ROYAUME DU MAROC

Ministère de l'Agriculture et de la Pêche Maritime

المغرب الاخضر
LE MAROC VERT

Direction of Strategy and statistics

Statistical Division

Use of Remote Sensing and GIS for building and updating Area Frame Sampling

Statistics Division

Crop yield forecasting based on remote sensing 12-14 October 2011, Rabat, Morocco

PRESENTATION OF THE AREA FRAME SAMPLING

Area Frame Sampling : (FAO)

Survey based on area frame

- Probabilstic survey where the sampling units
- at the last stage are pieces of land called "segments "

Survey based on area frame

- Probabilstic survey where the sampling units are pieces of land, at least, in one of the stage of sampling

We speak of an area frame survey when the sampling units are defined on a cartographic representation of the surveyed area

In Morocco : AFS is used for conducting agriculture surveys.

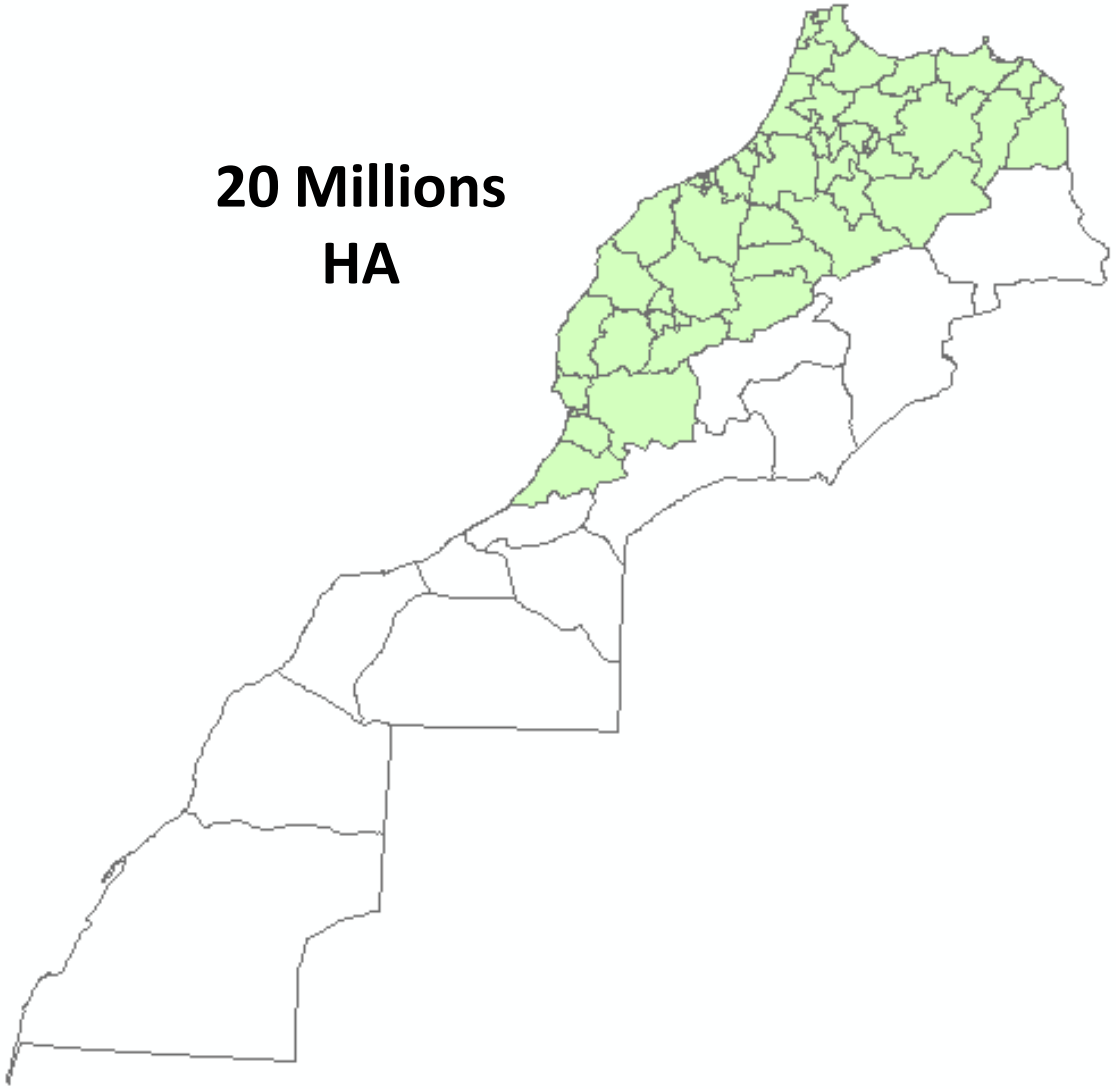
Actually we have two Frames Sampling for national survey:

- Area frame Sampling
- Liste Frame

1. **Area frame Sampling** : 95 % (of land with high agronomic potentiel)

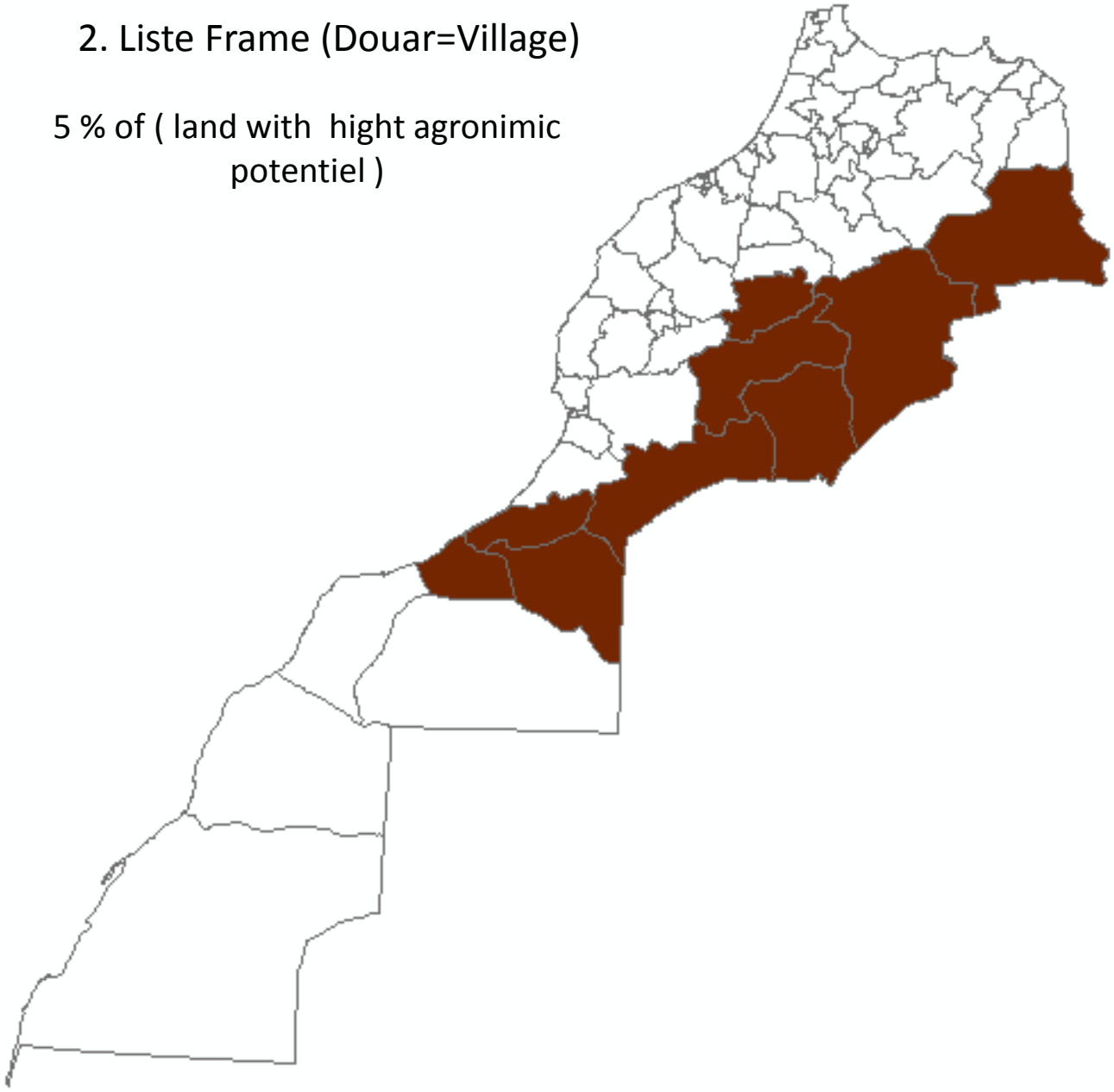
Stratum Number	Name of Strata
10	Rainfed area
20	Irrigated Land
30	Plantations
40	Forest
50	Ranges (pastures)
60	Small Towns
70	Cities
80	Villages (Douars)
90	Uncultivated area
100	Water

20 Millions HA



2. Liste Frame (Douar=Village)

5 % of (land with hight agronimic potentiel)

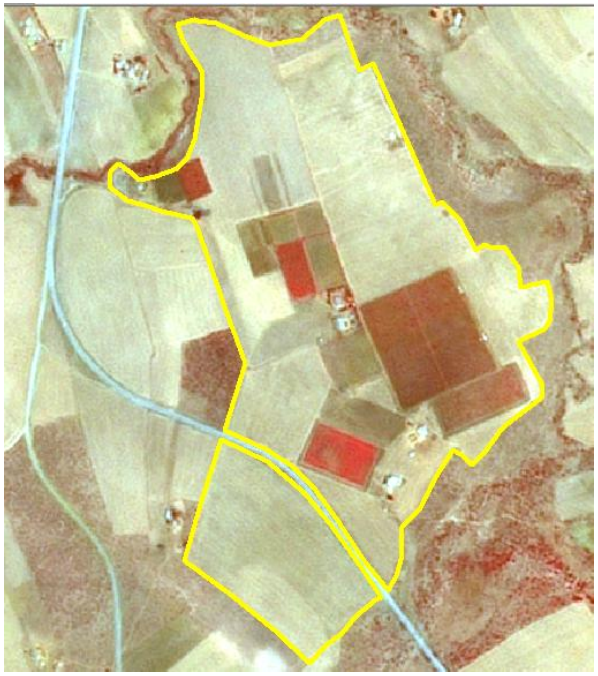


Statistics estimates for crops

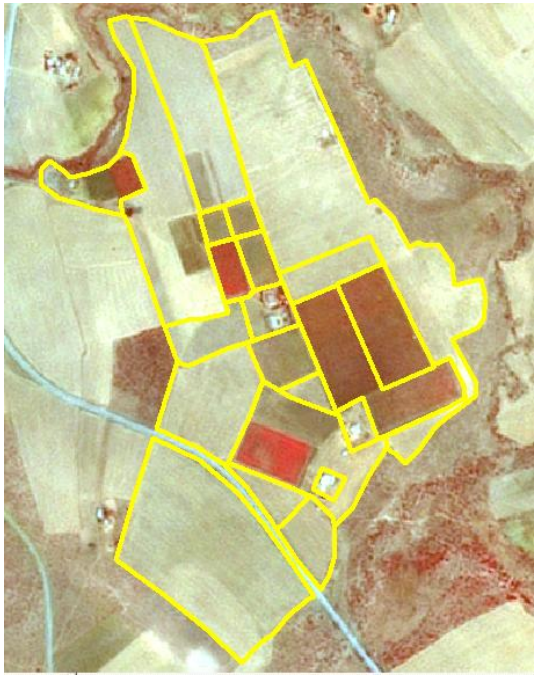
National sample

3000 Segments

Segment



Segment with parcels



the segment is subdivided into plots on which it collects information

Generally, AFS includes the following basic steps :

1) Prepration of the area frame
2) Establishment of the area frame
   2.1. Stratification
   2.2. Zoning and digitalisation of the zones (PSUs)
3) Selection of PSUs
4) Localisation of PSUs on the aerial photo and subdivide the PSUs on segments (SSUs)
5) Selection of the (SSUs)
6) Enlargement the photo of the SSUs
7) Identification of the boundaries of the SSUs on the field

Problems faced with the actaual area frame sampling

- **An old Frame : (> 10 years)**

Land utilization within each strata is constantly changing. (segments do not correspond to their stratum's definition)

- **Administratives boundaries** are constantly changing.

- **Urbain growing** (arable land)

- **Deforestation / reforestaion**

Change in area of :

- Irrigation and plantations (olives) area : Agricultural politcies, farm subsidies, projet …

- **Segment size :**
  1) segment boundaries are disappeared , or
  2) the segment contains too many plots to enumerate accurately in a reasonable amount of time.

- **Estimation of live stock ?**

- **The change in the needs of data :** (New strategy in agriculture: Green Morocco Plan: requires an appropriates statistics

What is the Solution ? New sample building

✓ **Improve stratification : Important level ?**

- ❑ Recognation and delineation of strata
- ❑ Collect of informations: (Type of strata, Land utilization , Systems production, type of livestock (intensive or extensive), climat, ……)
- ❑ Digitalisation of strata

❑ **Recognition and delineation of strata**

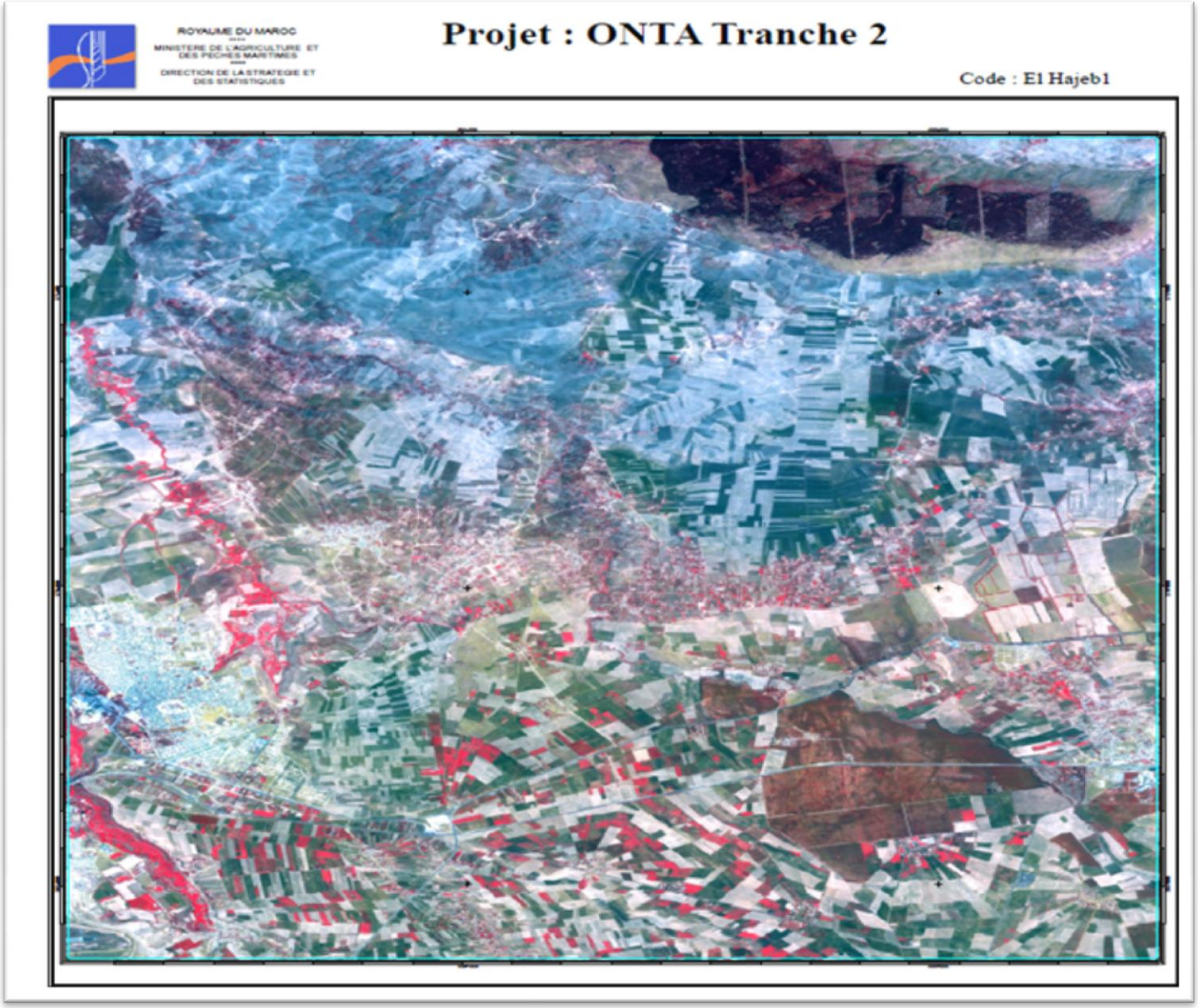
- Photo-interpretation on the orthorectified XS images Spot 5, 10 m

- **Each image is decomposed into 16 cuts of 1 / 25000**

Image (1/100 000)

Cuts (1/25 000)

