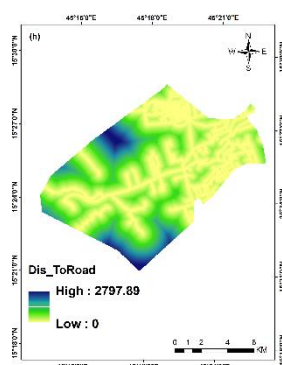
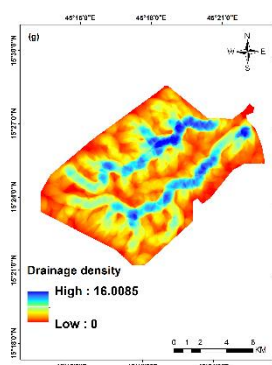
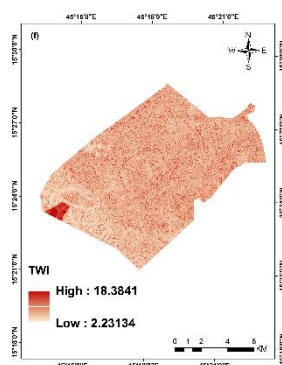
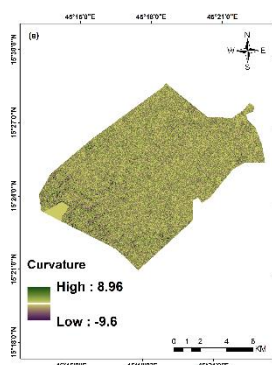
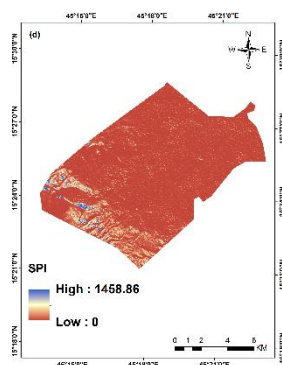
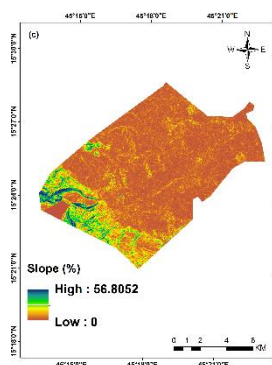
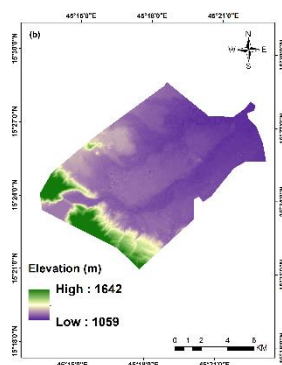
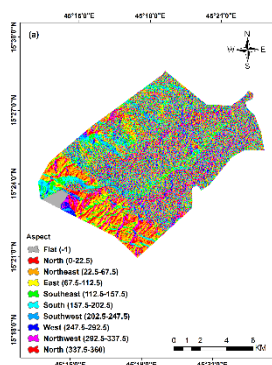


Figure S1. Flow chart for detecting flood areas in study areas using Sentinel-1 data.



