Application of GIS in urban planning

Iran Experiences of land use planning and air pollution

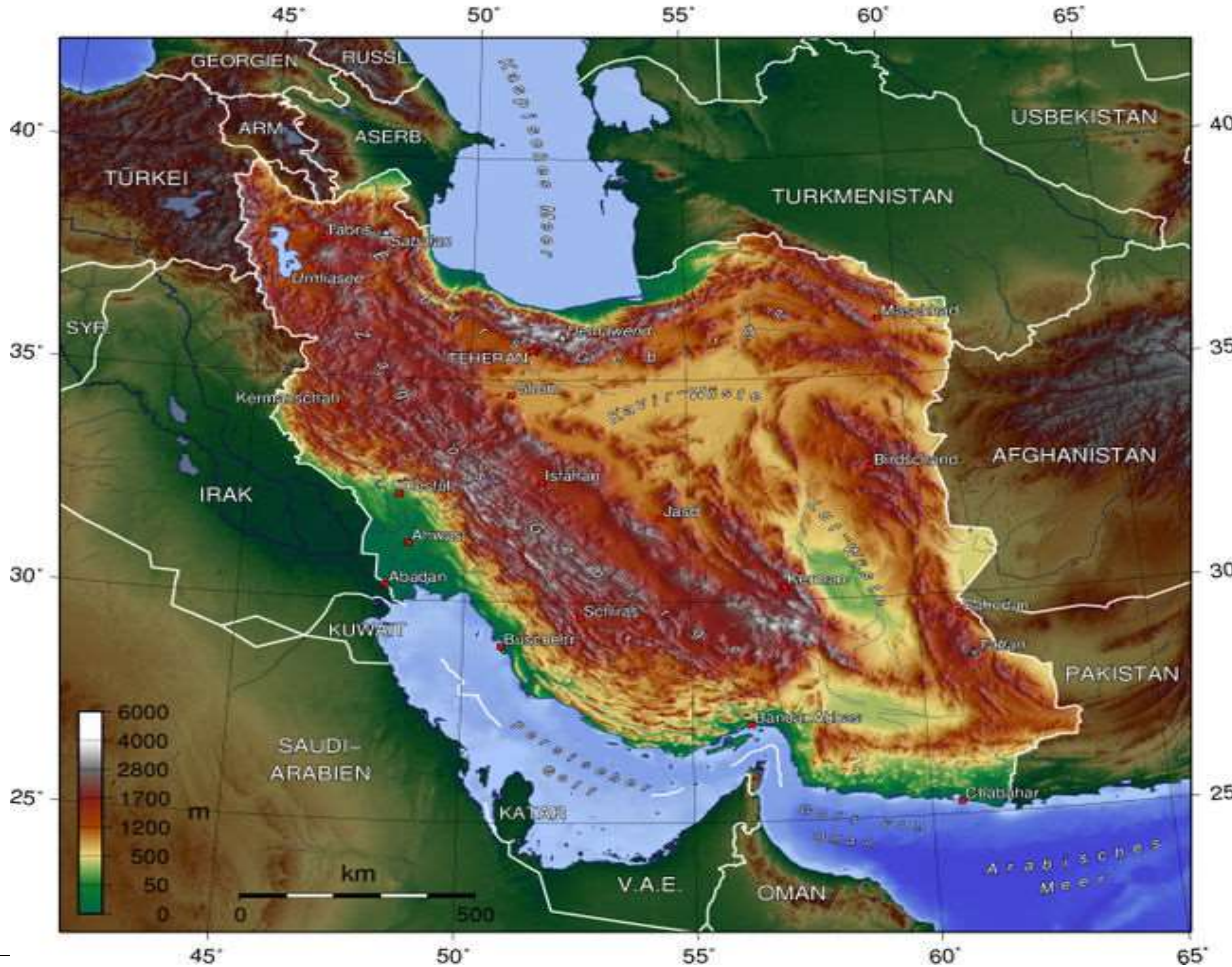
Index

- Introducing the case study
  - Geographical characteristics
  - Demographical characteristics
  - Urban Development
  - Challenges and Issues
- Reviewing Literature
  - Air pollution
  - Land use planning
- Using GIS
  - To understand the issues challenges
  - Providing solutions
  - Choosing the solution
- Conclusion

Geographical characteristic

Iran- Tehran Location in the World

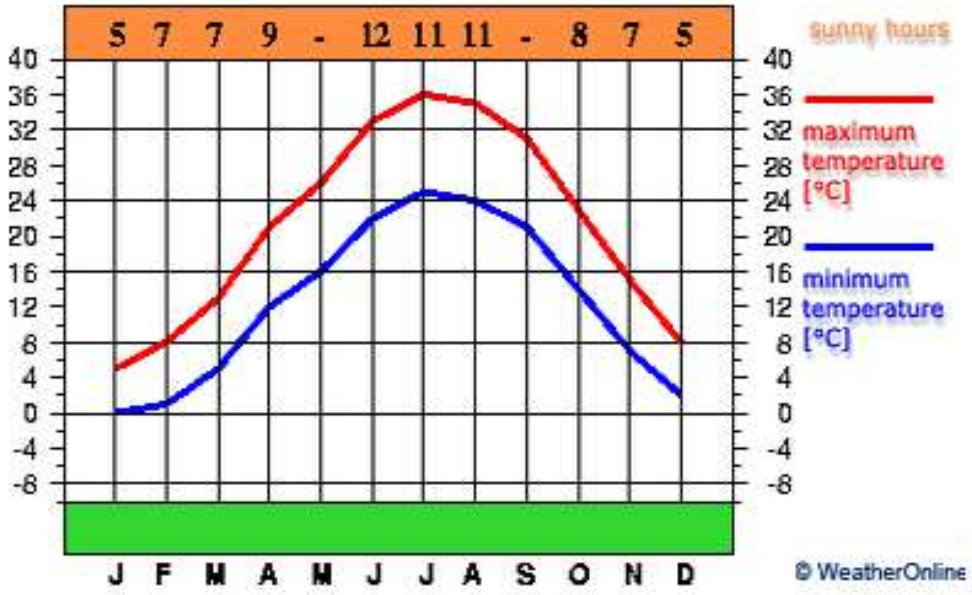
(Google map,2013)