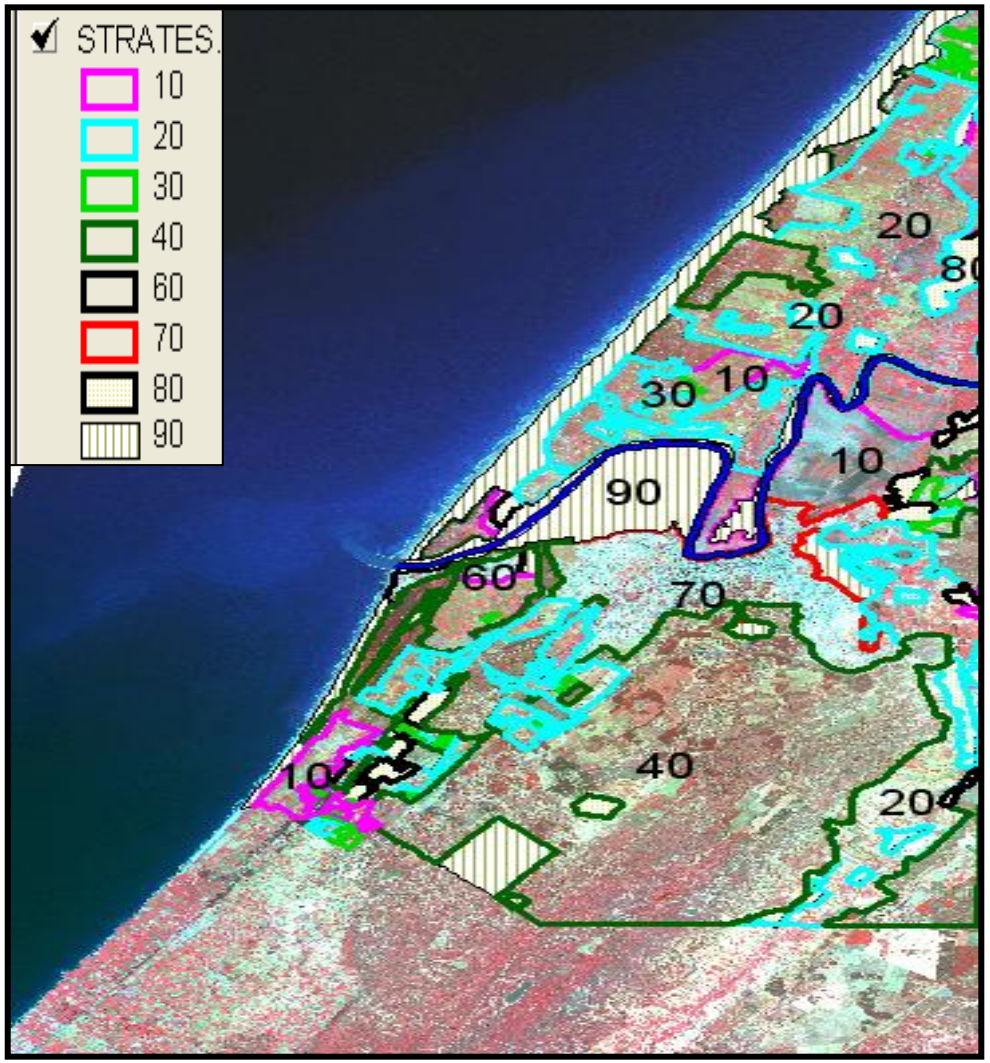
Cuts of 1/25000



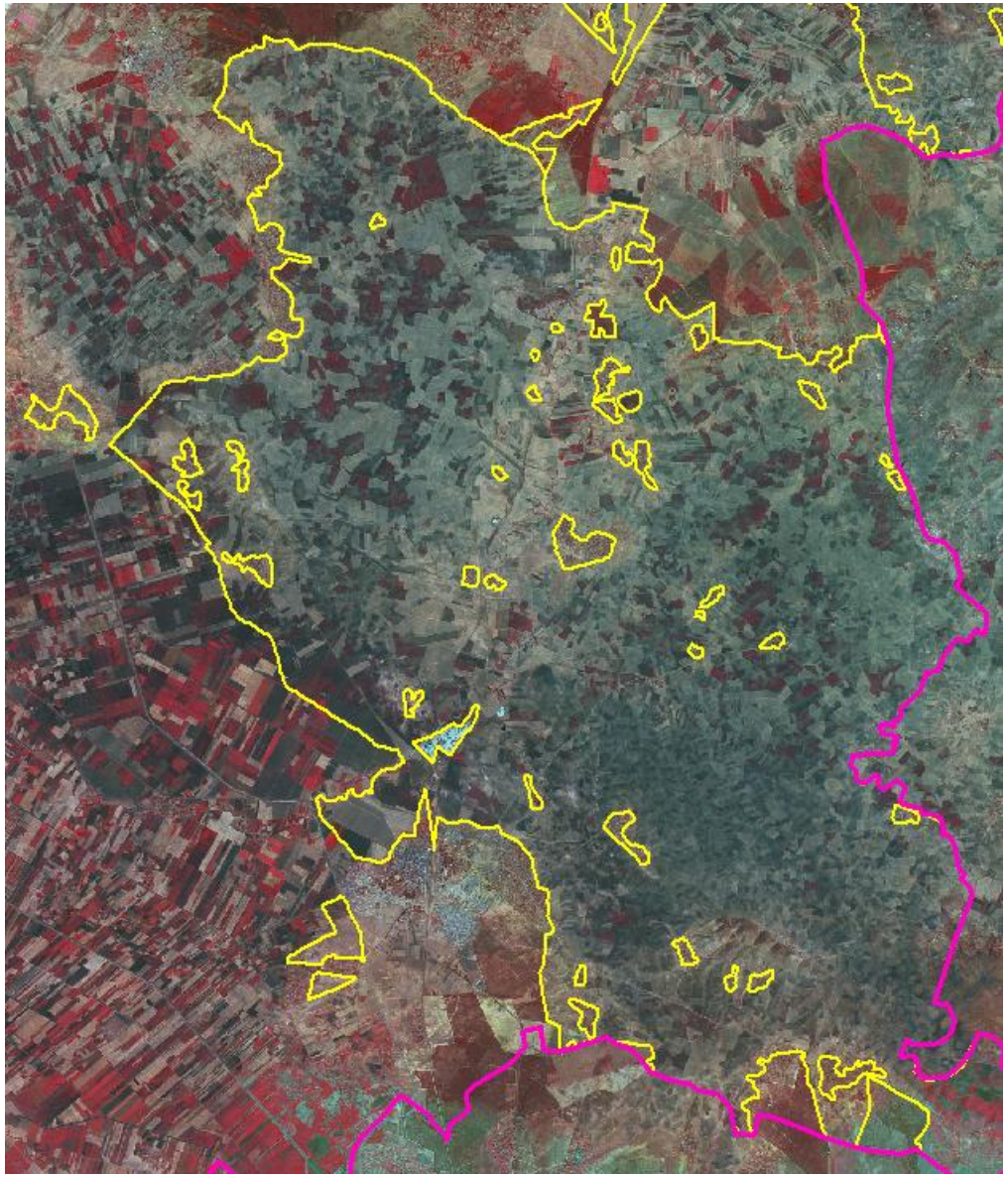
Strata construction
by photo-interpretation of images based on ground truth

Strata:

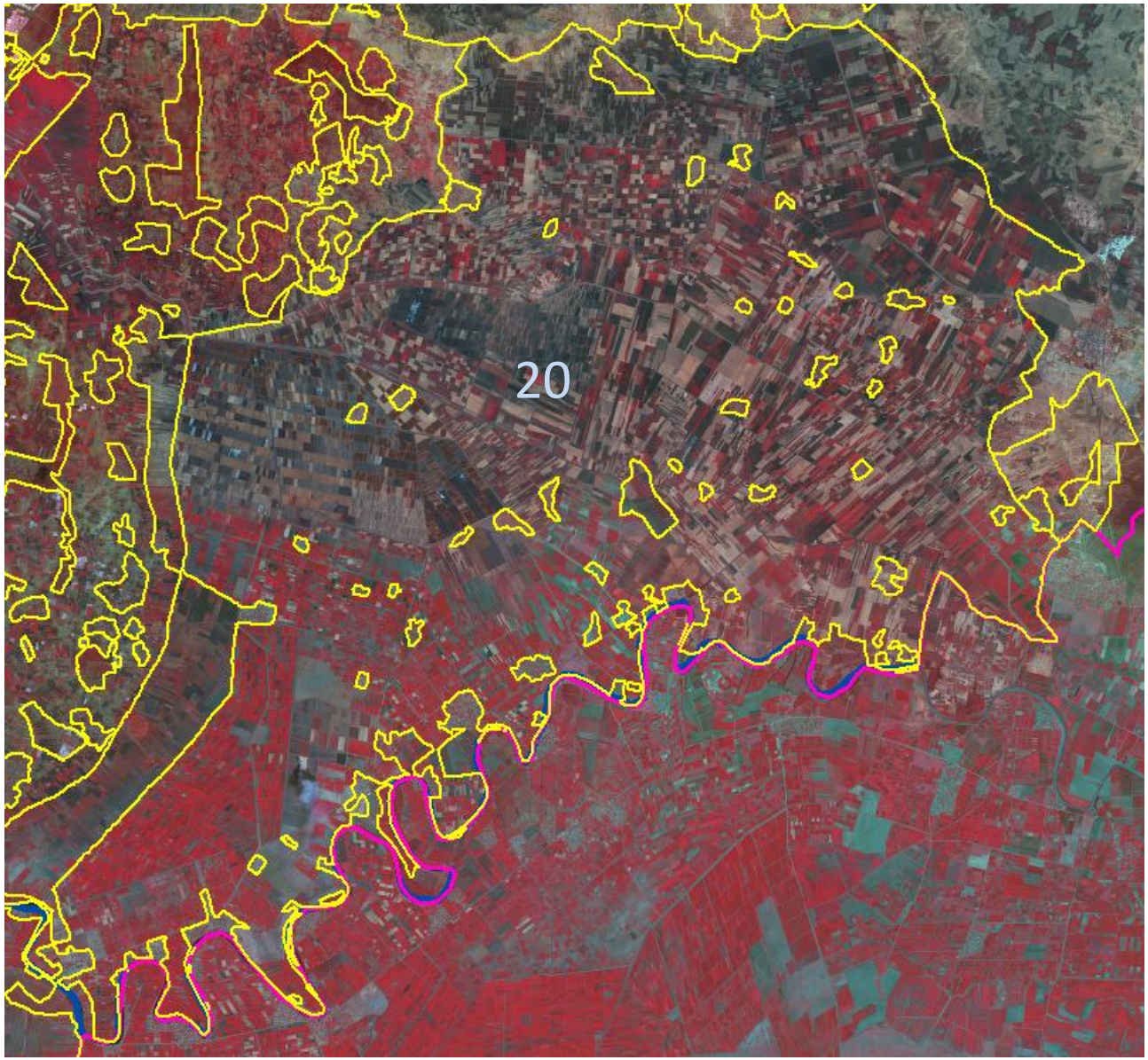
- St.10: Land rainfed area
- St.20: Irrigated Cropland
- St.30: Plantations
- St.40: Forest
- St.50: Ranges (pastures)
- St.60: Small Towns
- St.70: Cities
- St.80: Vilages (Douars)
- **St.90: Uncultuvated area**
- **St.100: Water**



