



Site Suitability of Wind Farms in Egypt using GIS

Introduction



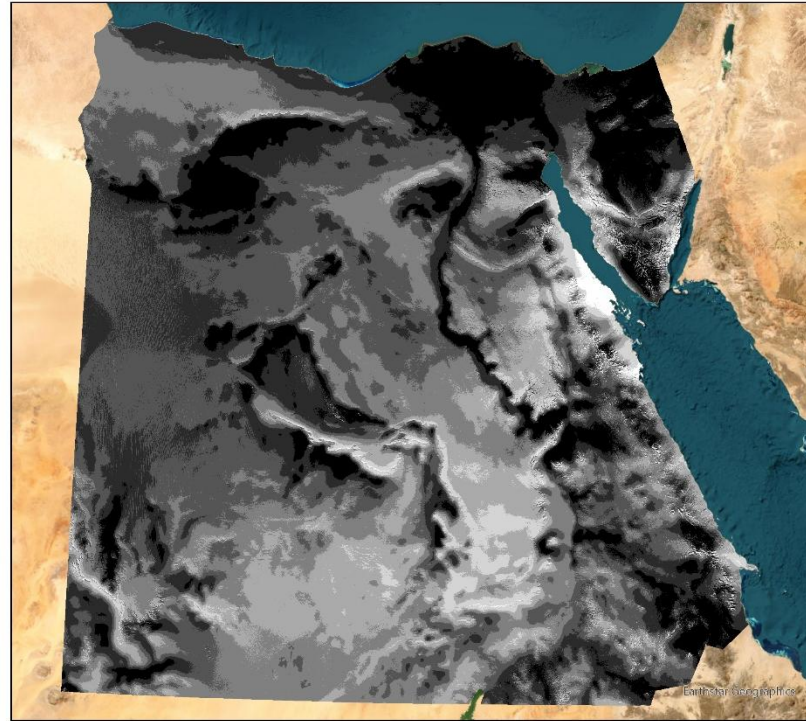
- Through the past two decades, Egypt has aimed to reduce its reliance on fossil fuels and shift toward clean energy sources .
- However, renewable energy still contributes only 12-15% of the country's electricity, which is low considering Egypt's strong wind and year-round solar potential .

Project Objectives

- ❑ Evaluate the locations of the existing wind farms
- ❑ Identify the most suitable location for building new wind farm

Wind Speed at 50m Height

Wind Speed at 50m Height



Legend

Wind_Speed
Value

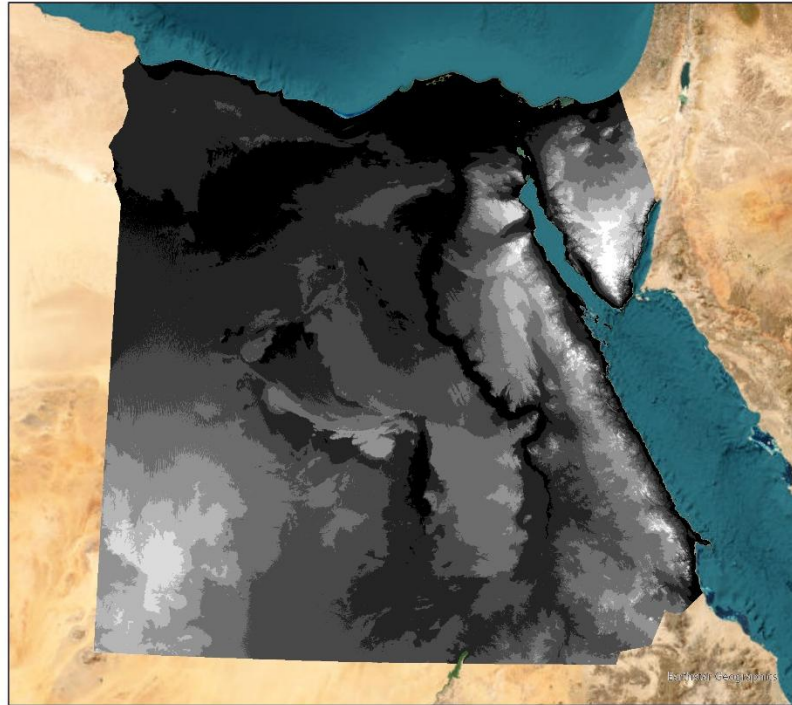
0.632 - 4.902
4.903 - 5.651
5.652 - 6.325
6.326 - 6.925
6.926 - 7.599
7.6 - 8.798
8.799 - 19.736

Digi



Digital Elevation Model (SRTM)