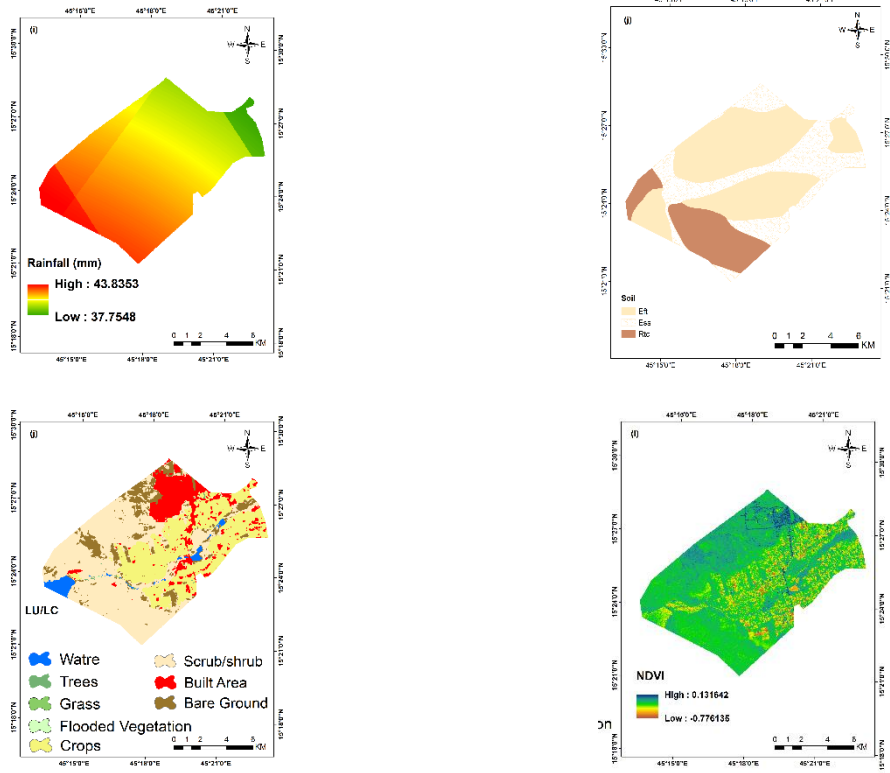


Figure S2. Flood conditioning factors (For Marib city case study). (a) Aspect, (b) elevation, (c) slope, (d) stream power index (SPI), (e) curvature, (f) topographic wetness index (TWI), (g) drainage density (Dd), (h) distance to road, (i) rainfall, (j) soil, (k) land use, and (l) NDVI.

