



akti

REPUBLIKA E SHQIPËRISË

KËSHILLI I MINISTRAVE
AGJENCIA E KËRKIMIT,
TEKNOLOGJISË DHE INOVACIONIT



VLERESIMI I VULNERABILITETIT TE UJRAVE NENTOKESORE – MENYRE EFIKASE PER MBROJTJEN E TYRE NGA NDOTJET

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VULNERABILITETI I UJRAVE NENTOKESORE?

Prirja dhe mundësia e ndotesave për të arritur pasqyren e ujrave nentokesore pas hyrjes së tyre në sipërfaqen e tokës.

Groundwater vulnerability is a measure of how easy or how hard it is for pollution or contamination at the land surface to reach a production aquifer.

Si përcaktohet ai?

Vulnerabiliteti i ujrave nentokesore përcaktohet si një komponent i veçantë në kontekstin e modelit RREZIK-RRUGE KALIMI-KAPES i cili përdoret në punimet e vlersimit të riskut:



Faktoret Kryesore te Vulnerabilitetit

- 1. Thellesia e ujrave nentokesore (trashesia e zone se pangopur):***
- 2. Norma mesatare e ngarkimit (ushqimit)***
- 3. Fluksi i ujerave nentokesore***
- 4. Temperatura e ujit dhe shkembinjve***
- 5. Kapaciteti Zbutes i Impaktit te Ndotjes***

Vleresimi i Vulnerabilitetit

Tre metodat te vleresimit te vulnerabilitetit te ujrave nentokesore jane:

- *Modelet statistikore*
- *Modelet e simulimit te bazuar ne proces*
- *Modelet e indeksit dhe mbivendosjes*

DRASTIC:

- *Depth to water = Niveli i ujrave nentokesore*
- *Net Recharge = Infiltrimi*
- *Aquifer media = Litologjia e akuiferit*
- *Soil media = Toka bujqesore*
- *Topography = Topografia*
- *Impact of Vadose Zone = Zona e pangopur*
- *Hydraulic Conductivity = Koeficienti I filtrimit*

GOD

- ***G***roundwater occurrence
- ***O***verall lithology
- ***D***epth to groundwater

- ***EPIK***, kjo metodë është zhvilluar nga (Buwal, 2000) dhe përdoret kryesisht për zona karstike.
 - Development of the ***E***pikarst,
 - Effectiveness of the ***P***rotective cover
 - Conditions of ***I***nfiltration
 - Development of the ***K***arst network
- ***COP***, kjo metodë është zhvilluar nga grupi punues COST620
 - ***C***oncentration of flow
 - ***O***verlying layers and
 - ***P***recipitation.

Metodologjia e punës

1. Mbledhja e te dhenave

2. Perpunimi i hartave

2.a. Skanimi i hartave topografike

2.b. Gjeoreferencimi + Dixhitalizimi (kthimi raster – vektoriale)

2.b. Krijimi i tabeles se attributeve

3. Analizimi i te dhenave

3.a. Llogaritja e Indeksit **DRASTIK**

- Percaktimi i rendesise relative (peshes – weight) se cdo parametri

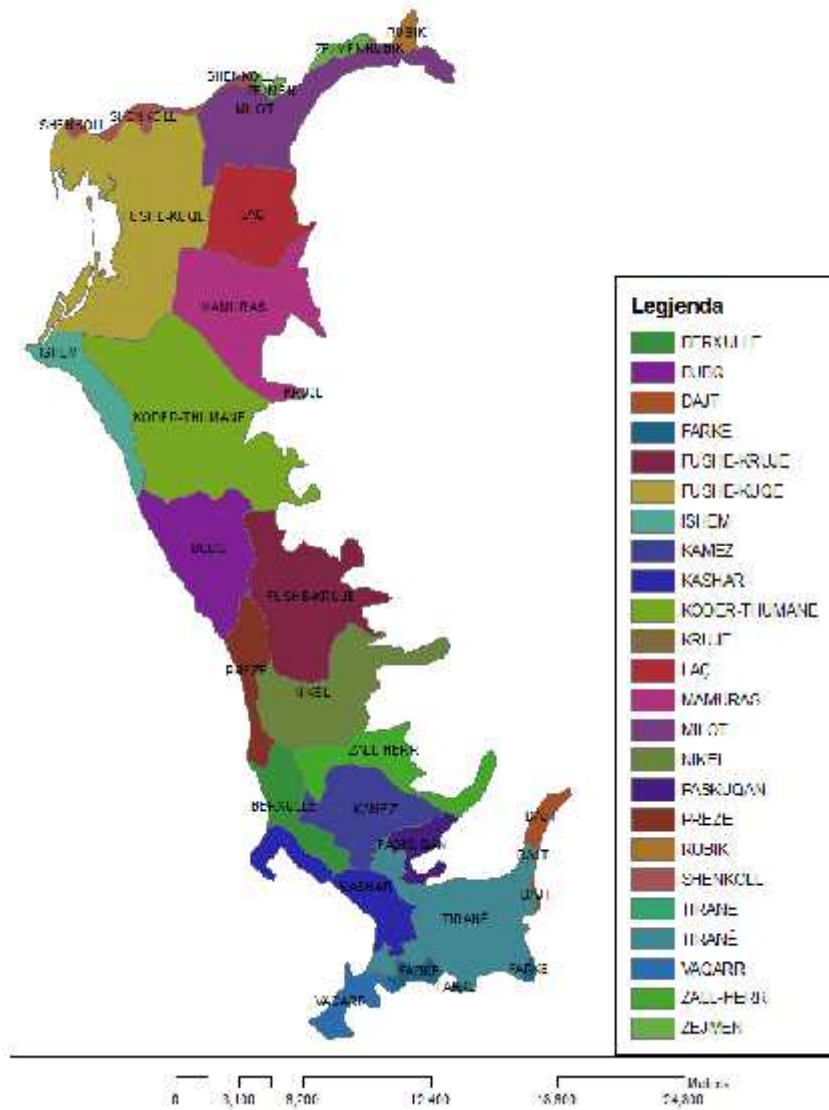
- Percaktimi i intervaleve (range) dhe kategorive (rating) per cdo parameter

3.b. Punimi ne Arc GIS - Ndertimi i Hartave te shkallezuara

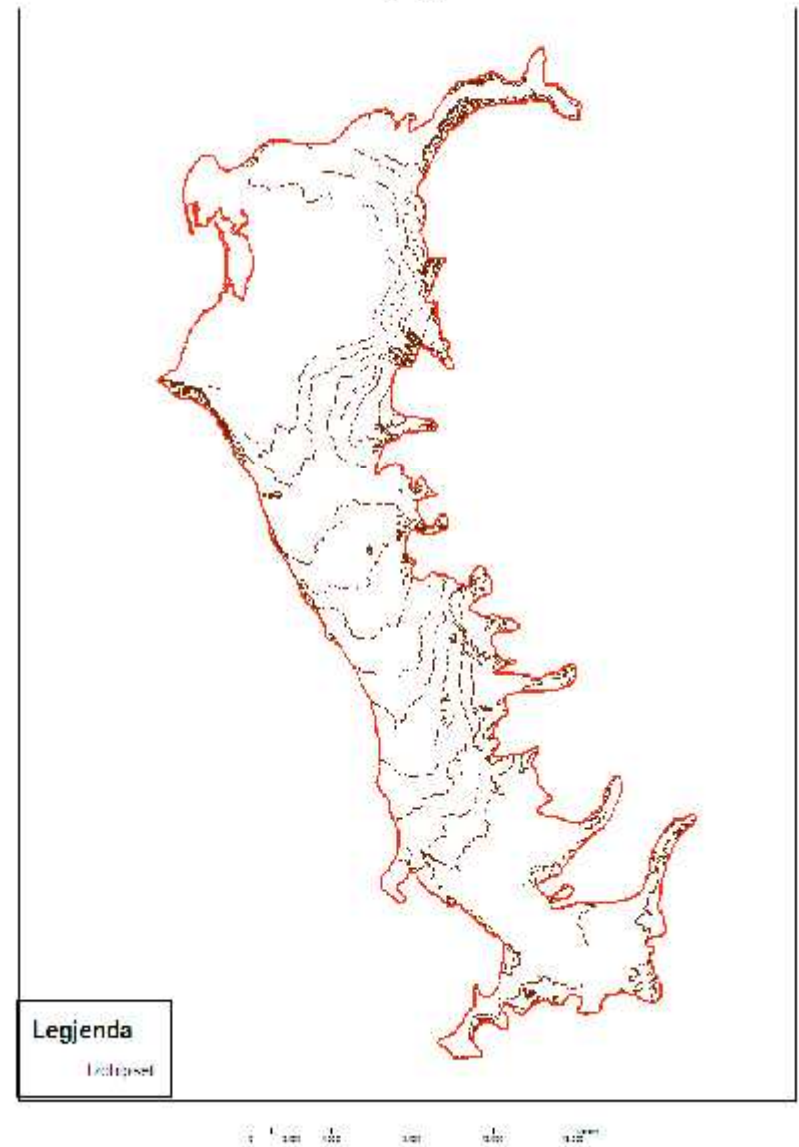
3.c. Analiza e ndjeshmerise se metodes **DRASTIK**

