



INTERBASIN WATER TRANSFER

Utility of Modern Tools of Remote Sensing (RS) and Geographical Information Systems (GIS) in Melen Watershed Protection Studies

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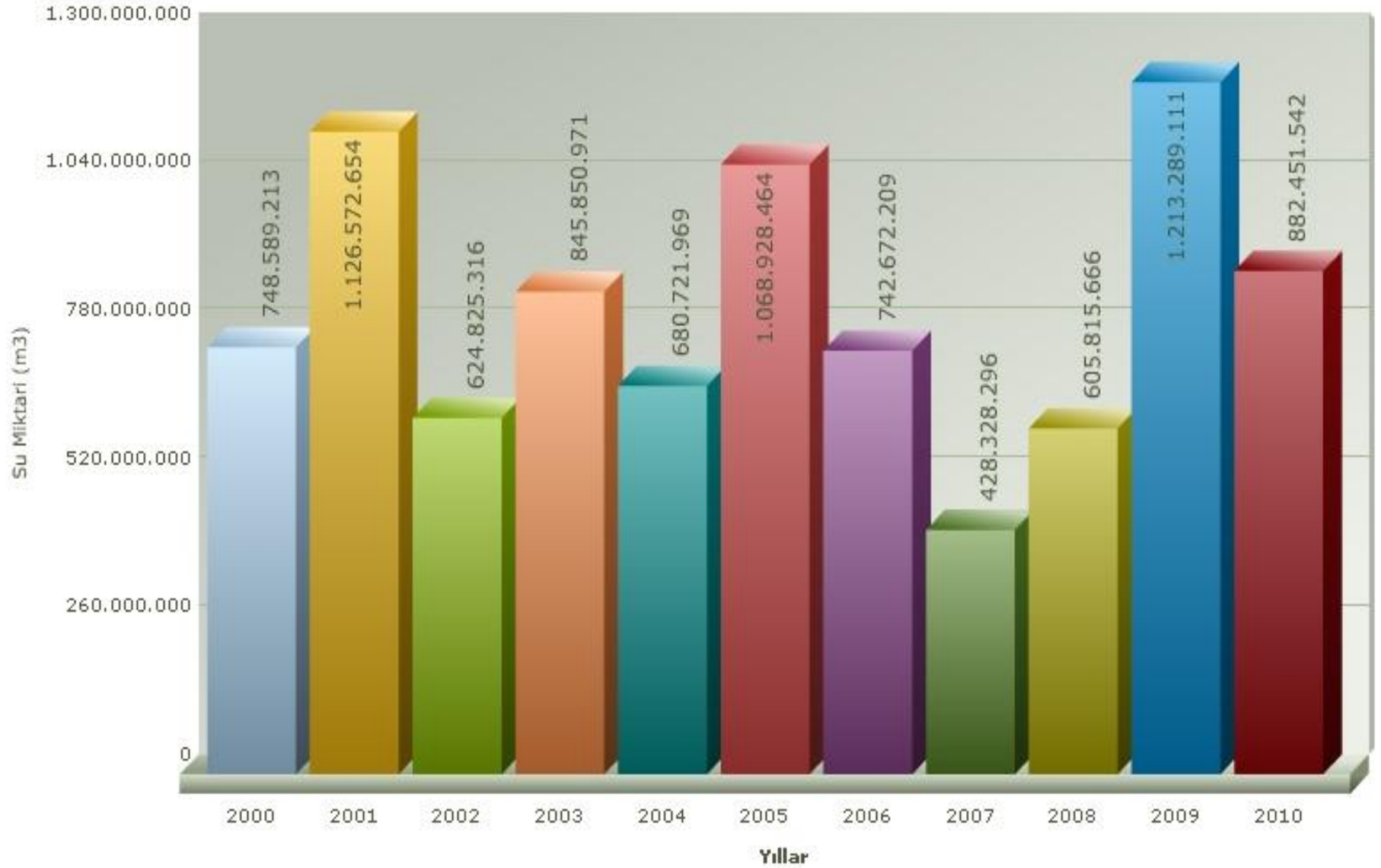
Megacity-Istanbul