Digital Elevation Model

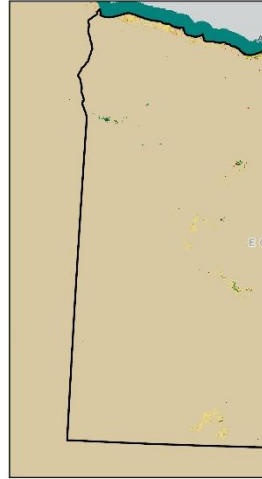


Legend

DEM
Value

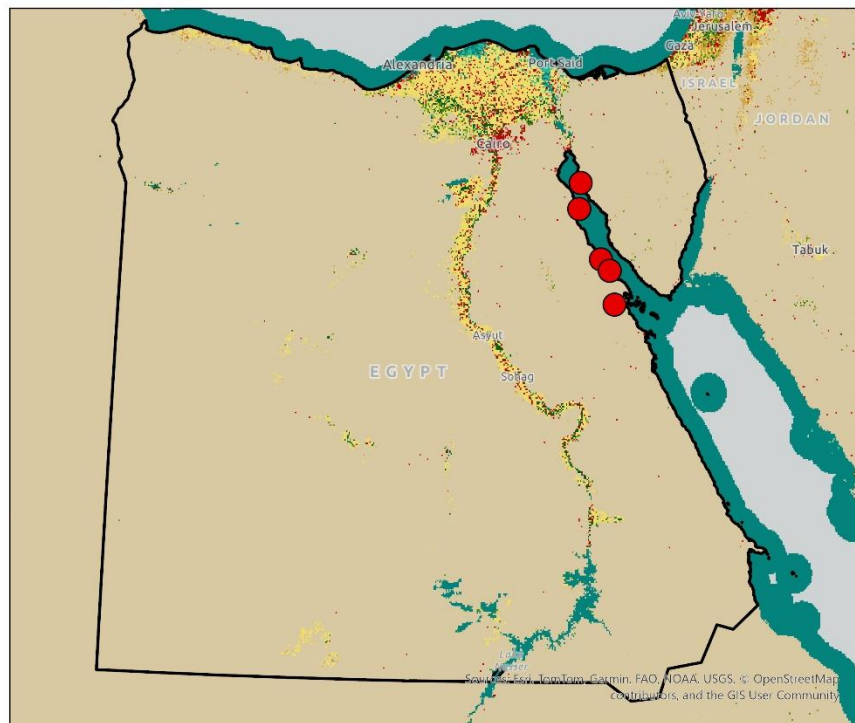
■	-186.999 - 98.592
■	98.593 - 230.404
■	230.405 - 351.231
■	351.232 - 494.027
■	494.028 - 658.792
■	658.793 - 867.494
■	867.495 - 1,208.008
■	1,208.009 - 2,614

LandCover



Land Cover (Esri)

LandCover Classification



Legend

● Current Stations

LandCover

■ Tree Cover

■ Shrubland

■ Grassland

■ Cropland

■ Built-up

■ Bare or sparse
vegetation

■ Snow and Ice

■ Permanent water
bodies

■ Herbaceous
wetland

■ Mangroves

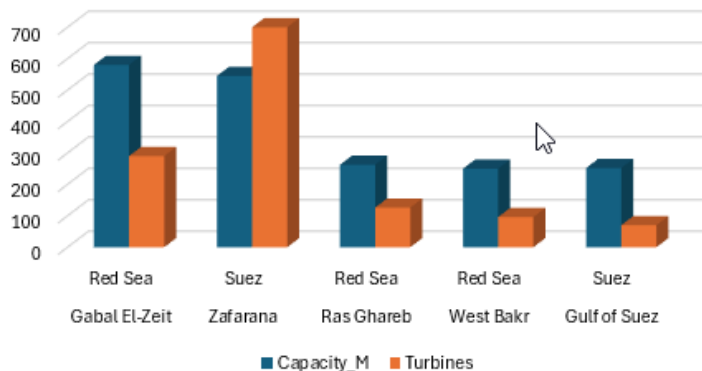
■ Moss and lichen



Current Stations (Power Technology)

Name	Governorat	Capacity_M	Turbines	Year_Start
Gabal El-Zeit	Red Sea	580	290	2018
Zafarana	Suez	545	700	2001
Ras Ghareb	Red Sea	262.5	126	2019
West Bakr	Red Sea	250	96	2021
Gulf of Suez	Suez	252	70	2015

Wind Farms

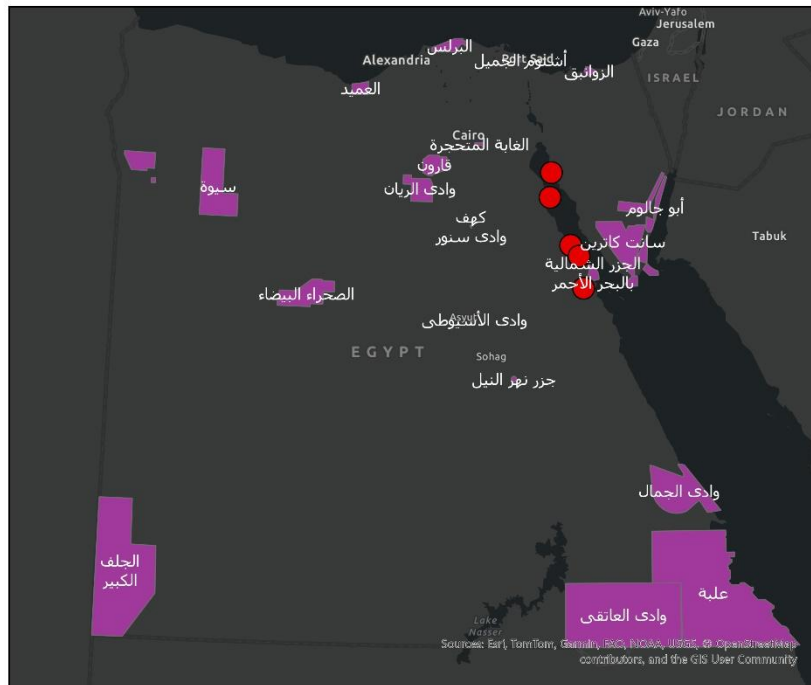


Current Stations



Nature Reserves (DIVA-GIS)