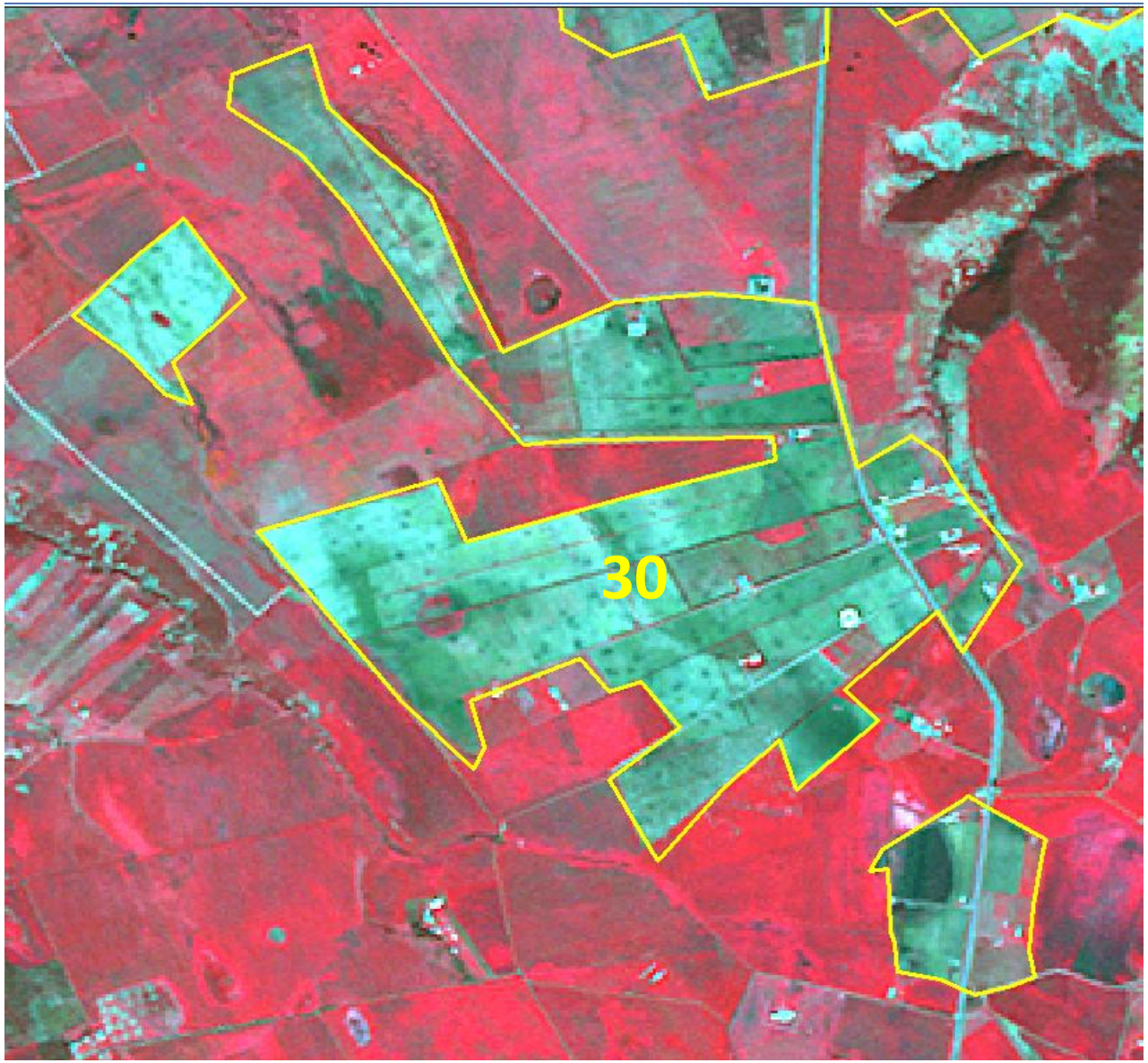
Stratum 10



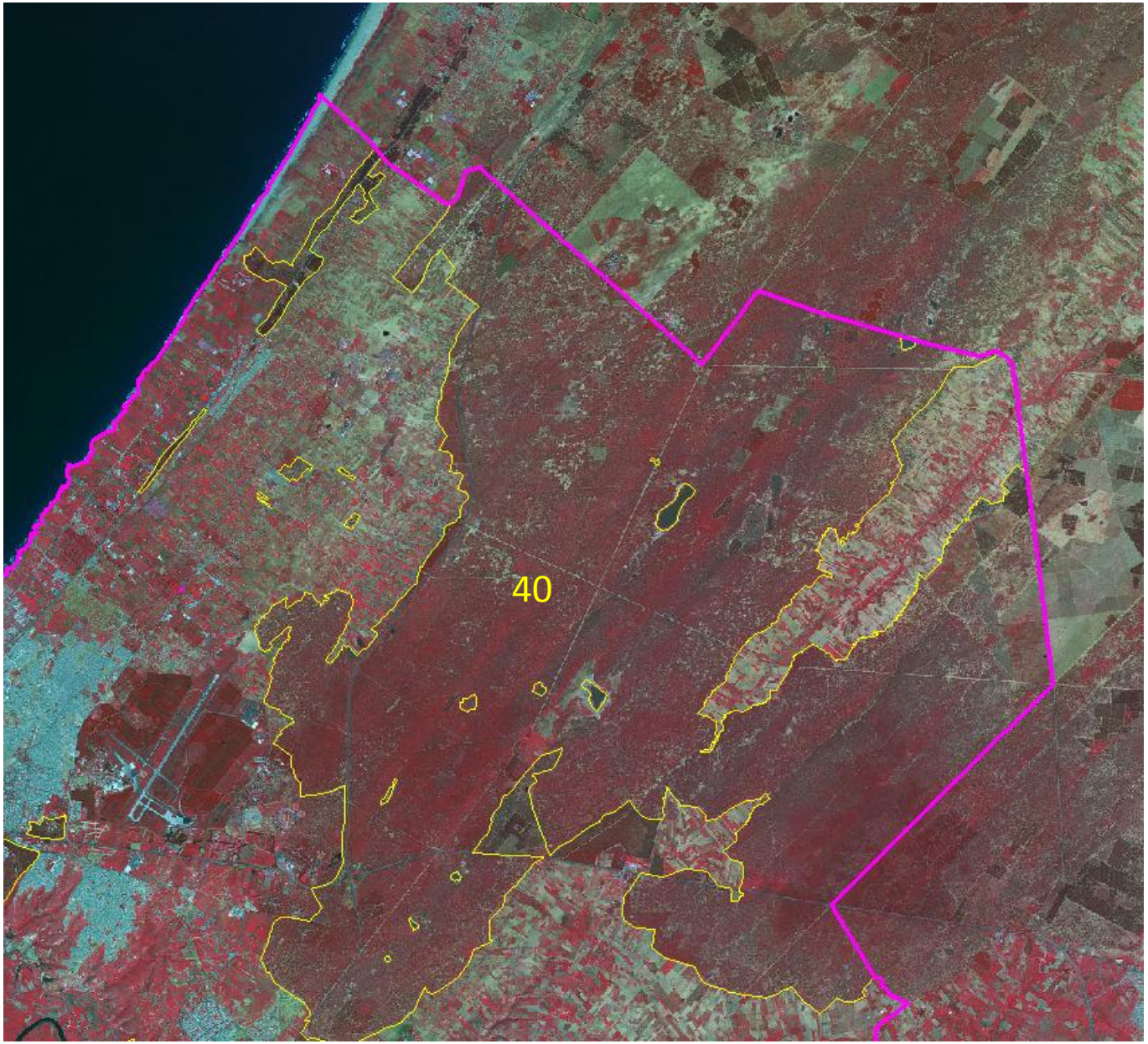
Stratum 20



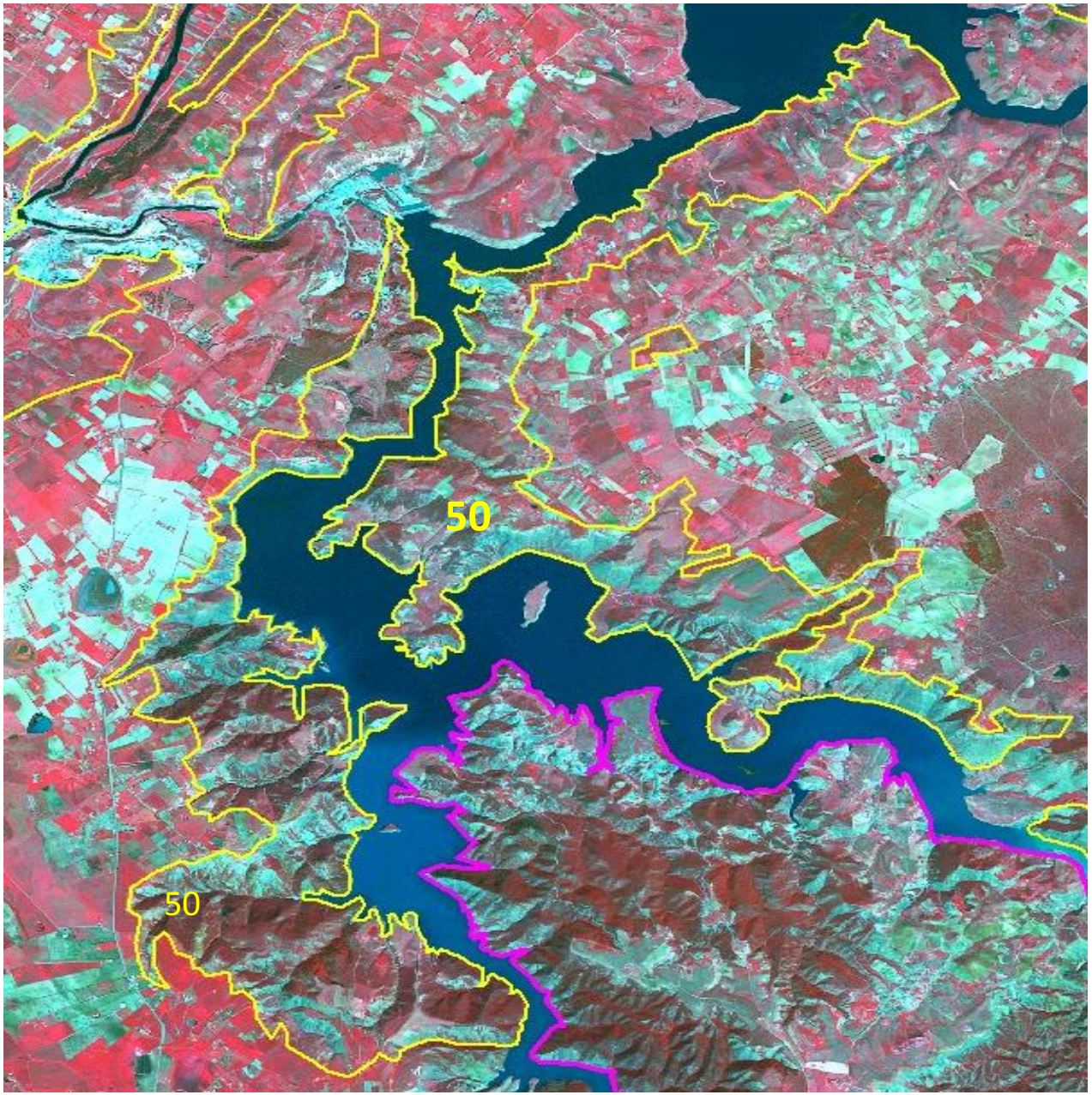
Stratum 30



Stratum 40

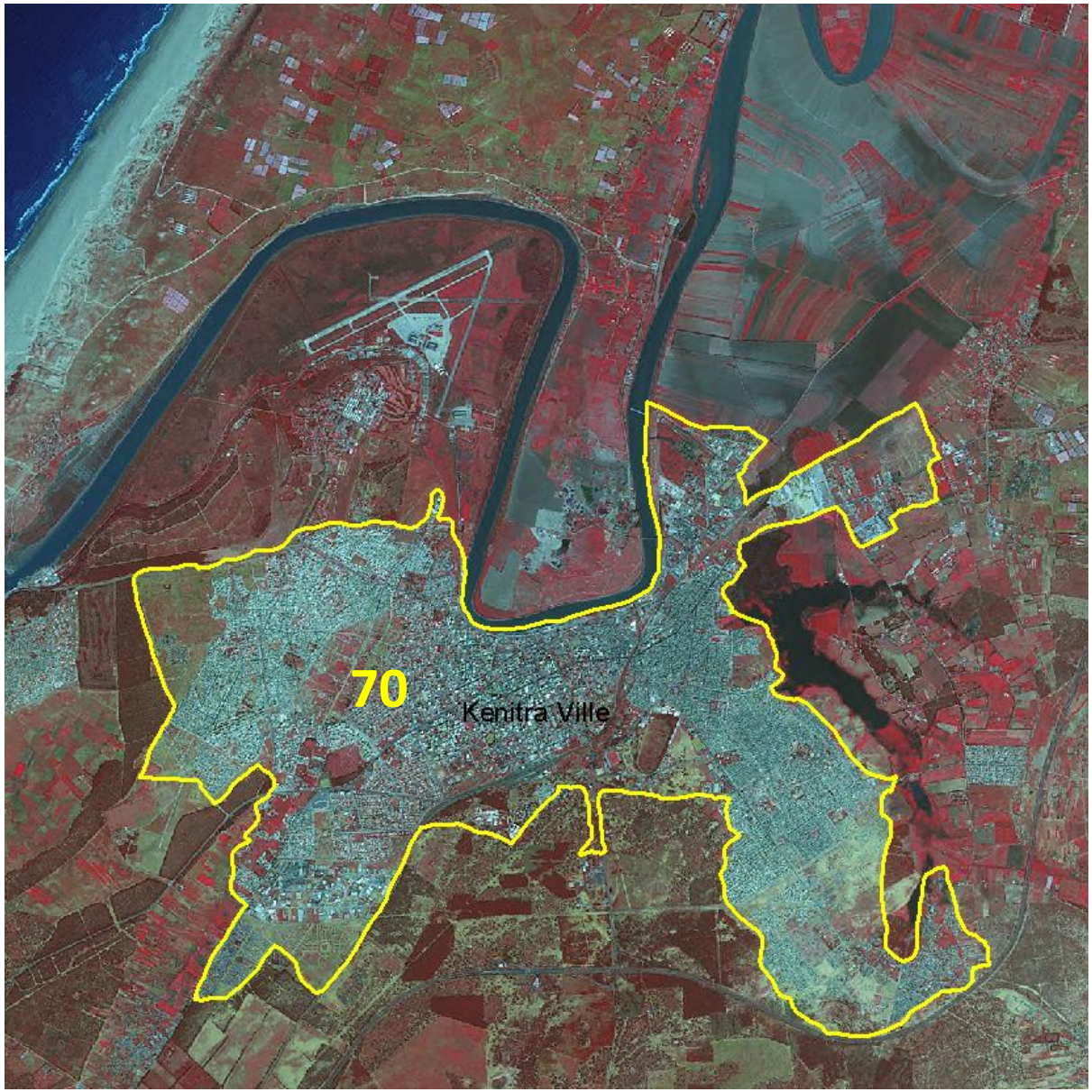


Stratum 50

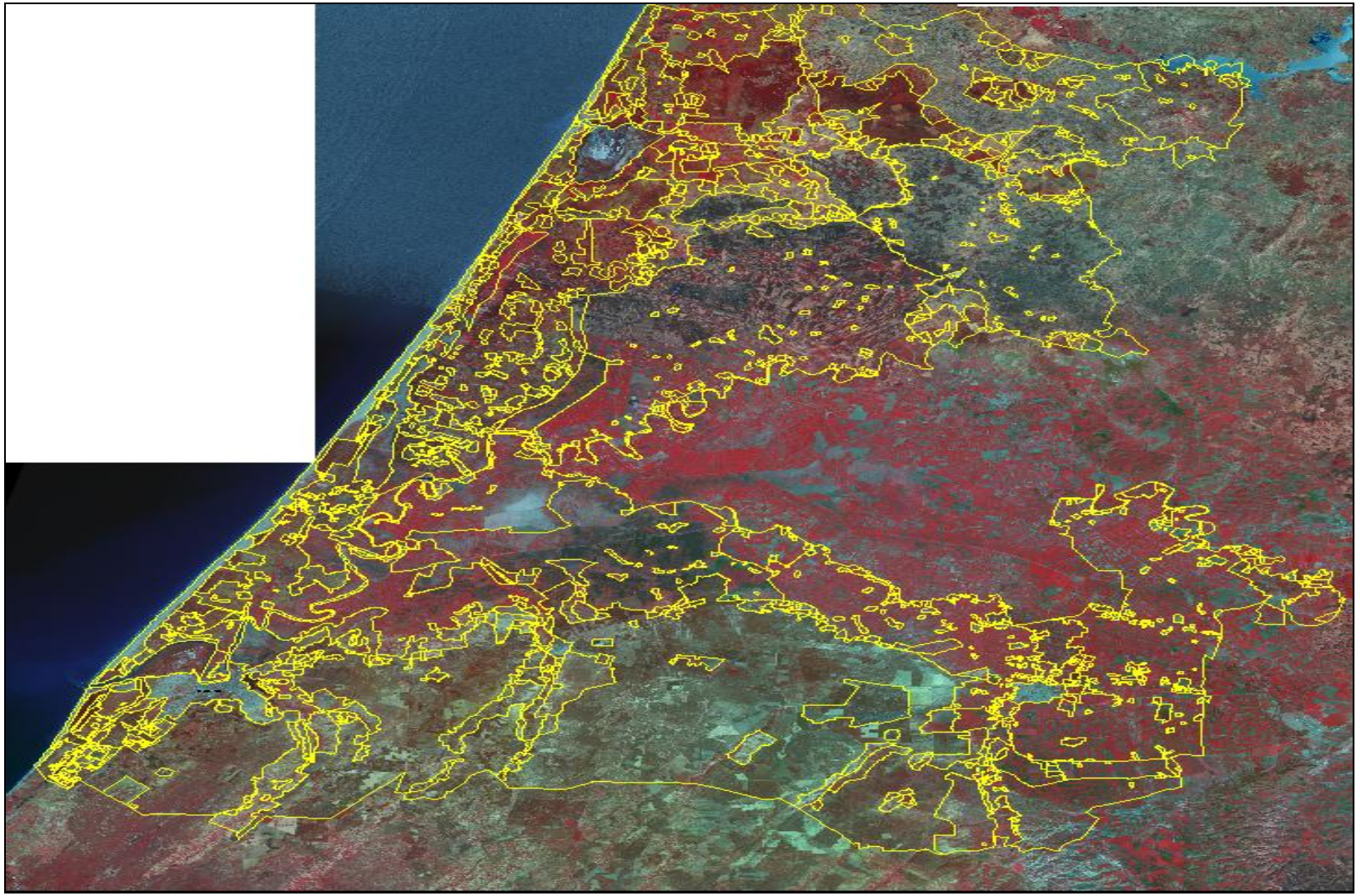


Stratum 60

Stratum 70

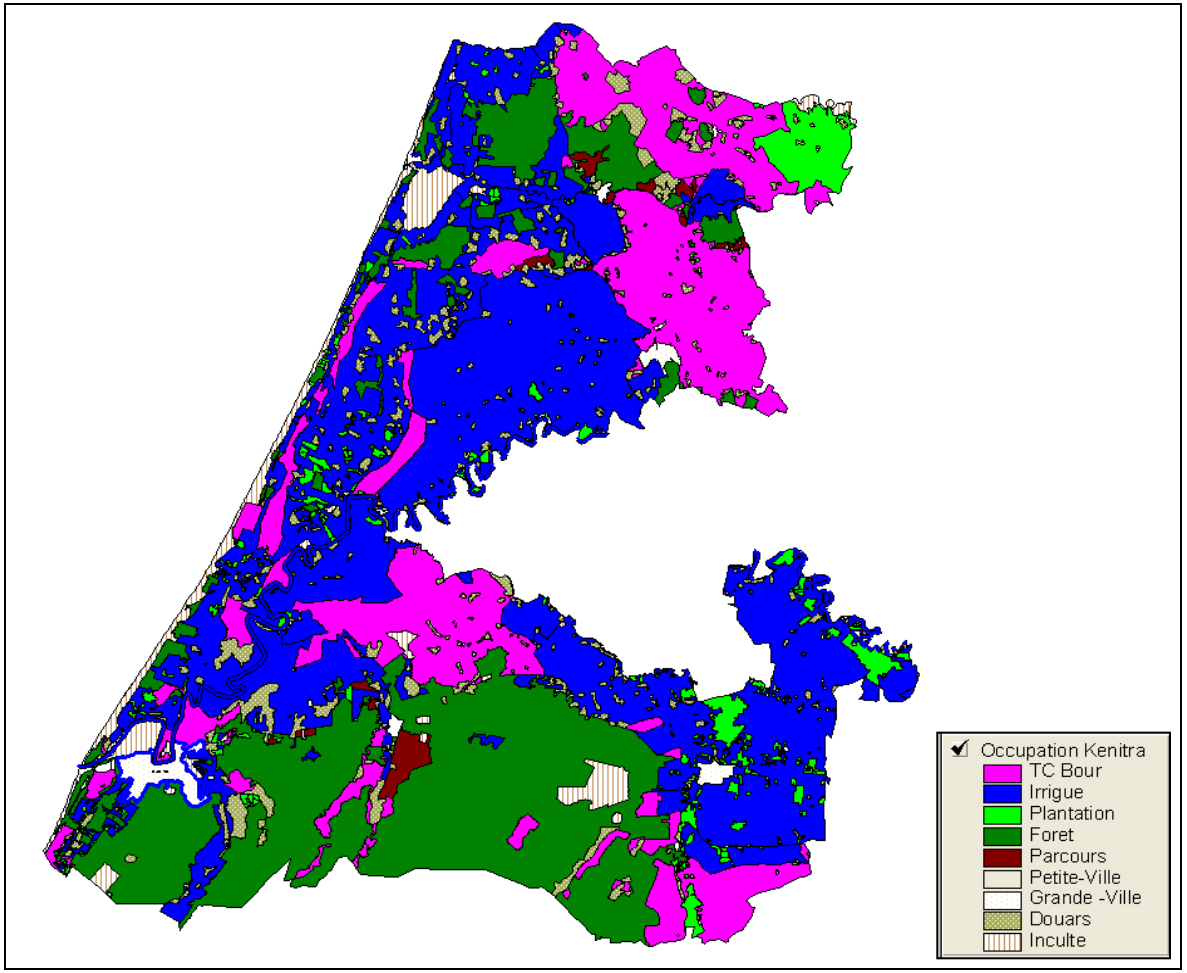


Digitalization



Results :

Stratification of the province of KENITRA County



Improve area frame methodology ? Yes we can

- Geomatic technics (remote sensig and GIS): provide a broad scope of tools to speed up area frame sampling procedures