Baseni i Tiranes

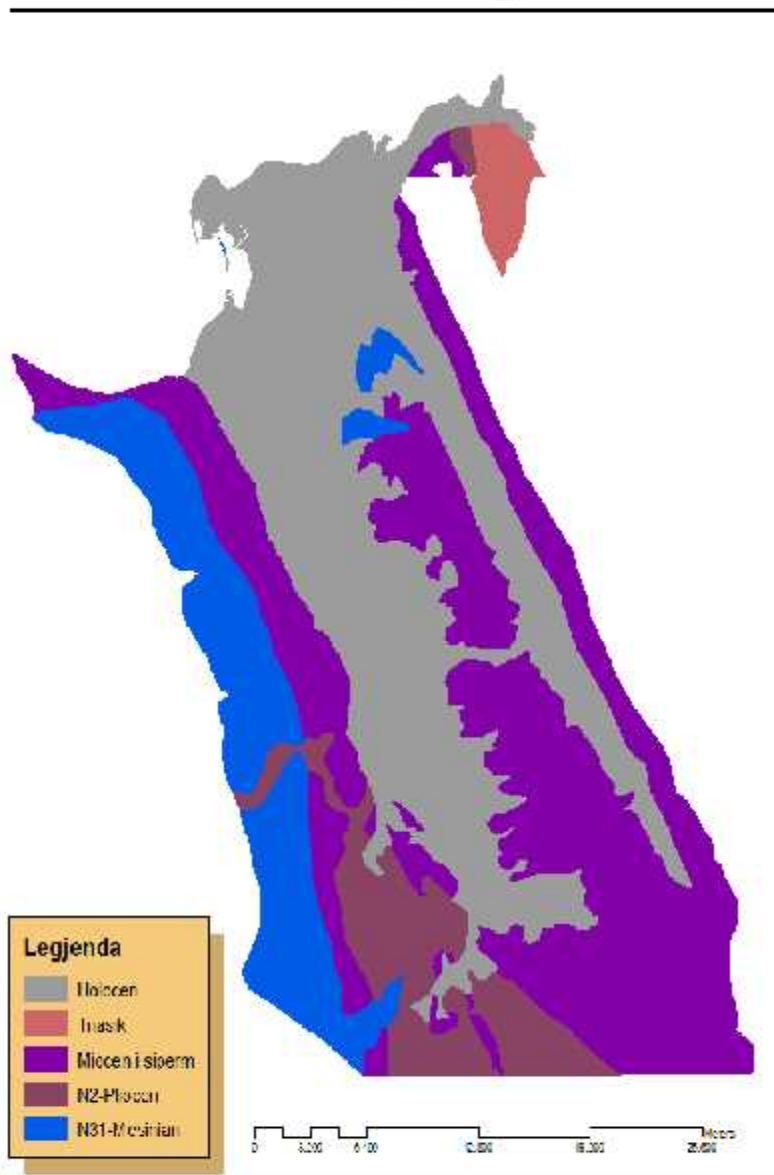
Harta Administrative



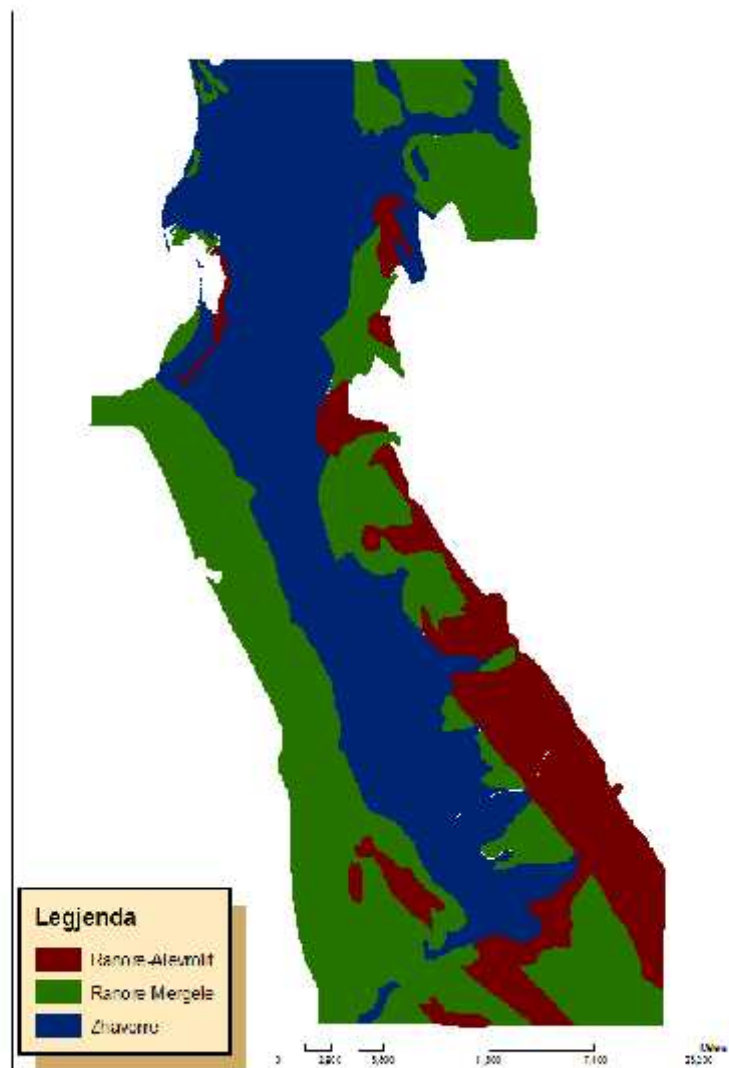
Harta Topografike



Harta Gjeologjike



Harta Hidrogjeologjike



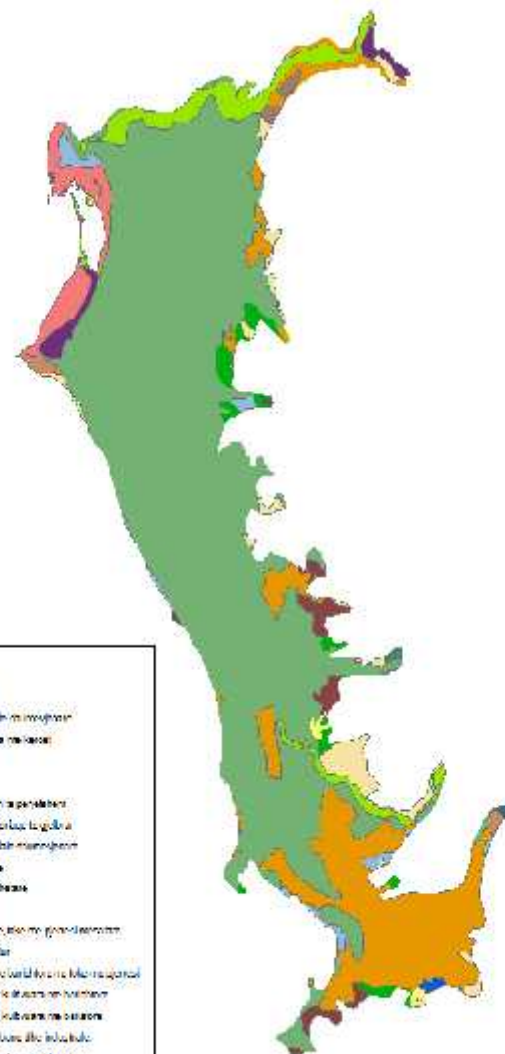
Harta e Rrjetit Hidrografik



Legjenda

- K.f.f. zone
- Kana
- Lume
- Hemua

Harta e Perdorit te Tokes



Legjenda

- Bukure
- Rritje rrethim me rrethim
- Ura e rrethim me rrethim
- Ura e rrethim me rrethim
- Krye
- Me pastrim e perdetim
- Pastrim me rrethim me rrethim
- Pastrim me rrethim me rrethim
- Hemua rrethim
- Hemua rrethim
- Pje rrethim
- Pje rrethim me rrethim me rrethim
- Ura e rrethim
- Rrethim me rrethim me rrethim me rrethim
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0 1000 2000 3000 4000 Metra

Tabela e materialit faktik

Nr.Shpimit	Niveli			Litologjia	Toka bujqesore	Topografia	Zona e pangopur	Koeficienti I filtrimit
	Pizometrik DrDw	Infiltrimi RrRw	ArAw					
318	15	50	Zh_kokerrtrashe	Lym rorer	2-4	Alevrit	50	
176	14	40	Zh_kokerrtrashe	Lym rorer	2-4	Rere pluhurore_alevrit	200	
193	24	30	Zh_kokerrtrashe	Lym rorer	2-4	Alevrit	200	
200	26	30	Zh_kokerrtrashe	Lym pluhuror	0-2	Suargjile rerore	200	
120	38	5	Zh_kokerrmesem	Lym argjilor	0-2	Suargjile	200	
121	37	5	Zh_kokerrmesem	Lym pluhuror	0-2	Suargjile	200	
196	36	5	Zh_kokerrmesem	Lym pluhuror	0-2	Suargjile rerore	200	
177	43	4	Zh_kokerrvogel	Lym argjilor	0-2	Suargjile	200	
275	40	4	Zh_kokerrvogel	Lym argjilor	0-2	Suargjile	200	
59	25	30	Zh_kokerrmesem	Lym pluhuror	0-2	Suargjile rerore	100	
330	32	30	Zh_kokerrmesem	Lym pluhuror	0-2	Suargjile rerore	100	
392	65	1	Zh_kokerrmesem	Lym pluhuror	2-4	Suargjile rerore	100	
340	35	5	Zh_kokerrmesem	Lym pluhuror	0-2	Suargjile rerore	200	
341	40	4	Zh_kokerrmesem	Lym argjilor	0-2	Suargjile	150	
344	30	30	Zh_kokerrmesem	Lym pluhuror	0-2	Suargjile rerore	200	
342	36	5	Zh_kokerrmesem	Lym argjilor	0-2	Suargjile	200	
347	25	30	Zh_kokerrmesem	Lym rorer	2-4	Rere pluhurore_alevrit	200	
355	44	4	Zh_kokerrmesem	Lym pluhuror	0-2	Suargjile	200	
345	45	4	Zh_kokerrvogel	Lym argjilor	0-2	Suargjile	50	
418	26	30	Zh_kokerrtrashe	Lym pluhuror	0-2	Alevrit	100	
503	50	2	Zh_kokerrvogel	Lym argjilor	0-2	Suargjile	50	
505	25	30	Zh_kokerrmesem	Lym rorer	2-4	Rere pluhurore_alevrit	50	
388	30	30	Zh_kokerrmesem	Lym pluhuror	0-2	Suargjile rerore	50	
1	25	30	Zh_kokerrmesem	Lym pluhuror	0-2	Suargjile rerore	100	
2	4	200	Zh_kokerrtrashe	e holle	0-2	Rere pluhurore	130	
3	6	200	Zh_kokerrtrashe	Mungon	2-4	Rere pluhurore	130	
51	35	5	Zh_kokerrvogel	Lym pluhuror	0-2	Suargjile rerore	50	
4	25	50	Zh_kokerrmesem	Lym pluhuror	0-2	Suargjile rerore	100	
5	4	500	Zh_kokerrtrashe	Mungon	0-2	Rere pluhurore	130	
6	6	500	Zh_kokerrtrashe	e holle	0-2	Rere pluhurore_alevrit	130	

LLOGARITJA E INDEKSIT DRASTIC

Cdo parametri te indeksit DRASTIC i caktohet nje numer ($w = 1 - 5$) per te treguar rendesine relative te tij ne raport me parametrat e tjere.

Cdo parameter mund te marr 1 deri 10 pike ($r = 1 - 10$), kundrejt variacionit te tij ne nje interval te caktuar.

Indeksi DRASTIC llogaritet si shume e produkteve te peshave dhe klasave per cdo parameter:

$$DI = D_R D_W + R_R R_W + A_R A_W + S_R S_W + T_R T_W + I_R I_W + C_R C_W$$

Pesha e parametrave:

Parametrat	Pesha
Niveli piezometrik	5
Infiltrimi	4
Litologjia e akuiferit	3
Toka buqesore	1
Topografia	2
Zona e pangopur	5
Koeficienti i filtrimit	3

Dhenia e peshes (rendesise) perfaqeson nje perpjekje per te caktuar rendesine relative qe secili faktor ka per te ndikuar ne transportin e ndotesit drejt akuiferit ose brenda tij.

Infiltrimi(mm/vit)

Intervali	Klasa
0-5	1
6-100	3
101-250	6
251-10 ³	8
>10 ³	9

Intervalet dhe Klasat

Topografia(%)

Intervali	Klasa
0-2	10
2-4	9
4-6	5
6-8	3
>8	1

Litologjia

Intervali	Klasa
Zhavorre kokerrtrashe	9
Zhavorre kokerrmesem	7
Zhavorre kokerrvogel	5
Rere kokerrmesem	3
Rere kokerrimet	1

Ndikimi i zones se pangopur

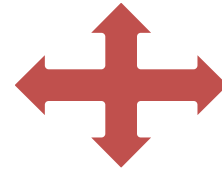
Intervali	Klasa
Mungon	10
Zhavorr+Rere	9
Rere pluhurore	7
Alevrit(pluhur)	5
Suargjile rerore	3
Suargjile	2
Argjile	1

Niveli Pizometrik(m)

Intervali	Klasa
0-2	10
2-5	9
5-10	7
10-15	5
15-30	3
30-45	2
>45	1

Toka bujqesore

Intervali	Klasa
E holle ose mungon	10
Zhavorr	9
Rere	7
Lym reror	5
Lym pluhuror	3
Lym argjilor	1



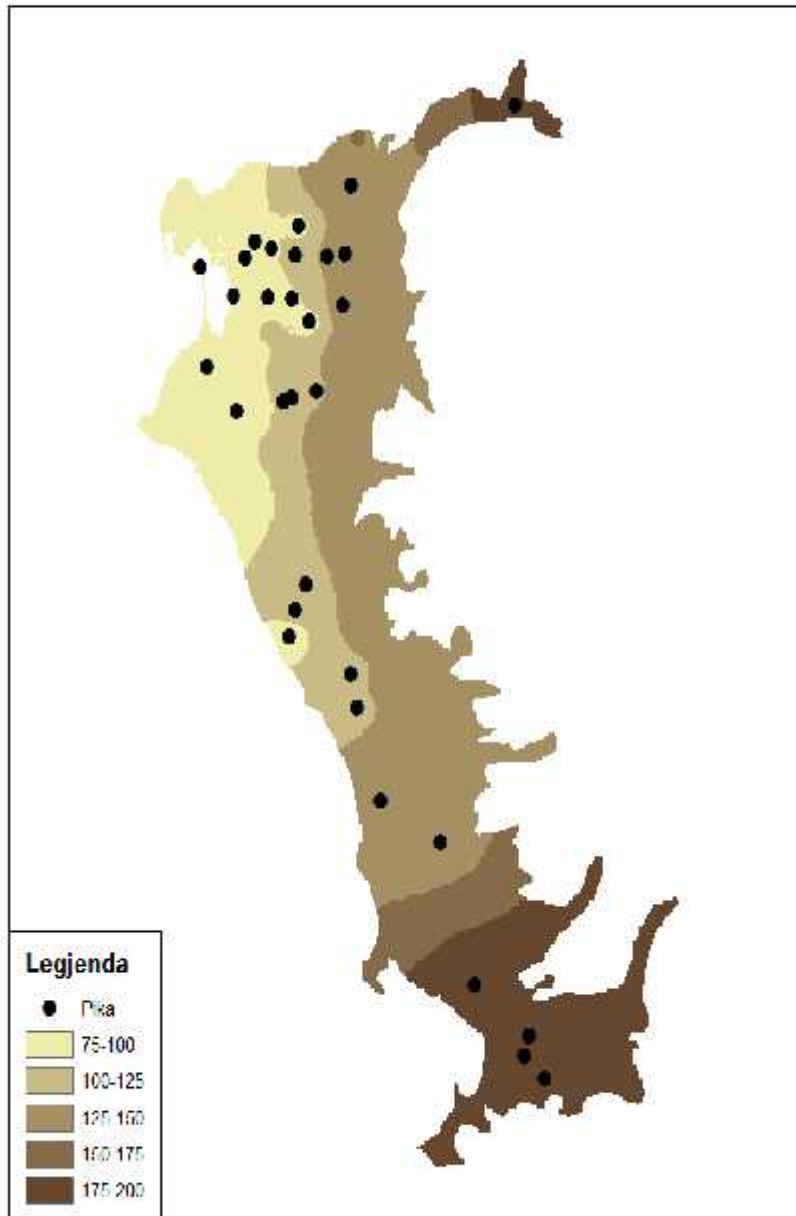
Koeficienti i filtrimit (m/dite)