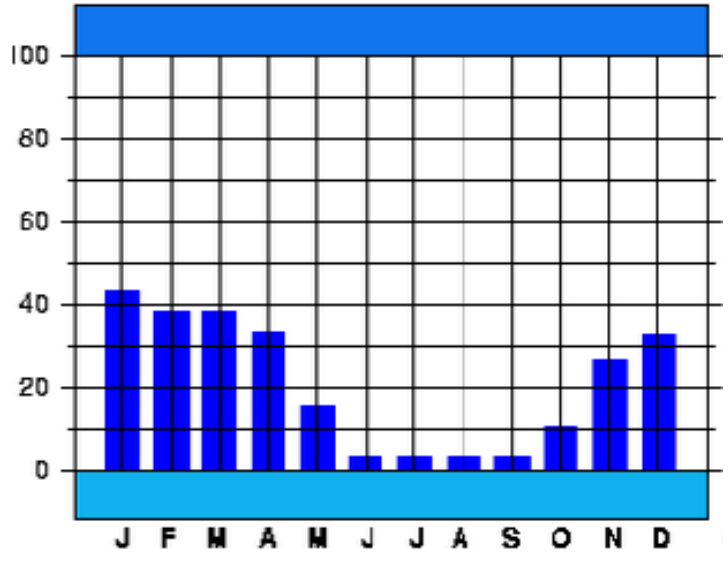
45°
50°
55°
60°
65°
40°
35°
30°
25°
GEORGIEN
RUSSL.
ARM.
ASERB.
TÜRKEI
TURKMENISTAN
USBEKISTAN
SYR.
IRAK
AFGHANISTAN
PAKISTAN
KUWAIT
SAUDI-
ARABIEN
KATAR
V.A.E.
OMAN
TEHERAN
Tabris
Urmiasee
Kermanschah
Isfahan
Jasd
Abadan
Schiras
Birdschand
Arabisches
Meer
6000
4000
2800
1700
1200
500
50
0
m
km
0
500

Geographical characteristic

- Iran is located in west part of Asia.
- Tehran is the capital city of Iran.
  - The formation of the city goes back to the 9th century
  - Tehran is located in the mountainous area
  - Elevation range : 1,200 m– 1,980 m (Lethbridge Elevation 910m)



Temperature and Sunny Hours



Precipitations (mm)

Iran- Tehran

- 29th largest metropolitan area in the world (population)

Metro Tehran

Area=1,274 km^2

Population (2012)= 14 M

Metro Toronto

Area=7,125 km^2

Population (2012)= 5 M

Urban

Area=730 km^2

Population(2012)=8 M

Density =10,000/km^2

Urban

Area=630 km^2

Population(2012)=2.5M

Density =4,000/km^2

Tehran as a metropolitan area is facing some serious challenges:
Fast growth, heavy traffic, air pollution, and so on …

Tehran

Tehran in Polluted day

Air Pollution

- Tehran's air pollution is above the world Standards.
- Based on data from air monitoring stations from 2005- 2010

Every year on average
Tehran had **250 days** which the air quality was
Unhealthy or worse based on "Air Quality Index"

About 2,500 people in Tehran die annually because of health problems caused by air pollution,

(2010, citing the capital's environmental organization)

POLLUTANT STANDARD INDEX

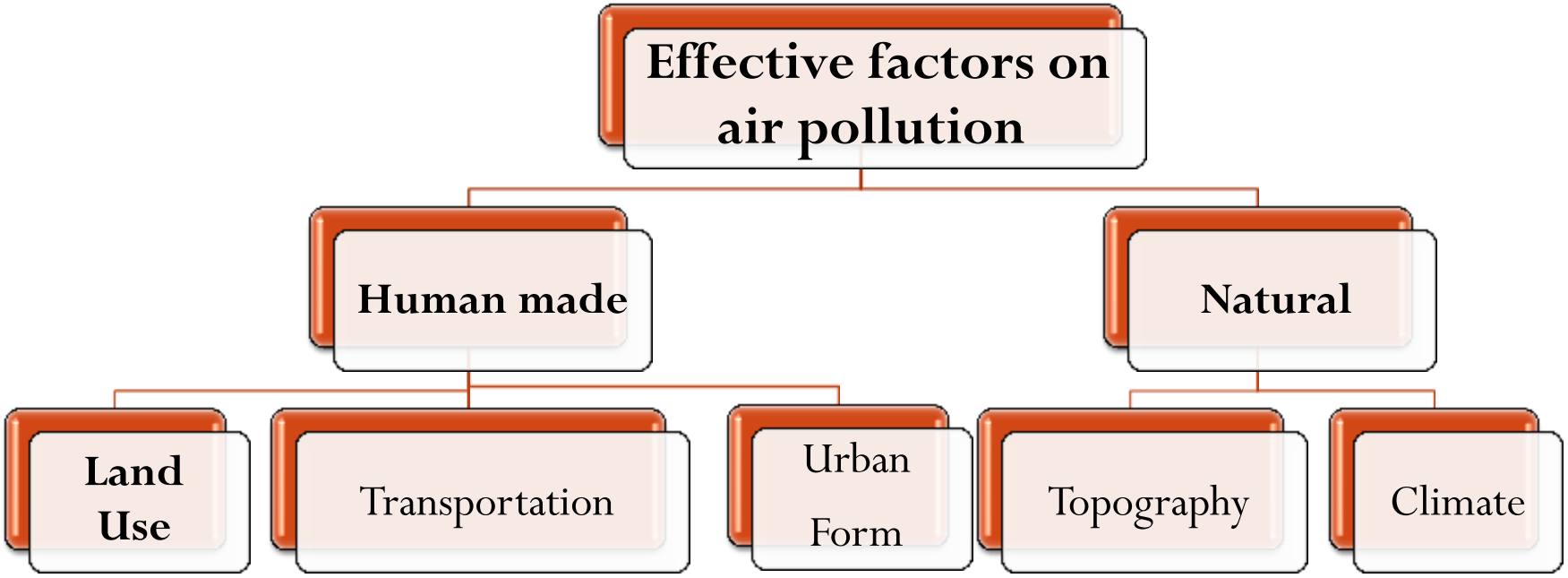
PSI	*Concentration*				
	CO(ppm)	O3(ppb)	NO2(ppb)	SO2(ppb)	PM10 (micro gr/m3)
	8 Hour	**1 Hour**	**1 Hour**	**24 Hour**	**24 Hour**
0	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
50	**4.50**	**60.00**	**150.00**	**30.00**	**75.00**
100	**9.00**	**120.00**	**300.00**	**140.00**	**150.00**
200	**15.00**	**200.00**	**600.00**	**300.00**	**375.00**
300	**30.00**	**400.00**	**1200.00**	**600.00**	**625.00**
400	**40.00**	**500.00**	**1600.00**	**800.00**	**875.00**
500	**50.00**	**600.00**	**2000.00**	**1000.00**	**1000.00**