Nature Reserves in Egypt



Win



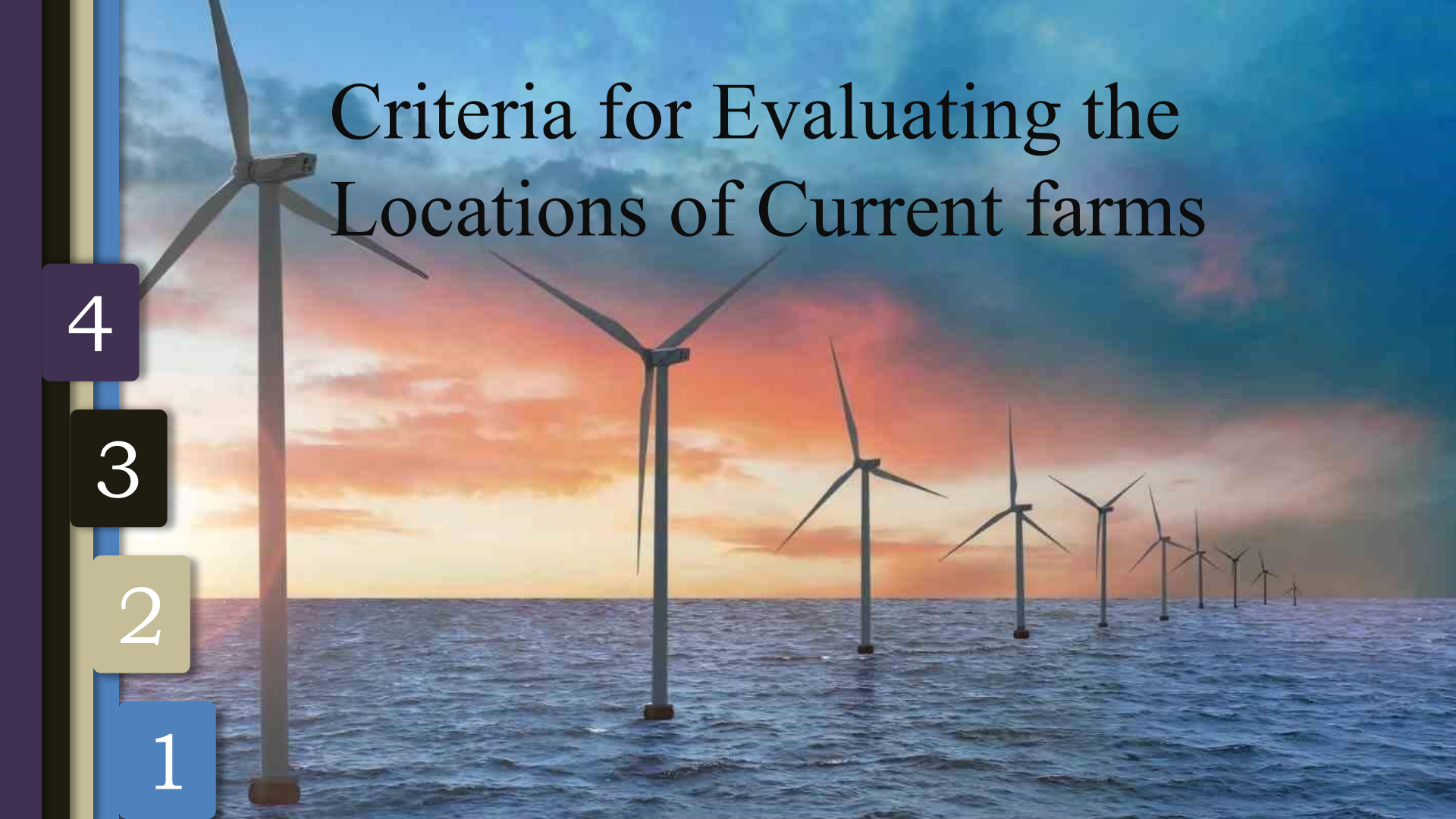
Criteria for Evaluating the Locations of Current farms

4

3

2

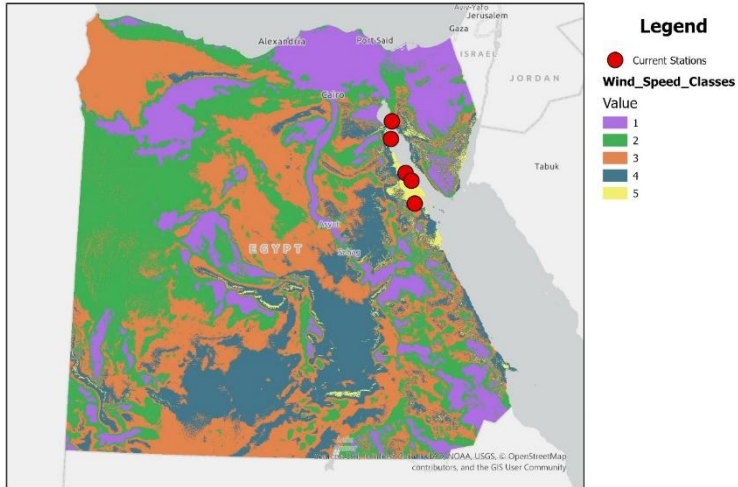
1



4

3

2

Wind_Speed_Classification

Start	End	New
0.63	5	1
5	6	2
6	6.8	3
6.8	8.2	4
8.2	19.7	5
NODATA	NODATA	NODATA

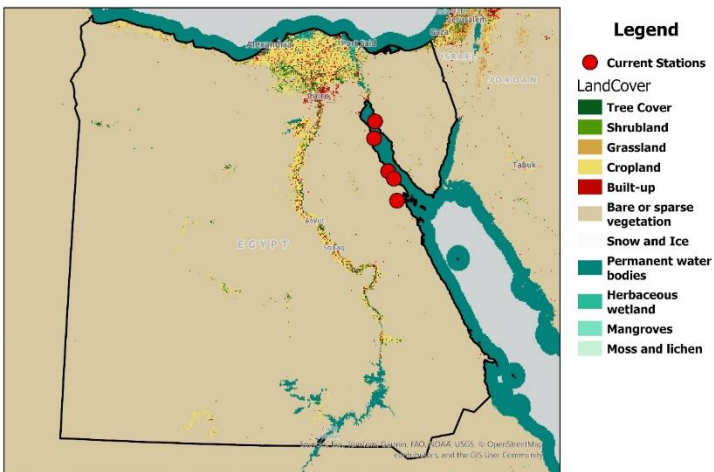
- Reclassified Wind Speed

1

4

3

LandCover Classification



Value	Scale
Tree Cover	2
Shrubland	3
Grassland	4
Cropland	3
Built-up	1
Bare or sparse vegetation	5
Snow and Ice	1
Permanent water bodies	1
Herbaceous wetland	2
Mangroves	1