Intervali	Klasa
0-5	1
5-10	2
15-25	3
25-50	6
50-100	8
>100	10

Tabela e llogaritjeve

Nr.Shpimit	X	Y	Niveli	Infiltrimi	Litologjia	Toka	Topografia	Zona e	Koeficienti I	Koeficienti	
			Pizometrik			bujqesore		pangopur	filtrimit	DRASTIC	
			DrDw	RrRw	ArAw	SrSw	TrTw	Irlw	KrKw	ID	
318	4587250	4394400	25	12	27	5	18	25	18		130
176	4616000	4390000	25	12	27	5	18	25	30		142
193	4613000	4389700	15	12	27	5	18	25	30		132
200	4612900	4388850	15	12	27	3	20	15	30		122
120	4612850	4384800	10	4	21	1	20	10	30		96
121	4611050	4385900	10	4	21	3	20	10	30		98
196	4613250	4386100	10	4	21	3	20	15	30		103
177	4612400	4382600	10	4	15	1	20	10	30		90
275	4611150	4384250	10	4	15	1	20	10	30		90
59	4593100	4390300	15	12	21	3	20	15	24		110
330	4594600	4390000	10	12	21	3	20	15	24		109
392	4596200	4387000	5	4	21	3	18	15	24		90
340	4611000	4387100	10	4	21	3	20	15	30		103
341	4609850	4684950	10	4	21	1	20	10	30		96
344	4612950	4387250	10	12	21	3	20	15	30		111
342	4613500	4385300	10	4	21	1	20	10	30		96
347	4610750	4389600	15	12	21	5	18	25	30		126
355	4614200	4387450	10	4	21	3	20	10	30		98
345	4606100	4384400	10	4	15	1	20	10	18		78
418	4689350	4392000	15	12	27	3	20	25	24		126
503	4608050	4382950	5	4	15	1	20	10	18		73
505	4607000	4388300	15	12	21	5	18	25	18		114
388	4606500	4386700	10	12	21	3	20	15	18		99
1	4500950	4388250	15	12	21	3	20	15	24		110
2	4577900	4398550	45	24	27	10	20	35	30		197
3	4576900	4399500	35	24	27	10	18	35	30		179
51	4606700	4387100	10	4	15	3	20	15	18		83
4	4598550	4387800	15	12	21	3	20	15	24		110
5	4578750	4398750	45	32	27	10	20	35	30		199
6	4581000	4396050	35	32	27	10	20	25	30		179

Harta e Koeficientit DRASTIC



Sa me i larte indeksi DRASTIC, aq me i madh potenciali ndotes.

Indeksi DRASTIC ndahet me tej ne pese kategori: shume i ulet, i ulet, mesatar, i larte dhe shume i larte.

Zonat qe i perkasin kategorive i larte dhe shume i larte jane me vulnerable ndaj ndotjes dhe kerkojne studim dhe vleresim te vecante.

Nje zone me ID te ulet nuk nenkupton qe ajo eshte privuar nga ndotja e ujrave nentokesore, por ajo eshte relativisht me pak e ndikuar (e ndjeshme) nga ndotja.

Z. e Tiranes - Vulnerabilitet shume i larte

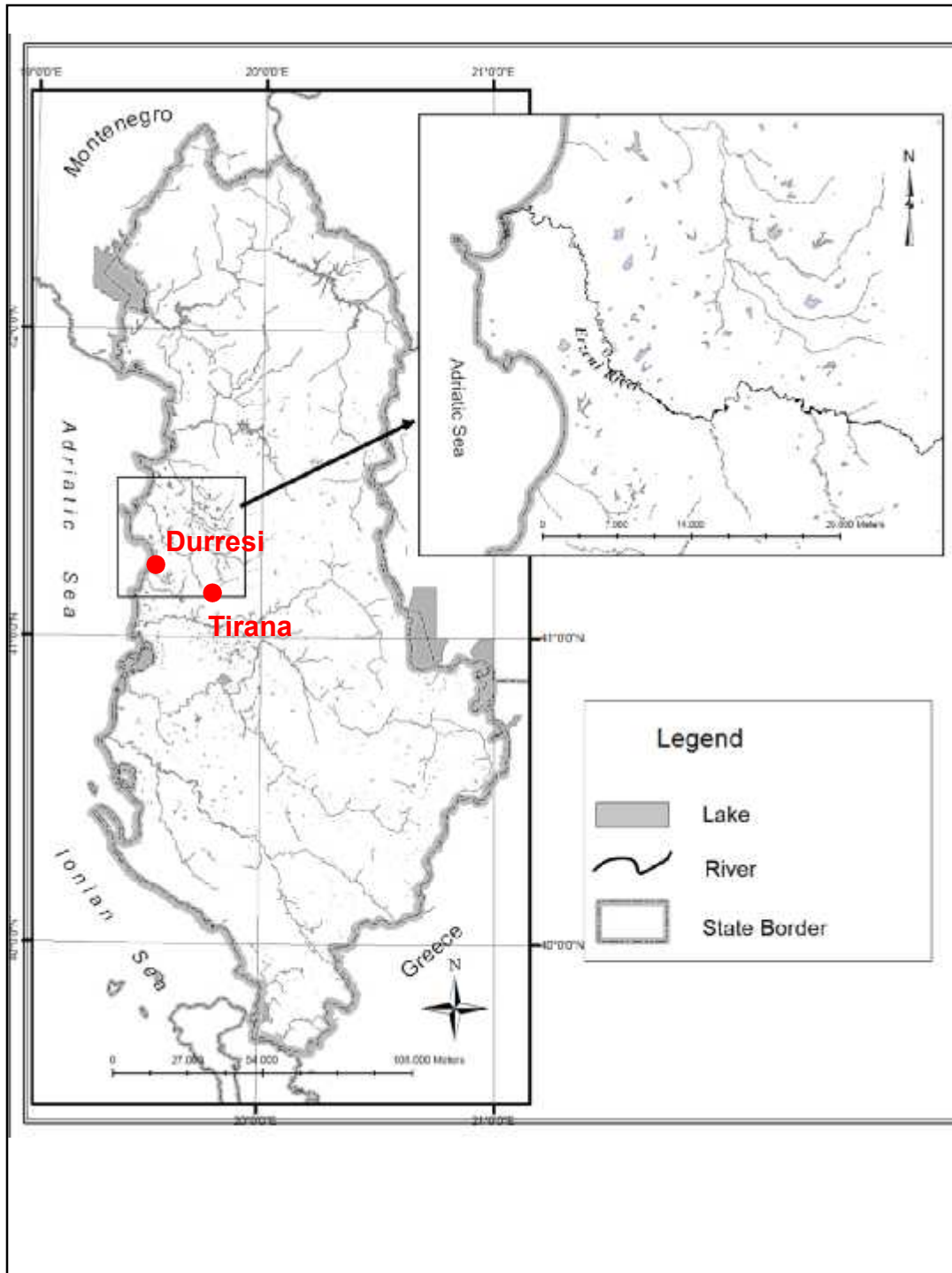
Z. e Laknasit - Vulnerabilitet i larte

**Z. lindore - Rinas - Fushe Kruje -
Vulnerabilitet mesatar**

Z. qendrore - vulnerabilitet i ulet

Z. perendimore - Vulnerabilitet shume i ulet

Baseni i Erzenit

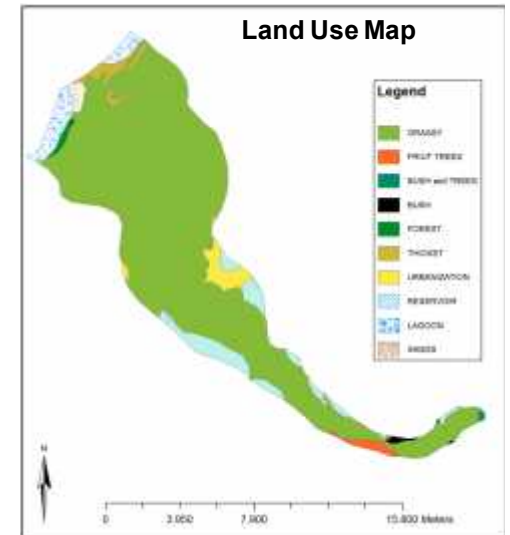
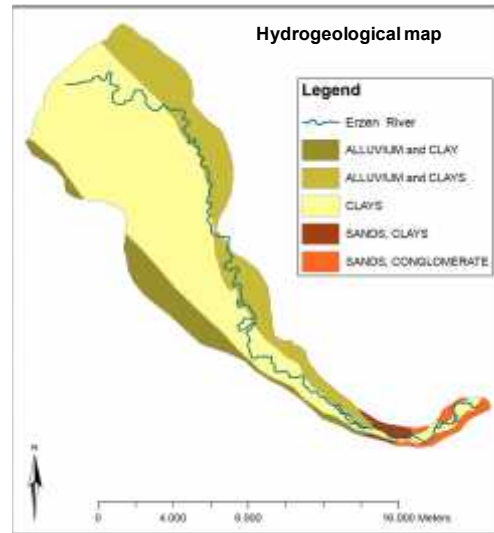
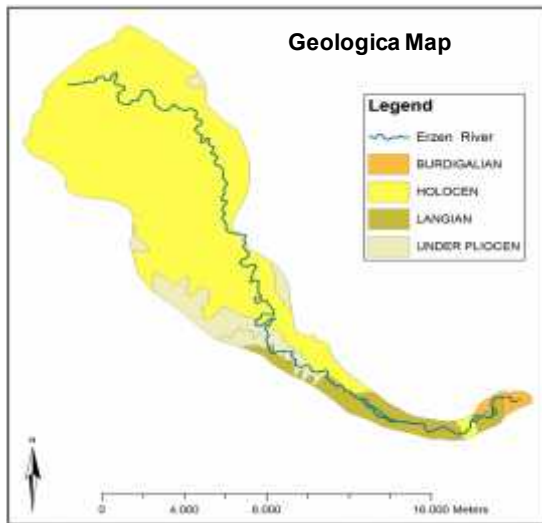


Perkeqesimi i cilesise te UN
per shkak te:

**Shfrytezim intensiv i
inerteve te lumit,**

**Venddepozitime te
mbetjeve urbane**

**Aktivitet bujqesor e
industrial i
konsiderueshem.**



Te dhena gjeologjike e hidrogjeologjike

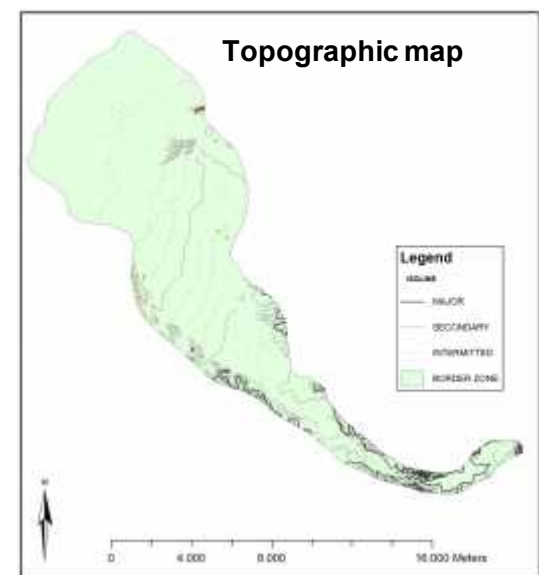
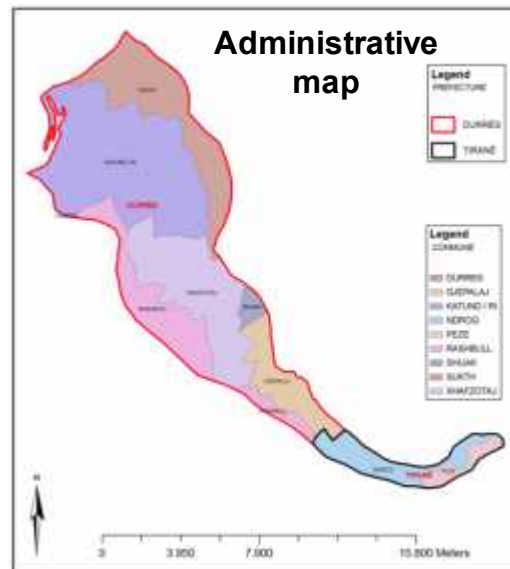
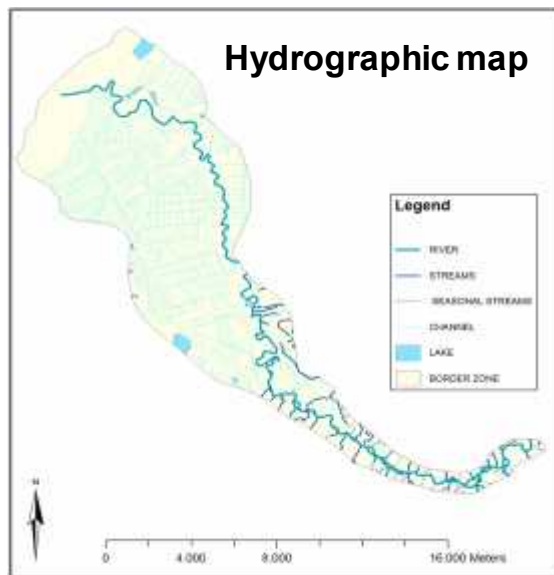
Te dhena mbi token bujqesore

