
Total	286	279	565
p = 0.035609			

Observed	Socio-hydrological spaces		
Homestead types	SHS2	SHS3	Total
Well-constructed	0	1	1
Non-well-constructed	298	278	576
Total	298	279	577

Expected	Socio-hydrological spaces		
Homestead types	SHS2	SHS3	Total
Well-constructed	0.52	0.48	1
Non-well-constructed	297.48	278.52	576
Total	298	279	577

p =	0.300956		
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Observed	Socio-hydrological spaces		
Homestead types	SHS1	SHS2	Total
Straw	25	64	89
Non-straw	261	234	495
Total	286	298	584

Expected	Socio-hydrological spaces		
Homestead types	SHS1	SHS2	Total
Straw	43.59	45.41	89
Non-straw	242.41	252.59	495
Total	286	298	584

p =	1.86E-05		
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Observed	Socio-hydrological spaces		
Homestead types	SHS1	SHS3	Total
Straw	25	27	52
Non-straw	261	252	513
Total	286	279	565

Expected	Socio-hydrological spaces		
Homestead types	SHS1	SHS3	Total
Straw	26.32	25.68	52
Non-straw	259.68	253.32	513
Total	286	279	565

p =	0.700343		
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Observed	Socio-hydrological spaces		
Homestead types	SHS2	SHS3	Total
Straw	64	27	91
Non-straw	234	252	486
Total	298	279	577

Expected	Socio-hydrological spaces		
Homestead types	SHS2	SHS3	Total
Straw	47.00	44.00	91
Non-straw	251.00	235.00	486
Total	298	279	577

p =	0.000102		
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Observed	Socio-hydrological spaces		
Homestead types	SHS1	SHS2	Total
Brick and tin	35	8	43
Non-brick and tin	251	290	541
Total	286	298	584
Expected			
Homestead types	SHS1	SHS2	Total
Brick and tin	21.06	21.94	43
Non-brick and tin	264.94	276.06	541
Total	286	298	584
p =	9.92E-06		

Observed	Socio-hydrological spaces		
Homestead types	SHS1	SHS3	Total
Brick and tin	35	4	39
Non-brick and tin	251	275	526
Total	286	279	565
Expected			
Homestead types	SHS1	SHS3	Total
Brick and tin	19.74	19.26	39
Non-brick and tin	266.26	259.74	526
Total	286	279	565
p =	4.09E-07		

Observed	Socio-hydrological spaces		
Homestead types	SHS2	SHS3	Total
Brick and tin	8	4	12
Non-brick and tin	290	275	565
Total	298	279	577
Expected			
Homestead types	SHS2	SHS3	Total
Brick and tin	6.20	5.80	12
Non-brick and tin	291.80	273.20	565
Total	298	279	577
p =	0.29271		