• Land Cover

2

1

4

[illegible]

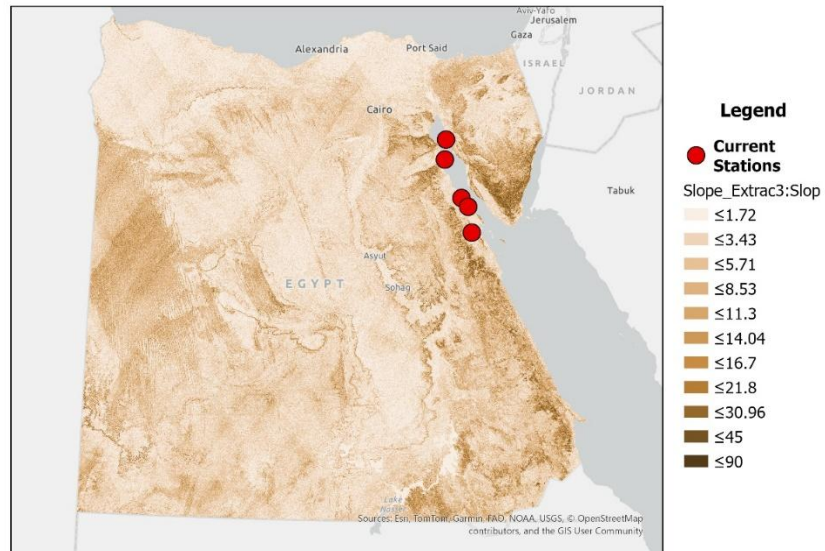
- 3

2

1



Egypt Land Slope



Start	End	New
0	2.95195	5
2.95195	7.379876	4
7.379876	14.169362	3
14.169362	24.501188	2
24.501188	75.274734	1
NODATA	NODATA	NODATA