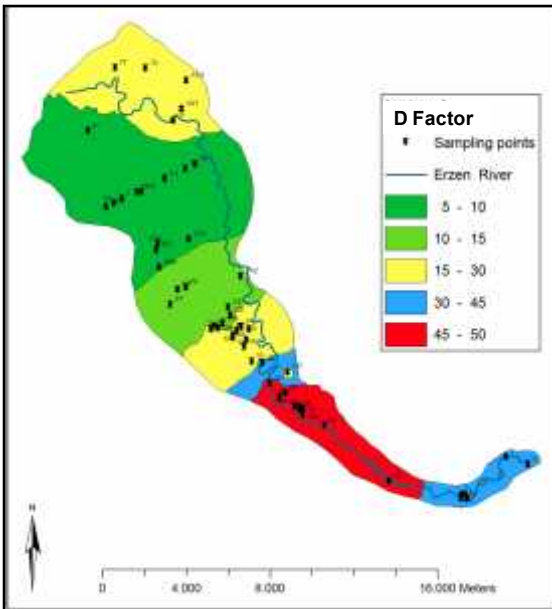
(i) Mbledhja e te dhenave

Te dhena hidrografike

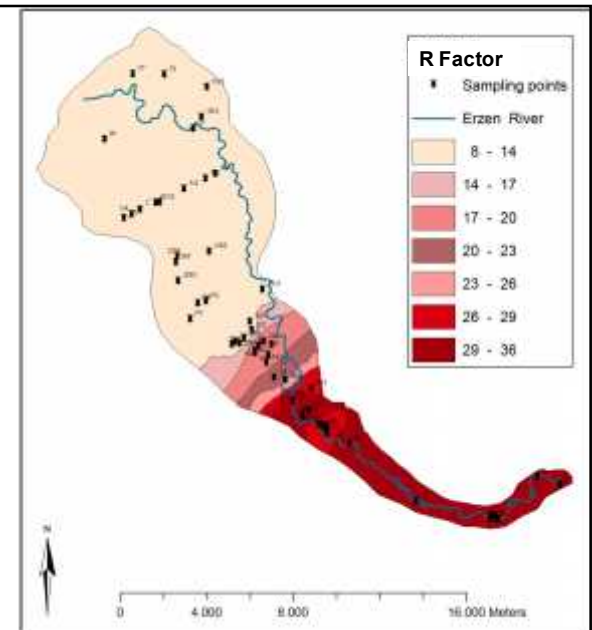
Te dhena administrative

Te dhena topografike

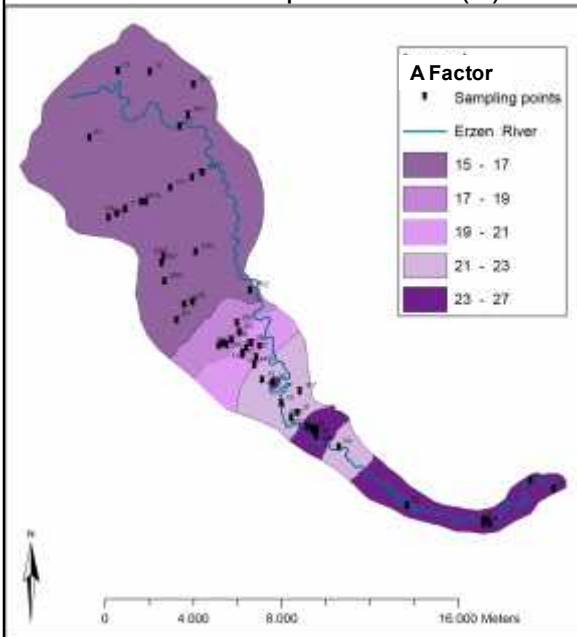




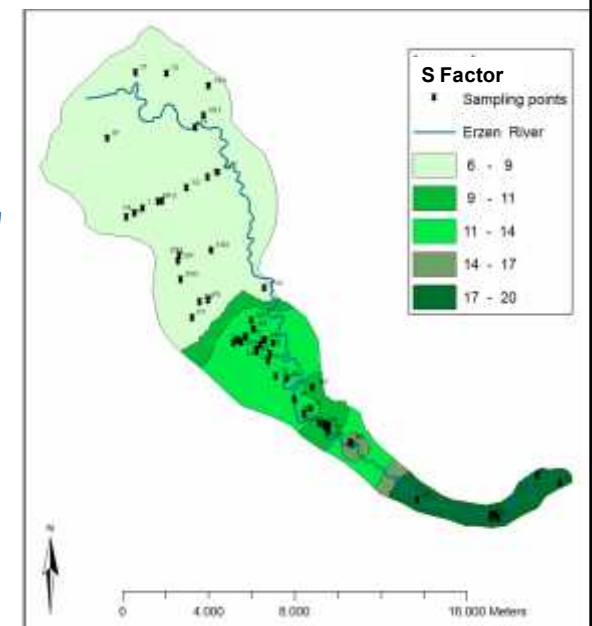
Factor score for depth to water (D)



Factor score for Net Recharge (R)



Factor score for Aquifer media (A)

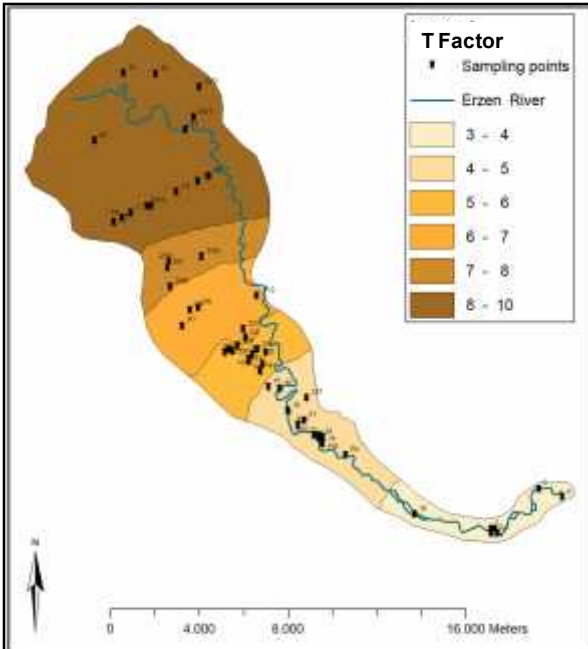


Factor score for Soil media (S)

Harta e shkallezimit te pikeve per faktoret DRASTIC

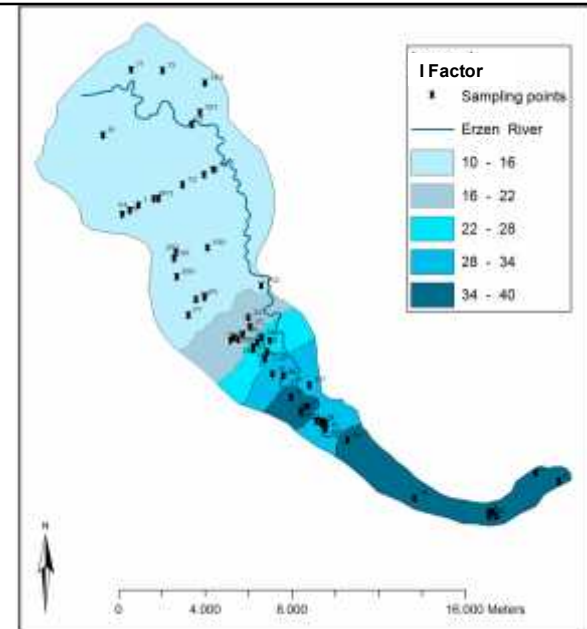
$$DI = DR * DW + RR * RW + AR * AW + SR * SW + TR * TW + IR * IW + CR * CW$$

By means of factor score maps we assess the influence of each parameter to groundwater vulnerability by a **number**.



Factor score for Topography (T)

Higher the number of each parameter – higher its influence to the vulnerability

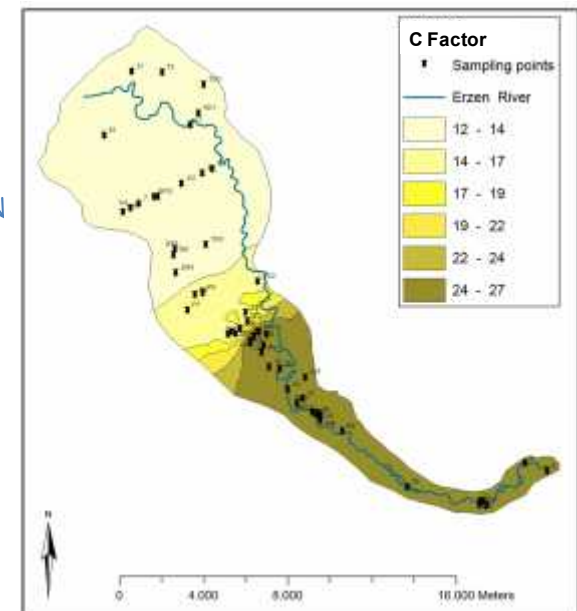


Factor score for Impact of vadose zone (I)

$$DI = DR * DW + RR * RW + AR * AW + SR * SW + TR * TW + IR * IW + CR * CW$$

Factor score for hydraulic Conductivity (C)

The highest numbers correspond to the worst conditions of the aquifer for a given parameter, with respect to its vulnerability to contamination.



$$DI = DR*DW + RR*RW + AR*AW + SR*SW + TR*TW + IR*IW + CR*CW$$

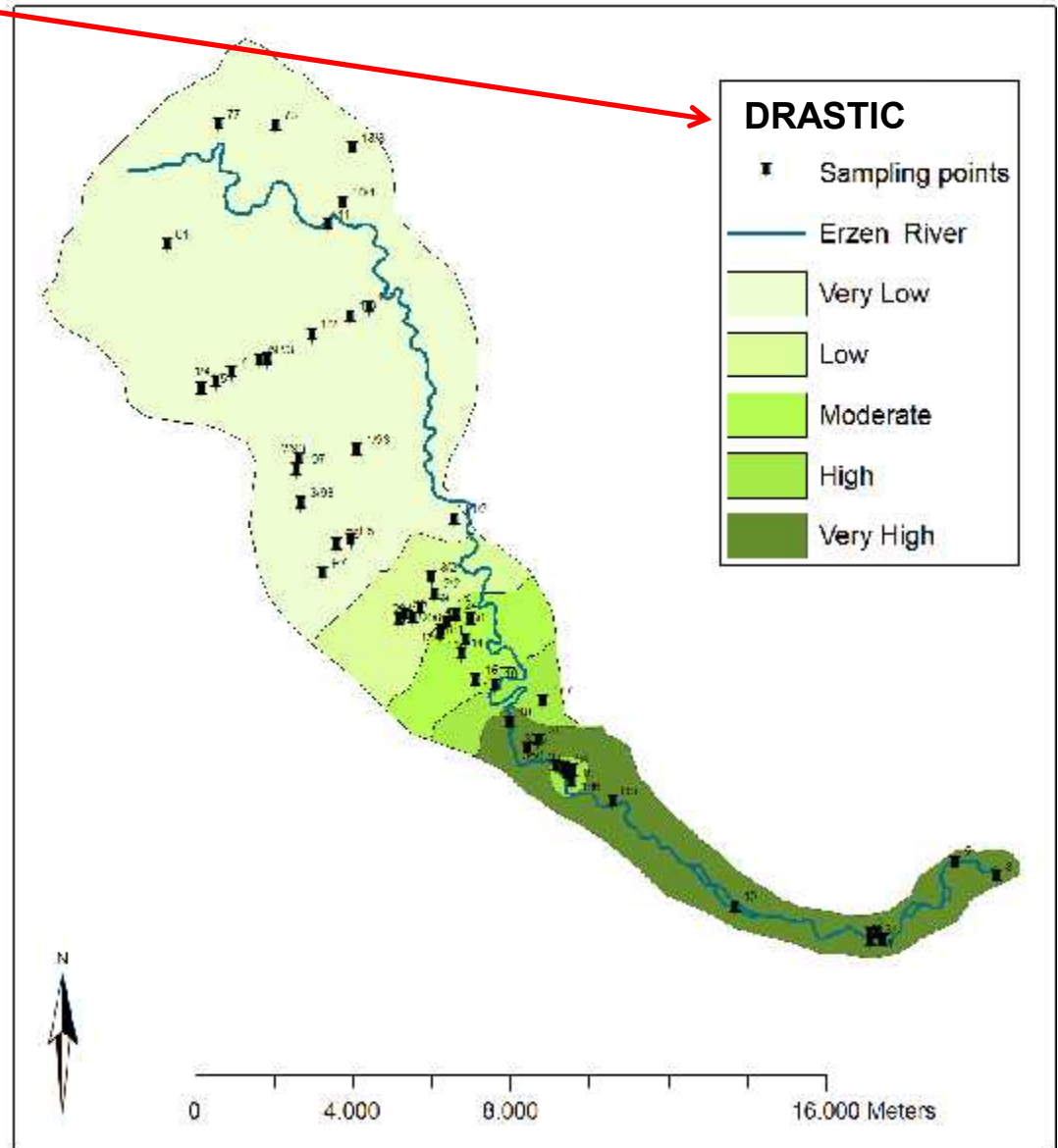
(iiii) Final step is the production of the Graduated Map for Drastic Index (vulnerability map).