Air Quality Index

PSI	Air Quality
0-50	**Good**
50-100	**Healthy**
100-200	**Unhealthy**
200-300	**Very Unhealthy**
>300	**Hazardous**

Air Quality	
Good	No health implications.
Healthy	Few hypersensitive individuals should reduce outdoor exercise.
Unhealthy	Slight irritations may occur, individuals with breathing or heart problems should reduce outdoor exercise.
Very Unhealthy	Healthy people will be noticeably affected. People with breathing or heart problems will experience reduced endurance in activities. These individuals and elders should remain indoors and restrict activities
Hazardous	Healthy people will experience reduced endurance in activities. There may be strong irritations and symptoms and may trigger other illnesses. Elders and the sick should remain indoors and avoid exercise. Healthy individuals should avoid out door activities.

How the air pollution can be mitigated?



There are two hypothesis:

It seems there is a correlation between land use and air pollution.

It seems land use planning can mitigate the air pollution.

The tool have been used for this research are GIS and SPSS

Land Use Planning and Mitigating Air Pollution

- **Zoning** is the effective Method in land use planning for mitigating the air pollution(EPA).

Other Land use planning strategies that have been used to mitigated Air pollution are

- Transport Oriented Development
- Infill development
- Jobs/Housing balance
- Mixed-use development
- Neotraditional neighborhood development