- Istanbul is a megacity with a population of over 13 million according to 2010 values.
- Its population increased by 170,000 capita/year within the past 2 years (2009-2010).
- Population density is 2551 capita/km².
- Water consumption is on the average 2 million m³/day; however, it increased to 2.5 million m³/day during August 2010.
- Istanbul is fed by surface water resources. As of 06 February 2011, the average capacity of the dams supplying water to the city is 91.07%.
- 50- years long term avg. precipitation value is 609.3 mm. The avg. ppt. value in 2007 was 522.5 mm.

**İSTANBUL'UN OCAK-ŞUBAT-MART-NİSAN-MAYIS-HAZİRAN-TEMMUZ-AĞUSTOS-EYLÜL-EKİM-KASIM-ARALIK
AYLARINDA ALDIĞI 12 AYLIK YAĞIŞ**



BARAJLARIMIZA YAĞMURLARDAN GELEN SU MİKTARLARI (m³)



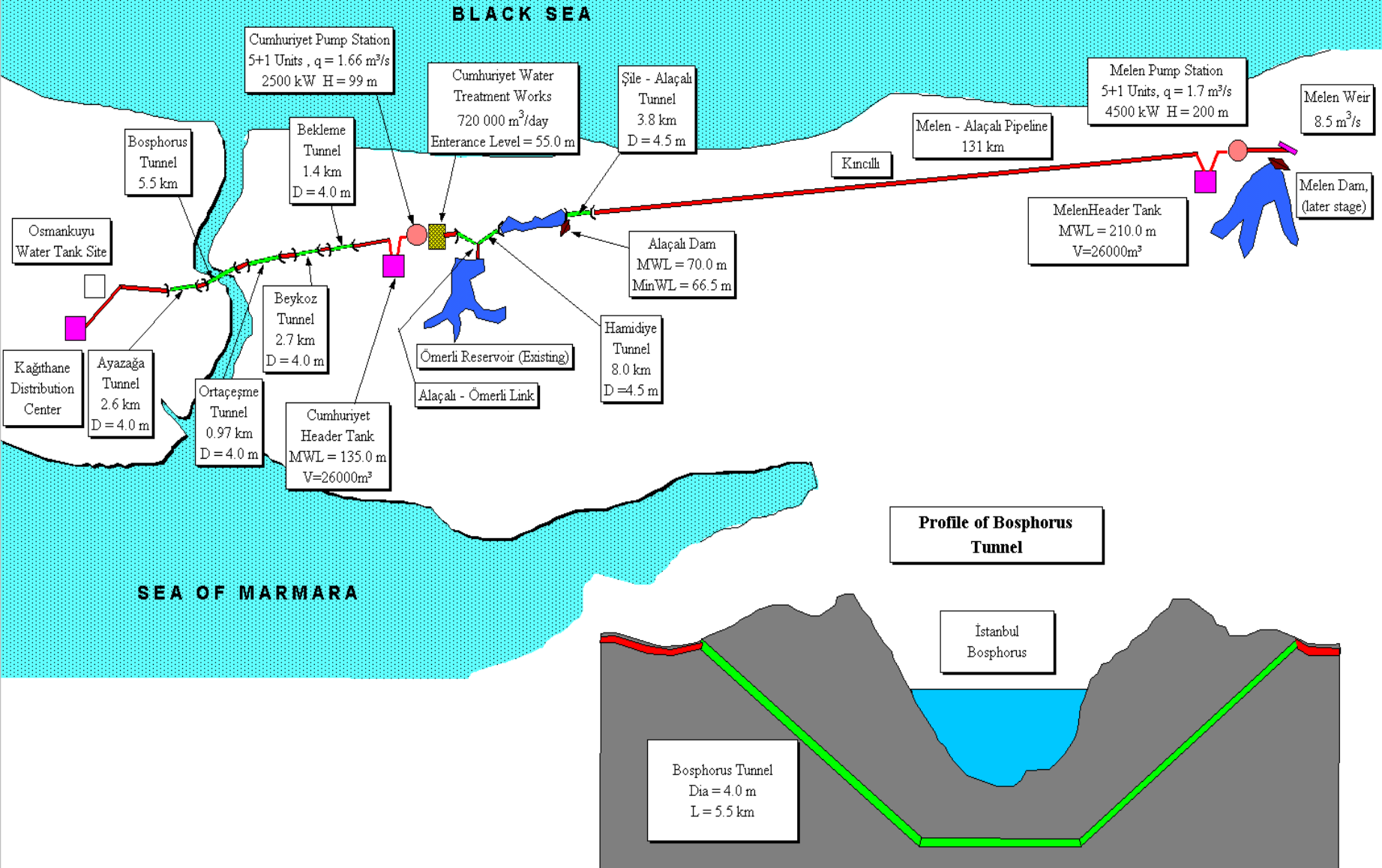
Interbasin Water Transfer

- Melen Water Supply Project (Melen System) is considered within the context of Greater Istanbul Water Supply II. Stage Project.
- The Project is accepted as the fundamental remedial measure for supplying water to Istanbul in the medium and long term.
- Great Istanbul Drinking Water 2nd Stage Project of Melen System is being carried out by the State Hydraulic Works (DSI) to supply water to Istanbul.
- It is estimated that more than 52% of Istanbul's water will be supplied by the Melen System after 2010.
- As the subcomponent of the Melen System Project, Melen Watershed Integrated Protection and Water Management Master Plan is an integrated management system aiming to protect, improve and maintain the water quality of the Melen River.

Interbasin Water Transfer



İSTANBUL WATER SUPPLY BÜYÜK MELEN PROJECT