20% - very highly vulnerable

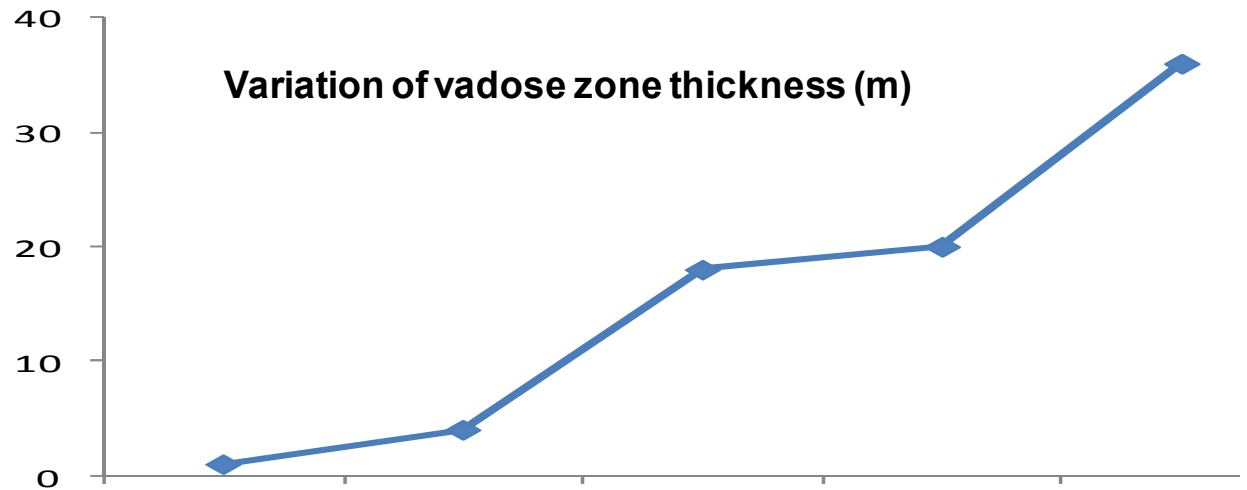
5% - highly vulnerable

15% - vulnerable at moderate to low levels

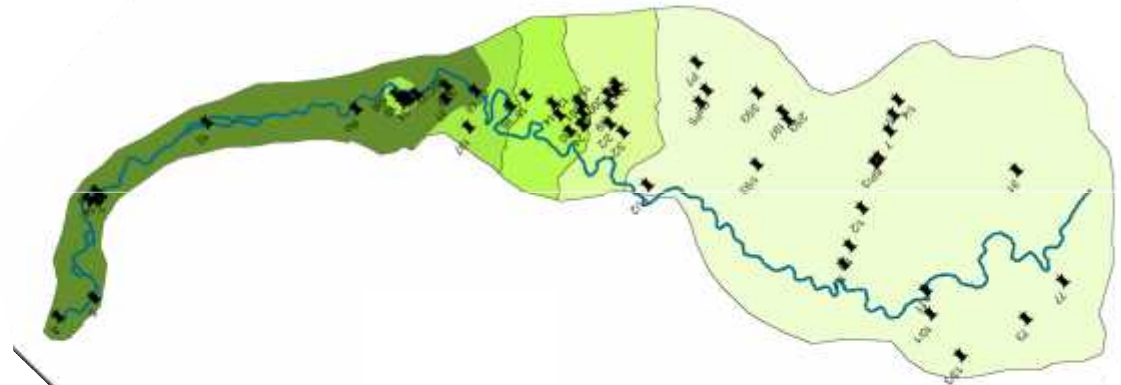
around 60% - very low vulnerable



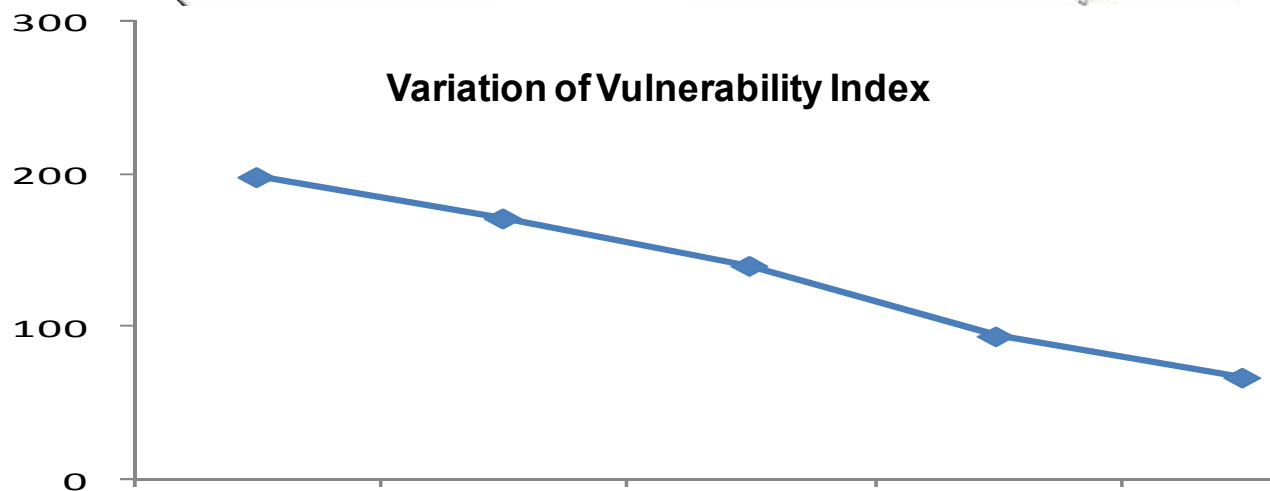
What is the meaning of the aquifer vulnerability map?

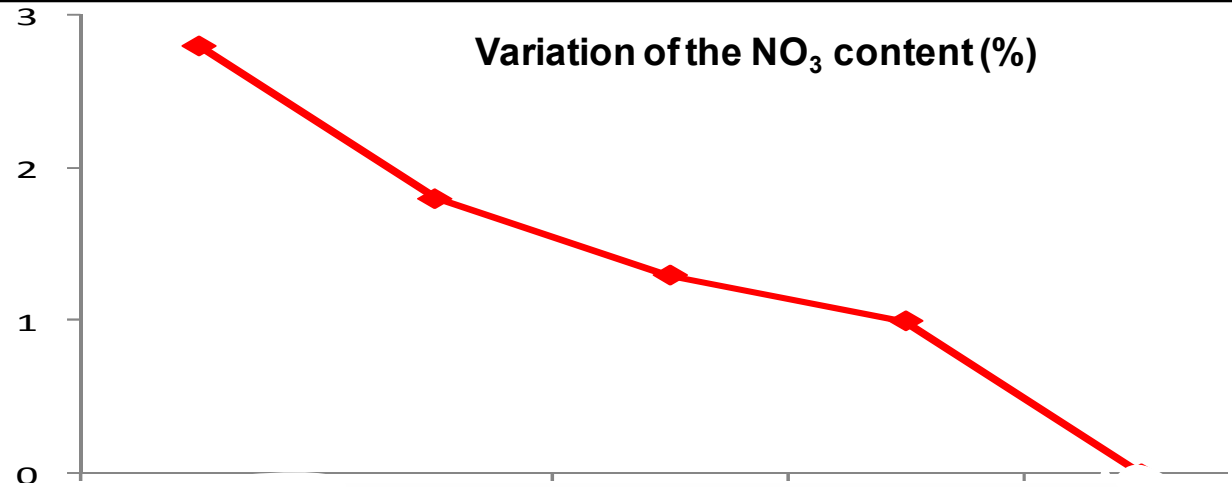


The lowest vulnerable areas are located in the northwestern sectors where a thick (20-30m) vadose zone with a well developed soil cover are present.

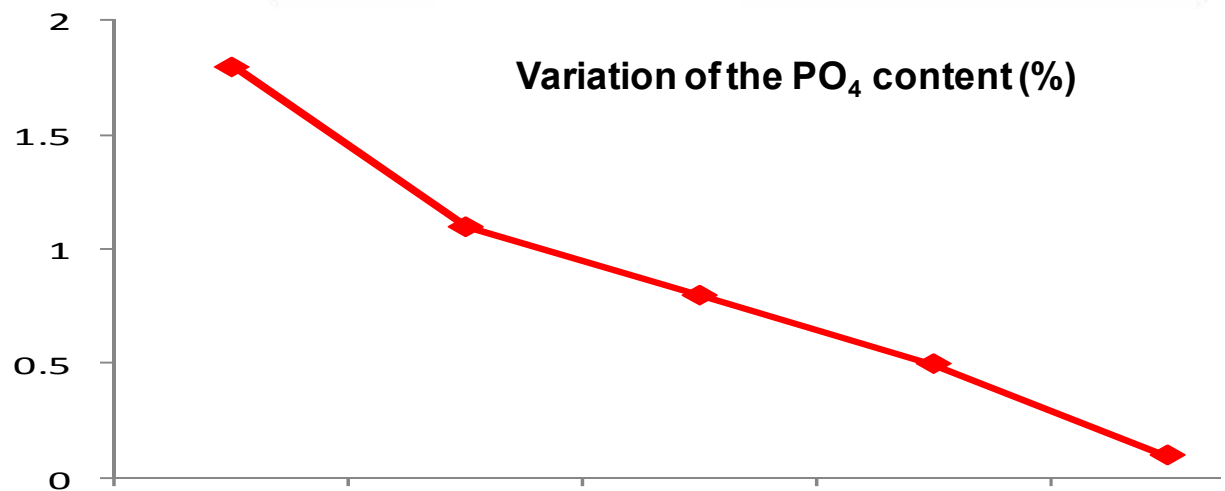
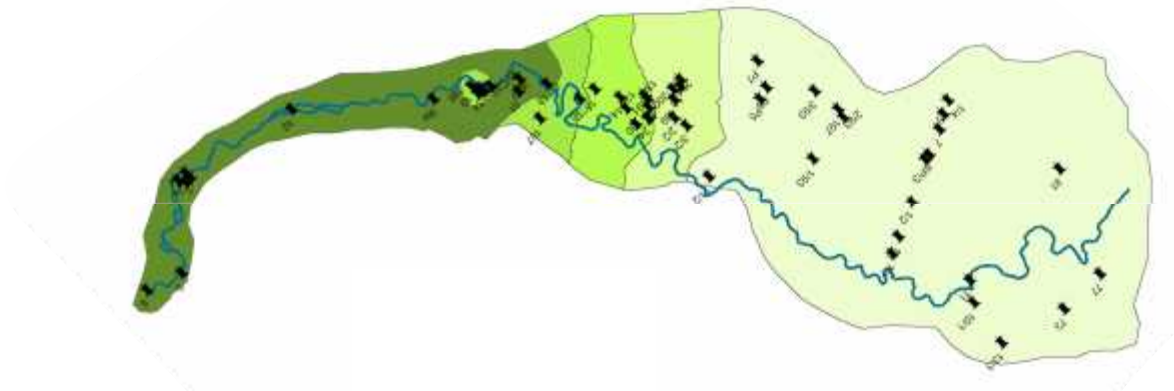


The most vulnerable areas of the aquifer are located in the southeast area of the basin where the soil cover and/or vadose zone are absent or very thin.



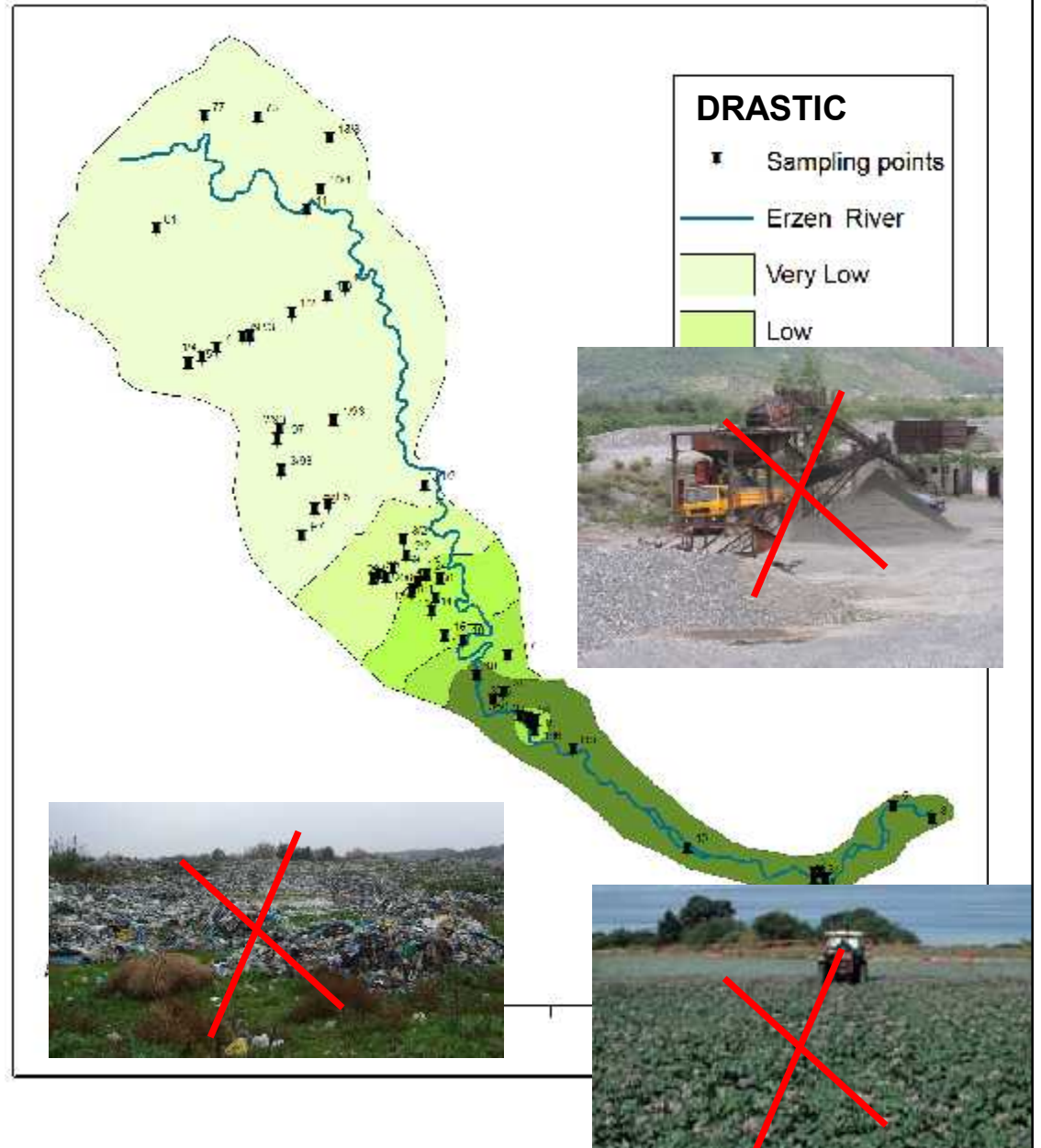


The configuration of the vulnerability map fit very well with the data of the qualitative monitoring.



