



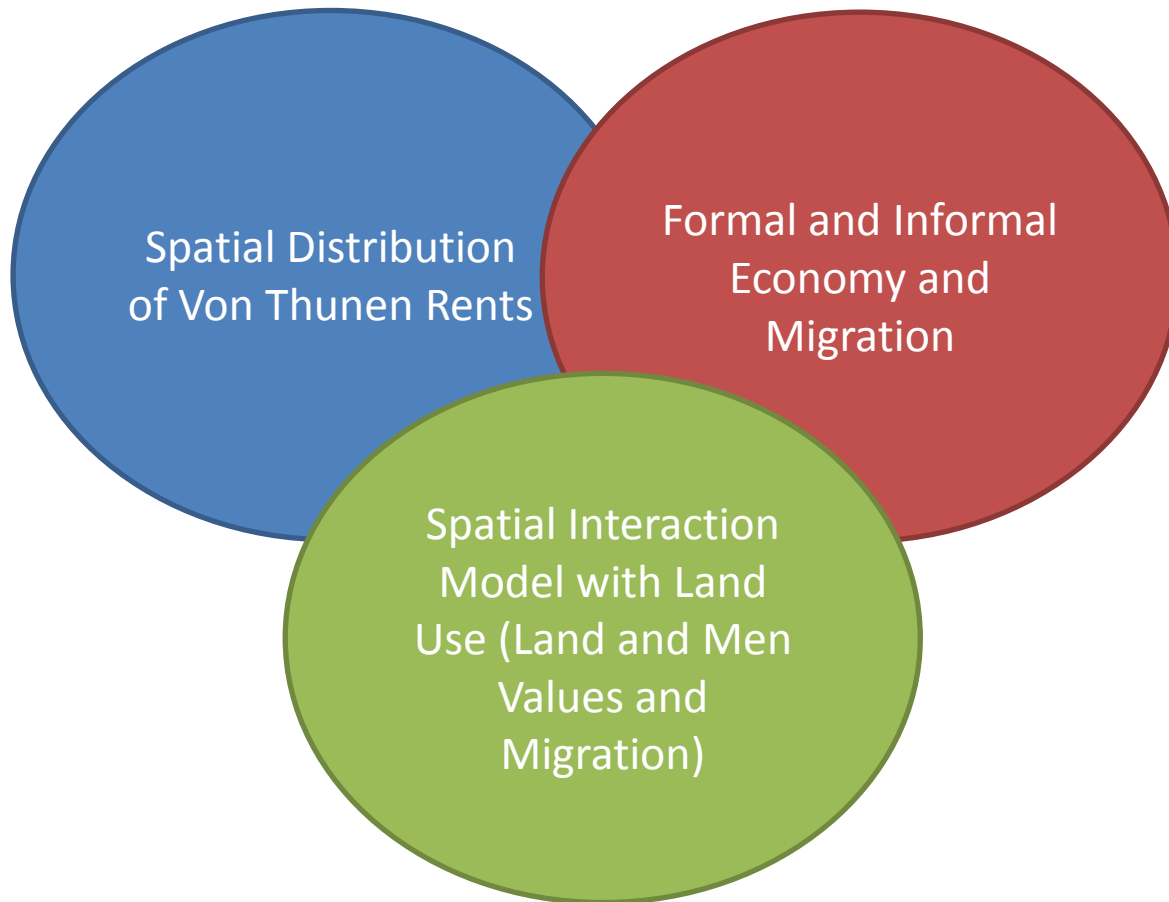
## International Workshop on Informal Migration

### **Scenarios for Rural – Urban Migration in Morocco: An Application of a Spatial Interaction Model to Tahadart basin– Tangier (Morocco)**

**Tomaz Ponce Dentinho (Azores University, Portugal and RAI), Joao Borba (Azores University, Portugal and RAI), Abdellatif Khattabi (Ecole Nationale Forestière d'Ingénieurs, Sale, Morocco), Paulo Silveira (Azores University, Portugal and RAI)**

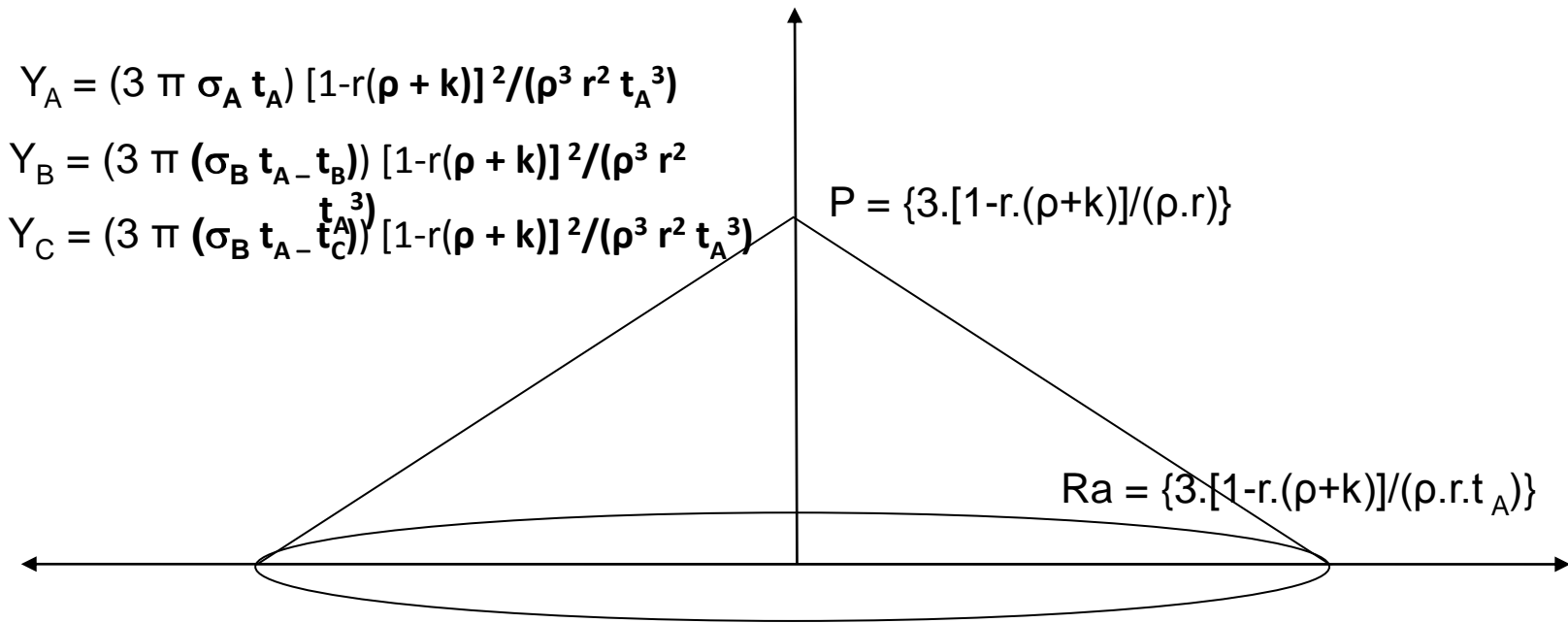
8-11<sup>th</sup> April 2014, Marrakech /Rabat

# International Workshop on Informal Migration



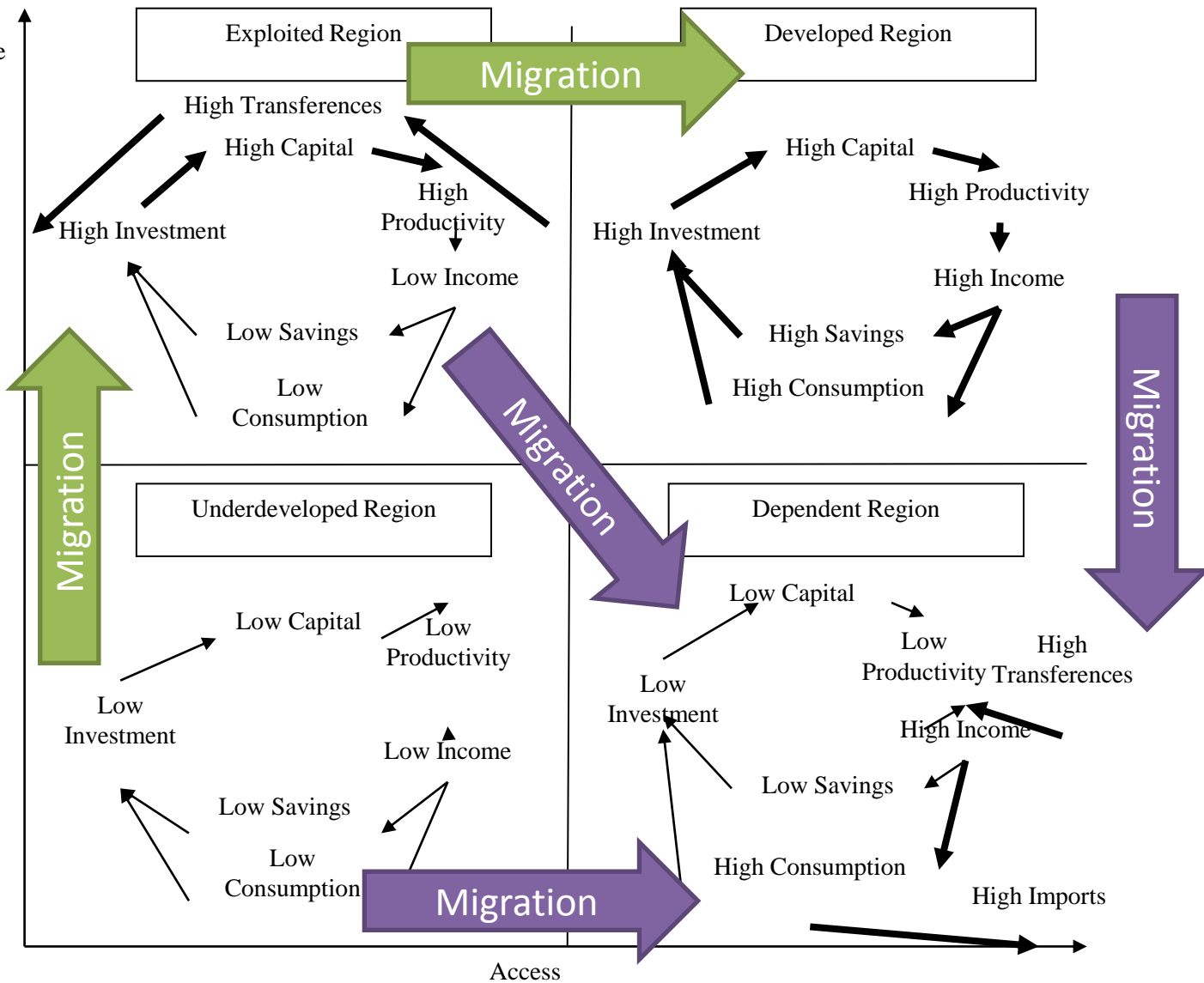
8-11<sup>th</sup> April 2014, Marrakech /Rabat