- Integrating steps of AFS in an automatic process held on GIS platform

GIS application for automating the steps of the area frame sampling

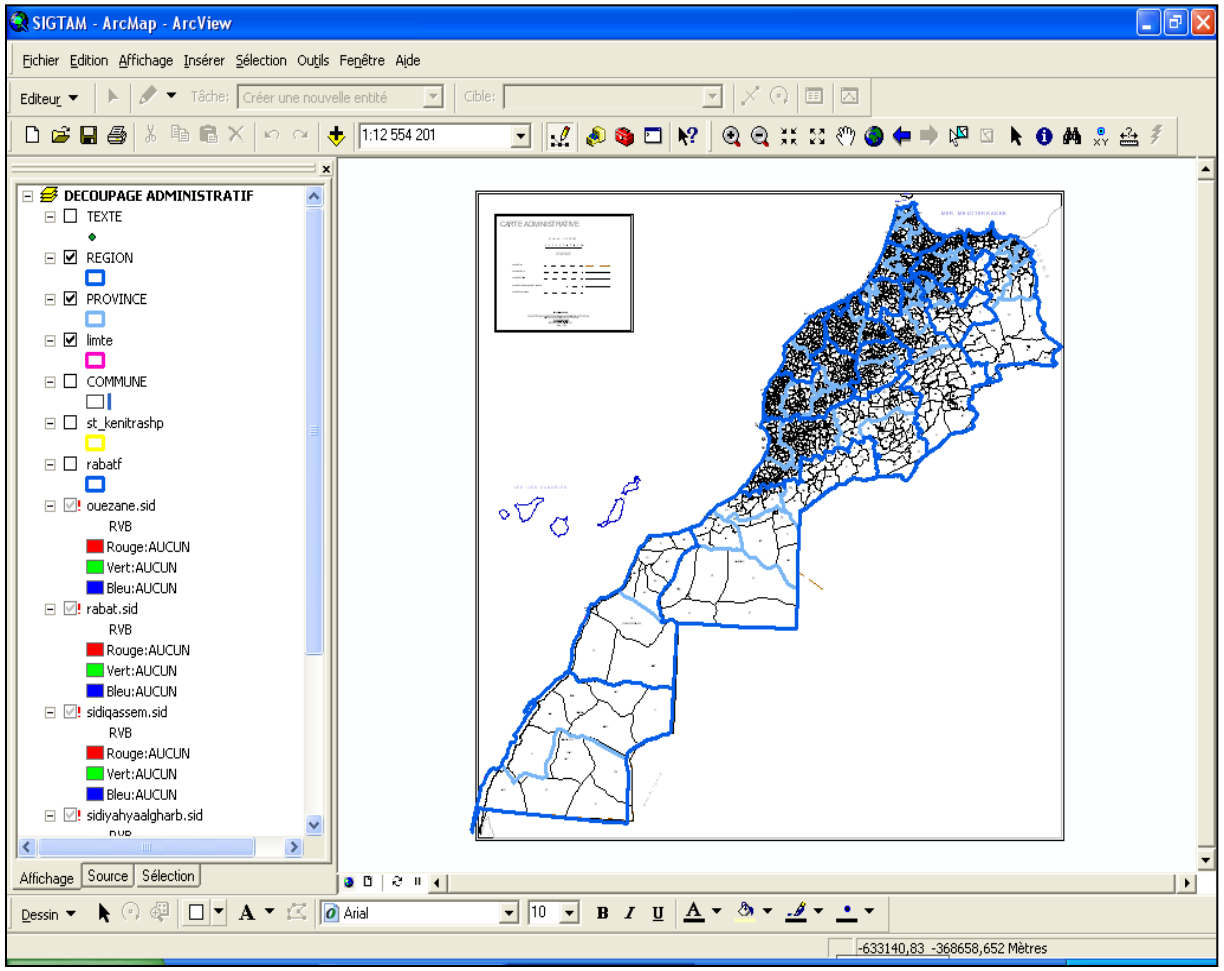
Main steps of Drawing the Sample

- Preparation of the GIS project
- Parameters setting of zones and segments and sample size
- Natural constraints application
- Generation of PSUs
- Thematic constraints application
- Zones Drawing (PSU)
- Generation of segments
- Segments drawing (SSU)
- Drawn segments are to be adjusted to natural borders.
- Segment Maps Editing

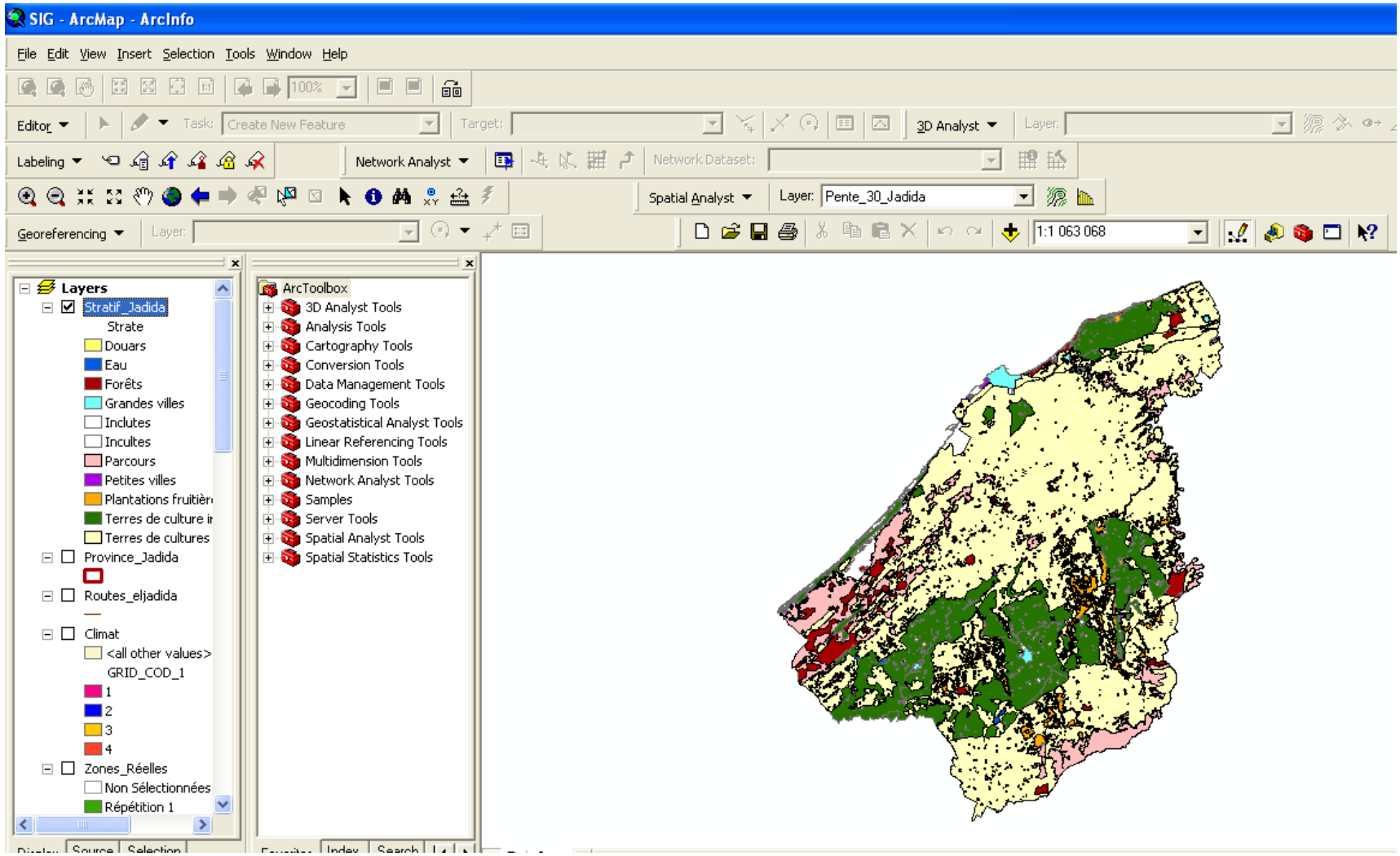
Creating a GIS project

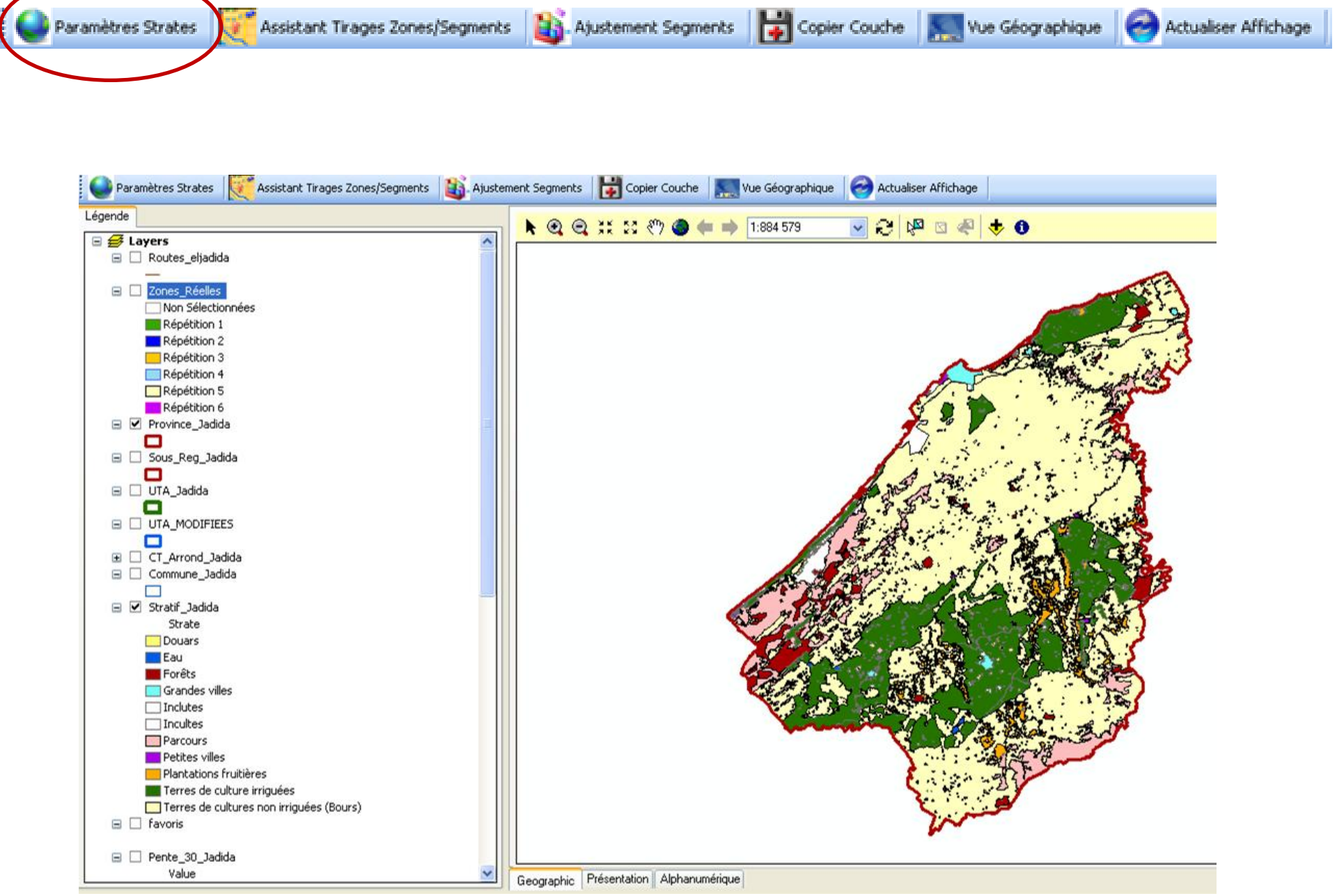
✓ Important layers

- Administrative boundaries
- Stratification
- Natural constraints
- Thematic constraints
- Images / Othophotos
- Others layers

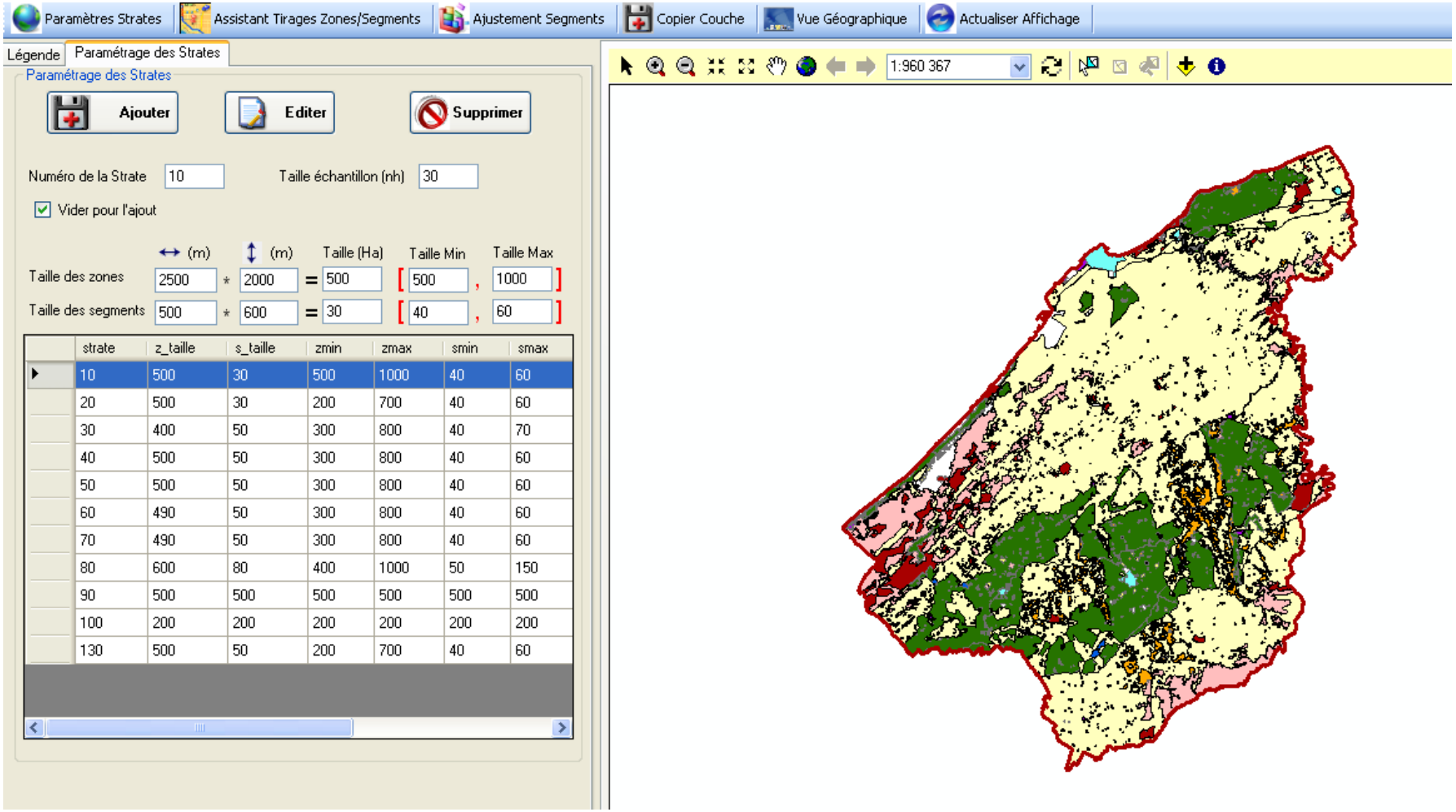


GIS project


SIG - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
Editor Task: Create New Feature Target: 3D Analyst Layer:
Labeling Network Analyst Network Dataset:
Spatial Analyst Layer: Pente_30_Jadida
Georeferencing Layer: 1:1 063 068
Layers
Stratif_Jadida
Strate
Douars
Eau
Forêts
Grandes villes
Inclutes
Incultes
Parcours
Petites villes
Plantations fruitièr
Terres de culture ir
Terres de cultures
Province_Jadida
Routes_eljadida
Climat
<all other values>
GRID_COD_1
1
2
3
4
Zones_Réelles
Non Sélectionnées
Répétition 1
ArcToolbox
3D Analyst Tools
Analysis Tools
Cartography Tools
Conversion Tools
Data Management Tools
Geocoding Tools
Geostatistical Analyst Tools
Linear Referencing Tools
Multidimension Tools
Network Analyst Tools
Samples
Server Tools
Spatial Analyst Tools
Spatial Statistics Tools

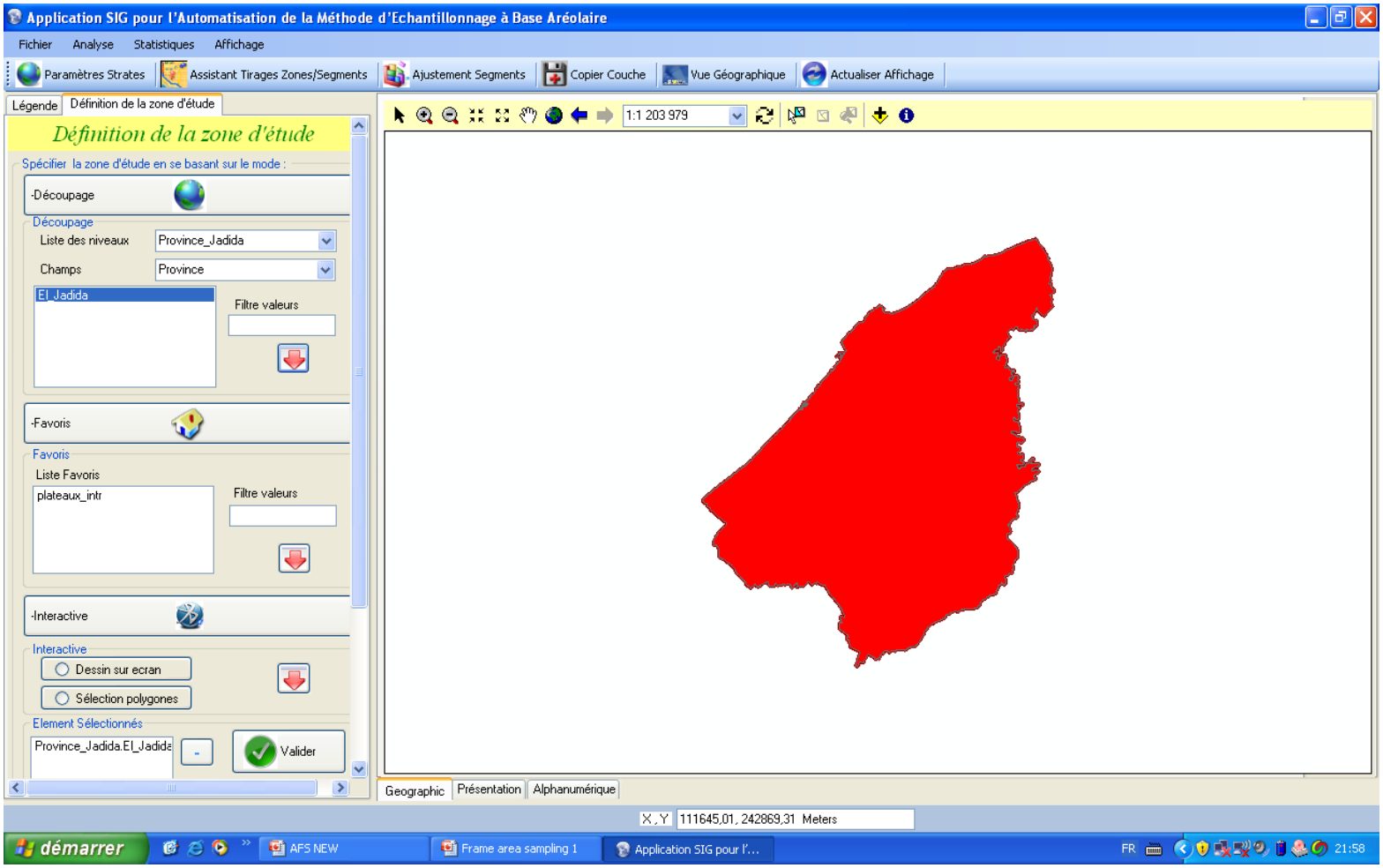

Paramètres Strates
Assistant Tirages Zones/Segments
Ajustement Segments
Copier Couche
Vue Géographique
Actualiser Affichage
Légende
Layers
Routes_eljadida
Zones_Réelles
Non Sélectionnées
Répétition 1
Répétition 2
Répétition 3
Répétition 4
Répétition 5
Répétition 6
Province_Jadida
Sous_Reg_Jadida
UTA_Jadida
UTA_MODIFIEES
CT_Arrond_Jadida
Commune_Jadida
Stratif_Jadida
Strate
Douars
Eau
Forêts
Grandes villes
Inclutes
Incultes
Parcours
Petites villes
Plantations fruitières
Terres de culture irriguées
Terres de cultures non irriguées (Bours)
favoris
Pente_30_Jadida
Value
1:884 579
Geographic
Présentation
Alphanumérique