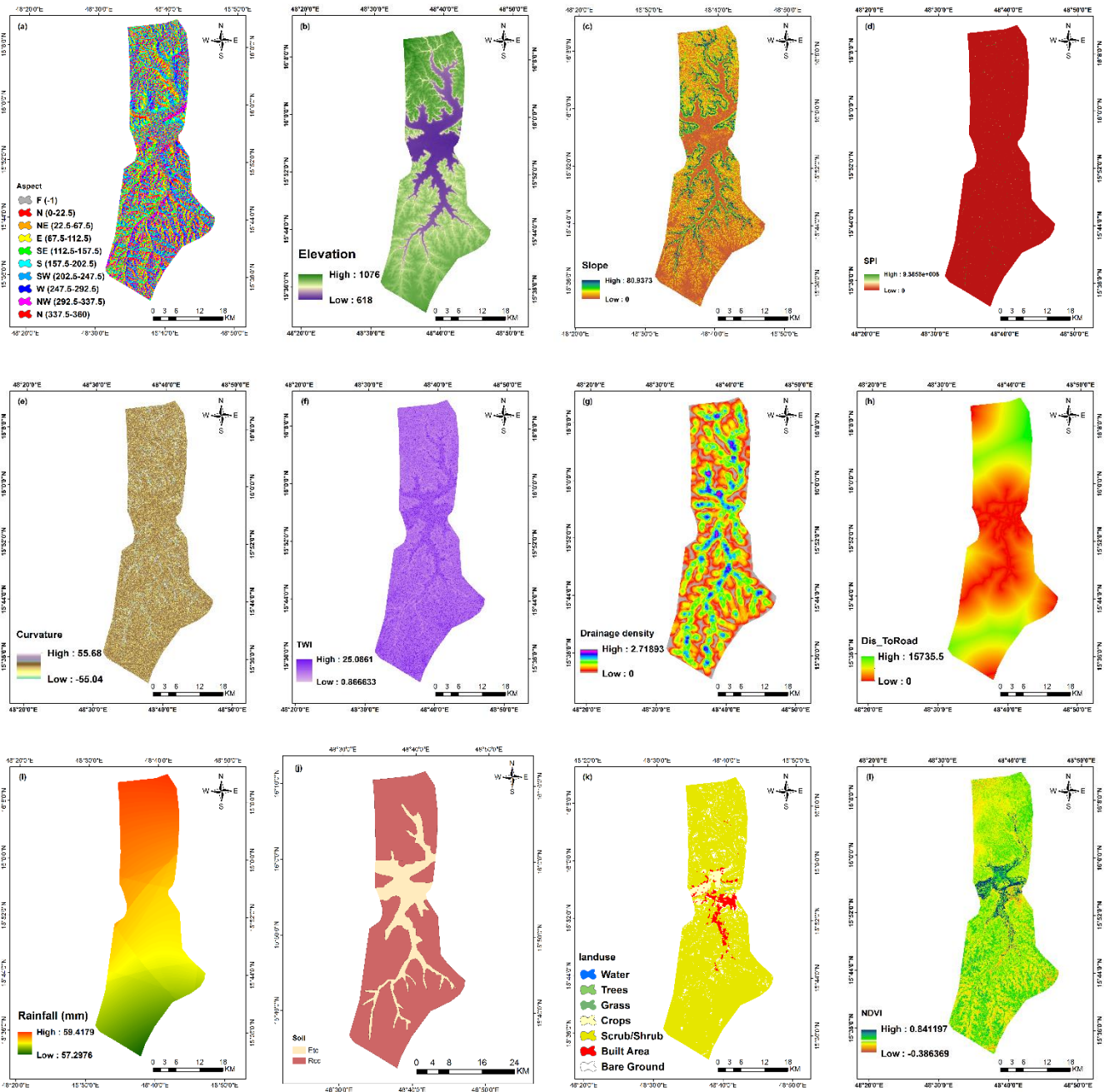


Figure S3. Flood conditioning factors (For Shibam city case study). (a) Aspect, (b) elevation, (c) slope, (d) stream power index (SPI), (e) curvature, (f) topographic wetness index (TWI), (g) drainage density (Dd), (h) distance to road, (i) rainfall, (j) soil, (k) land use, and (l) NDVI.