Spatial  
Distribution of  
Von Thunen  
Rents



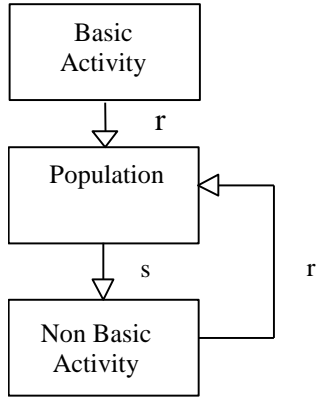
Von Thünen Rent Distribution A, B, C) Scenarios

Spatial Distribution of Von Thunen Rents



Formal and Informal Economy

Market Economy



$$E_t = E_b + E_c$$

$$E_c/P = s$$

$$P/E_{tb} = r$$

$$E_{tb} = [1/(1-rs)] E_b$$

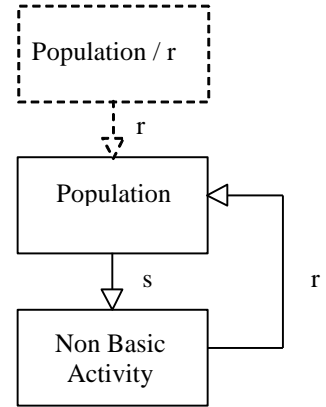
$$P_{tb} = [r/(1-rs)] E_b$$

$$E_{to} = [1/(1-rs)] (P_{to}/r) - (P_{to}/r)$$

$$E_{to} = [rs/(1-rs)] (P_{to}/r)$$

$$E_{to} = [s/(1-rs)] P_{to}$$

Subsistence Economy



Employment pushed by Basic Employment

$$E_{tb} = [1/(1-rs)] E_b$$

Employment pushed by subsistence population

$$E_{to} = [s/(1-rs)] (P_t - rE_{tb})$$

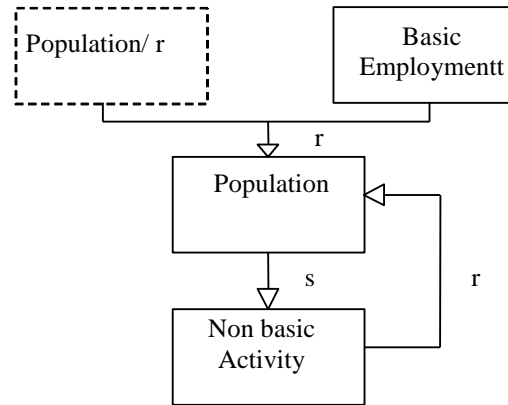
$$E_t = E_{tb} + E_{to}$$

Indicator of Relative Income:  $w = E_{tb}.r/P_t$

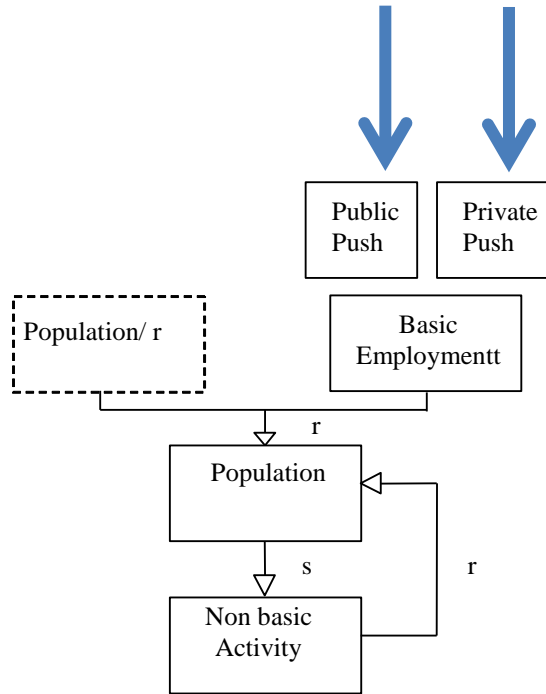
When  $E_b = 0 \Rightarrow w = rs/(1-rs)$

When  $P_o = 0 \Rightarrow w = 1/(1-rs)$

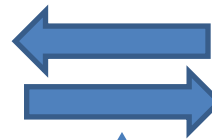
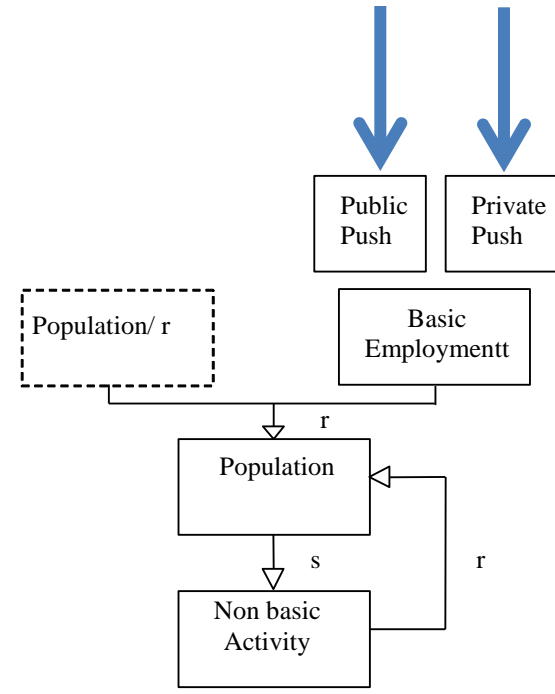
Mixed Economy



### Rural Areas



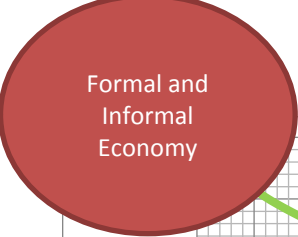
### Urban Areas



$$w_r = E_{tb}/E_t$$

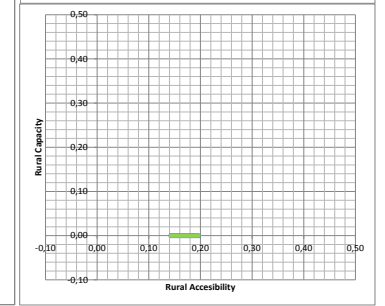
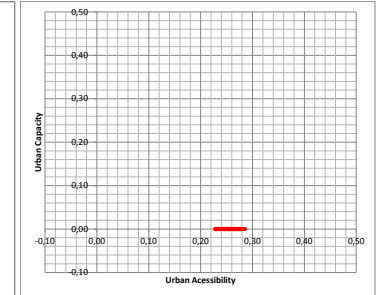
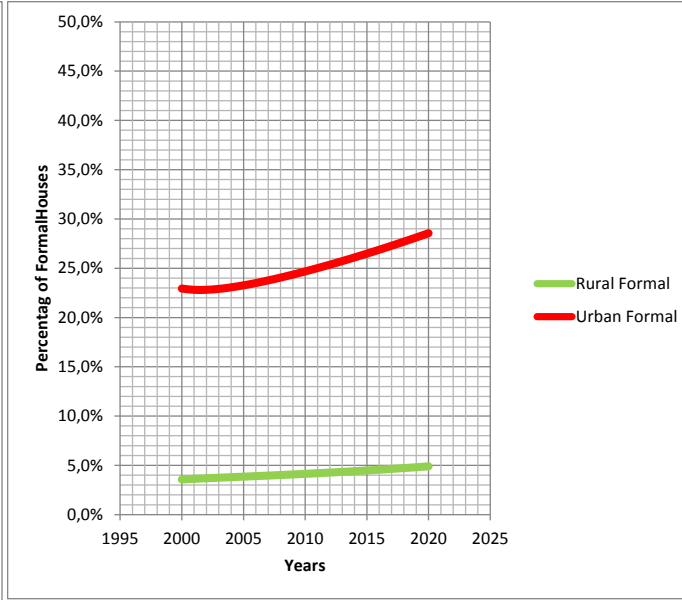
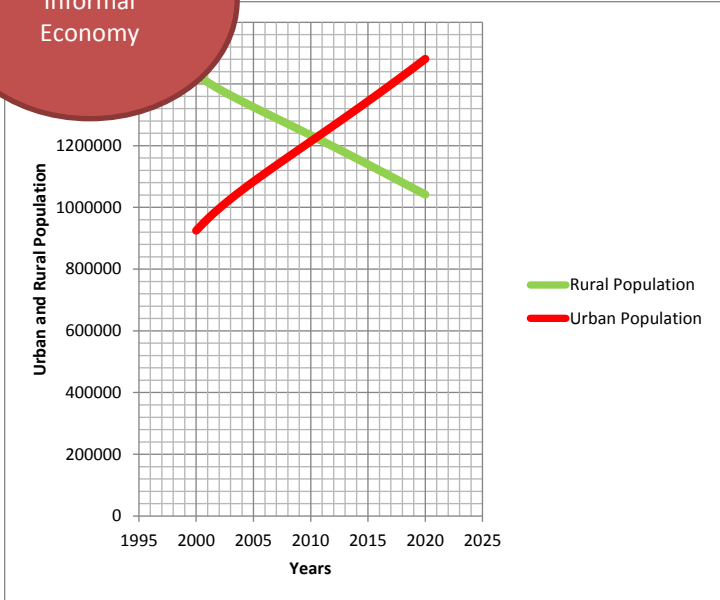
$$w_u = E_{tb}/E_t$$