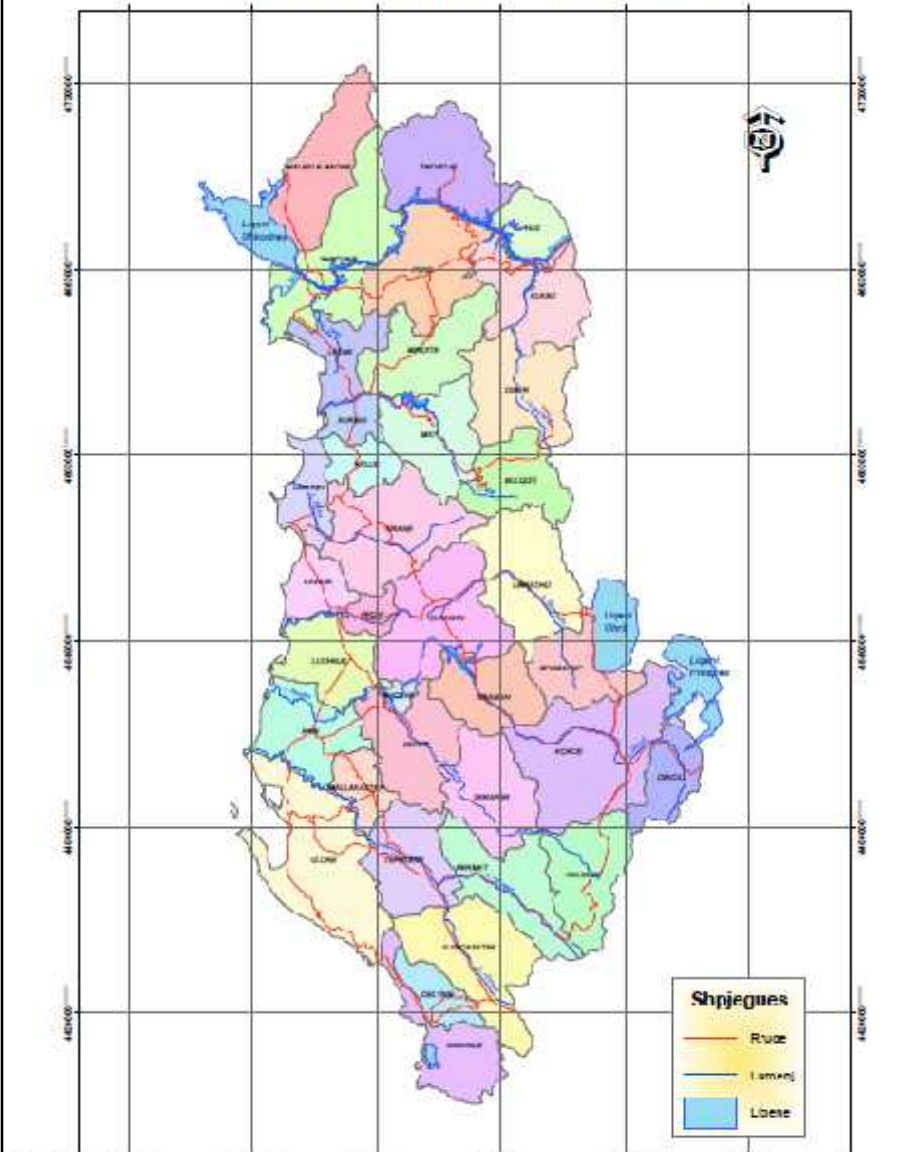
This method produces final products – vulnerability maps - that can be easily used by water-resource decision makers.

Every industrial or agricultural in the highly vulnerable zone of the basin – endanger the groundwater quality.



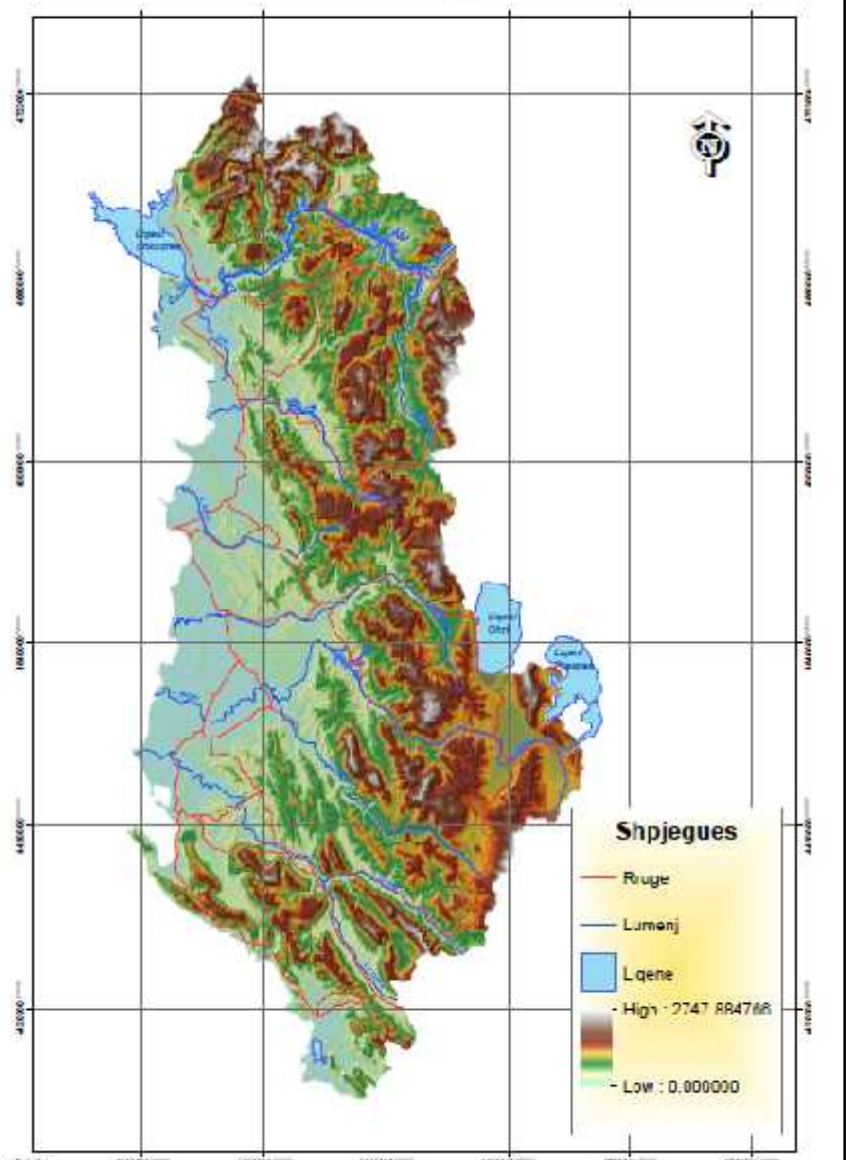
HARTA E VULNERABILITETIT TE SHQIPERISE

HARTA ADMINISTRATIVE E SHQIPERISE



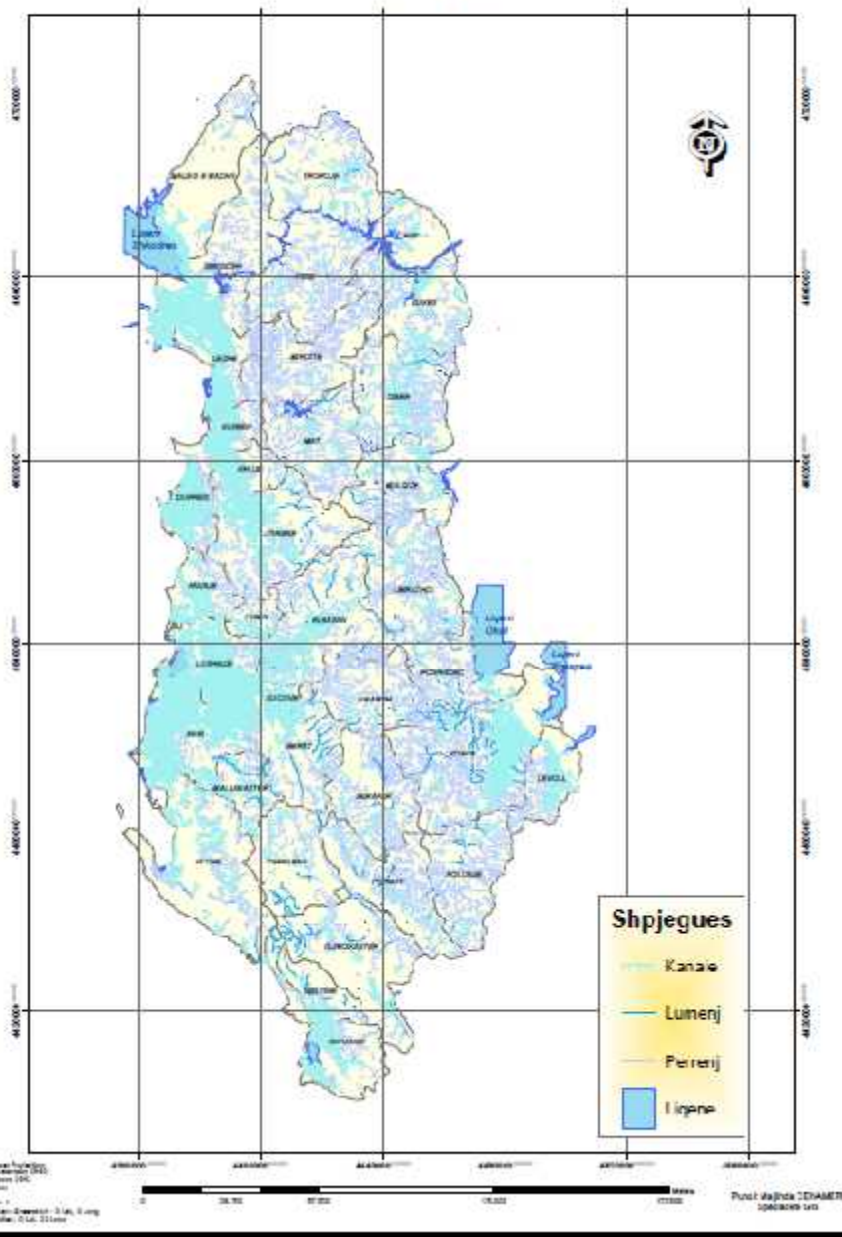
Date: 14.05.2015
 Autor: Institut Kombëtar i Statistikut
 Skala: 1:500,000
 Projekti: Harta Administrative e Shqipërisë
 Koordinatat: UTM
 Puntë: Mbledhja (Dhëmbri)
 Koordinatat: UTM