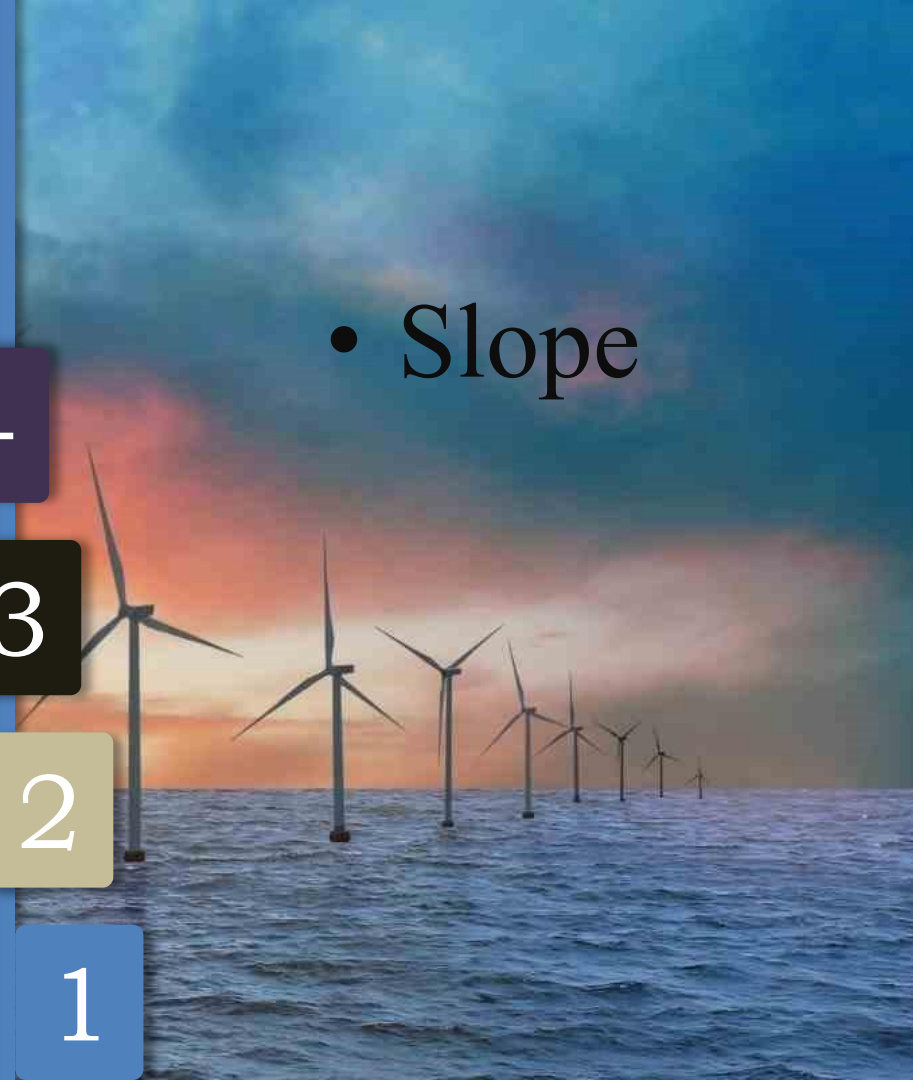
• Slope

4

3

2

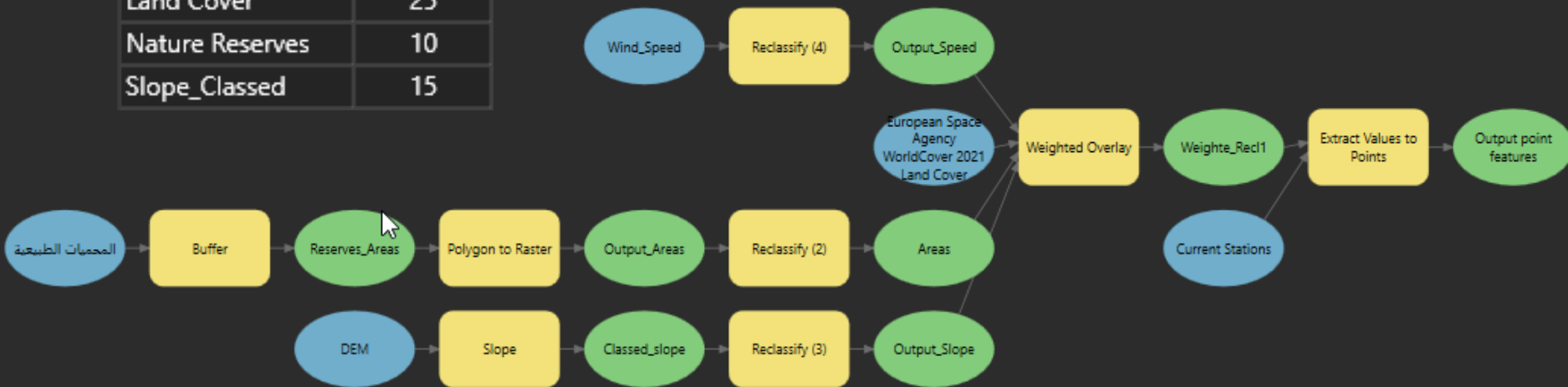
1



Processing Workflow



Rasters	+	▼	%	=
Wind Speed			50	
Land Cover			25	
Nature Reserves			10	
Slope_Classed			15	



Results

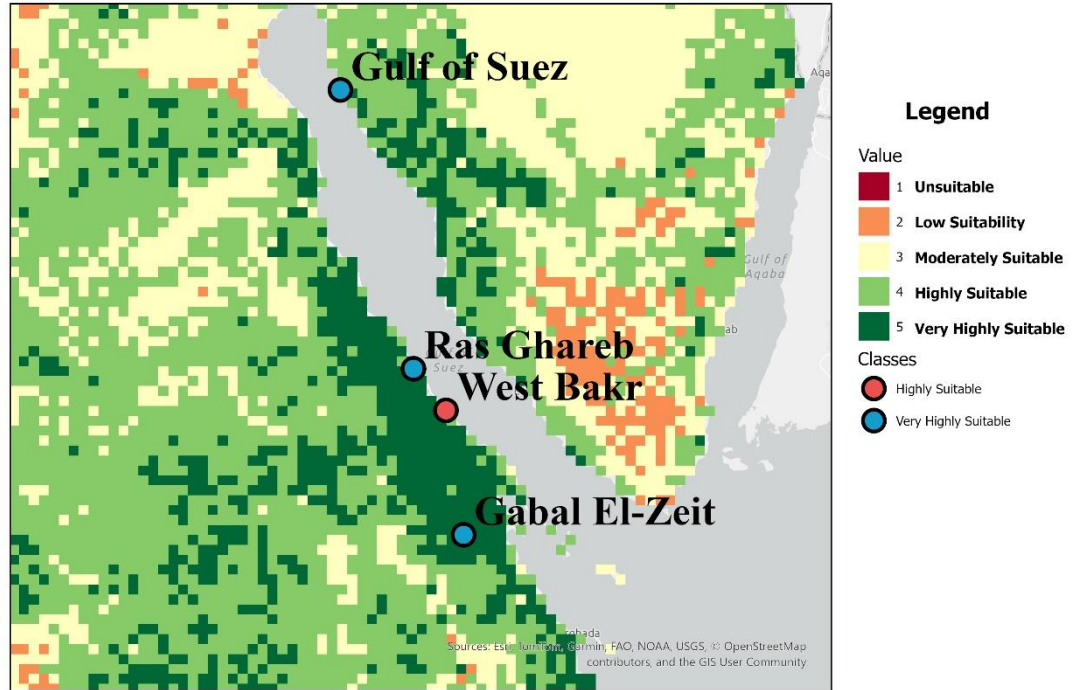
- **Very Highly Suitable**

1. Gulf of Suez
2. Ras Ghareb
3. Gabal El-Zeit

- **Highly Suitable**

1. West Bakr

Evaluation of Current Stations

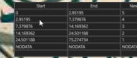


Criteria for identifying the most suitable location for new wind power station

- Distance from Nature Reserves (2 km² Buffer)



- Slope



1

2

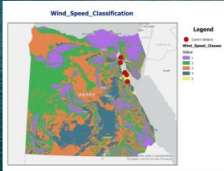
3

4

5

- Wind Speed reclassified

Old	Old	New
0.0	1	1
0.5	2	2
1	3	3
1.5	4	4
2	5	5
2.5	6	6
3	7	7
3.5	8	8
4	9	9
4.5	10	10
5	11	11
5.5	12	12
6	13	13
6.5	14	14
7	15	15
7.5	16	16
8	17	17
8.5	18	18
9	19	19
9.5	20	20
10	21	21
10.5	22	22
11	23	23
11.5	24	24
12	25	25
12.5	26	26
13	27	27
13.5	28	28
14	29	29
14.5	30	30
15	31	31
15.5	32	32
16	33	33
16.5	34	34
17	35	35
17.5	36	36
18	37	37
18.5	38	38
19	39	39
19.5	40	40
20	41	41
20.5	42	42
21	43	43
21.5	44	44
22	45	45
22.5	46	46
23	47	47
23.5	48	48
24	49	49
24.5	50	50
25	51	51
25.5	52	52
26	53	53
26.5	54	54
27	55	55
27.5	56	56
28	57	57
28.5	58	58
29	59	59
29.5	60	60
30	61	61
30.5	62	62
31	63	63
31.5	64	64
32	65	65
32.5	66	66
33	67	67
33.5	68	68
34	69	69
34.5	70	70
35	71	71
35.5	72	72
36	73	73
36.5	74	74
37	75	75
37.5	76	76
38	77	77
38.5	78	78
39	79	79
39.5	80	80
40	81	81
40.5	82	82
41	83	83
41.5	84	84
42	85	85
42.5	86	86
43	87	87
43.5	88	88
44	89	89
44.5	90	90
45	91	91
45.5	92	92
46	93	93
46.5	94	94
47	95	95
47.5	96	96
48	97	97
48.5	98	98
49	99	99
49.5	100	100