$W_r$   
 $\leftrightarrow$   
 $W_u$

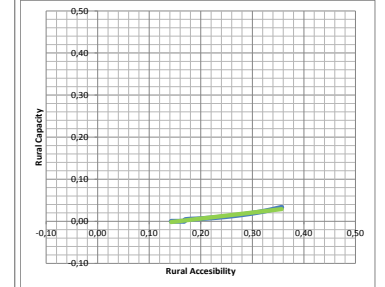
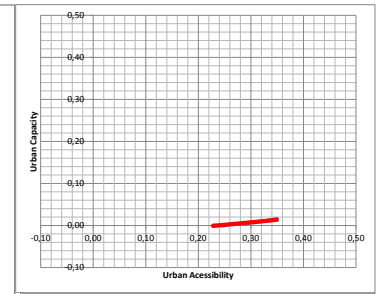
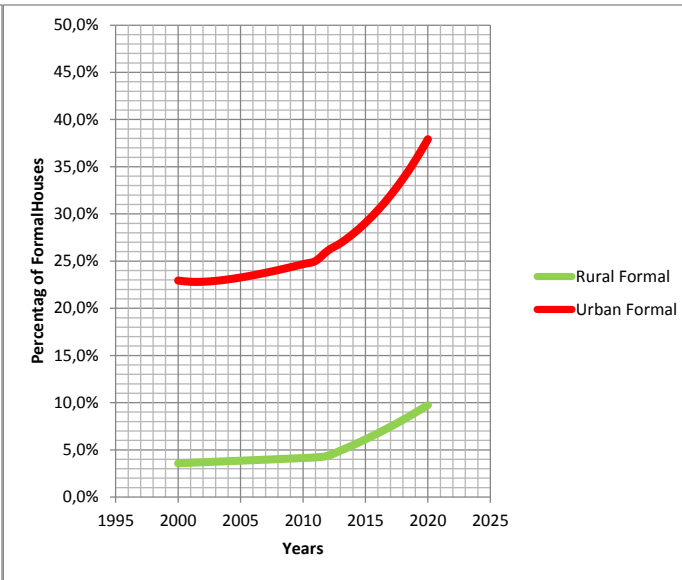
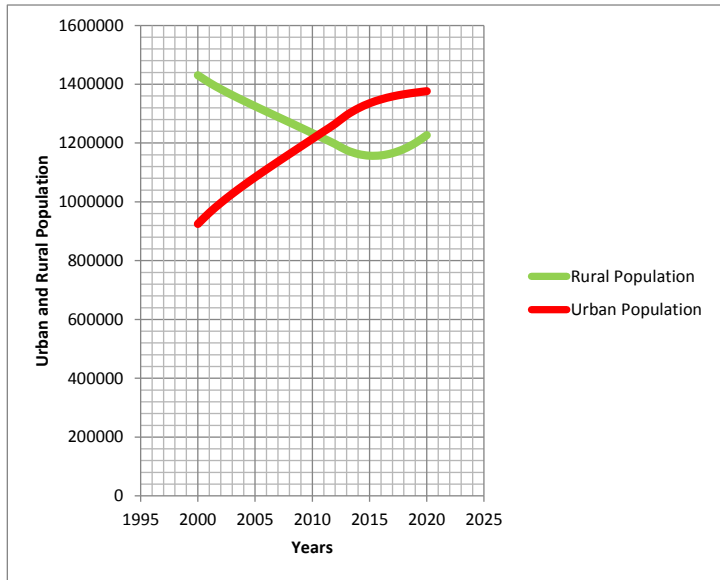


Formal and Informal Economy

### Business as Usual Increasing public Investment in Urban Areas

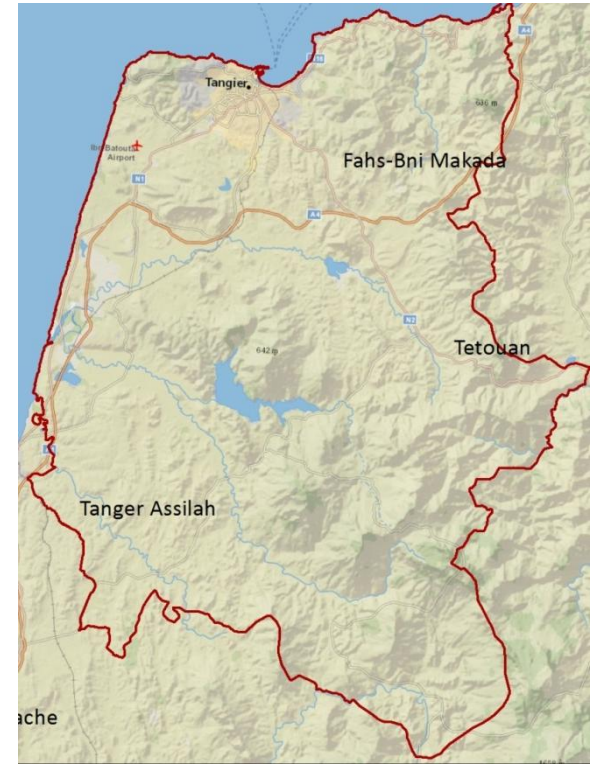
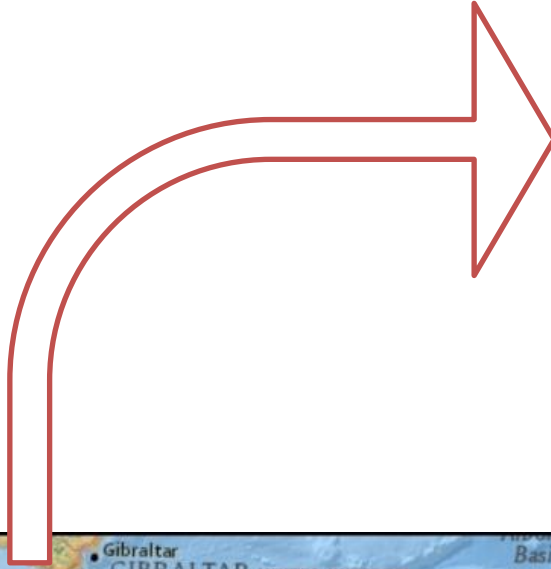


### Increasing innovation in rural and urban



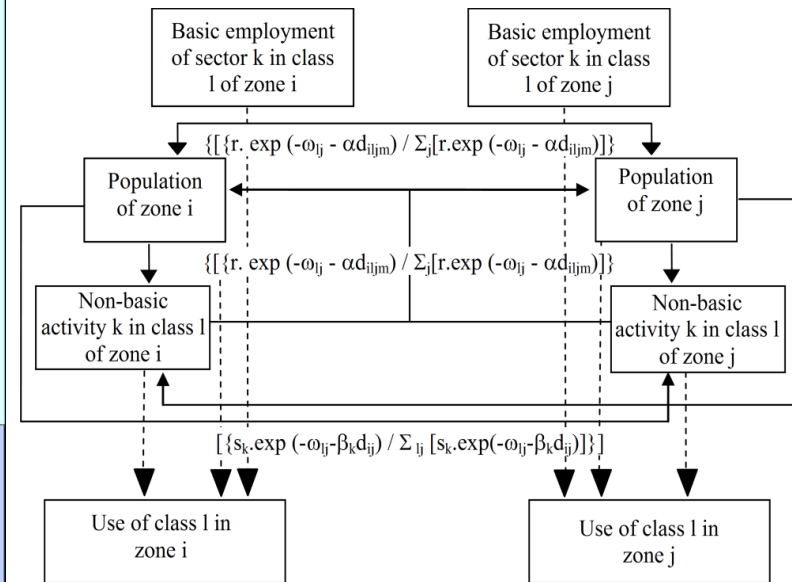
Spatial Interaction  
Model with Land  
Use (Land and  
Men Values and  
Migration)