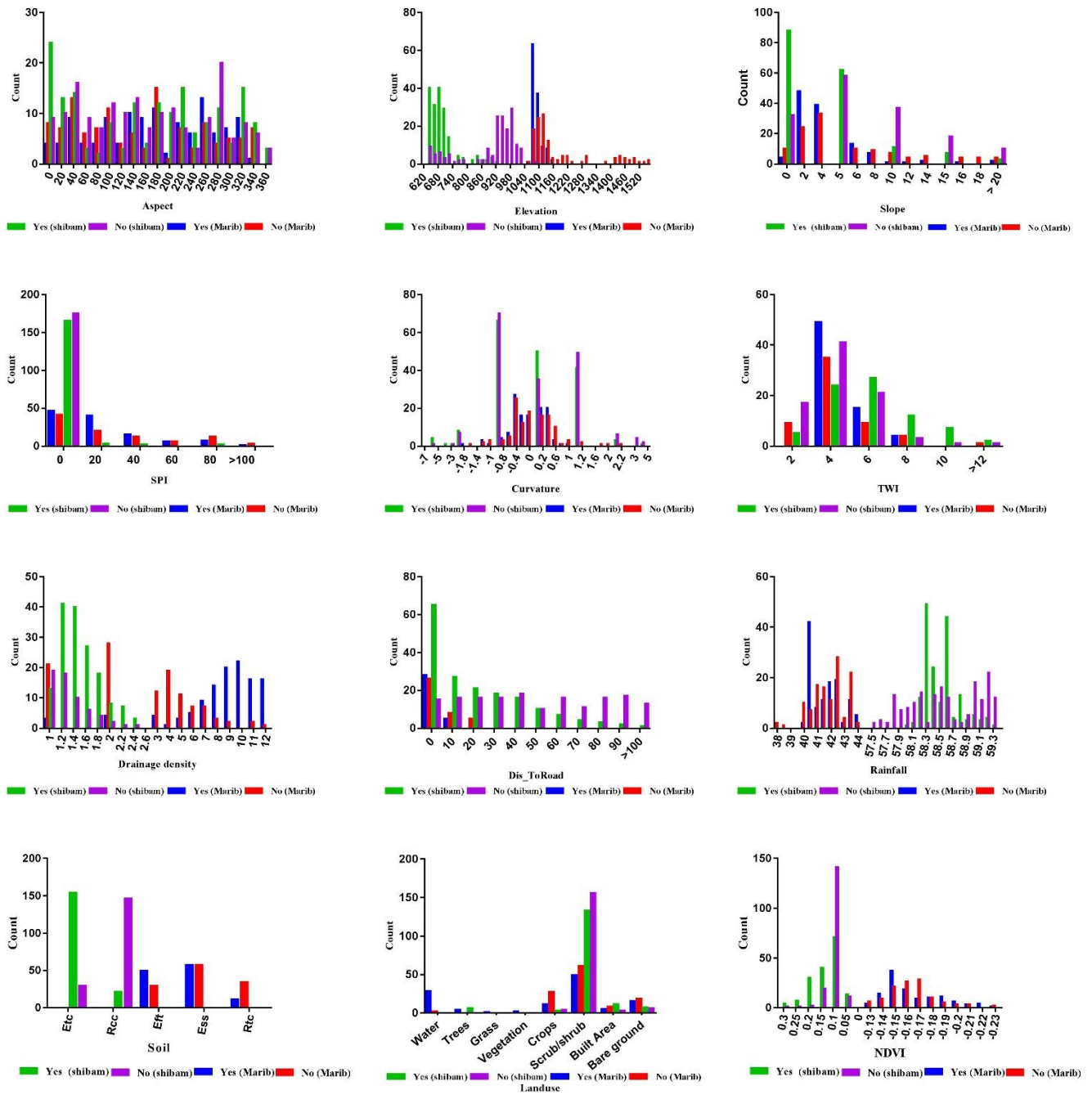


Figure S4. Factors distribution by Floods occurrences

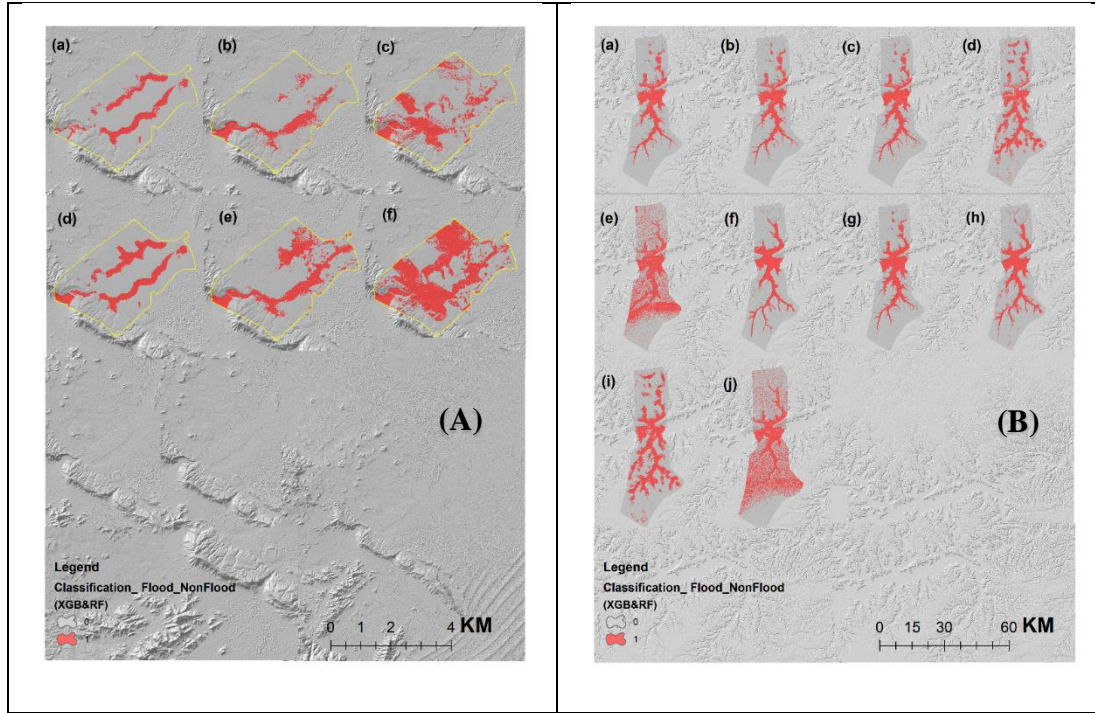


Figure S5. (A) Flood classification maps. For the XGB algorithm: (a) 12 factors, (b) 11 factors, and (c) 10 factors and For the RF algorithm: (d) 12 factors, (e) 11 factors, and (f) 10 factors, for Marib city case study. (B) Flood classification maps. For the XGB algorithm: (a) 12 factors, (b) 11 factors, (c) 10 factors, (d) 9 factors, and (e) 8 factors and For the RF algorithm: (f) 12 factors, (g) 11 factors, (h) 12 factors, (i) 11 factors, and (j) 10 factors, for Shibam city case study.