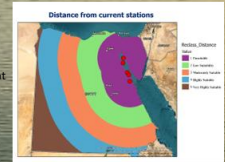


- Land Cover

Value	Color	Legend
1	Blue	Water
2	Green	Forest
3	Yellow	Barren
4	Orange	Desert
5	Red	Urban
6	Purple	Wetland
7	Brown	Soil
8	Light Green	Grassland
9	Dark Green	Shrubland
10	Light Blue	Coastal
11	Dark Blue	Marine
12	Light Yellow	Barren
13	Dark Yellow	Desert
14	Light Orange	Urban
15	Dark Orange	Wetland
16	Light Purple	Soil
17	Dark Purple	Grassland
18	Light Brown	Shrubland
19	Dark Brown	Coastal
20	Light Blue	Marine



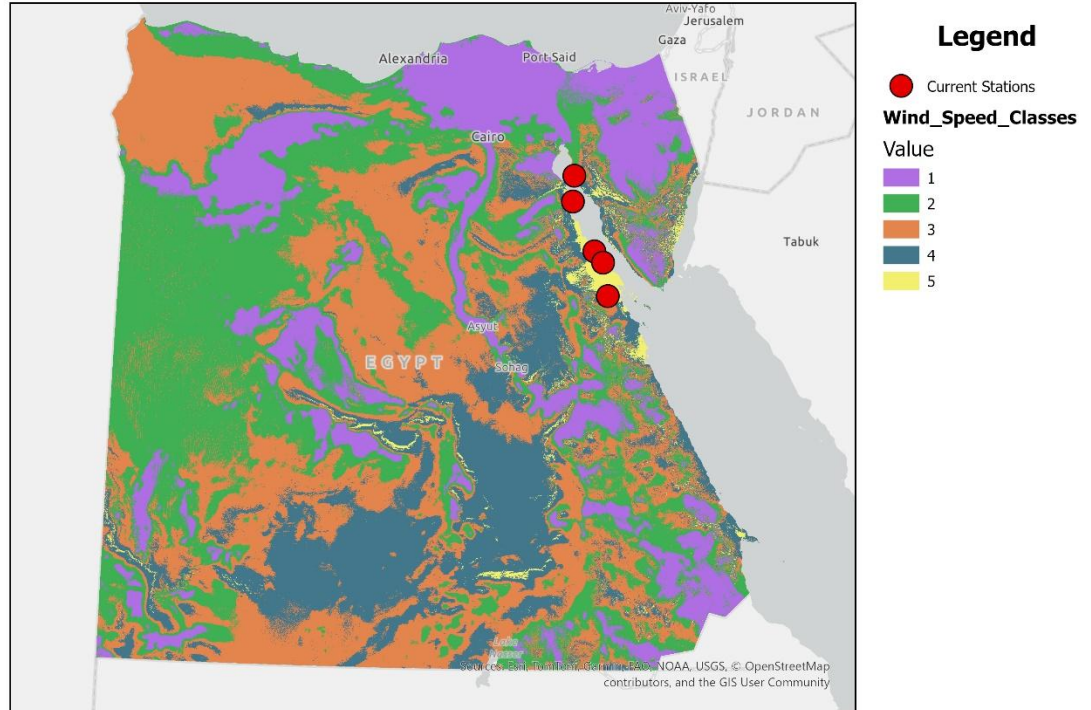
- Distance from current farms



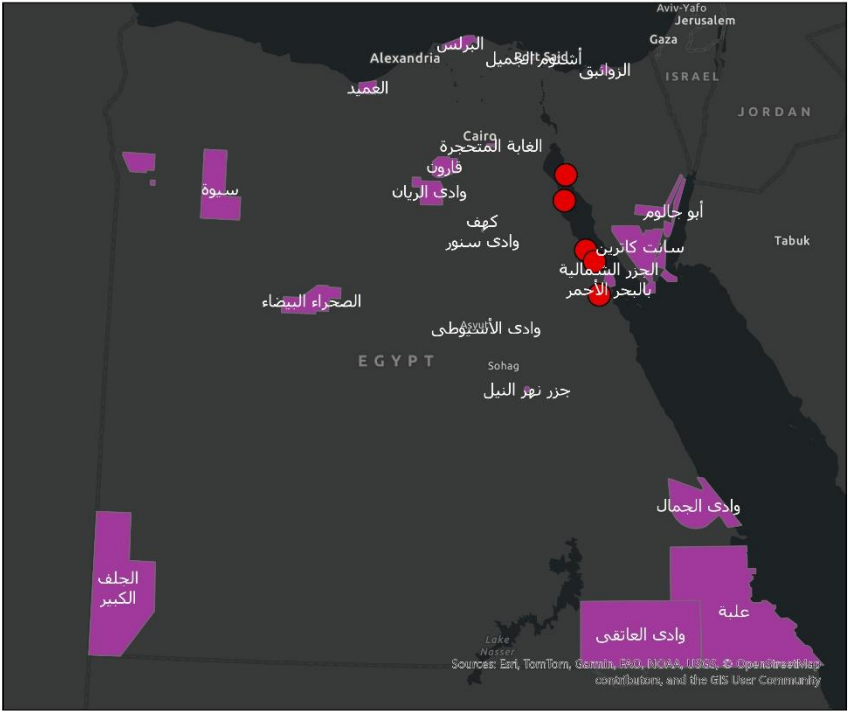
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Wind_Speed_Classification