HARTA FIZIKE E SHQIPERISE

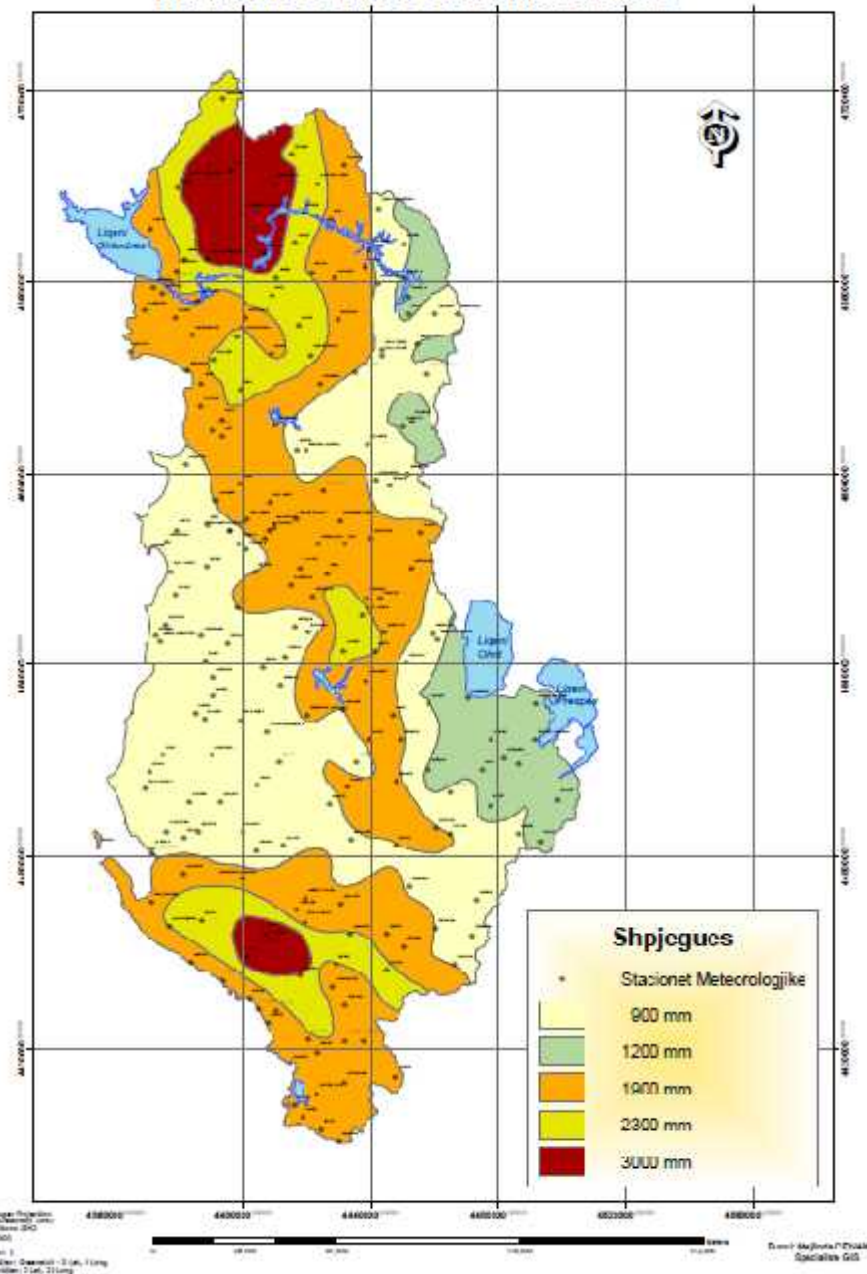


Date: 14.05.2015
 Autor: Institut Kombëtar i Statistikut
 Skala: 1:500,000
 Projekti: Harta Fizike e Shqipërisë
 Koordinatat: UTM
 Puntë: Mbledhja (Dhëmbri)
 Koordinatat: UTM

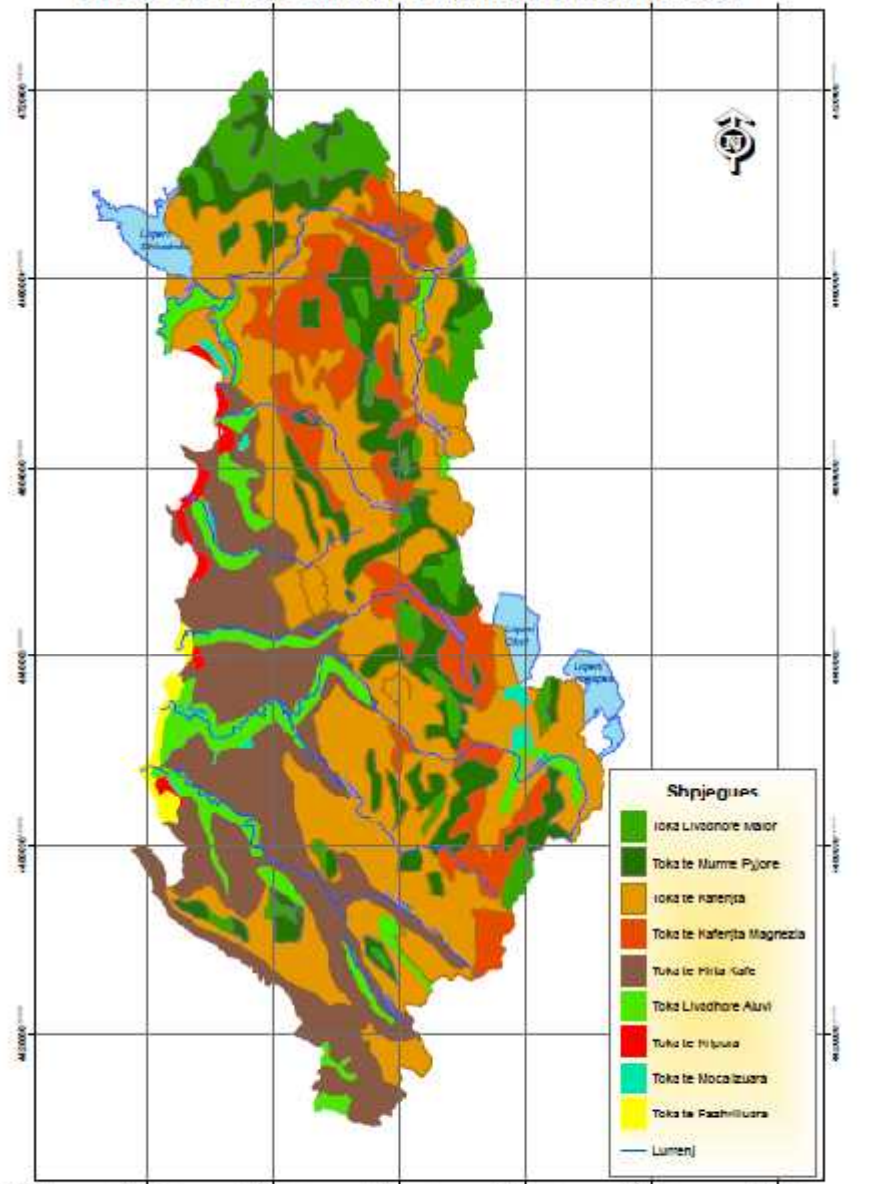
HARTA HIDROGRAFIKE E SHQIPERISE



HARTA E SHQIPERISE NDARJA E ZONAVE SIPAS RRESHJEVE

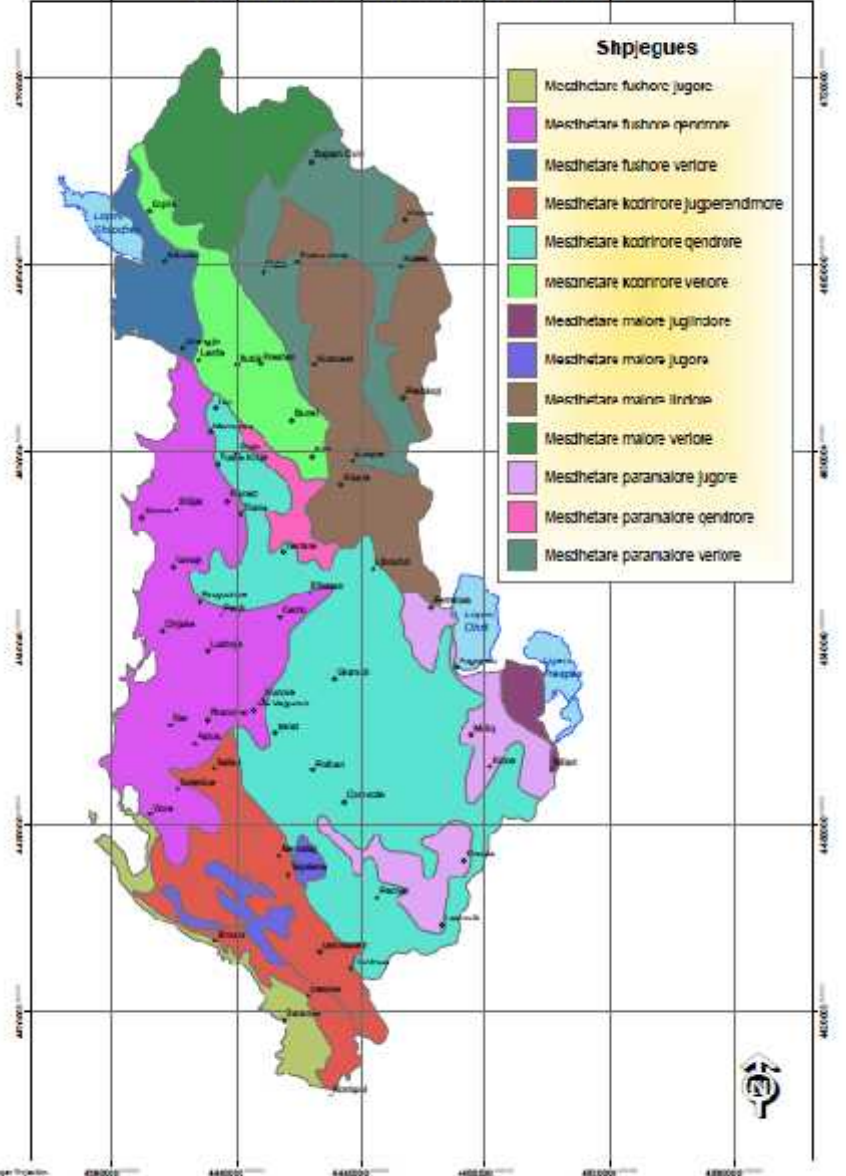


HARTA E SHQIPERISE TIPET E TOKAVE SIPAS KLASIFIKIMIT KOMBETARE

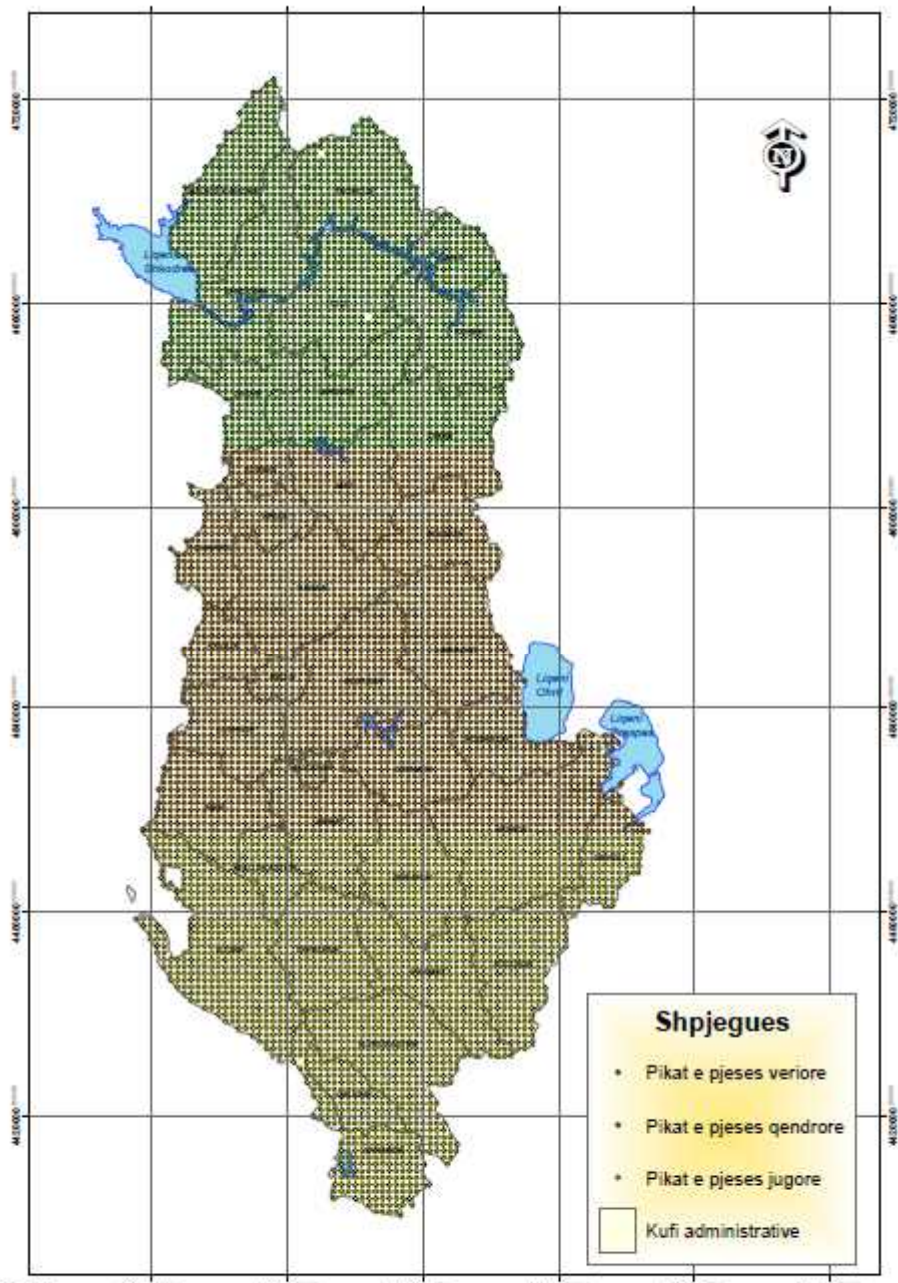


Datum: Single Projection
 Reference: European ETRS
 Datum: Pulkovo 1942
 SR: 430000
 North Arrow: 1
 Projection: Cassini - 1 km, 10 mg
 Contour Interval: 0 km, 11 mg
 Puntat: Majinda GDSHANC
 Spacialize: G2