## Case Study Areas Tahaddart - Tanger(MOROCCO)



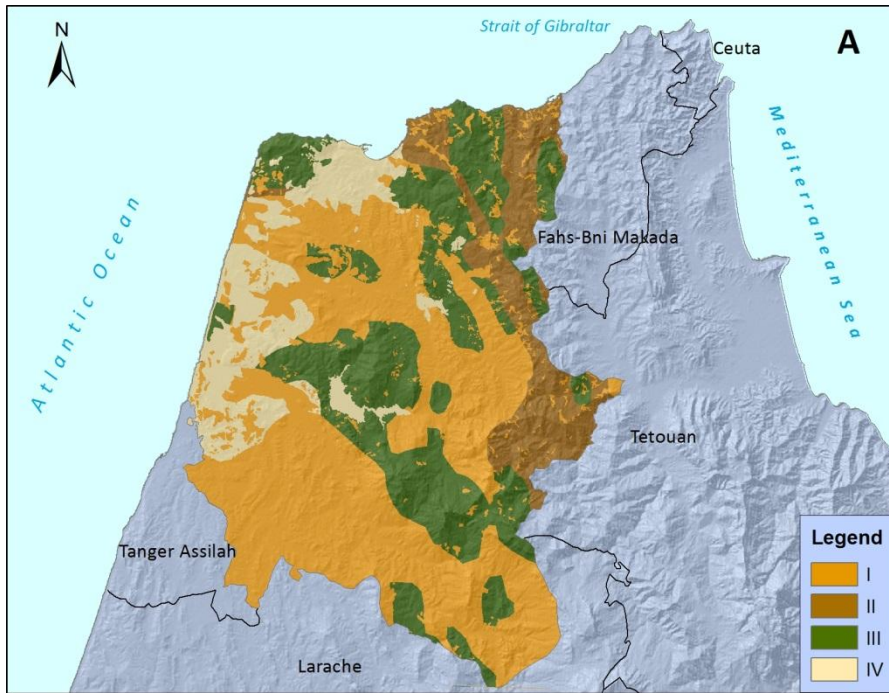


# Spatial Interaction Model With Land Use

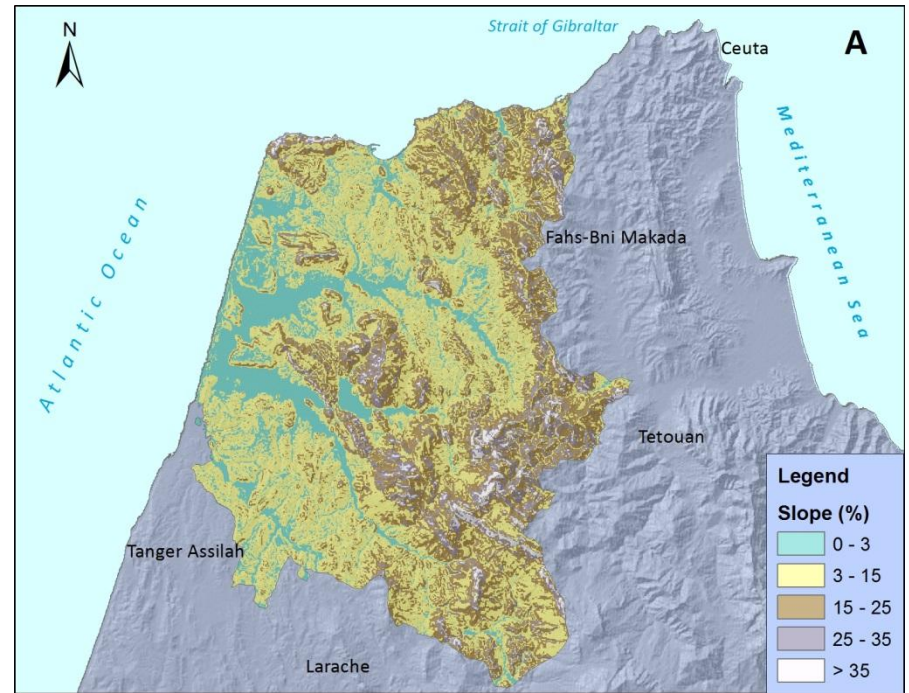


# Methodology

## Suitable Areas for each activity (Variables)

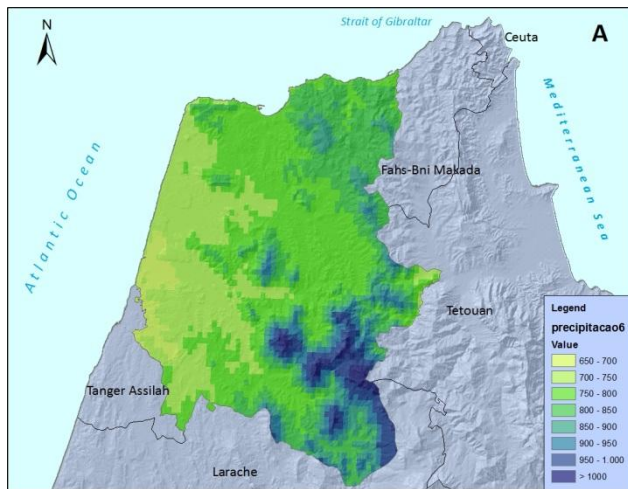


Soils Capability

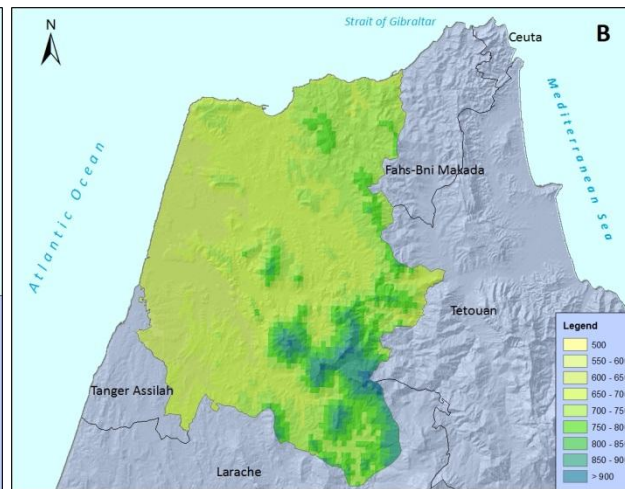


Slope

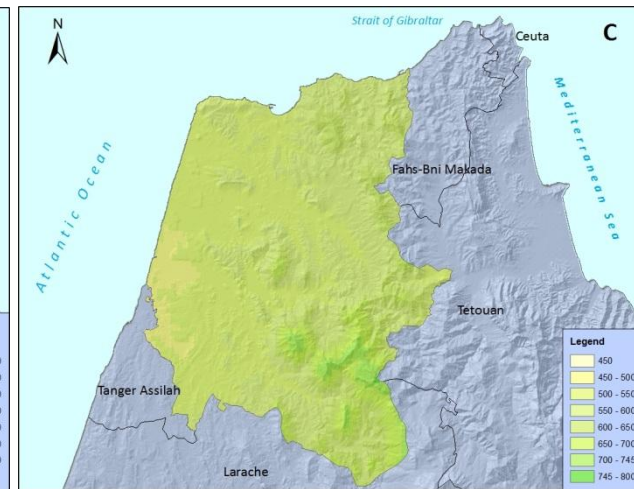
## Suitable Areas for each activity (Variables)



Annual Accumulated Rainfall (actual scenario)

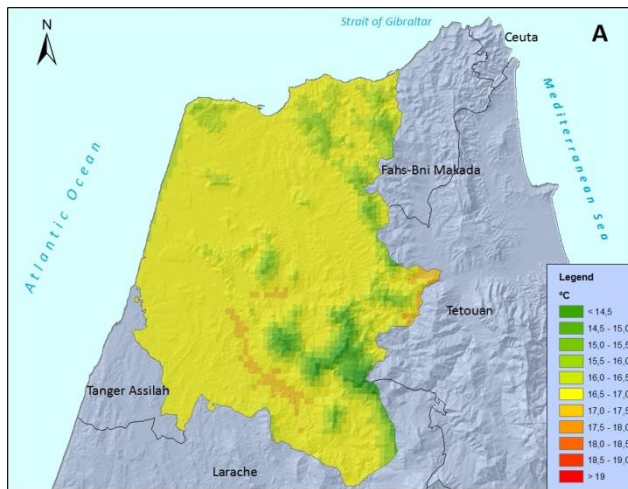


Annual Accumulated Rainfall (scenario A1b)

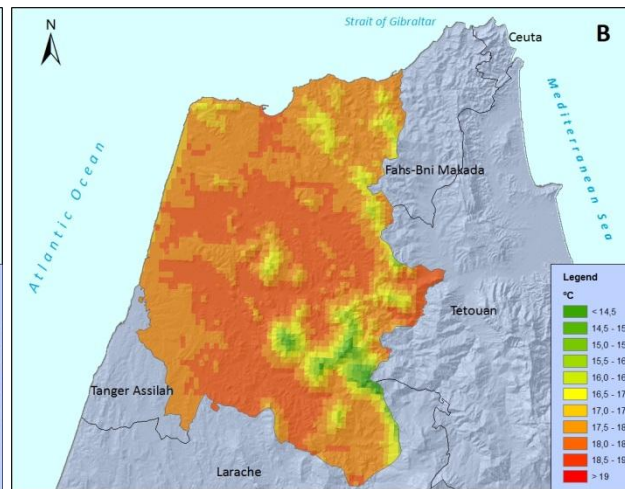


Annual Accumulated Rainfall (scenario A2)