Land use planning strategies

Neighbourhood scale

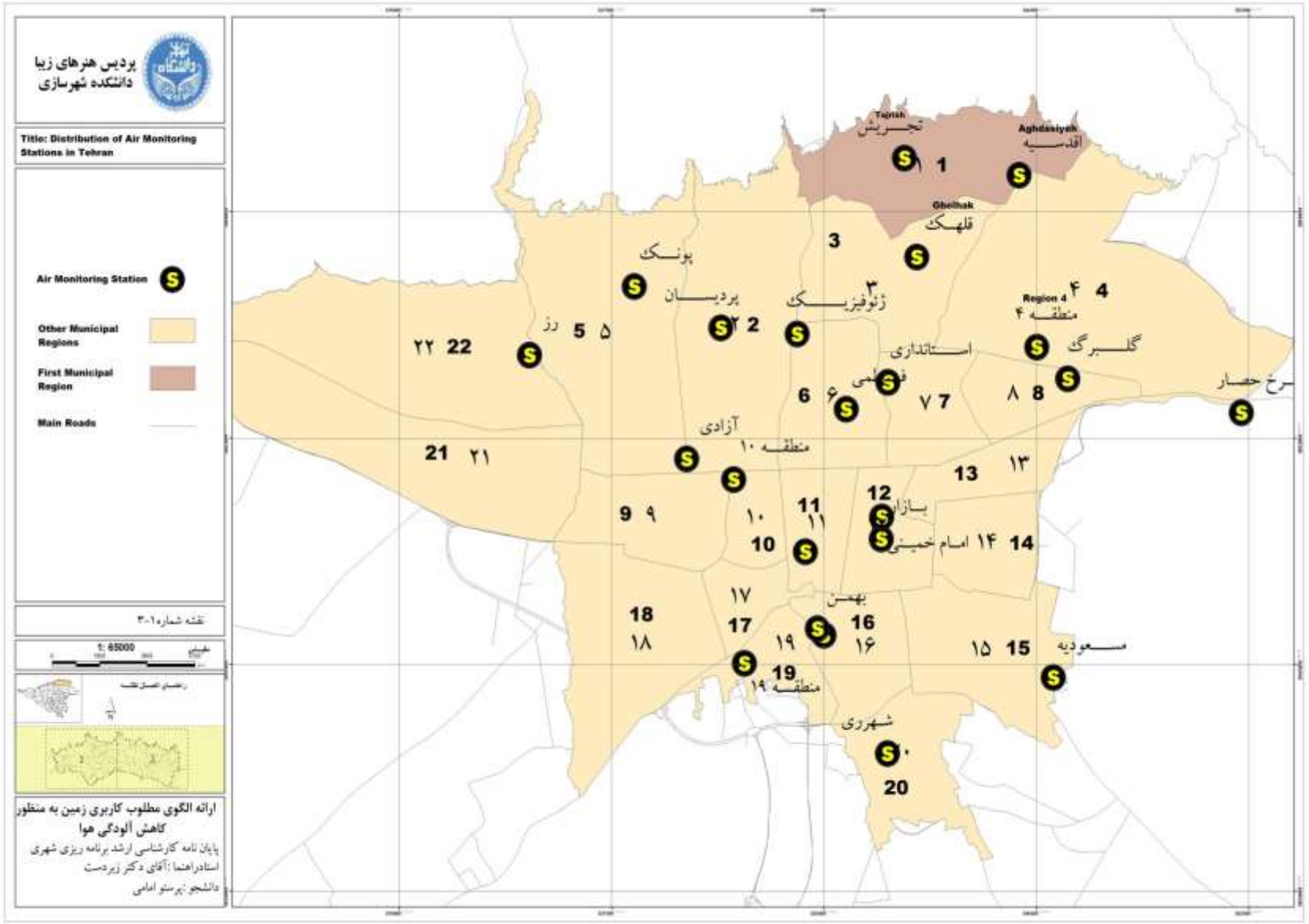
Regional scale

Changing urban design and land use

Redistribution of population and jobs

- Mix land use
- Neotraditional neighborhood development
- TOD
- Infill development
- Jobs/Housing balance

Change Land use Planning Strategies → **Change Urban Form** → **Change Travel Patterns** → **Change Emission pattern**


پردیس هنرهای زیبا
دانشکده شهرسازی
Title: Distribution of Air Monitoring Stations in Tehran
Air Monitoring Station
Other Municipal Regions
First Municipal Region
Main Roads
نقشه شماره ۱-۳
ارائه الگوی مطلوب کاربری زمین به منظور کاهش آلودگی هوا
پایان نامه کارشناسی ارشد برنامه ریزی شهری
استادراهنما :آقای دکتر زیردست
دانشجو :پرستو امامی
Tajrish
تجریش
Aghdasiyeh
اقدسیه
Gholhak
قلهک
پونک
پردیسان
ژنوفیزیک
Region 4
منطقه ۴
گلبرگ
استانداری
آزادی
منطقه ۱۰
بازار
امام خمینی
بهمن
منطقه ۱۹
شهرری
مسعودیه
سرخ حصار

Preparing the Data

From 22 municipal regions in Tehran

Frist municipal was selected for this research:

- It has specific urban structure
- It is diverse in term of services
- Residential- land Use is the dominant land use in the area

Air pollution has been monitored with three monitoring station:

Aghdasiyeh, Gholhak, and Tajrish

Data that has been used:

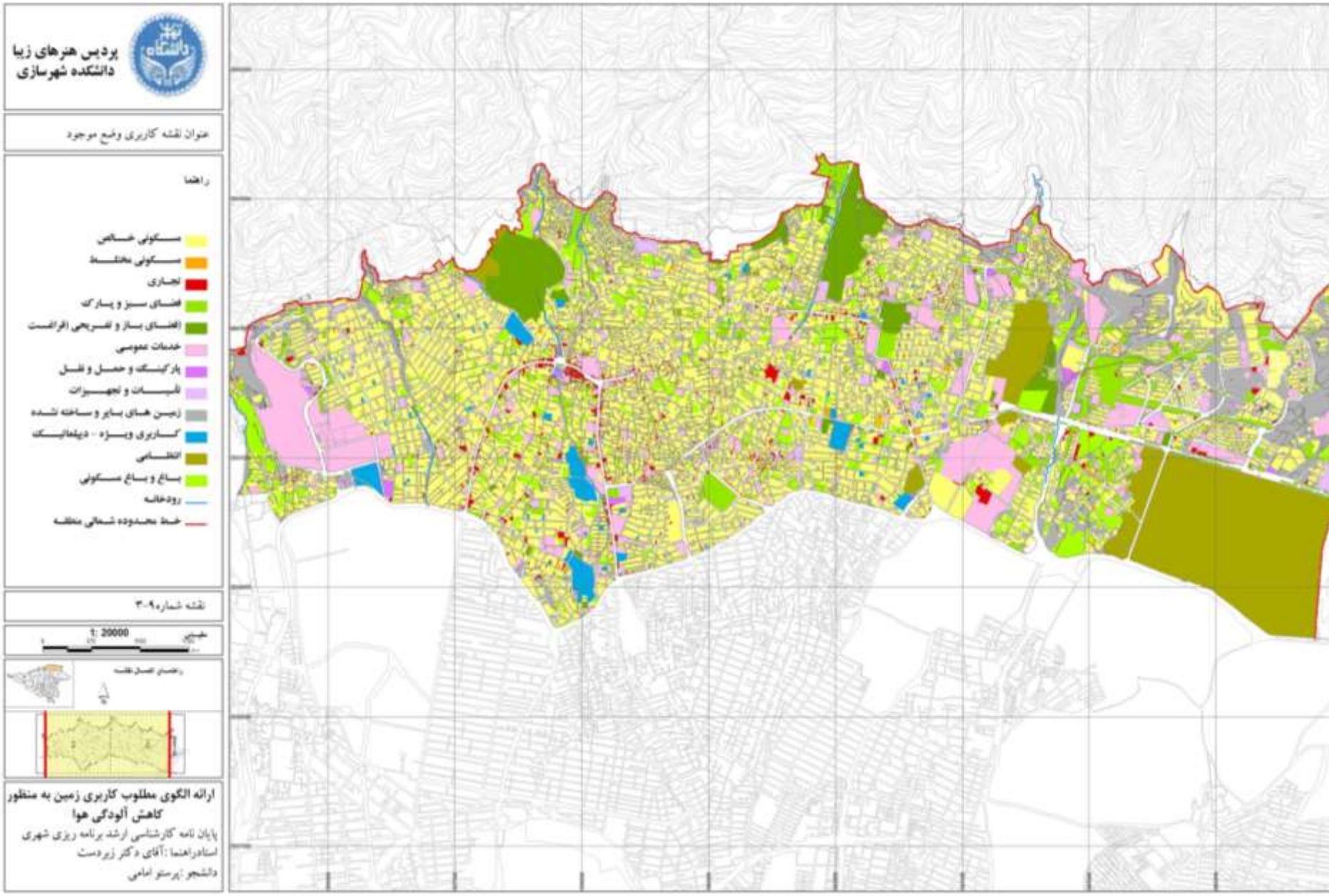
1- Daily PSI (2005-2010)