HARTA E SHQIPERISE NDARJA E ZONAVE KLIMATERIKE



Datum: Single Projection
 Reference: European ETRS
 Datum: Pulkovo 1942
 SR: 430000
 North Arrow: 1
 Projection: Cassini - 1 km, 10 mg
 Contour Interval: 0 km, 11 mg
 Puntat: Majinda GDSHANC
 Spacialize: G2

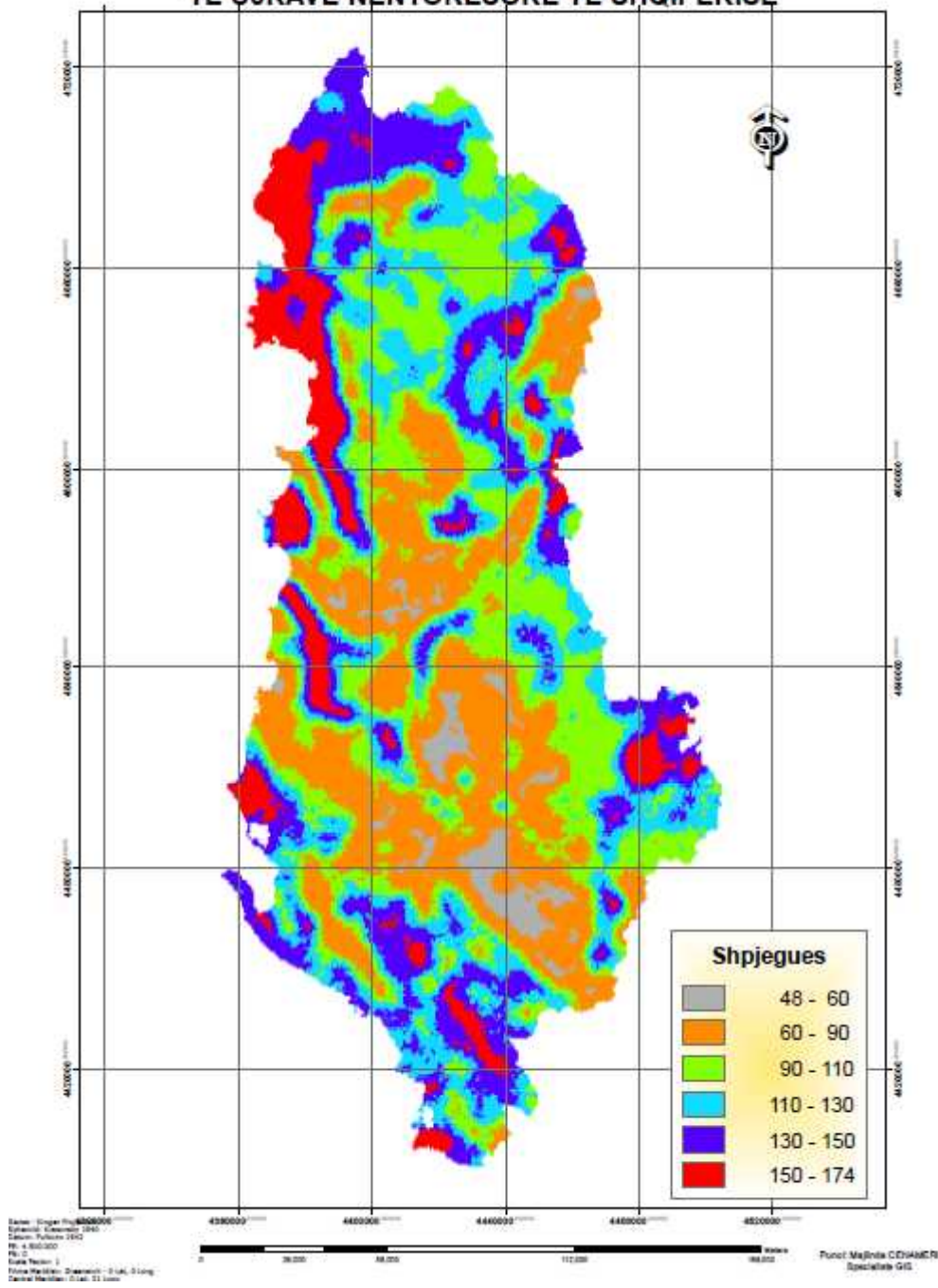


Data: Prapje Projektus
 Koordinat: UTM/ETRS 1989
 Datum: Falcus 1972
 M: 4 500 000
 M.S.O.
 Skala Niveli: 1
 Proje: Republika e Kosovës - 2.04, 4.14
 Central Republika - 0 Lat, 21 Long



Punët Mësimore CDHAM/CR
 Specializim GIS

HARTA E VLERESIMIT TE VULNERABILITETIT TE UJRAVE NENTOKESORE TE SHQIPERISE



KONTROLLI I MODELIT

- **Metoda e vulnerabilitetit te akuiferit kerkon vleresimin e subjektivitetit ne zgjedhjen e shkallezimit per cdo parameter per te rritur besueshmerine.**
- **Hapi i pare i analizes eshte llogaritja e vleres se vulnerabilitetit duke perdorur 6 parametra (hartat) nga 7 te mundshem (dmth, duke menjanuar njerin).**
- **Per krahasim, vlerat e fituara rishkallezohen me faktorin 7/6.**

Lodwik et al. (1990) percaktuan **MASEN E NDJESHMERISE**

$$S_i = \frac{V_i}{N} - \frac{V_{xi}}{n}$$

te levizjes se nje parametri, ku n :

S_i - ndjeshmeria,

V_i - indeksi i Vulnerabilitetit per qelizen e i-te,

N - numri total i parametrave te te vulnerabilitetit,

V_{Xi} - indeksi i vulnerabilitetit per qelizen e i-te, per n-1 parametra

n - numri i parametrave te perdorur ne analizen e ndjeshmerise.

- (Gogu and Dessargues, 2000) llogariten **INDEKSIN E VARIACIONIT**:

$$VI = \frac{V_i - V_{xi}}{V_i}$$

- V_i është indeksi fillestar i vulnerabilitetit të nenzones së i -te.

- **PESHA EFEKTIVE** (WX_i) mund të llogaritet për secilën nenzonë si:

$$W_{xi} = \frac{X_{ri} - X_{wi}}{V_i} * 100$$

- ku:
 - X_{ri} dhe X_{wi} janë respektivisht vlerat e shkallezuara dhe peshat për parametrin X të dhëna në nenzonën e i -te, dhe
 - V_i është indeksi i vulnerabilitetit për nenzonën e i -te.

- Statistikat e **mases se ndjeshmerise** (S_i) nga levizja e nje parametri tregojne parametrin me te ndjeshem ndaj ndotjes se akuiferit,
- **Indeksi i variacionit** mat efektin e levizjes se nje parametri ne vulnerabilitetin e ujrave nentokesore ndaj ndotjes.
- **Pesha efektive** (W_{Xi}) verifikon saktesine e dhenies se peshes relative te cdo parametri ne llogaritjen e indeksit DRASTIK.

Statistikat mbi ndjeshmërinë ndaj lëvizjes së një parametri

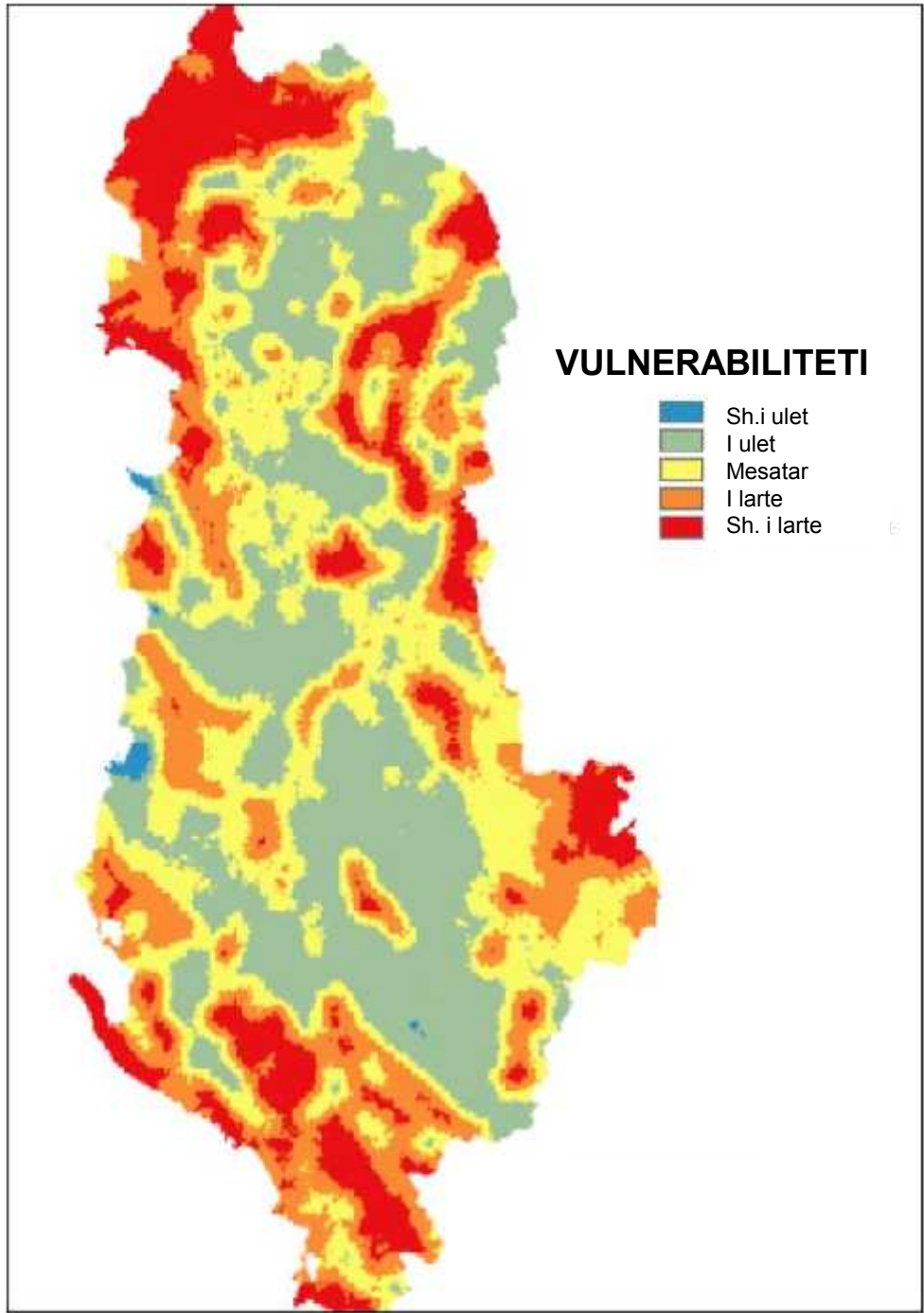
Parametri i ndjeshmërisë (S)	Min	Max	Mes	DS
D	0.02	1.93	0.83	0.40
R	0.19	1.95	1.10	0.38
A	0	1.48	0.65	0.38
S	0.38	3.76	2.20	0.77
T	0.19	6.19	3.31	1.13
I	0.14	2.62	0.95	0.36
C	0	1.67	0.63	0.40

Indeksi i Variacionit të parametrimit të përjashtuar në DRASTIC

Indeksi i Variacionit	Min	Max	Mes	DS
D	7.23	31.82	16.06	5.03
R	2.08	16.84	8.32	3.23
A	6.25	20.27	13.82	3.75
S	1.16	11.11	4.03	1.80
T	13.33	55.56	31.92	8.99
I	3.13	26.47	12.33	5.37
C	5.36	21.62	13.53	3.76

Analiza statistikore e peshës efektive

Faktorët e peshës efektive	Pesha e dhënë (Xwi)	Pesha e dhënë në (%)	Pesha mesatare e kalkuluar (Wxi)	Pesha e kalkuluar (Xwi)	Pesha efektive mesatare (%)	Peshat e korigjuara (Xwi)
D	3	15	16.35	3.31	16.35	3
R	2	10	8.32	2.5	12.35	2
A	5	25	23.15	2.91	14.38	3
T	4	20	26.12	4.42	21.84	5
S	1	5	4.11	1.24	6.13	1
I	2	10	8.31	2.63	12.99	3
C	3	15	13.62	3.23	15.96	3





FALEMINDERIT!