Table S1. The statistical properties of used data indices for Marib city (mean, min, max and median)

Factors	Class	pixels	min	max	mean	median
Aspect	Flat	75909	47056	106199	77909.4	76927.5
	North	93326				
	Northeast	106199				
	East	84138				
	Southeast	77946				
	South	94573				
	Southwest	68834				
	West	72002				
	Northwest	59111				
	North	47056				
Elevation		280175	6032	301273	79544.2	25415.5
		301273				

		84619				
		30103				
		28257				
		22574				
		20051				
		13038				
		9320				
		6032				
Rainfall		13985	13985	122932	79528.7	89660.5
		25720				
		72454				
		87131				
		92190				
		102298				
		109995				
		122932				
		112476				
		56106				
Landuse	Water	18756	1004	355074	99407.13	45541
	Trees	1604				
	Grass	1004				
	Vegetation	1004				
	Crops	234396				
	Scrub/shrub	355074				
	Built area	111093				
	Bare Ground	72326				
Slope		321280	8056	321280	113634.4	49981
		268816				
		96749				
		49981				
		32382				
		18177				
		8056				
NDVI		28829	28829	411107	159051	122960
		74068				
		158291				
		411107				
		122960				
SPI		571308	5046	571308	159088.2	49810
		152550				
		49810				
		16727				
		5046				
TWI		189251	23368	314189	158997.4	182302
		314189				
		182302				

Drainage density		85877	61195	242694	158597.6	151999
		23368				
		240575				
		242694				
		151999				
Distance to road		96525	47011	360751	159233.6	120147
		61195				
		360751				
		192349				
		120147				
Curvature	Concave	75910	1	473708	265147	321732
		47011				
		321732				
SOIL	Plat	473708	145148	411558	265365.3	239390
	Convex	1				
	Eft (sedimentary soils, dry	239390				
	sedimentary soils, and dry					
	limestone soils)					
	Ess (dry sandy soils)	411558	145148			
	Rtc (Dry soil, Sedimentary soil,	145148				
	dry limestone soils, and shallow					
	soils)					

Table S2.The statistical properties of used data indices for Shibam city (mean, min, max and median)

Factors	Class	pixels	min	max	mean	median
Aspect		159367	94712	159367	124033.1	123752.5
	North	144960				
	Northeast	124799				
	East	138188				
	Southeast	127974				
	South	94712				
	Southwest	108976				
	West	112916				
	Northwest	122706				
	North	105733				
Elevation		148323	39619	274451	124033.1	89453.5
		82046				
		56701				
		39619				
		40668				
		96861				
		274451				
		230894				
		210585				

Rainfall		60183				
		39426	39426	183508	124033	128212
		77765				
		111474				
		139077				
		122753				
		174868				
		133671				
		89963				
		167825				
Landuse		183508				
	Water	1203	1203	1076528	177293.57	41307
	Trees	41307				
	Grass	2459				
	Crops	1076528				
	Scrub/shrub	11677				
	Built area	46219				
Slope	Bare Ground	61662				
		571835	19064	571835	177190	100947
		259181				
		192495				
		100947				
		61774				
		35034				
NDVI		19064				
		409233	6957	661873	248052.2	139616
		661873				
		139616				
SPI		22582				
		6957				
		1238510	36	1238510	248066.2	436
		1209				
		436				
TWI		140				
		36				
		389115	18846	520739	248065.8	226284
		520739				
		226284				
Drainage density		85345				
		18846				
		329908	100063	337699	247921.6	260519
		337699				
Distance to road		260519				
		211419				
		100063				
		386725	79162	386725	248066	252481

		286248				
		252481				
		235714				
		79162				
Curvature	Concave	466526	10159	763645	413443.33	466526
	Plat	763645				
	Convex	10159				
SOIL	Etc (dry soil, dry sedimentary soil, soil dry, and limestone soil)	251801	251801	988530	620165.5	620165.5
	Rcc (dry limestone, soil dry, shallow calcareous soil, and shallow soil)	988530				5