2- Land-Use

3- Slope and Elevation

4- Wind

5- Traffic Volume


پردیس هنرهای زیبا
دانشکده شهرسازی
عنوان نقشه کاربری وضع موجود
راهنما
مسکونی خالص
مسکونی مختلط
تجاری
فضای سبز و پارک
فضای باز و تفریحی (فراغت
خدمات عمومی
پارکینگ و حمل و نقل
تاسیسات و تجهیزات
زمین های بایر و ساخته نشده
کاربری ویژه - دیپلماتیک
انتظامی
باغ و باغ مسکونی
رودخانه
خط محدوده شمالی منطقه
نقشه شماره۹-۳
1: 20000
ارائه الگوی مطلوب کاربری زمین به منظور کاهش آلودگی هوا
پایان نامه کارشناسی ارشد برنامه ریزی شهری
استادراهنما :آقای دکتر زیردست
دانشجو :پرستو امامی

Preparing Data

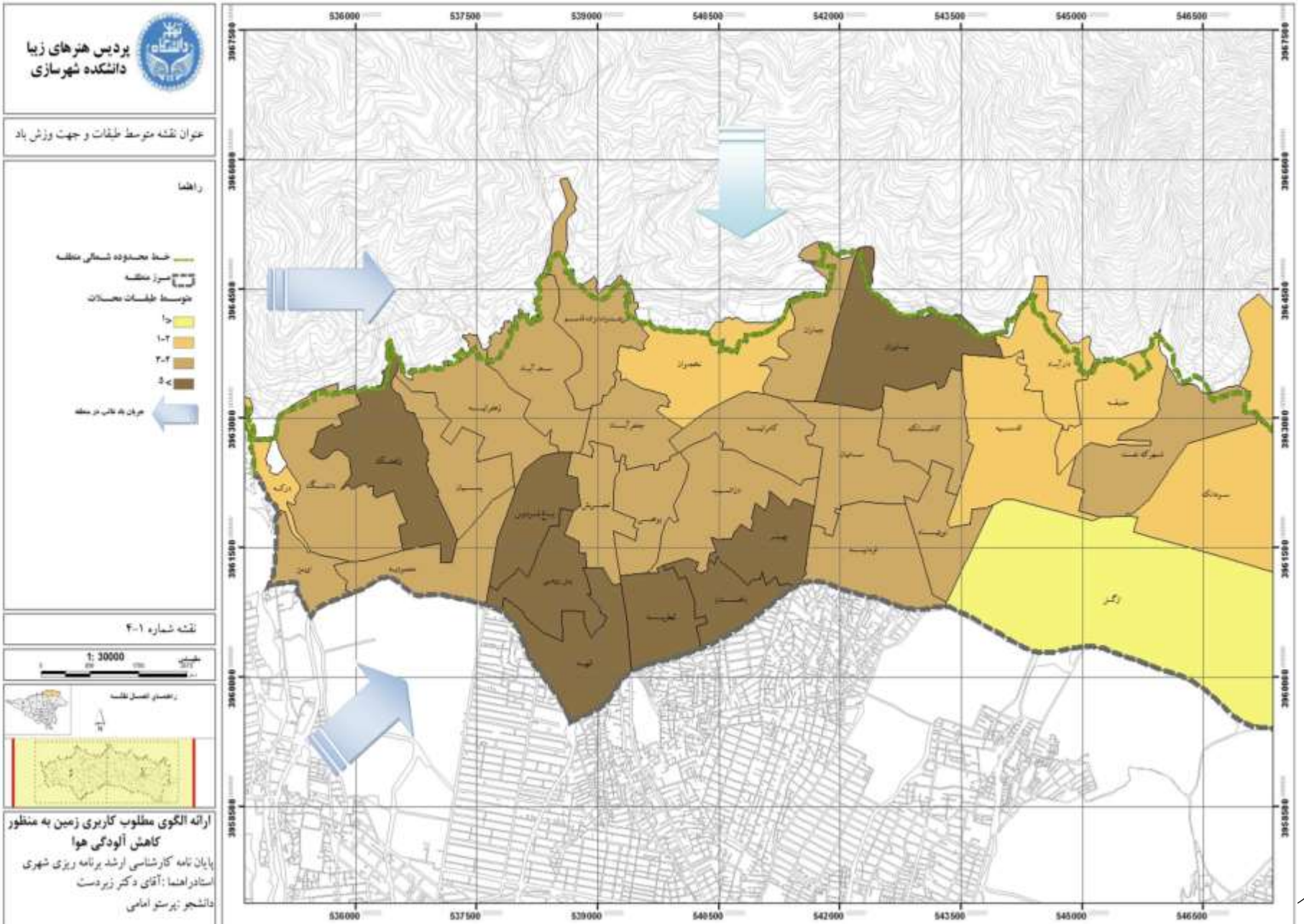
PSI	Land Use	Traffic	Others
5 particles	Population	Average volume	Wind
1825 days	Energy usage	Rush hour	slope
	Floors	Direction	
	Road Hierarchy		
	Neighbourhoods limits		
	Land-Use Categories		
	Others		