Parameters setting of zones, segments and sample size



strate	z_taille	s_taille	zmin	zmax	smin	smax
10	500	30	500	1000	40	60
20	500	30	200	700	40	60
30	400	50	300	800	40	70
40	500	50	300	800	40	60
50	500	50	300	800	40	60
60	490	50	300	800	40	60
70	490	50	300	800	40	60
80	600	80	400	1000	50	150
90	500	500	500	500	500	500
100	200	200	200	200	200	200
130	500	50	200	700	40	60

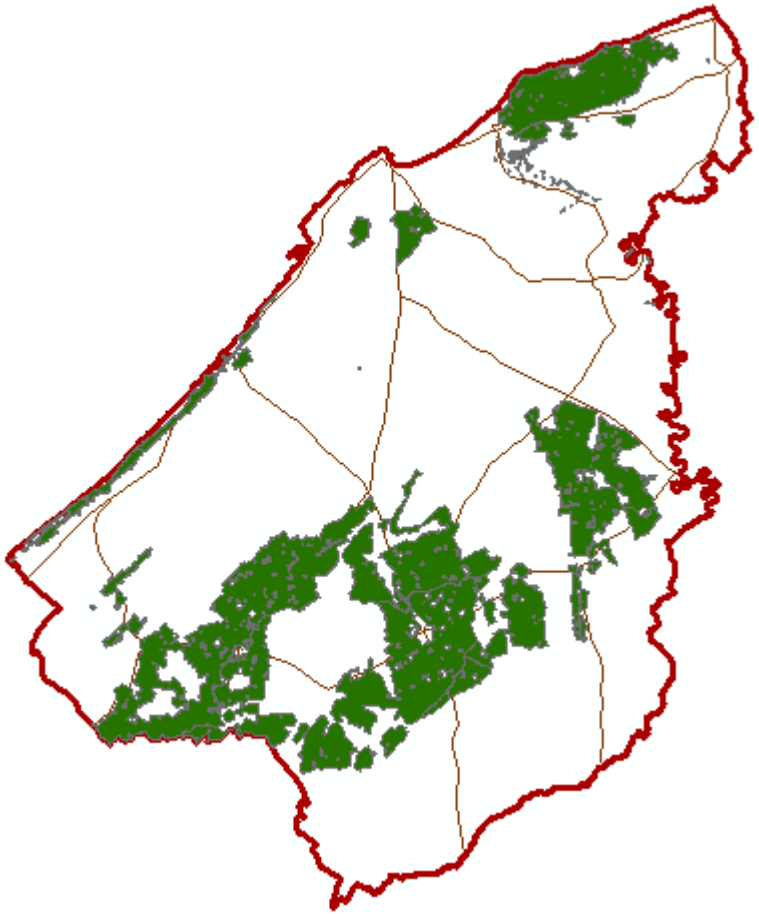
Selection of the area of interest : Province of El Jadida



Selection of the Strata

Strata 20: (Irrigated Land)

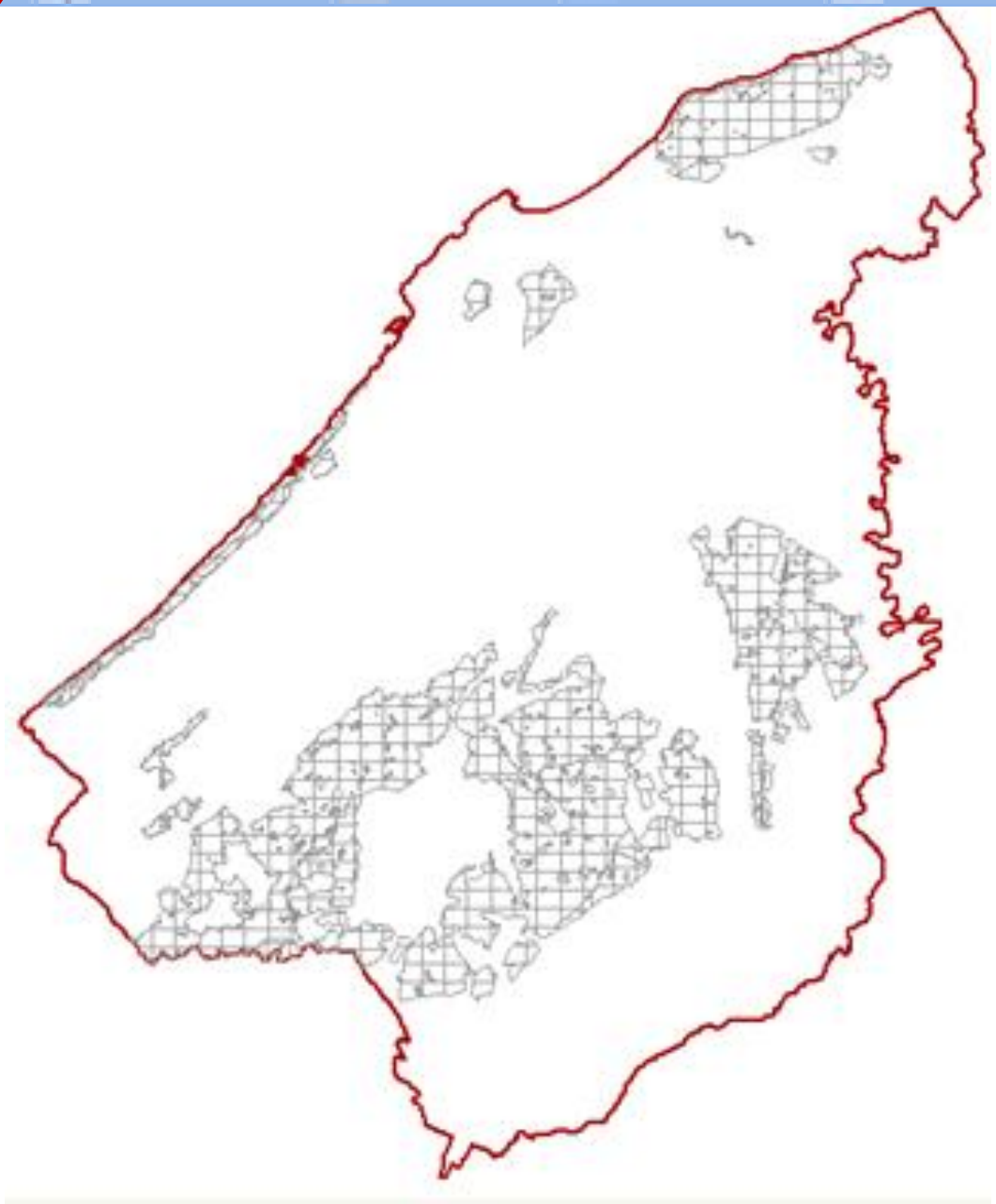
Applying naturals constraints (roads, railway, highway, ……)



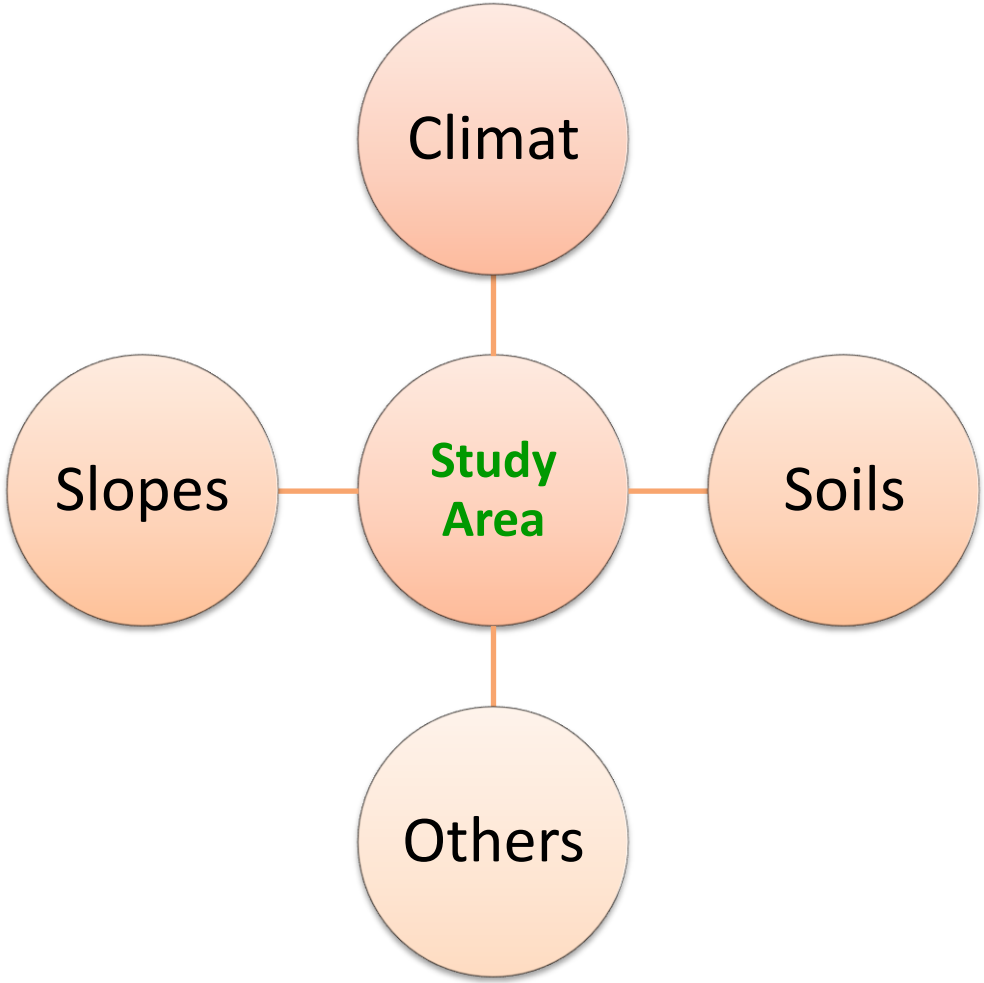
Generation of the rectangular zones PSUs

600 Ha

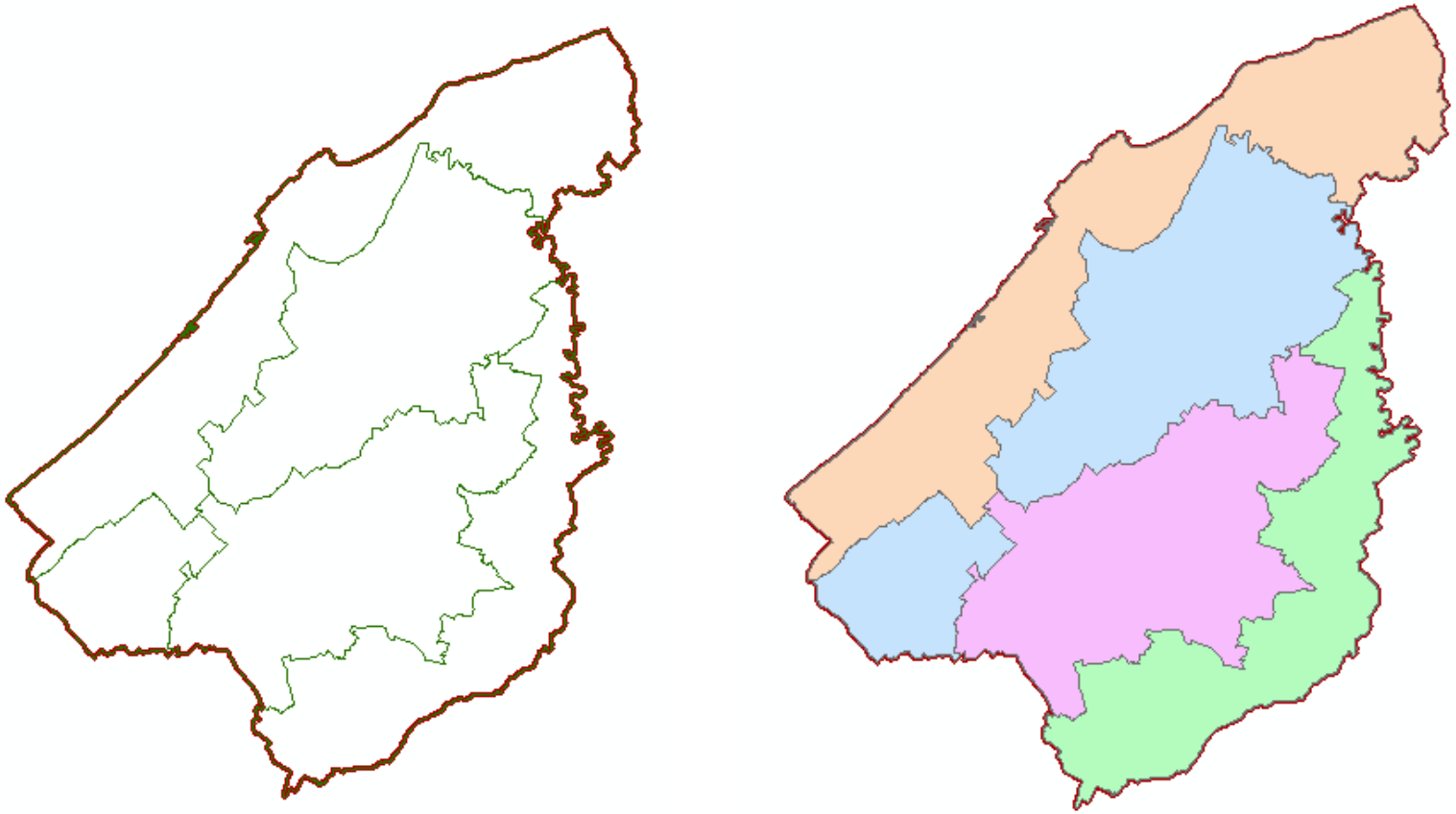
El Jadida province
Strata 20 (Irrigated land)



To improve the representativity of the sample

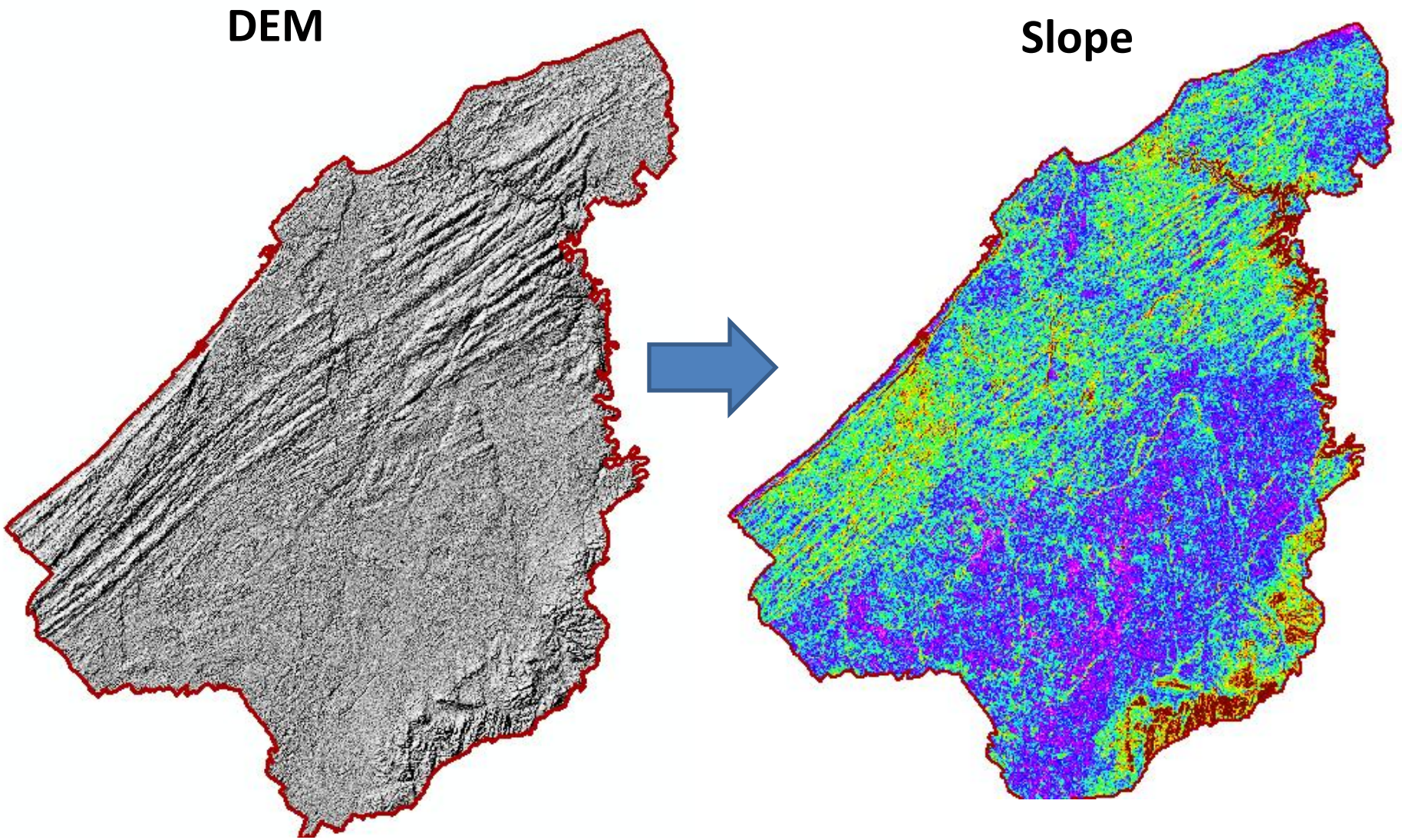


Application of the thematiques constraintes : Agroclimatics zones (Agricultural unites)