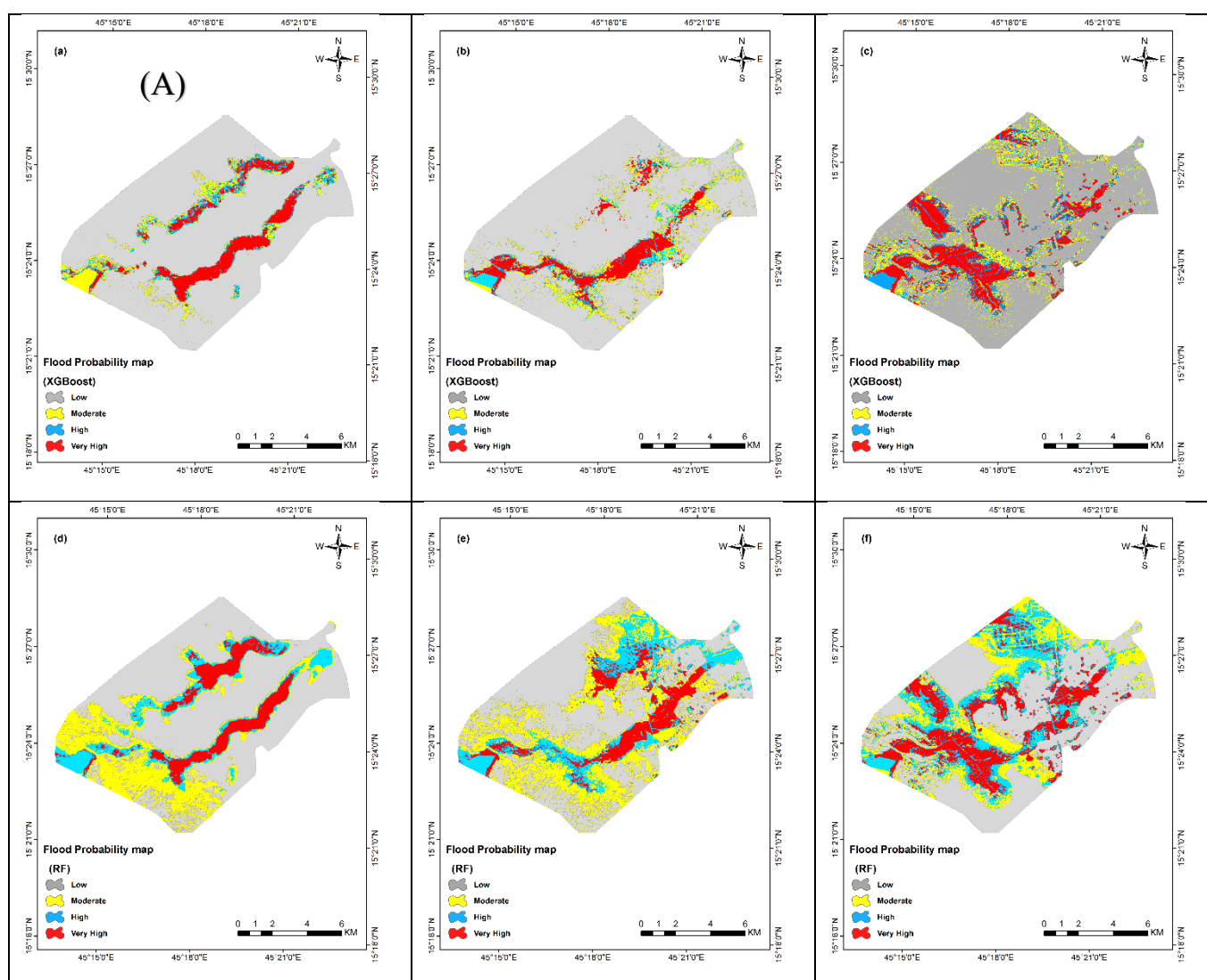


Figure S6. (A) Flood probability maps (For Marib City). For the XGB algorithm: (a) 12 factors, (b) 11 factors, and (c) 10 factors; For the RF algorithm: (d) 12 factors, (e) 11 factors, and (f) 10 factors. (B) Flood probability maps (For Shibam City). For the XGB algorithm: (a) 12 factors, (b) 11 factors, (c) 10 factors, (d) 9 factors, and (e) 8 factors; For the RF algorithm: (f) 12 factors, (g) 11 factors, (h) 10 factors, (i) 9 factors, and (j) 8 factors.