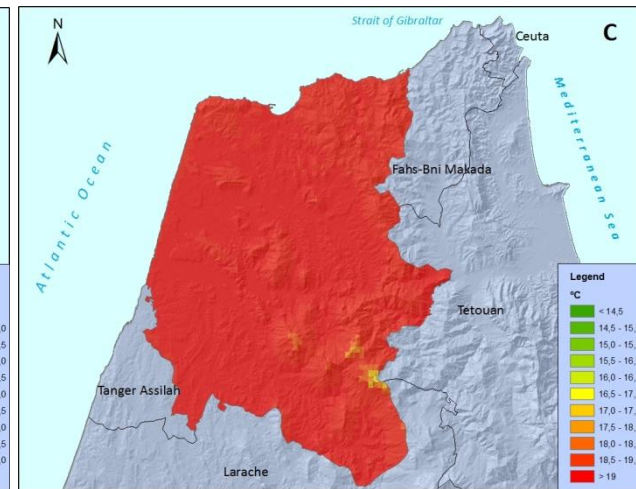
## Suitable Areas for each activity (Variables)



Annual Average Temperature (actual scenario)



Annual Average Temperature (scenario A1b)



Annual Average Temperature (scenario A2)

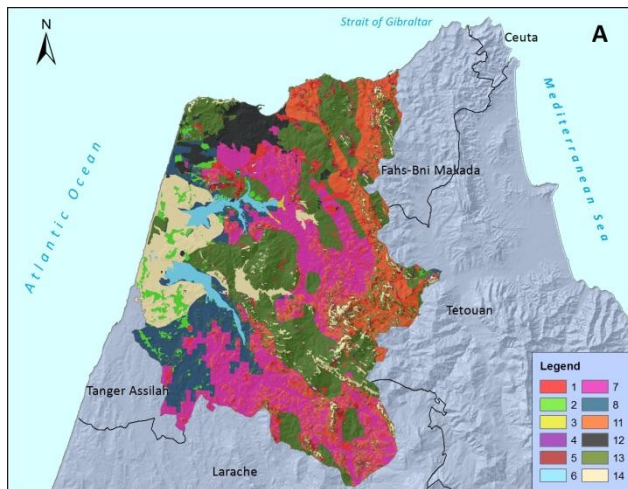
## Suitable Areas for each activity (Variables)

Factor	Activities (Uses)					
	<i>Urban</i>	<i>Rural Dwellers</i>	<i>Irrigated Crops</i>	<i>Dry Crops</i>	<i>Pasture</i>	<i>Forest</i>
<i>Annual Average Temperature I (°C)</i>	-	$\geq 14$	$\geq 14$	$\geq 14$	12,5	0
<i>Annual Accumulated Rainfall (mm)</i>	-	-	-	$\geq 550$	$\geq 650$	$\geq 400$
<i>Slope (%)</i>	0 - 25	0 - 25	0 - 5	0 - 15	0 - 25	0 - 35
<i>Soils Capability</i>	I - V	I - II	I - II	I - II	I - II	I - III

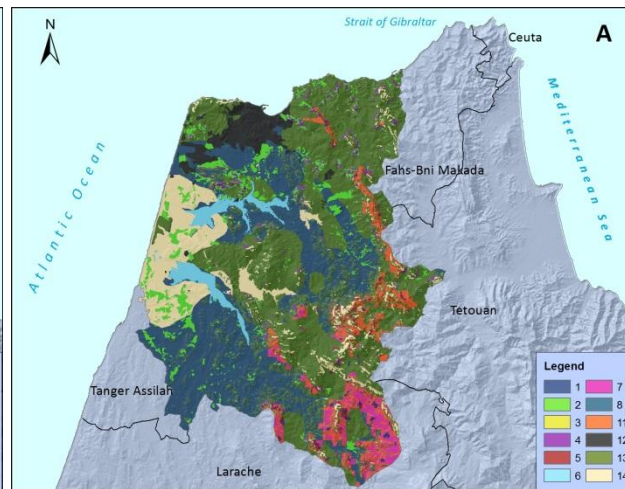
## Suitable Areas for each activity (Variables)

Class	Activities (Uses)						
	Urban	Rural Dwellers	Irrigated Crops	Dry Crops	Pasture	Forest	
1		X	-	X	X	X	
2		X	-	X	-	X	
3	-	-	X	X	X	X	
4	-	X	-	-	-	X	
5	-	X	-	-	X	X	
6	-	-	X	X	-	X	
7	-	-	-	X	X	X	
8	-	-	-	X	-	X	
9	-	-	X	-	-	X	
10	-	-	X	-	X	-	
11	-	-	-	-	X	X	
12	X	-	-	-	-	-	
13	-	-	-	-	-	X	
14	-	-	-	-	-	-	

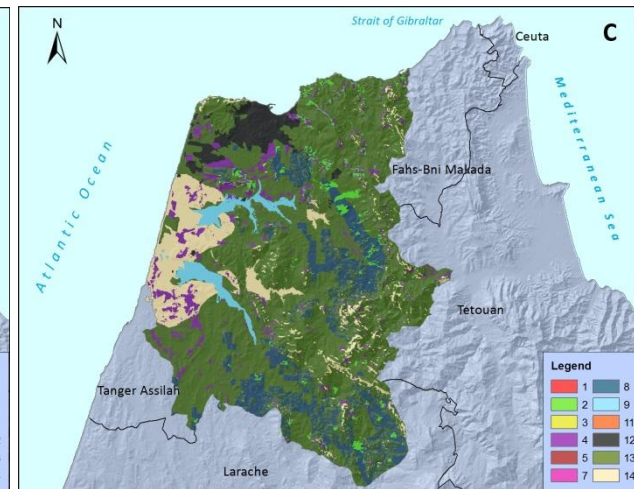
## Suitable Areas for each activity (Class)



Classes (actual scenario)



Classes (scenario A1b)



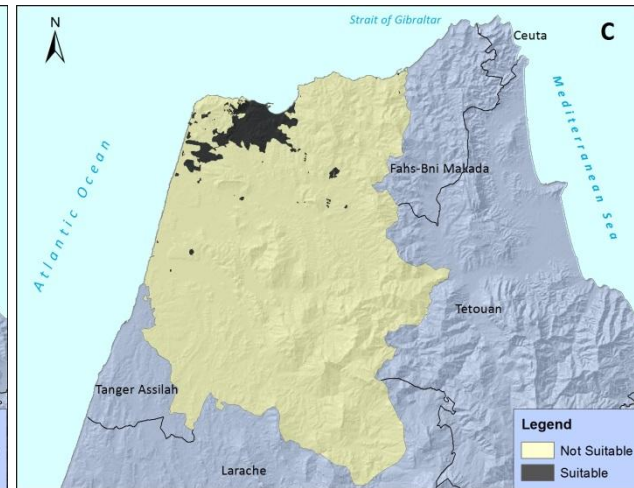
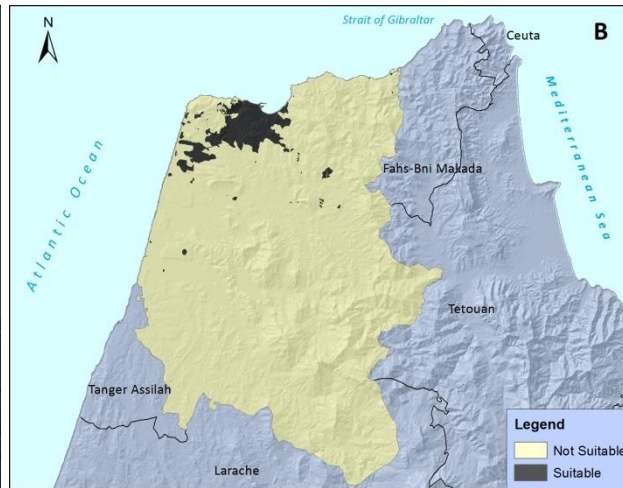
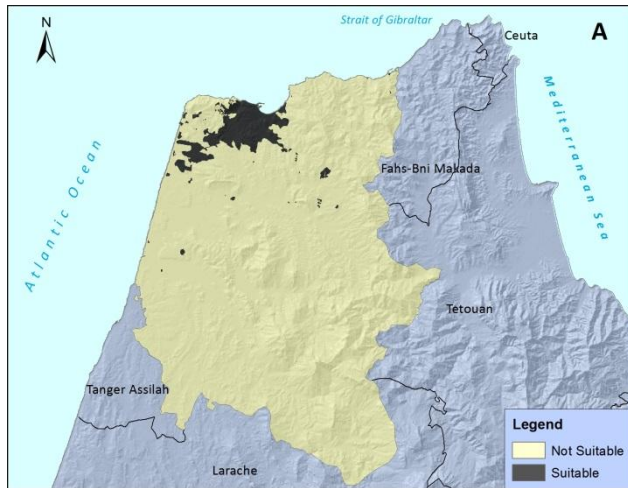
Classes (scenario A2)

## Suitable Areas for each activity

Urban (actual scenario)

Urban (scenario A1b)