There were some issues with preparing the data

1- Each data had different source (for numbers of Floors and Land use)

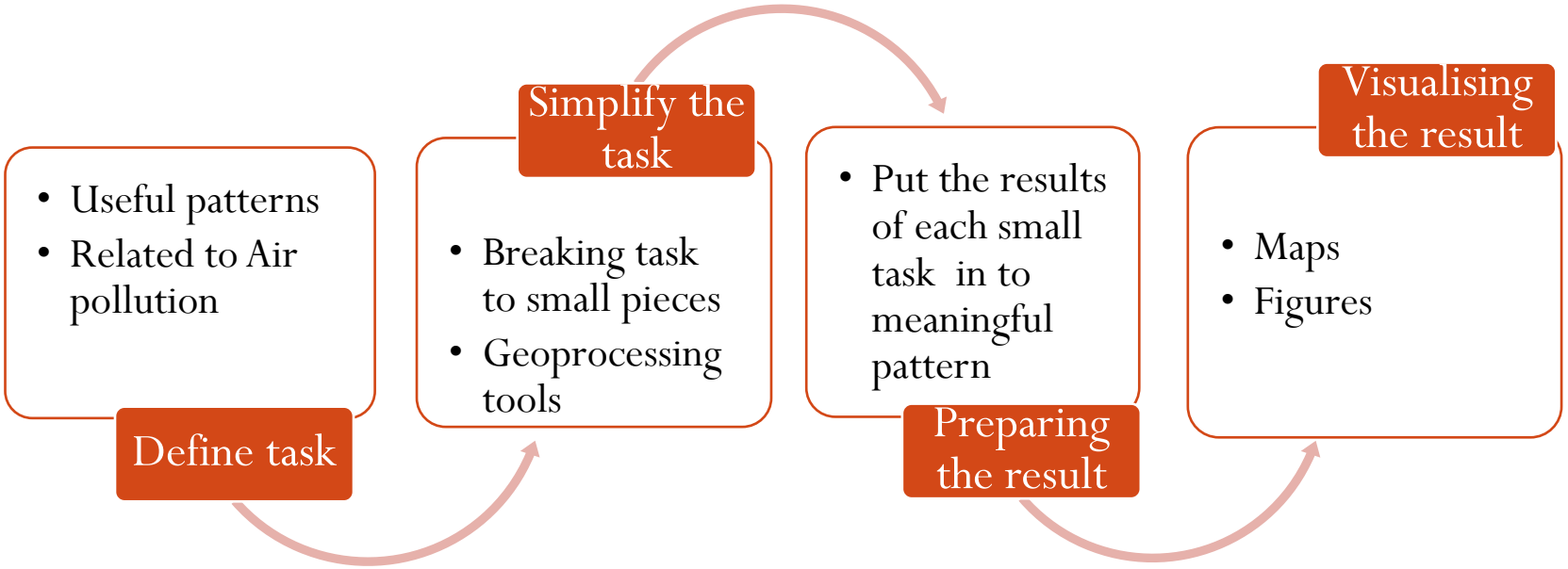
2- Lack of access to the various Extensions in GIS (for Example, Spatial analyst, Network Analyst..)