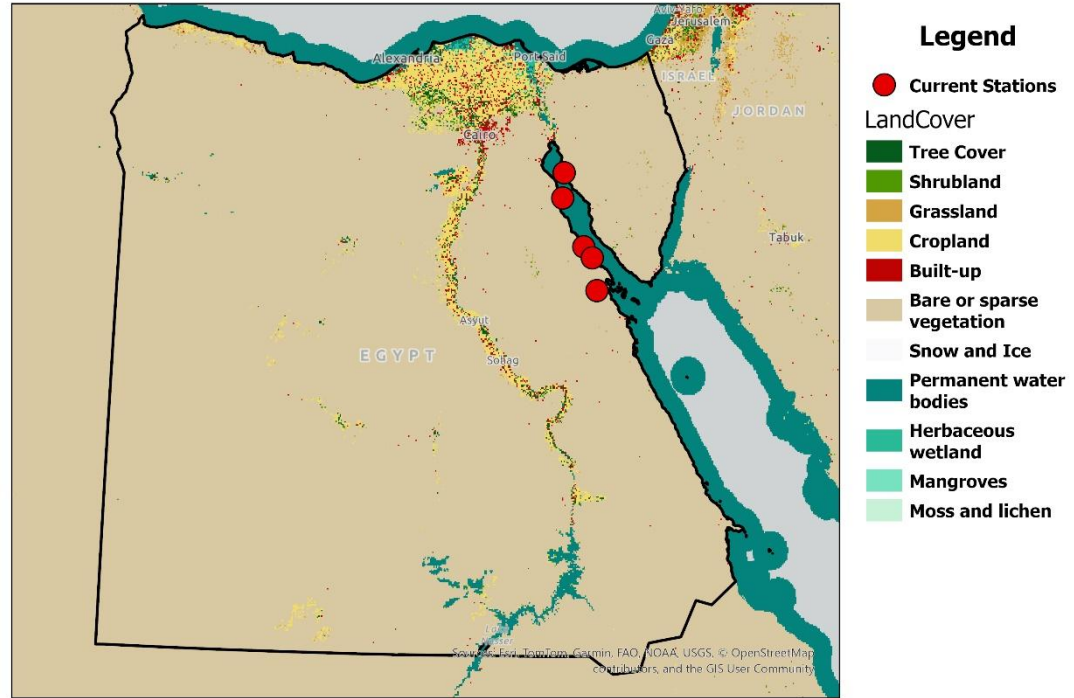
- Distance from Nature Reserves (2 km² Buffer)



- Land Cover

Value	Scale	
Tree Cover	2	▼
Shrubland	3	▼
Grassland	4	▼
Cropland	3	▼
Built-up	1	▼
Bare or sparse vegetation	5	▼
Snow and Ice	1	▼
Permanent water bodies	1	▼
Herbaceous wetland	2	▼
Mangroves	1	▼