UTA

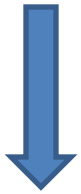
Example : Constraint of Slope



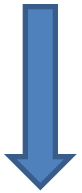
DEM from the Maryland University

Step 1: DEM download from internet spatial resolution 90 m

Overlay of zones (PSUs) with layers of constraints UTA and slopes



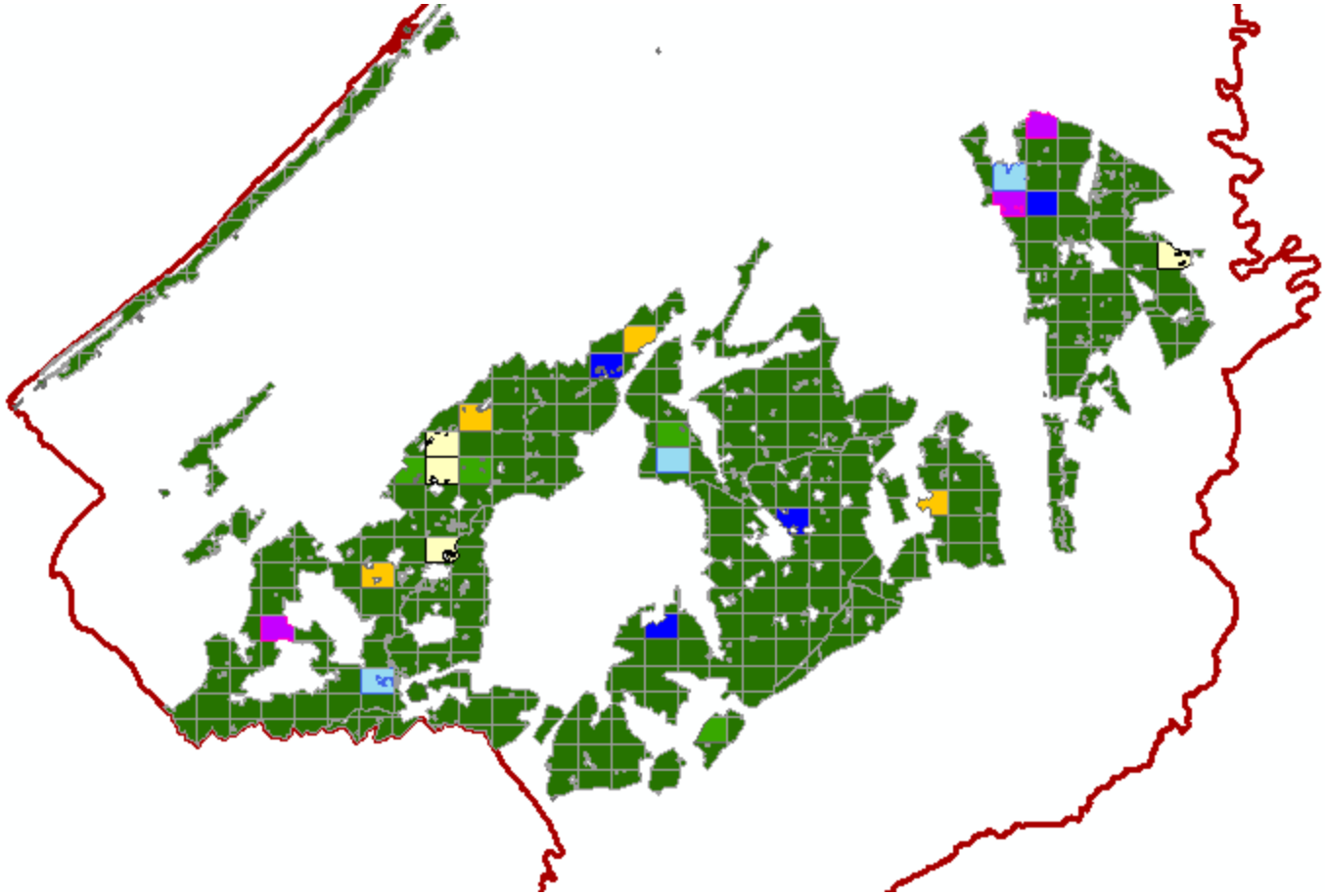
Zones with climate and slope value



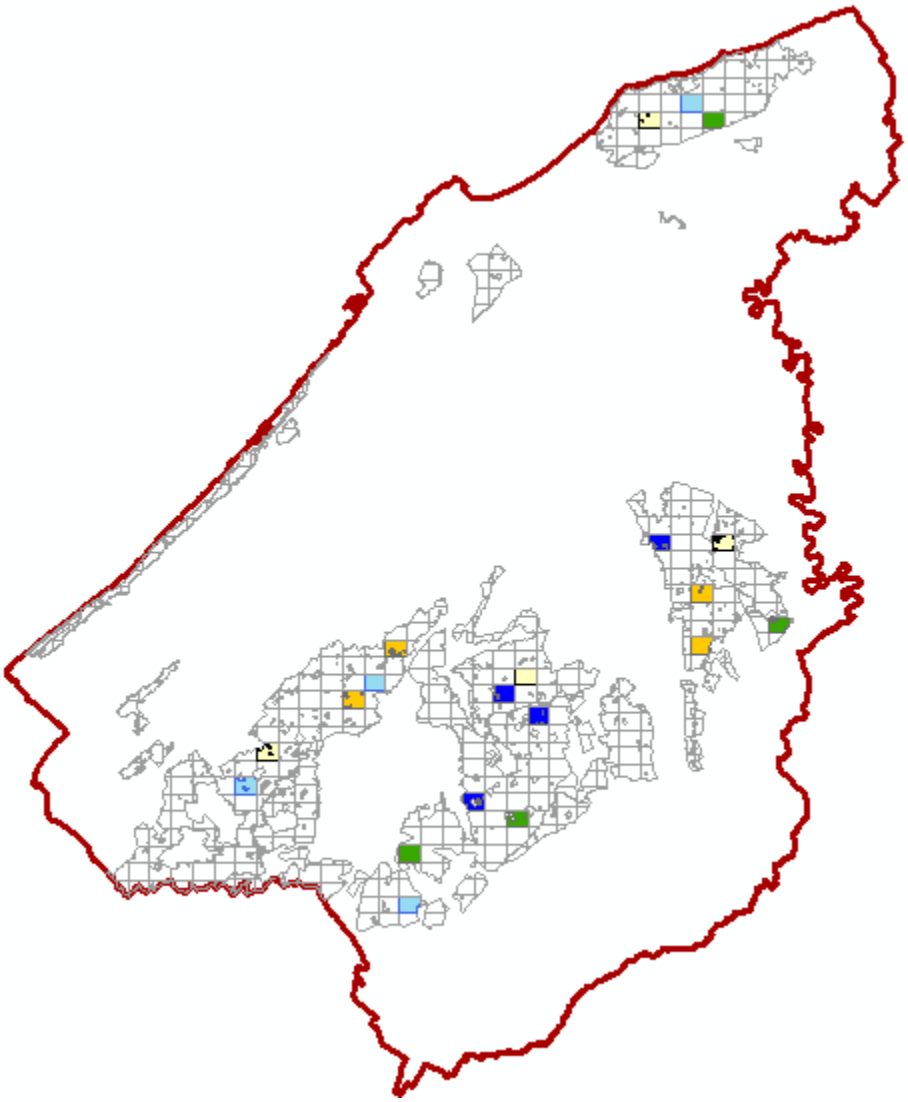
Sampling Base

Rondom Systematic

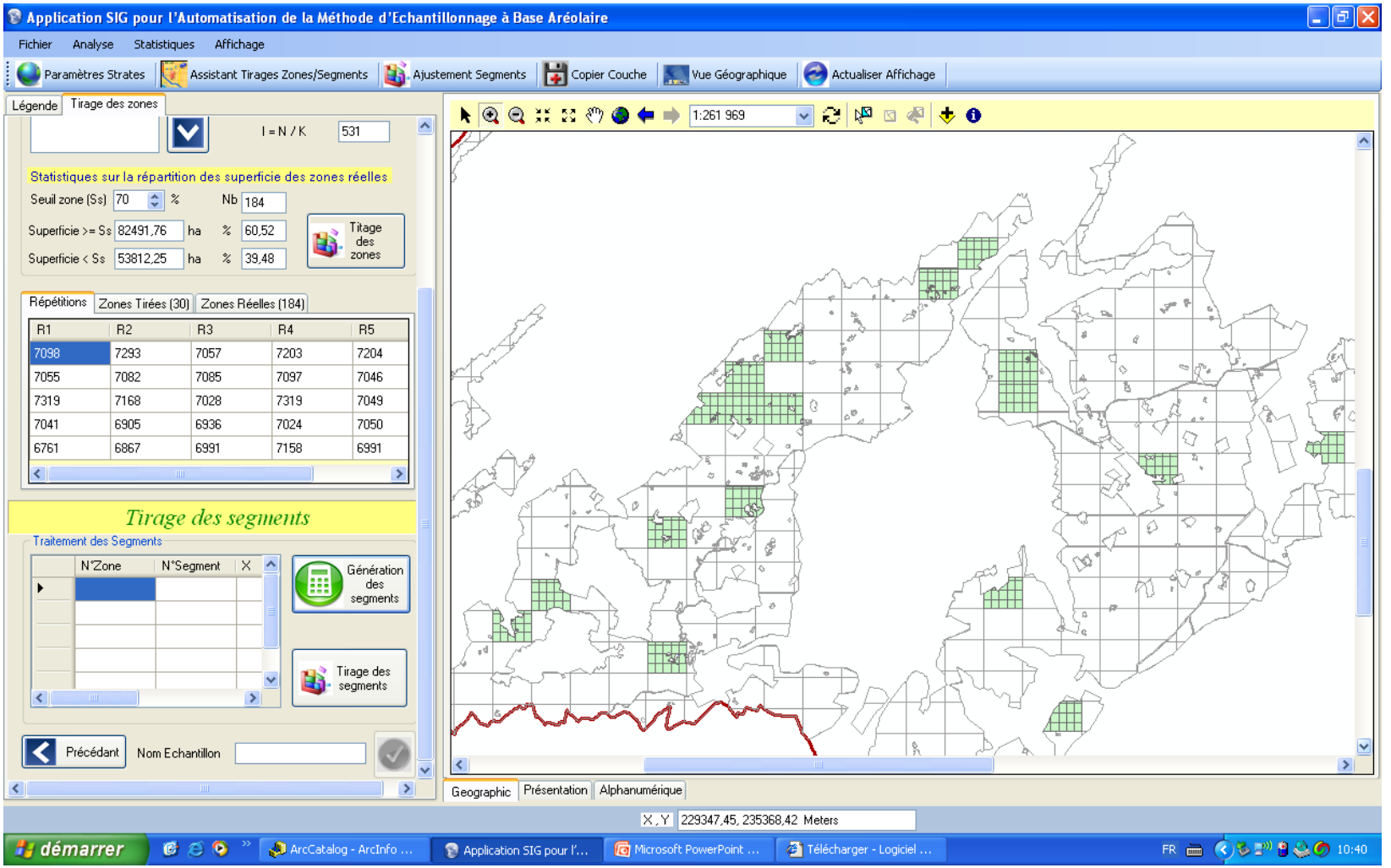
Selection of zones : PSUs



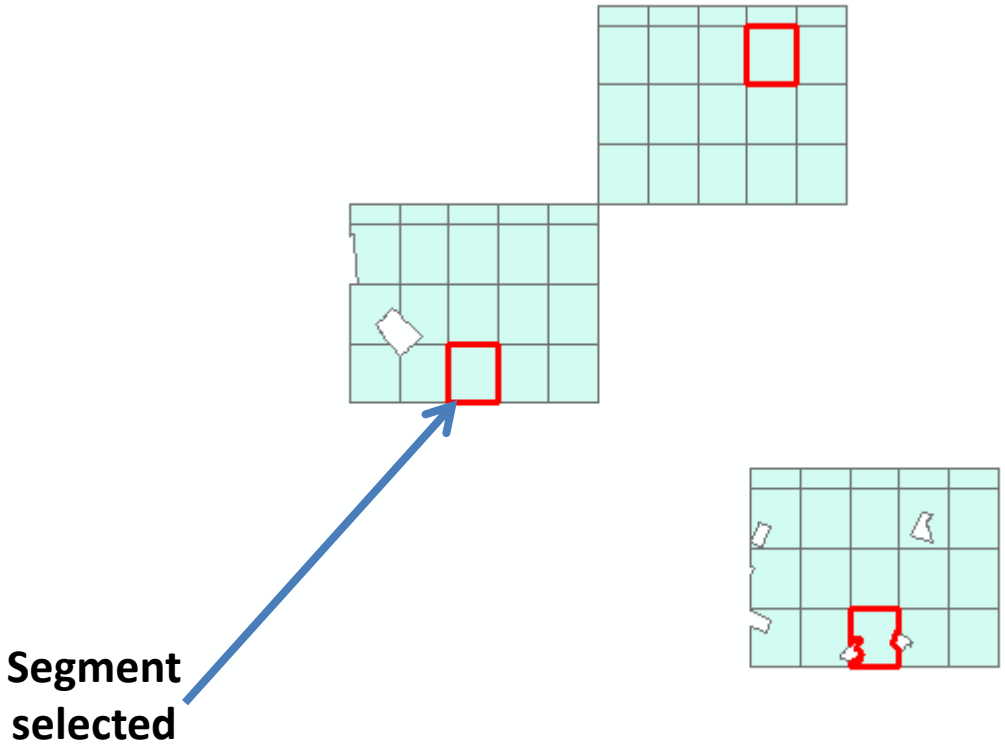
Sample of PSU selected



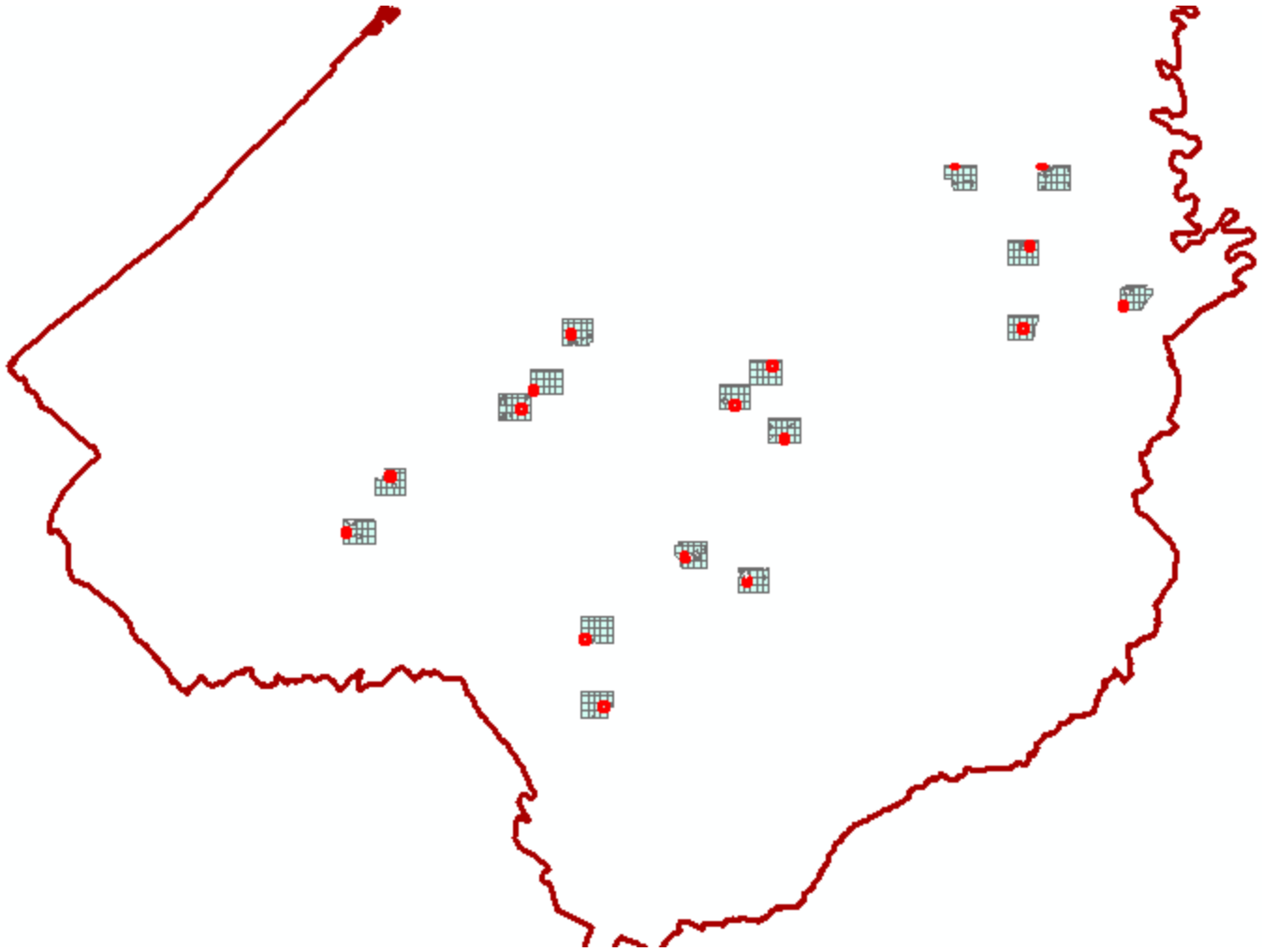
Segment generation



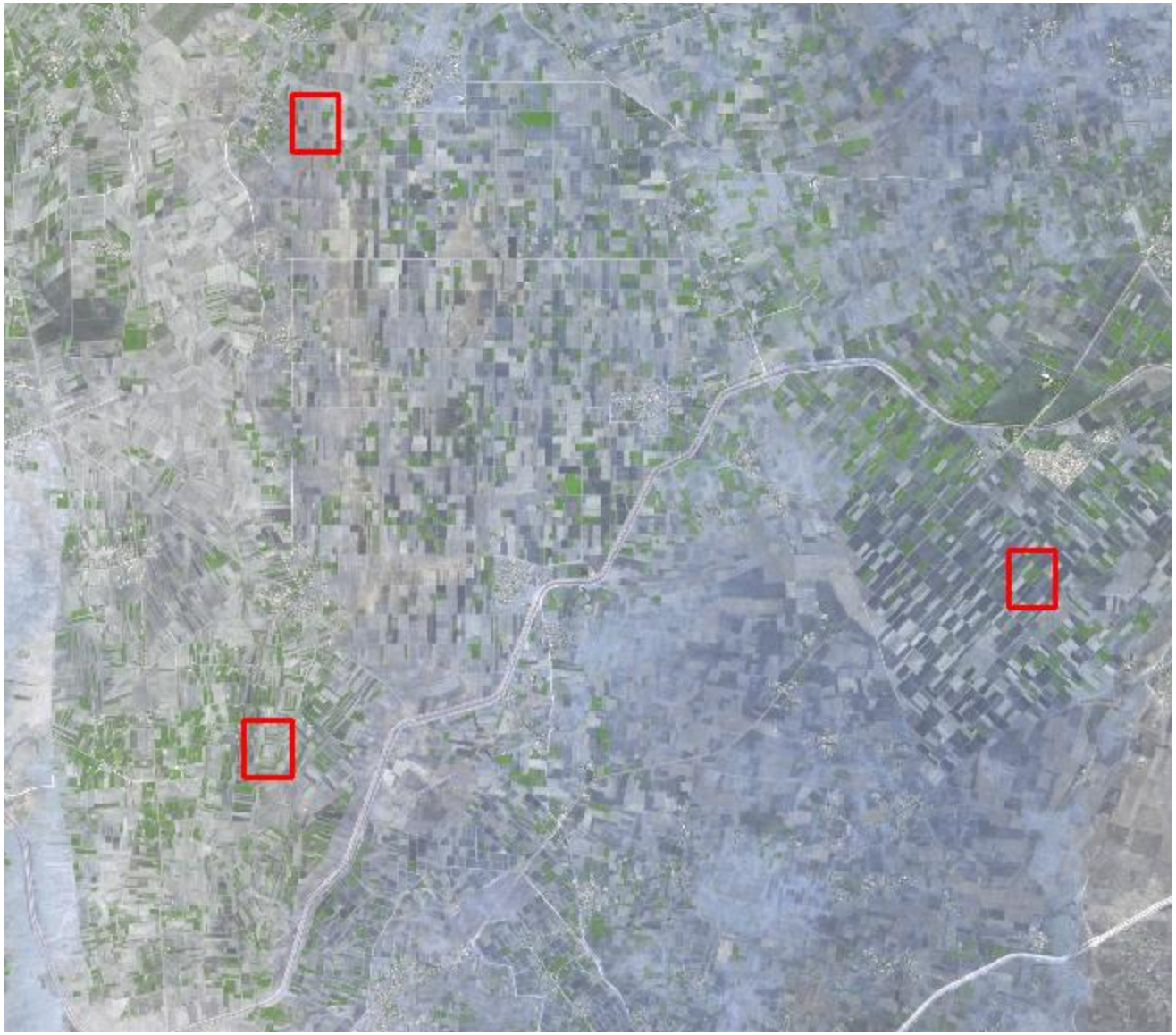
Selection of segment : Simple rondom selection



Selection of segment



Localisation of the selected segment on the spot image 2.5



form used to collect data on the segment

IV. UTILISATION DU SOL DANS LE BLOC (Terres situées à l'extérieur du segment).

Cultures	Superficie (ha)
Blé Dur	
Blé Tendre	
Orge	
Maïs	
Autres Céréales	
Légumineuses	
Cultures Industrielles	
Maraîchage	
Plantations	
Fourrages	
Jachères	
Parcours	

V. EFFECTIF DU CHEPTEL DE L'EXPLOITATION

1. L'exploitant est-il éleveur ? ..... [_____]
(1=Oui, 2=Non)

2. Bovins

Race	Sexe	< 1 an	1 à < 2 ans	2 à < 3 ans	3 à < 9 ans	≥ 9 ans	Total
Locale	Fem.						
	Mal.						
Améliorée	Fem.						
	Mal.						

3. Ovins/Caprins

Espèce	Sexe	< 6 mois	6 à < 12 mois	1 à < 2 ans	2 à < 6 ans	≥ 6 ans	Total
Ovins	Fem.						
	Mal.						

ROYAUME DU MAROC
MINISTERE DE L'AGRICULTURE ET DE LA PECHE MARITIME
DSS/DStat

LE MAROC VERT

ETUDE DE RENOUVELLEMENT DE L'ECHANTILLON AREOLAIRE NATIONAL : IDENTIFICATION, RECONNAISSANCE ET ENQUETE DES UNITES DE SONDAGE

DATE DE PASSAGE :.....

I. IDENTIFICATION

	Province	S/Reg	CT/ CMV/CDA	Commune rurale	Douar	N° Segment	N° Rép.	N° de l'exploitant = N° du Lot
Nom								
Code								