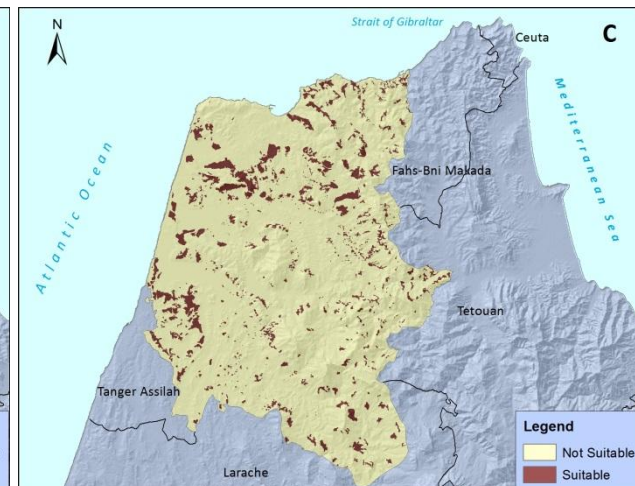
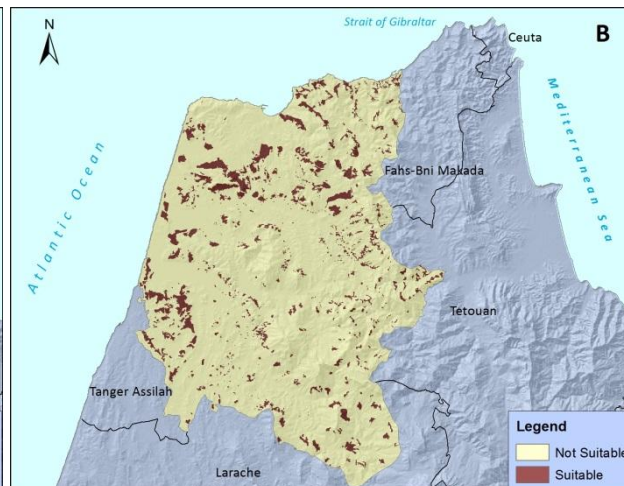
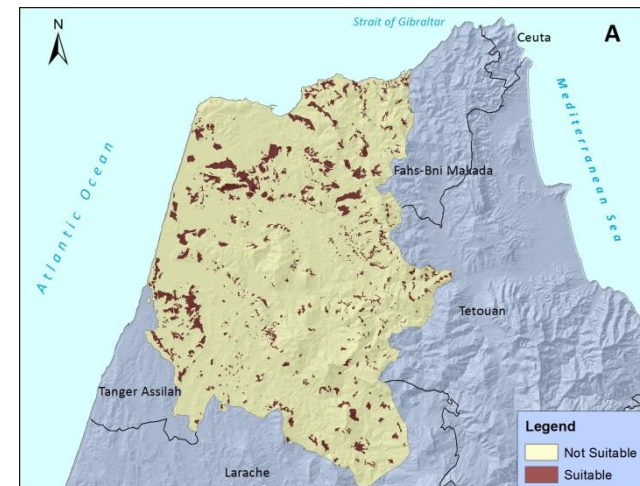
Urban (scenario A2)



Rural Dwellers (actual scenario)

Rural Dwellers (scenario A1b)

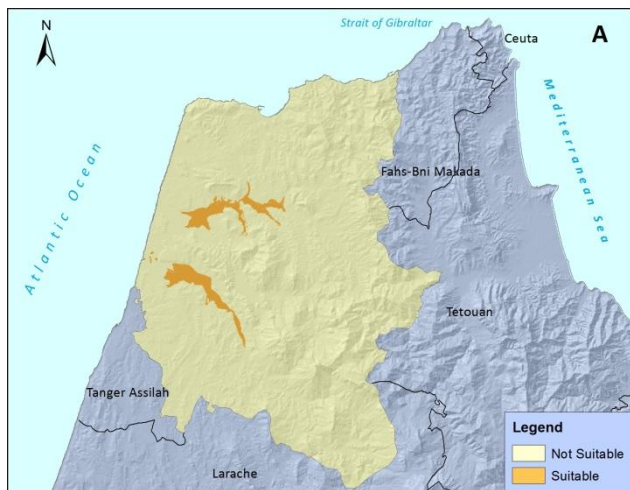
Rural Dwellers (scenario A2)



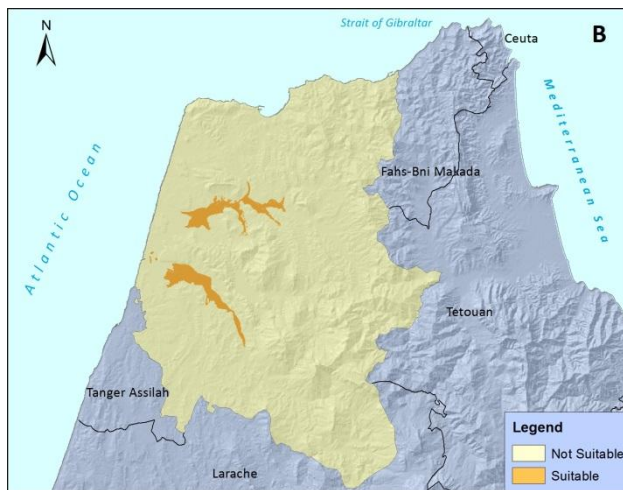


## Suitable Areas for each activity

Irrigated Crops (actual scenario)



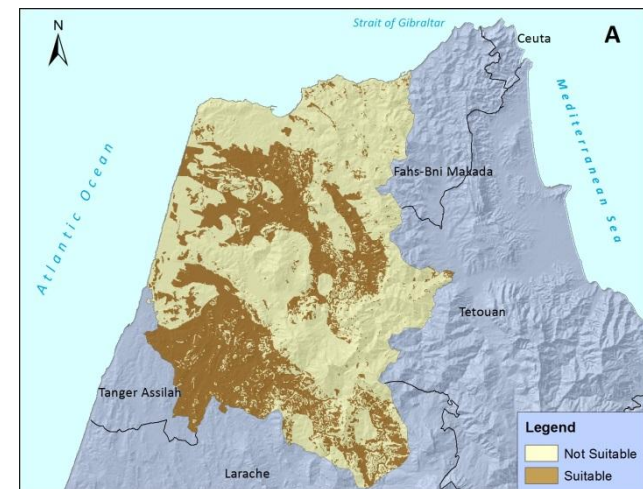
Irrigated Crops (scenario A1b)



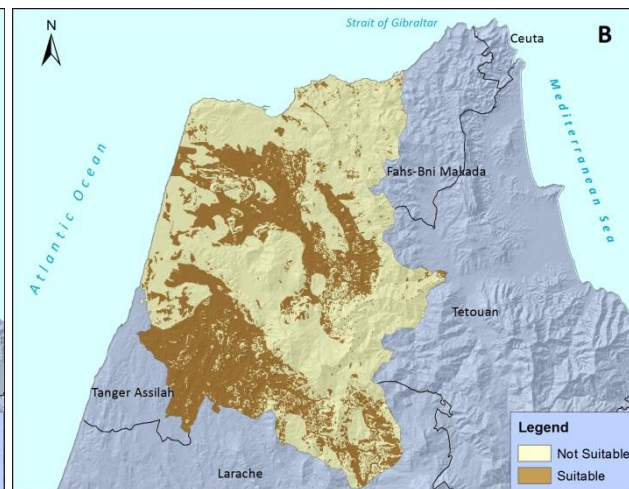
Irrigated Crops (scenario A2)



Dry Crops(actual scenario)



Dry Crops (scenario A1b)



Dry Crops (scenario A2)



## Suitable Areas for each activity

Pasture (actual scenario)



Pasture (scenario A1b)



Pasture (scenario A2)



Forest (actual scenario)



Forest (scenario A1b)



Forest (scenario A2)



# Results

## Land Use Occupation Actual Scenario

## Employment Distribution Actual Scenario

Basic Employment Actual Scenario		Zone A	Zone B	Zone C	Total
	Urban	83113	3558	0	86671
	Rural Areas	987	1278	3068	5332
	Irrigated	0	587	361	948
	Dry Crops	89	579	5672	6340
	Pasture	341	712	994	2047
	Forest	15	20	72	107
Non Basic Employment Actual Scenario	Urban	216249	26941	0	243190
	Rural Areas	4868	2997	4667	12532
	Irrigated	0	595	370	965
	Dry Crops	216	626	5701	6542
	Pasture	377	727	1008	2112
	Forest	87	62	118	268
Population		696397	55317	67135	<b>818879</b>
Total Basic Employment		84544	6734	10167	<b>101445</b>
Total Non-Basic Employment		221797	31948	11864	<b>265609</b>
	Activities	Zone A	Zone B	Zone C	Total
Available Areas Actual Scenario (ha)	Urban	6076,8	2204,9	0,0	8281,7
	Rural Areas	3957,9	6777,4	7408,3	18143,6
	Irrigated	0,0	3573,3	2197,5	5770,7
	Dry Crops	3448,2	21907,4	51021,8	76377,4
	Pasture	14013,6	15937,6	55485,9	85437,1
	Forest	31216,0	35759,0	110928,5	177903,6
	Total	58712,6	86159,5	227042,0	371914,1
	Occupied Areas Actual Scenario (ha)	Urban	5988,6	470,0	0,0
Rural Areas		4165,9	2705,0	4231,1	11102,0
Irrigated		0,0	3569,7	2219,5	5789,3
Dry Crops		1716,6	5013,4	45608,7	52338,7
Pasture		5271,4	10182,8	14109,1	29563,3
Forest		2180,6	1549,9	2958,1	6688,7
Total		19323,2	23490,8	69126,6	111940,5