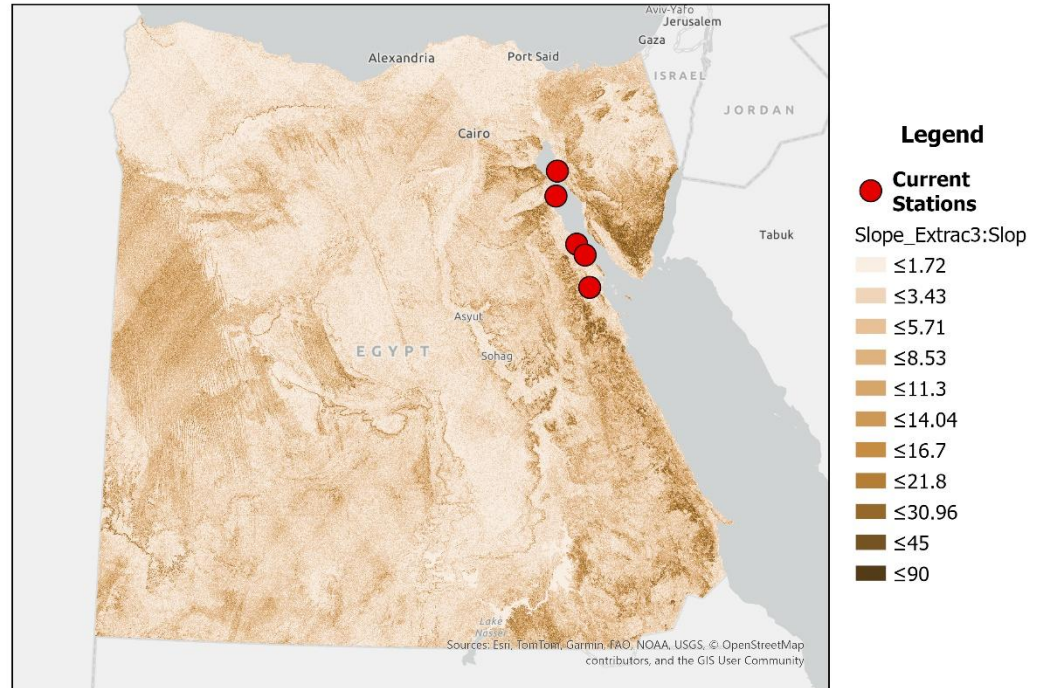
LandCover Classification



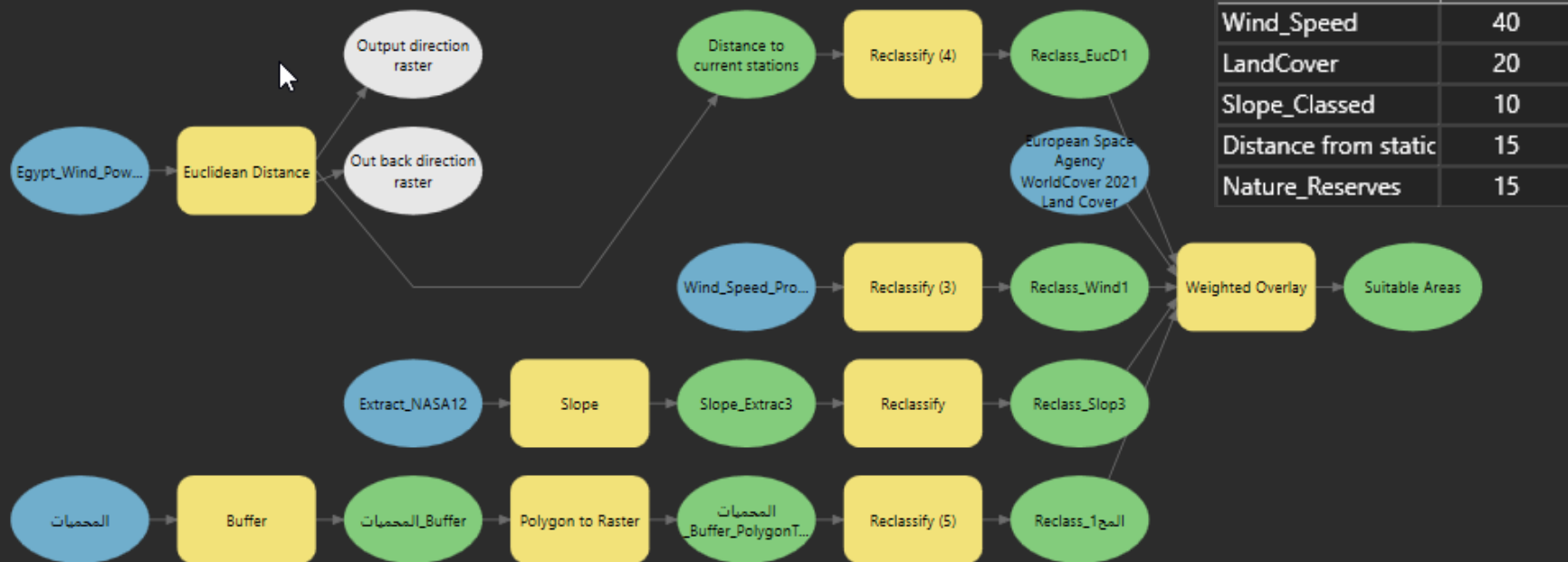
- Slope

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0	2.95195	5
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7.379876	14.169362	3
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Egypt Land Slope



Processing Workflow

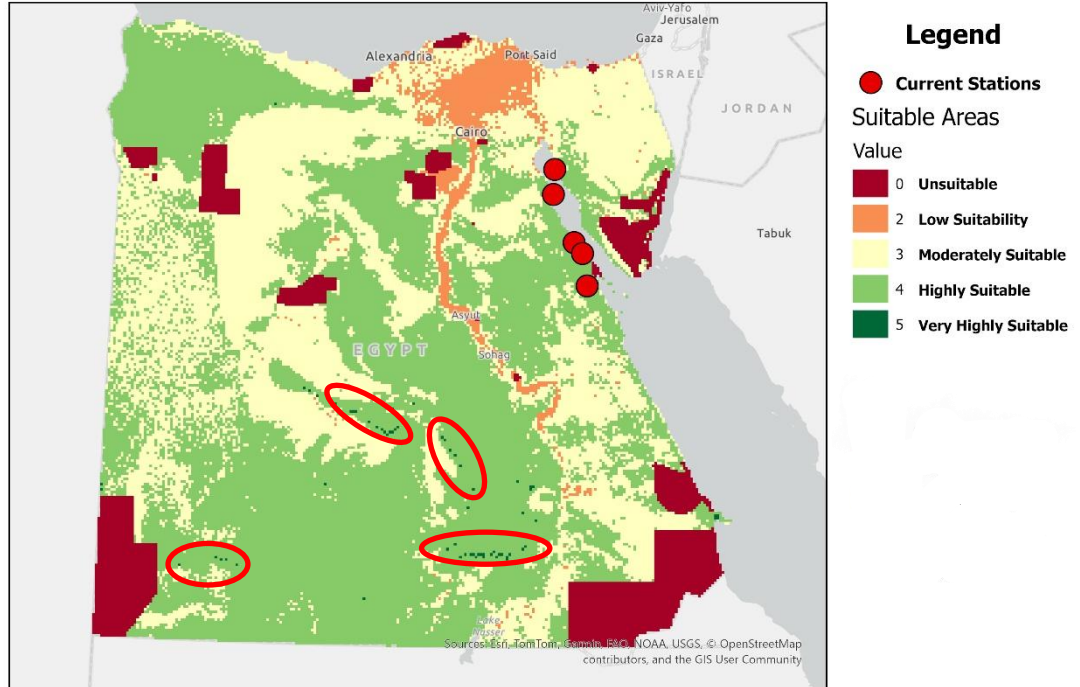


Results

So , the most suitable locations for establishing new wind farms are identified in El Wadi Al Gadid Governorate :

- Western Aswan
- El Kharga , El Dakhla Oases
- The eastern of the Gilf Kebir Plateau .

Suitable Areas for building New Wind_Power_Station





Class	Suitability Degree	Area (km ²)	Color
0	Unsuitable	83097.63	
2	Low Suitability	35464.62	
3	Moderately Suitable	364446.97	
4	Highly Suitable	496770.61	
5	Very Highly Suitable	1341.18	
		981121.01	

Area (km²)



■ 0 Unsuitable

■ 2 Low Suitability

■ 3 Moderately Suitable

■ 4 Highly Suitable

■ 5 Very Highly Suitable

Chart

References



- <https://www.power-technology.com/>
- <https://globalwindatlas.info/en/>
- <https://livingatlas.arcgis.com/en>
- <https://en.tutiempo.net/climate>
- <https://blog.arabnubia.com/>



Thank you