3- Raw Excel files and unorganized data

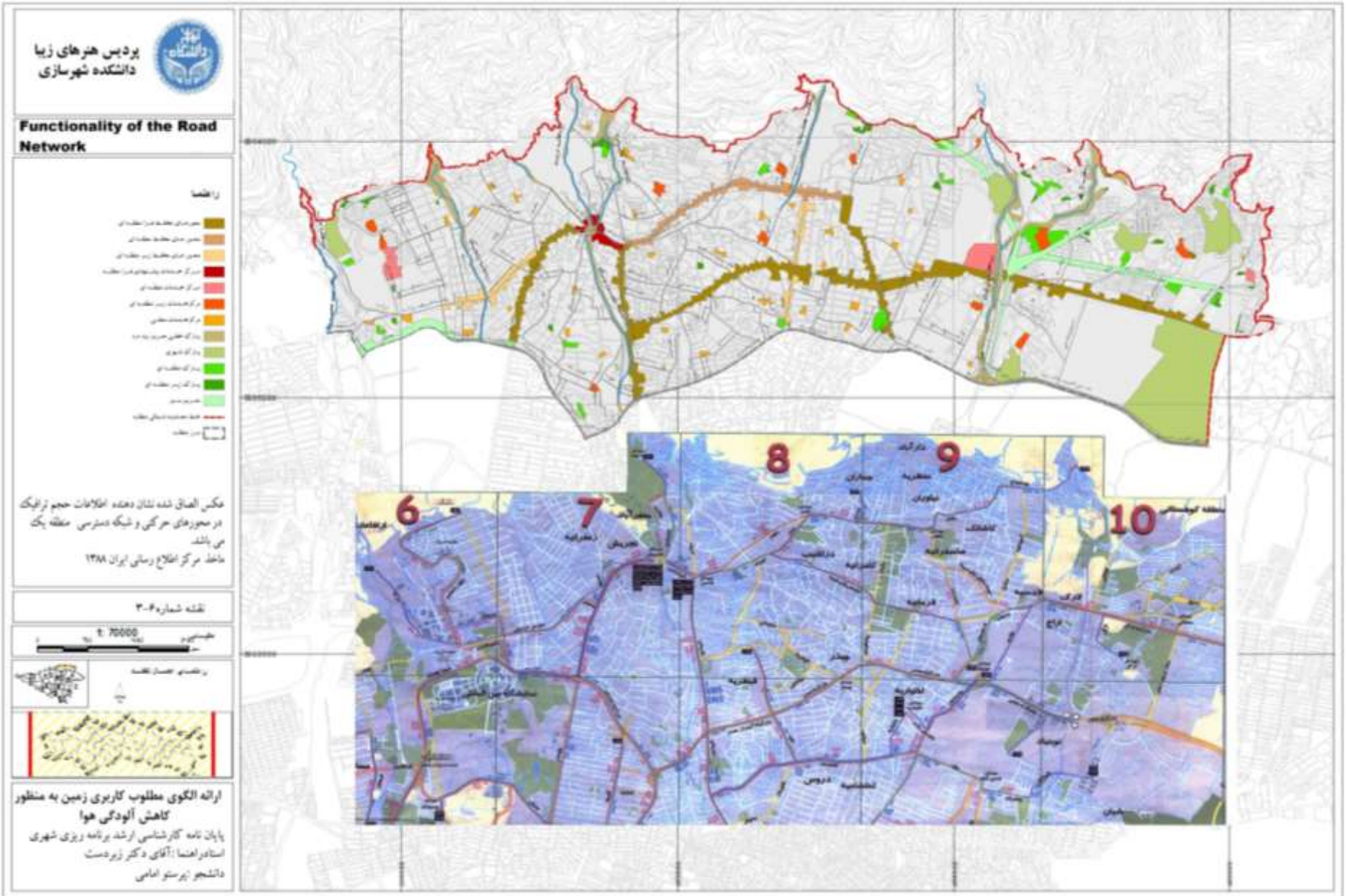

پردیس هنرهای زیبا
دانشکده شهرسازی
عنوان نقشه متوسط طبقات و جهت وزش باد
راهنما
خط محدوده شمالی منطقه
مرز منطقه
متوسط طبقات محلات
جدا
۱-۲
۳-۴
۵<
جریان باد غالب در منطقه
نقشه شماره ۴-۱
1: 30000
ارائه الگوی مطلوب کاربری زمین به منظور کاهش آلودگی هوا
پایان نامه کارشناسی ارشد برنامه ریزی شهری
استادراهنما :آقای دکتر زیردست
دانشجو :پرستو امامی

Spatial Analysis

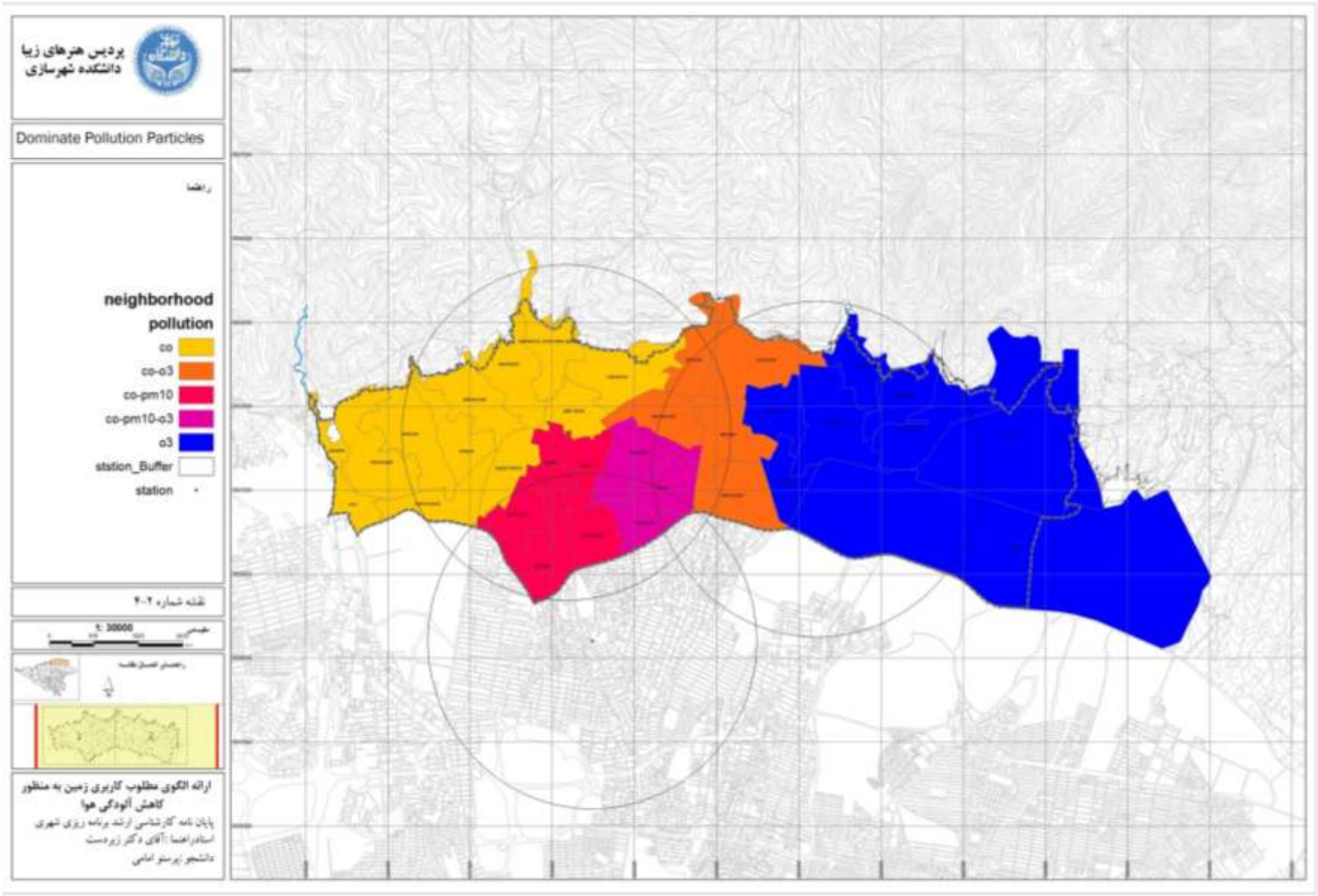
- Rule of geography:
  - First rule is " everything is related to everything else, but near things are more related then the distant things"(Toblers,1970)