## Distances between each zone

	Zona A	Zona B	Zona C	Zona D
Zona A	10	32	58	160
Zona B	32	7	65	157
Zona C	58	65	12	162
Zona D	160	157	162	-

# Results

Simulations of 4 scenarios

**A1b – a**

No reoccupation of the territory by others activities

**A1b – b**

reoccupation of the territory by others activities

**A2 – a**

No reoccupation of the territory by others activities

**A2 – b**

reoccupation of the territory by others activities

# Results

## A1b a

## A1b b

Basic Employment Scenario A1b - a		Zone A	Zone B	Zone C	Total
	Urban	82543	3488	0	86031
	Rural Areas	987	1278	3068	5333
	Irrigated	0	580	360	940
	Dry Crops	56	612	5672	6340
	Pasture	22	17	375	414
	Forest	15	20	72	107
	Non Basic Employment Scenario A1b - a	Urban	214412	26259	0
Rural Areas	4538	2697	4685	11920	
Irrigated	0	594	370	964	
Dry Crops	212	649	5701	6562	
Pasture	28	20	386	434	
Forest	86	61	117	264	
Population		685190	54427	66055	<b>805671</b>
Total Basic Employment		84193	6071	9548	99812
Total Non-Basic Employment		219275	30281	11259	260816

Basic Employment Scenario A1b - b		Zone A	Zone B	Zone C	Total
	Urban	83052	3520	0	86572
	Rural Areas	987	1313	3068	5368
	Irrigated	0	588	361	949
	Dry Crops	56	1478	5682	7216
	Pasture	22	17	375	414
	Forest	19	25	72	116
	Non Basic Employment Scenario A1b - b	Urban	214551	27541	0
Rural Areas	4541	2827	4752	12121	
Irrigated	0	596	370	966	
Dry Crops	212	1517	5713	7441	
Pasture	28	20	387	435	
Forest	90	67	118	275	
Population		691512	54929	66664	<b>813105</b>
Total Basic Employment		84197	6978	9558	100733
Total Non-Basic Employment		219423	32568	11340	263330

The population decreases in comparison with the current scenario:

A1b – a : - 13 208

A1b – b : - 5774

# Results

## A2 - a

## A2 - b

Basic Employment Scenario A1b - a		Zone A	Zone B	Zone C	Total
	Urban	83113	3558	0	86671
	Rural Areas	987	1278	3068	5332
	Irrigated	0	575	351	926
	Dry Crops	58	133	2439	2630
	Pasture	0	0	0	0
	Forest	15	20	72	107
	Non Basic Employment Scenario A1b - a	Urban	213677	20598	0
Rural Areas	3954	2689	3985	13378	
Irrigated	0	582	356	92	
Dry Crops	148	166	2456	201	
Pasture	0	0	0	103	
Forest	86	62	110	54	
Population	683061	51245	37902	<b>772208</b>	
Total Basic Employment	84173	5564	5930	95666	
Total Non-Basic Employment	217864	24098	6907	13829	

Basic Employment Scenario A1b - b		Zone A	Zone B	Zone C	Total
	Urban	83113	3558	0	86671
	Rural Areas	987	1378	3268	5632
	Irrigated	0	575	358	933
	Dry Crops	69	283	2569	2922
	Pasture	0	0	0	0
	Forest	15	20	102	137
	Non Basic Employment Scenario A1b - b	Urban	213748	21496	0
Rural Areas	3955	2852	4236	13386	
Irrigated	0	582	363	92	
Dry Crops	159	318	2587	201	
Pasture	0	0	0	104	
Forest	86	63	141	54	
Population	683434	53824	40023	<b>777281</b>	
Total Basic Employment	84184	5814	6297	96295	
Total Non-Basic Employment	217949	25311	7327	13837	

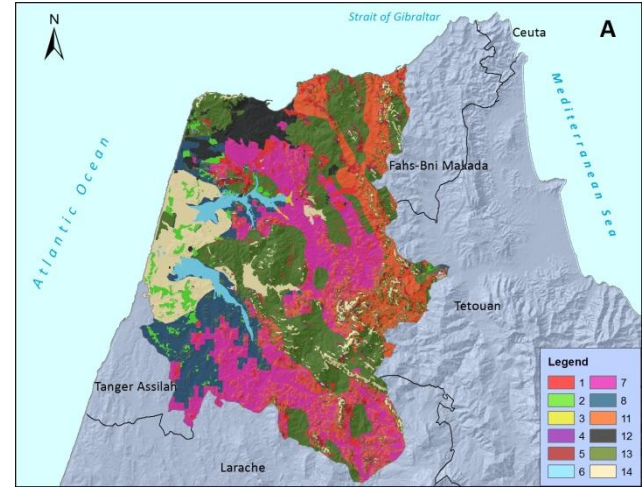
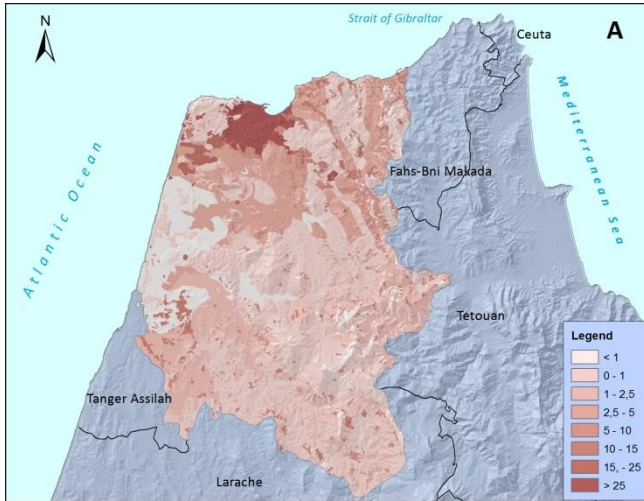
The population decreases in comparison with the current scenario:

A2 – a : - 46 671

A2 – b : 41 598

Population in rural areas is most affected

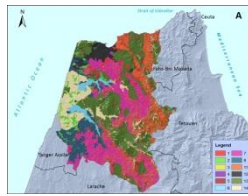
### Actual Scenario



### Bid Rents

		Zone A											
Class	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	
Actual Scenario	14,64	13,82	0	14,03	14,14	0	9,21	0	0	0	5	38,37	
		Zone B											
Class	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	
Actual Scenario	1,05	1,12	1,44	1,05	0,78	0,25	0,21	0,46	0	0	4,46	26,12	
		Zone C											
Class	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	
Actual Scenario	3,48	4,5	0,91	1,05	0,01	23	0	0	0	0	1,78	0	

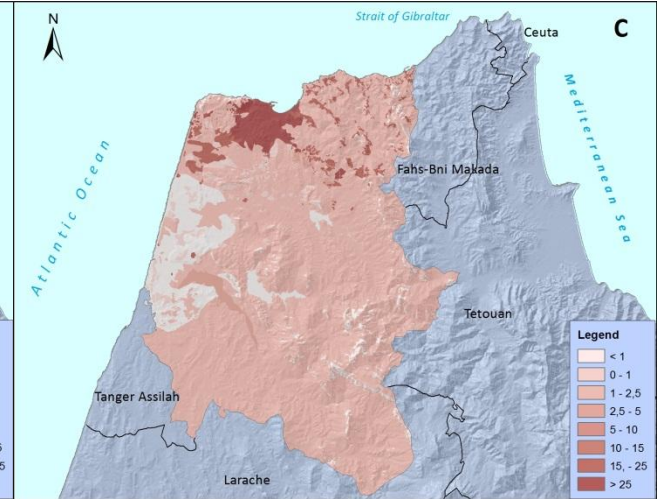
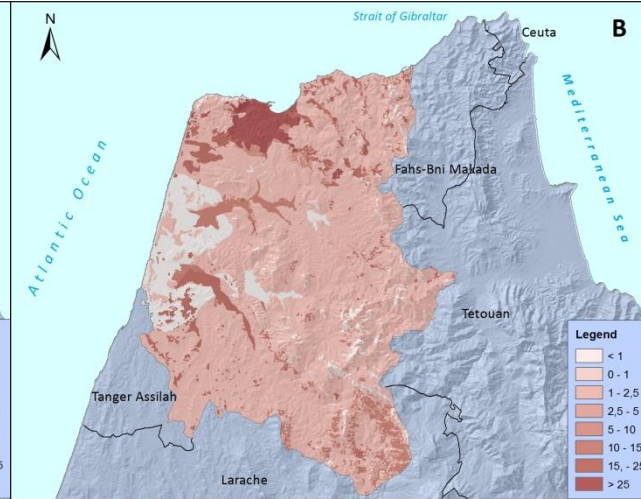
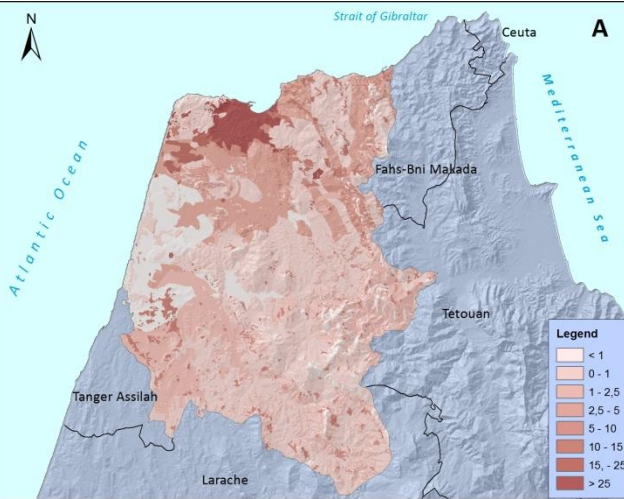
Spatial Interaction Model with Land Use (Land and Men Values and Migration)