II. CARACTERISTQIUE DE L'EXPLOITATION

1. Nom et Prénom du répondant :.....

2. Qualité du répondant.....[_____] N° de téléphone .....
(1=Exploitant, 2=Gérant, 3=Membre de la famille.)

3. Nombre d'enfants actuellement scolarisés.....Garçons [_____] Filles..... [_____

4. L'exploitant réside t il à l'intérieur du segment..... [_____
(1=Oui, 2=Non)

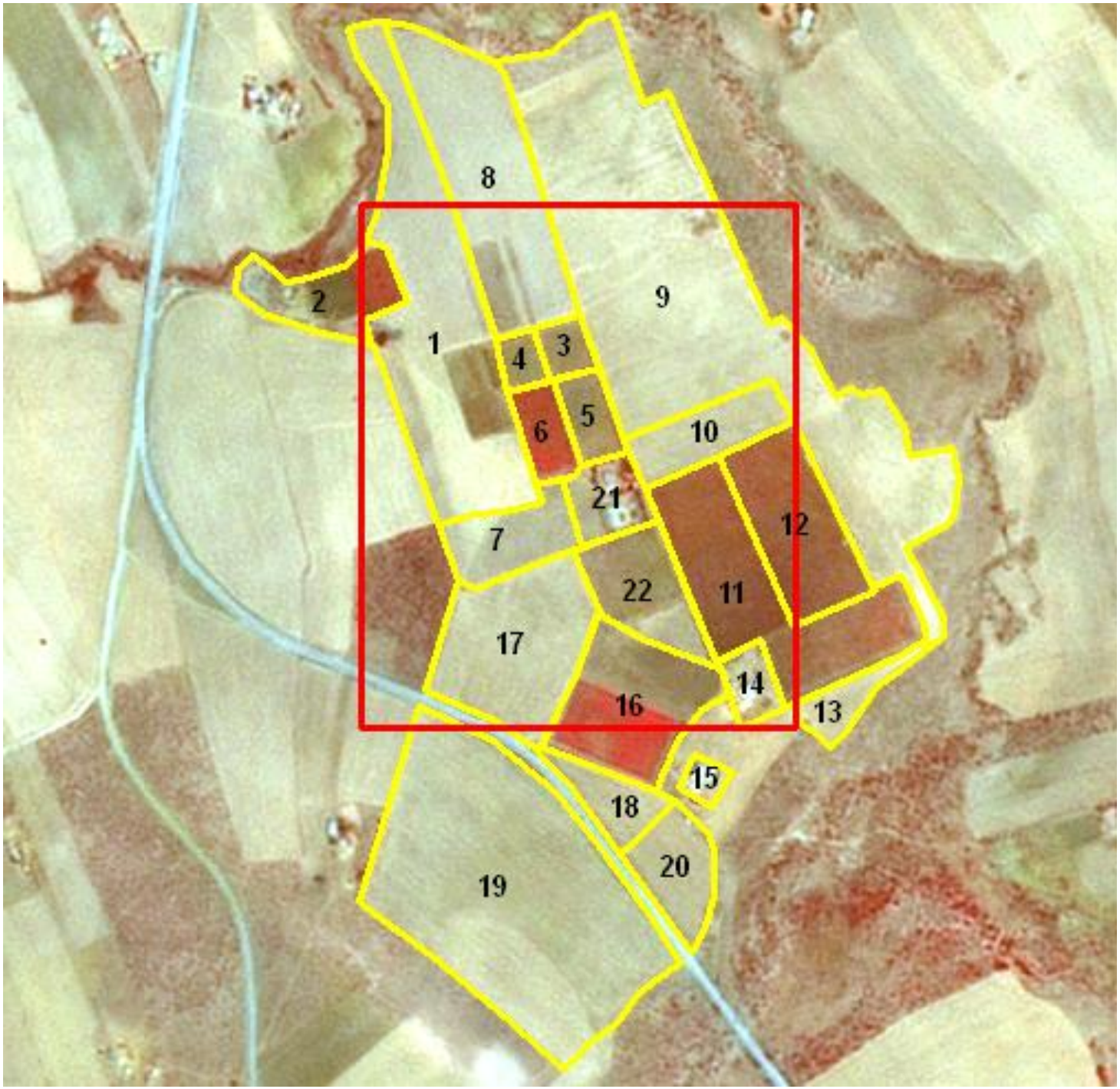
5. Superficie totale exploitée (Ha)..... [_____

6. Nombre de tracteurs..... [_____

7. Quantité totale d'engrais achetée (campagne 2009/2010)

	Total	*DAP*	*UREE (6%)*	*Ammonitrates (33.5%)*	*Sulfate d'ammonium (21%)*

The form used to collect data is a segment map support where enumerators report soil occupation on the map with plot borders

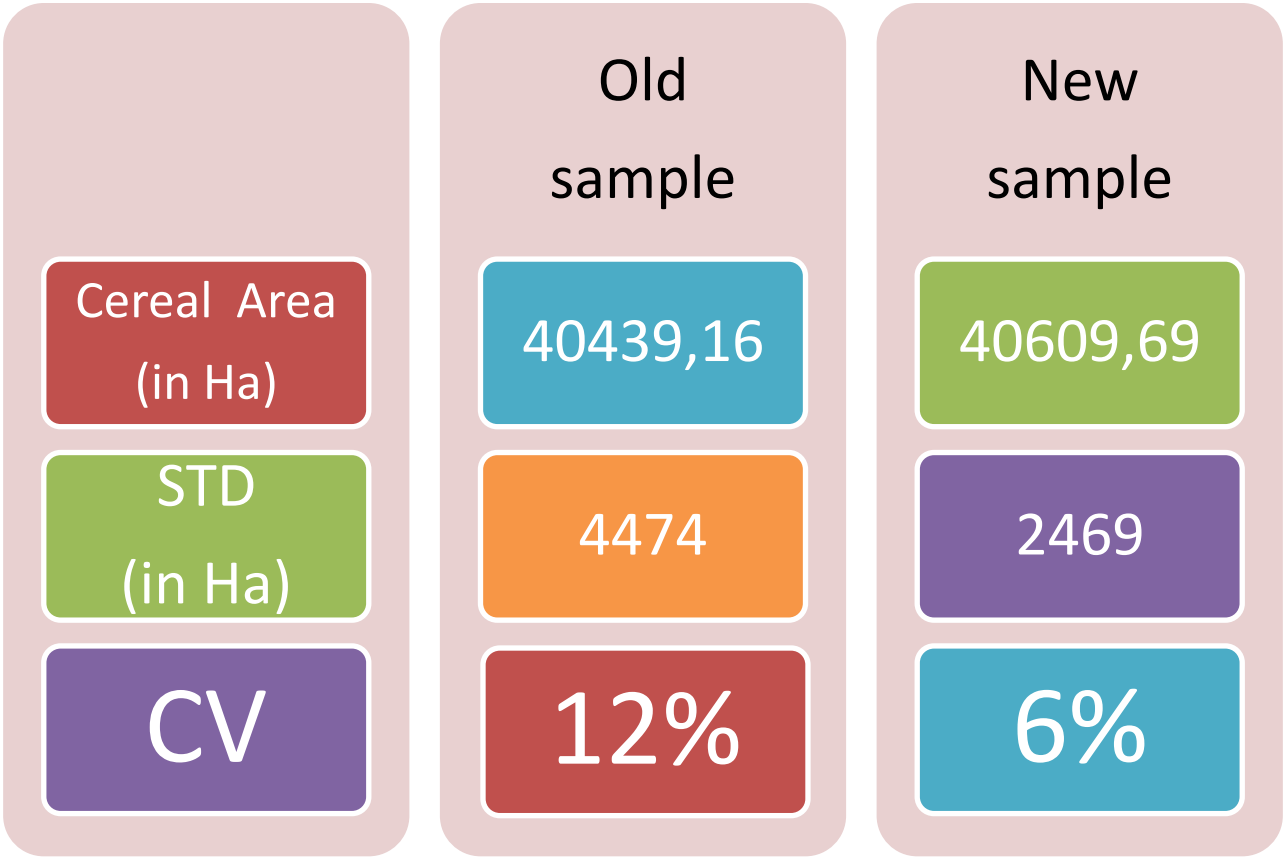

8
2
9
1
4
3
6
5
10
21
12
7
22
11
17
14
16
13
15
18
20
19

TESTING THE PROPOSED PROCEDURE

Zone : Gharb (high agricultural potential with more than 500 mm and high quality soils)

Stratum : Irrigated annual crops, but farmers use water for crops other than cereals. The total area is 187000 Ha

Sample size : 56 segment (K=8, R=7) sampled with the computer based new procedure


Old sample
New sample
Cereal Area (in Ha)
40439,16
40609,69
STD (in Ha)
4474
2469
CV
12%
6%

Conclusion

In conclusion, the comparison of results reveals that the Contribution of satellite imagery is crucial in mastering the stratification and consequently the estimates of areas of different cultural field especially in areas with high diversity and high dynamics of land

Compared to the old method, the new procedure of sample preparation (automatic generation of zoning and segmentation) brings a new breath to the establishment and maintenance of the AFS

Contribution of DSS to E-Agri Project

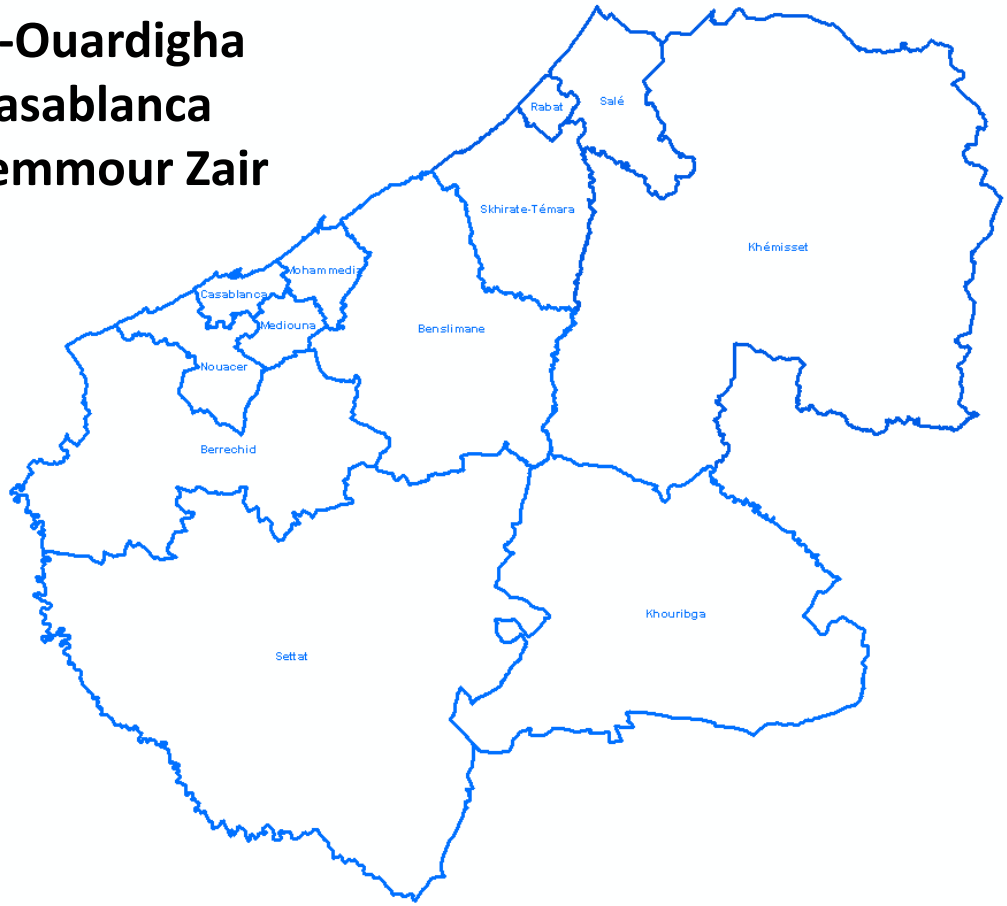
Ground truth for classification of low resolution images