Integrated Watershed Management (IWM)

IWM deals with

- ✓ planning,
- ✓ management,
- ✓ monitoring

of activities covering the utilization of natural resources by taking into account the social, political, economical and institutional factors prevailing in the watershed with the aim of **sustainable management of natural resources**.

In this manner, sustainable utilization and protection of watersheds may be maintained in the most effective and proper means of coordination.

Integrated Watershed Management (IWM)

- In IWM studies, topics like;
 - ✓ Management supported by Geographical Information Systems (GIS) and Remote Sensing (RS),
 - ✓ Management of Point Sources of Pollutants,
 - ✓ Management of Non-point (diffuse) Sources of Pollutants,
 - ✓ Management of Solid and Hazardous wastes,
 - ✓ Water quality modeling, and
 - ✓ Model aided managementare considered.

A fundamental concern of IWM is preparation of Watershed Protection Master Plans.

Integrated Watershed Management (IWM)

The main components of Watershed Protection Master Plans are;

- Characterization of the watershed,
- Summary of the significant human-induced pressures and their corresponding impacts,
- Identification of protection areas,
- Mapping the watershed,
- Determination of protection master plans according to the findings,
- Raising public awareness,
- Maintaining communication with the Institutional Stakeholders,
- Preparation of the action plans that takes into account the outcomes of information sharing and harmonization among the various stakeholders.

Framework of the Melen Project

- Water Quality Management
- Regional Wastewater Management
- Regional Solid Waste Management