**Actual Scenario**

**A1b - a**

**A2 - a**



Zone A												
Class	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
Actual Scenario	14,64	13,82	0	14,03	14,14	0	9,21	0	0	0	5	38,37
Scenario A1b	19,11	19,75	0	19,64	19,3	0	0	8,57	0	0	5,25	37,21
Scenario A2	0	19,53	0	19,75	0	0	0	4,09	0	0	5,32	36,13
Zone A												
Class	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
Actual Scenario	0	0	0	0	0	0	0	0	0	0	0	0
Scenario A1b	4,47	5,93	0	5,61	5,16	0	-9,21	8,57	0	0	0,25	-1,16
Scenario A2	-14,64	5,71	0	5,72	-14,14	0	-9,21	4,09	0	0	0,32	-2,24



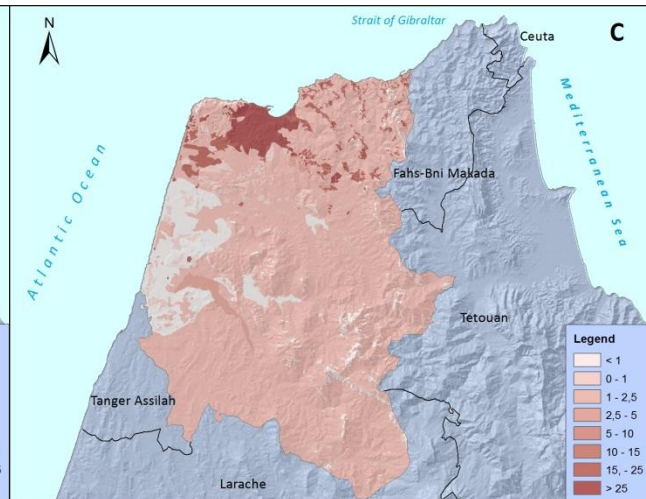
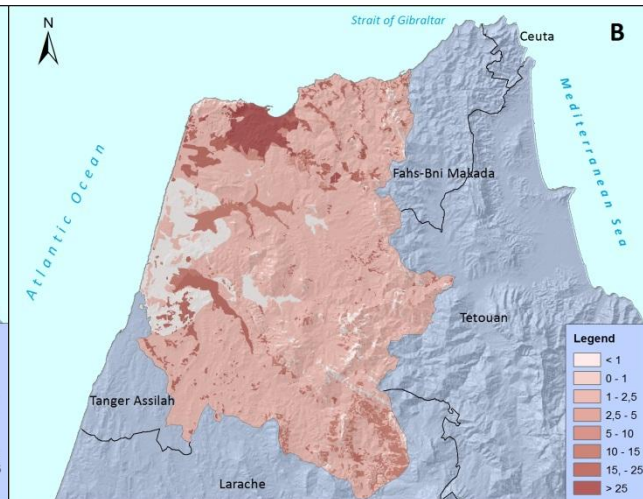
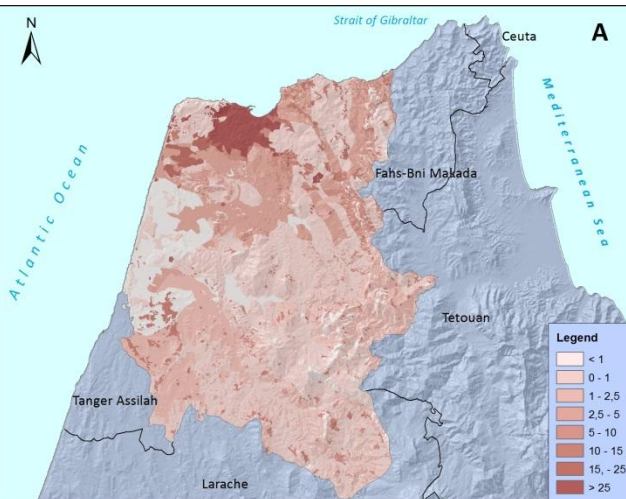
Spatial Interaction Model with Land Use (Land and Men Values and Migration)



### Actual Scenario

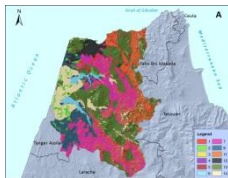
### A1b - a

### A2 - a



Bid Re	Zone B											
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
Actual Scenario	1,05	1,12	1,44	1,05	0,78	0,25	0,21	0,46	0	0	4,46	26,12
Scenario A1b	1,42	1,33	0	1,34	0,08	13,35	0	1,12	0	0	2,5	25,45
Scenario A2	0	1,18	0	0,75	0	0	0	1,08	0	0	3,42	25,21
Class	Zone B											
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
Actual Scenario	0	0	0	0	0	0	0	0	0	0	0	0
Scenario A1b	0,37	0,21	-1,44	0,29	-0,7	13,1	-0,21	0,66	0	0	-1,96	-0,67
Scenario A2	-1,05	0,06	-1,44	-0,3	-0,78	-0,25	-0,21	0,62	0	0	-1,04	-0,91

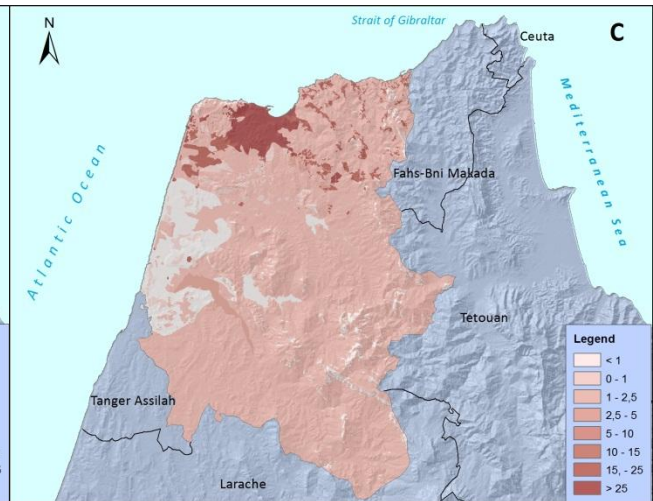
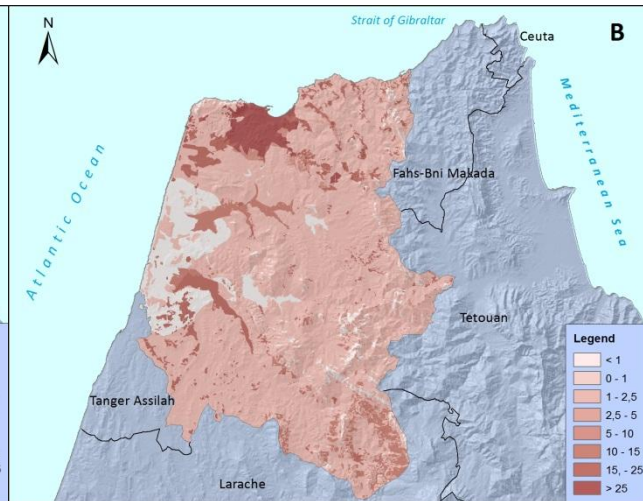
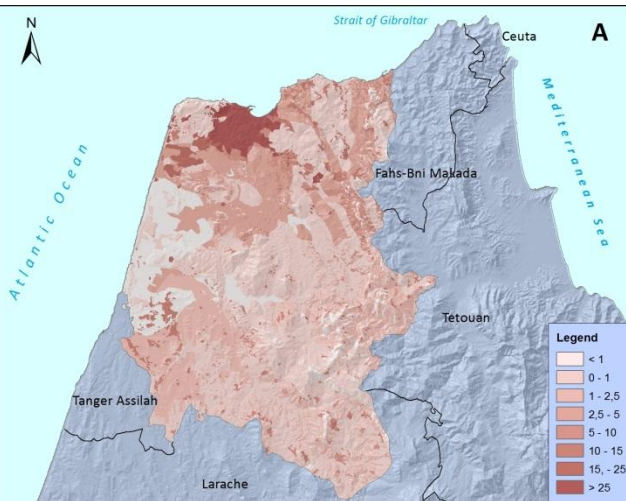
Spatial Interaction Model with Land Use (Land and Men Values and Migration)



**Actual Scenario**

**A1b - a**

**A2 - a**



Zone C														
Class	C13	C14	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
Actual Scenario	1,78	0	3,48	4,5	0,91	1,05	0,01	23	0	0	0	0	1,78	0
Scenario A1b	1,21	0	10,9	22,75	0	1,33	1,05	21,43	11,34	0	0	0	2,62	0
Scenario A2	1,01	0	0	1,22	0	1,48	0	0	0	4,33	5,23	0	2,55	0
Zone C														
Class	C13	C14	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
Actual Scenario	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenario A1b	-0,57	0	7,42	18,25	-0,91	0,28	1,04	-1,57	11,34	0	0	0	0,84	0
Scenario A2	-0,77	0	-3,48	-3,28	-0,91	0,43	-0,01	-23	0	4,33	5,23	0	0,77	0

# Further Work

The Harris and Wilson hypothesis is

$$\Delta W_j(t, t + 1) = \varepsilon [D_j(t) - KW_j(t)] W_j(t)$$