Années	Régions	Provinces	Strates	Superficie	Nombre de segments
2010 - 2011	Chaouia - Ouardigha	Settat	10, 20, 80	503836	94
		Berrechid	10, 20, 80	233921	62
		Khouribga	10, 80	246786	
		Ben Slimane	10, 80	135257	44
	Grand Casablanca	Casa	10, 80	73236	30
	Rabat Zemmour Zair	Rabat	10	80785	29
		Khemisset	10	384444	81

Campagne agricole 2010-2011

1 700 000 Ha

Chaouia-Ouardigha
Grand Casablanca
Rabat Zemmour Zair



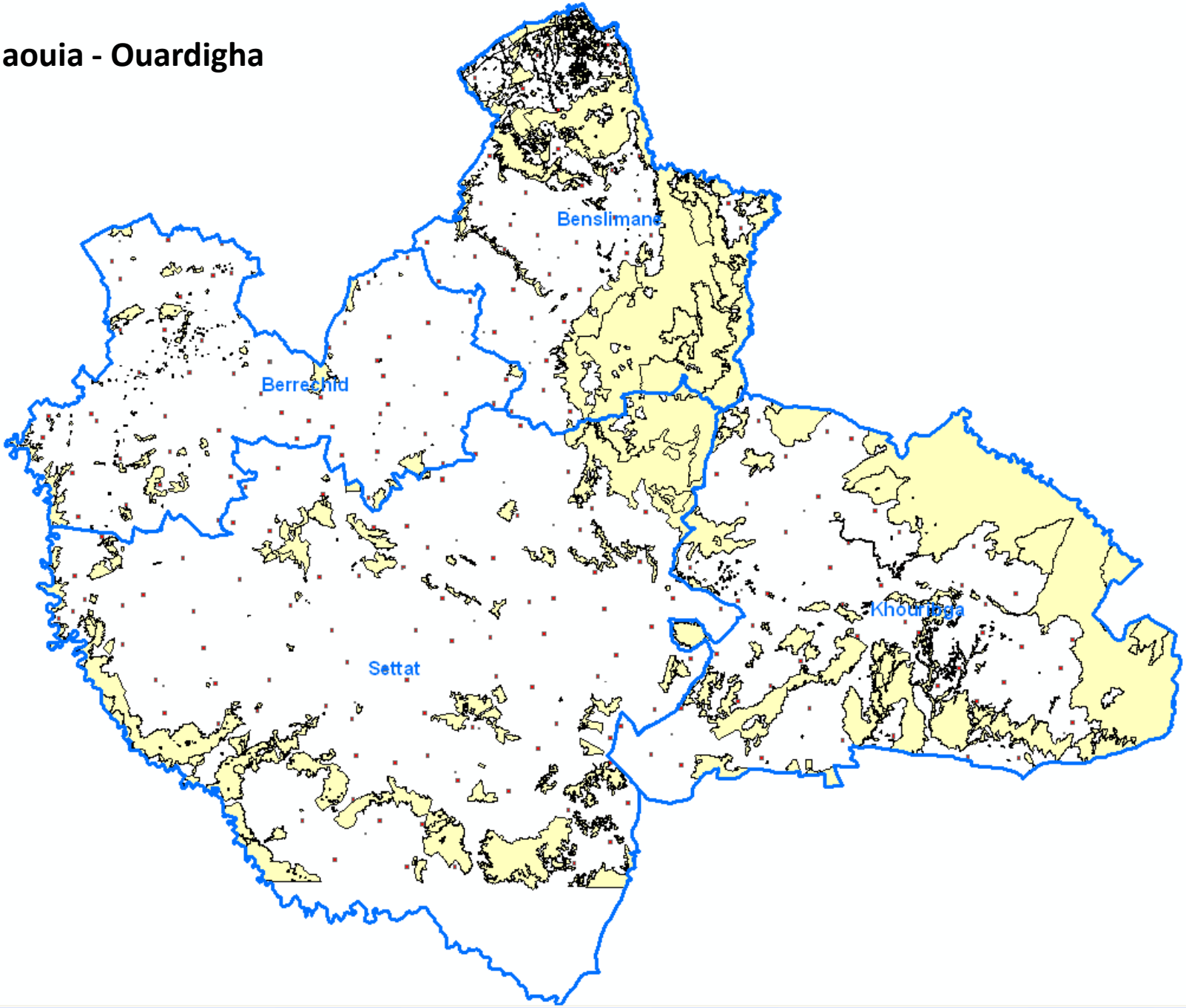
13 938 Ha

400 segments

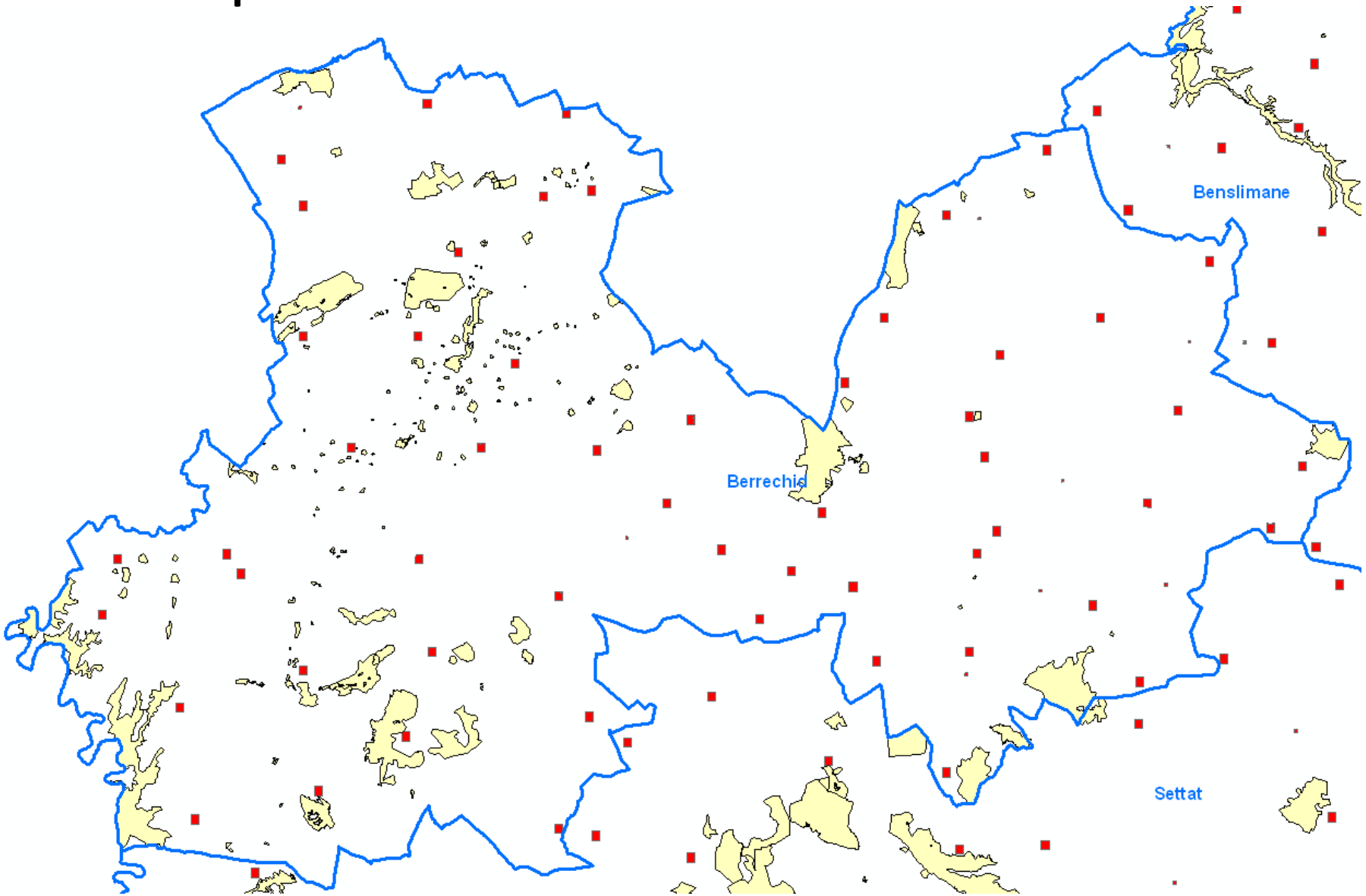
2 909 exploitations

4700 parcelles

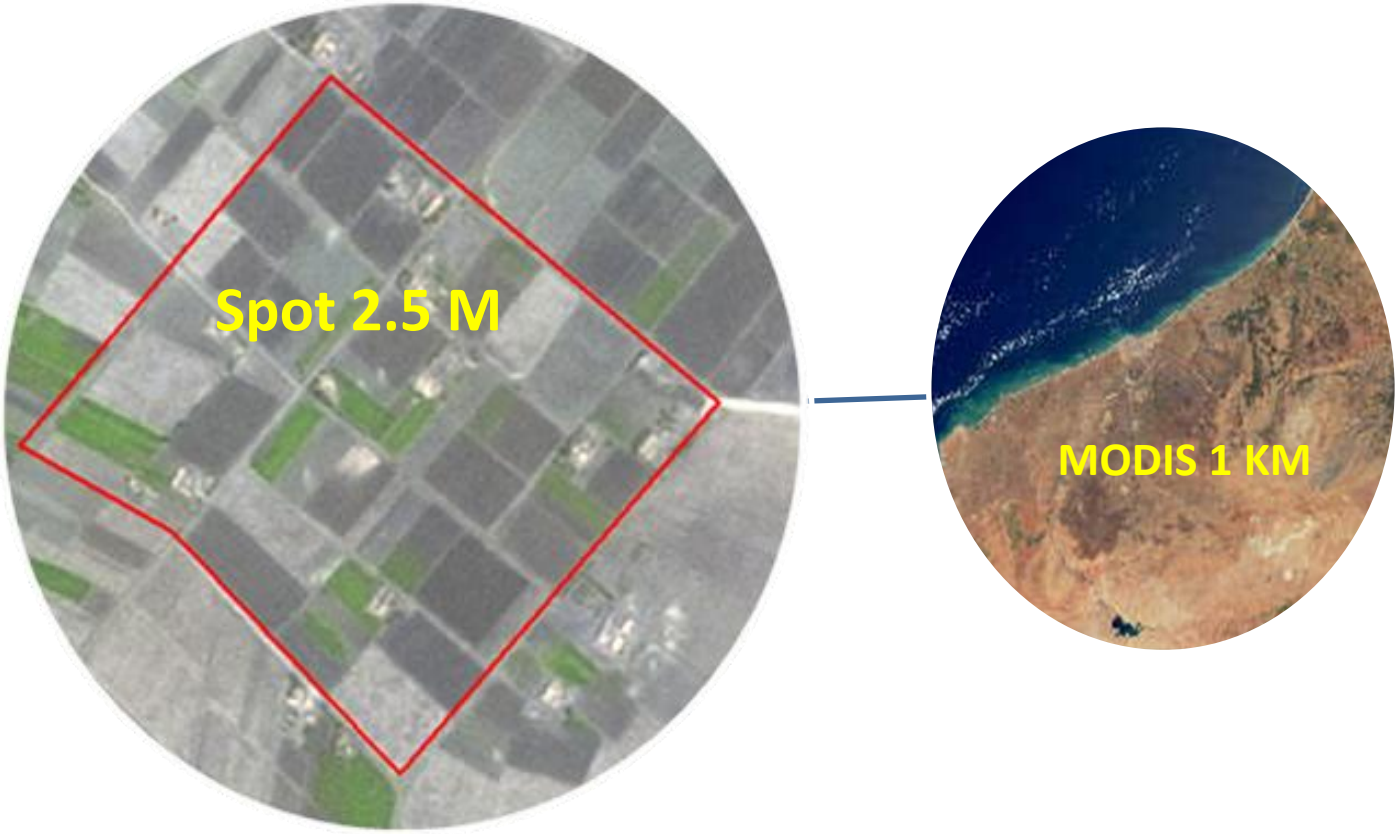
Chaouia - Ouardigha



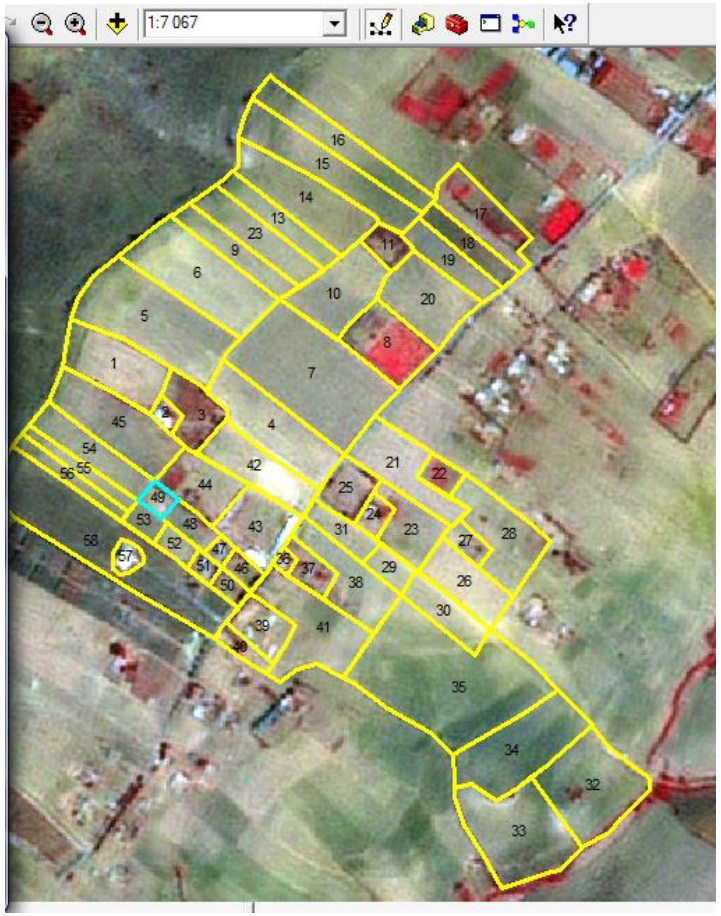
Berrechid province



Effort de localisation des segments sur l'image basse résolution ?



Very good rectification


1:7 067
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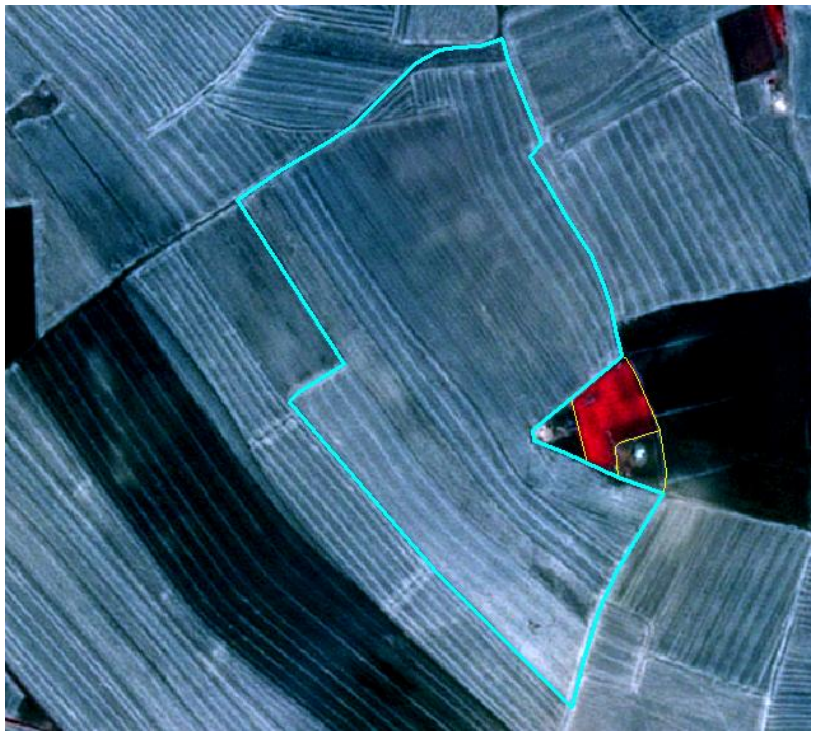
58

0,01 Ha

43 Ha



Thank you
for attention