Road Functionality



Dominate Pollution



Correlation of land use and air pollution for the case study

- Preparing data for SPSS analysis

  1- Land use data

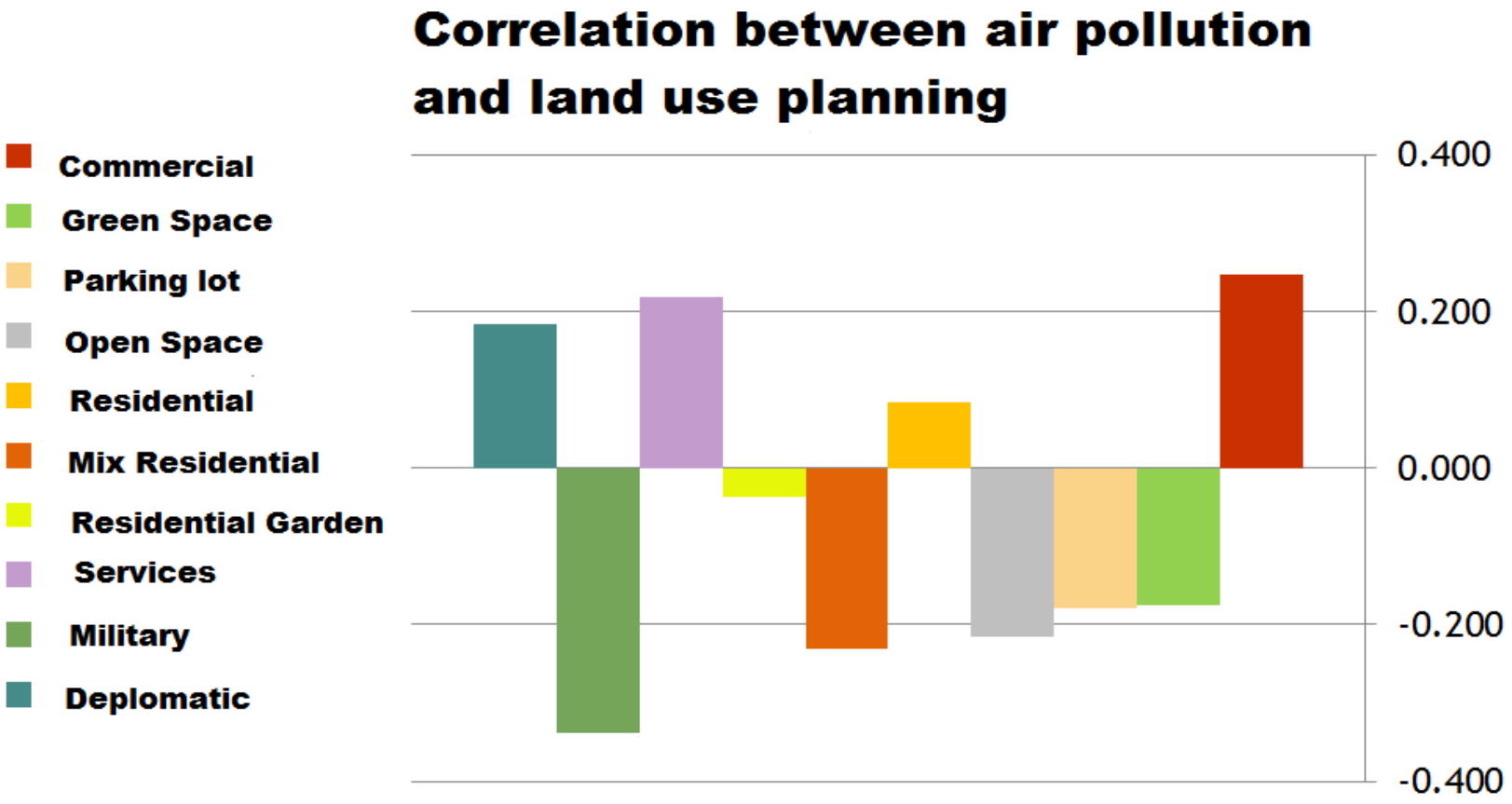
  2- Air pollution

  3- Wind, slope, sunny hours and temperature.

Preparing land use data for SPSS

- Mixing Infrastructure, Parking lot and Transportation
- **Mixing Green spaces, Parks and Recreation**
- **Putting industrial land use aside**
- **Using Floors data (Urban form variable)**

Correlation land use and CO



Correlation and suitable land use Plan

Diplomatic	Military	Services	Garden residential	Mix residential	Residential	Open Space	Parking Lot	Green Space	Commercial	Emissions in 2010
0.185	-0.339	0.219	-0.037	-0.230	0.085	* -0.215	-0.178	-0.176	0.248	Co
0.168	-0.201	0.200	0.004	-0.276	-0.049	-0.173	-0.191	-0.157	0.237	
-0.146	0.802	-0.18	-0.132	0.207	-0.006	0.318	0.244	0.056	-0.317	O_3
.There is no meaningful correlation between land use and NO2										No_2
-0.125	0.405	-0.20	-0.133	0.209	0.018	0.0303	0.244	0.041	-0.317	So_2
0.260	-0.326	0.16	-0.068	-0.159	0.180	-0.710	-0.148	-0.238	0.205	PM_{-10}

Conclusion

- Land use planning can reduce air pollution

For providing suitable land use plan:
Mix use strategy :

- Enhance access to public transportation
- Balance between land use that increase or reduce the air pollution
- Improve the accessibility
- Enhance walkability
- Improve access to commercial zones with neighbourhood scale