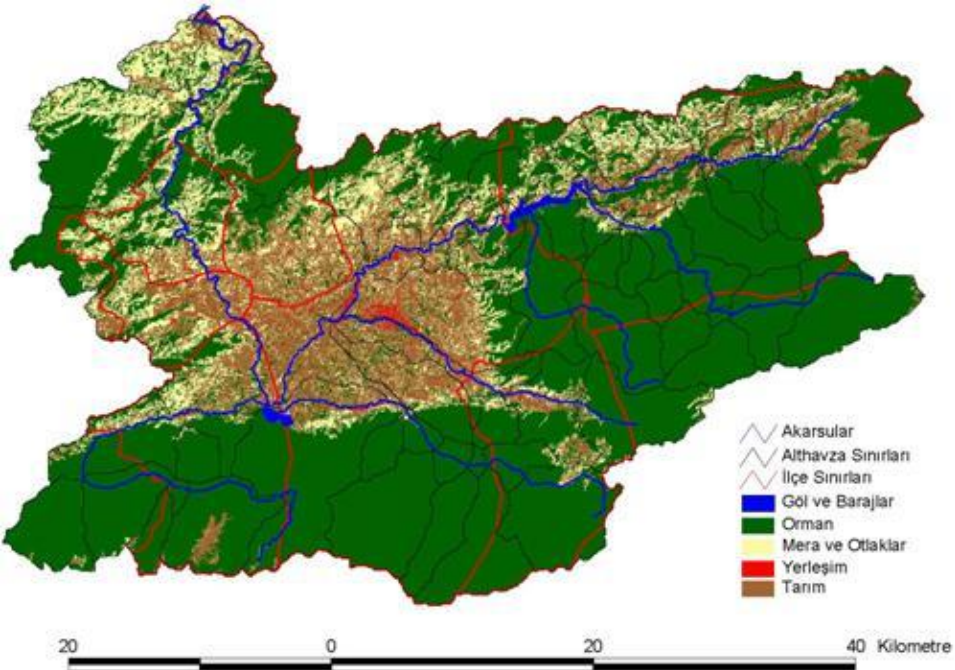
Watershed
Protection
Action
Plan

Melen Watershed

In this study, GIS and RS are used as decision support system tools during the preparation of the protection plans of Büyük Melen Stream.

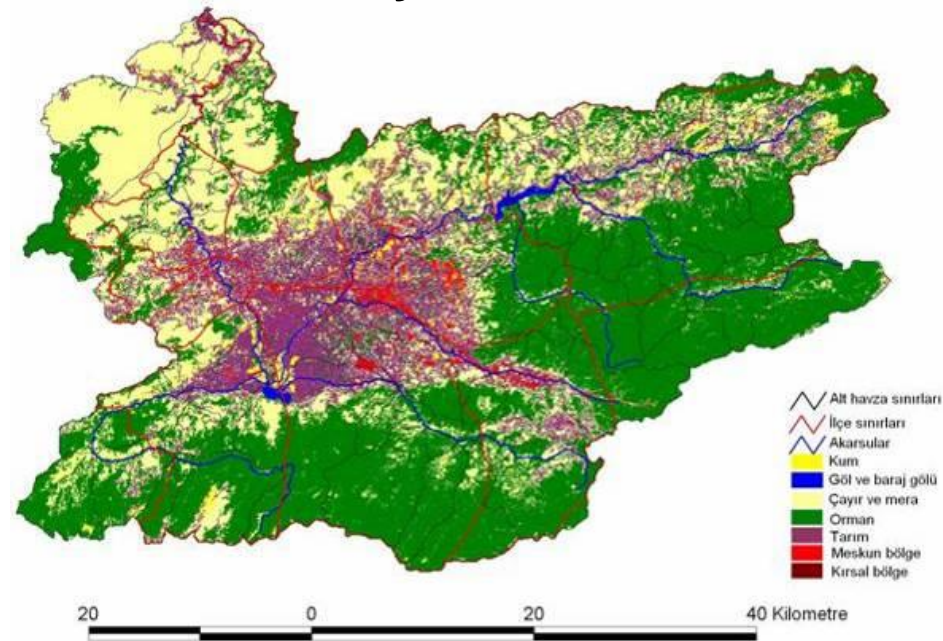
- The surface area of the watershed is 2.437 km².
- Almost half of the land is covered by forests while the 39% of the other half is spared to agricultural activities.
- The majority of the watershed lies within the Düzce Province of Turkey.
- Surface water quality of the area has been deteriorated due to uncontrolled and unregulated human activities.
- The areal values are obtained by utilizing the LANDSAT image belonging to August, 2006.
- Land-use changes are calculated by utilizing LANDSAT image belonging to 1987.
- The accuracy of these images is around 80%.
- After a series of land-use classifications and verifications, the final areas for each land-use activity are calculated.

Land-use Distribution

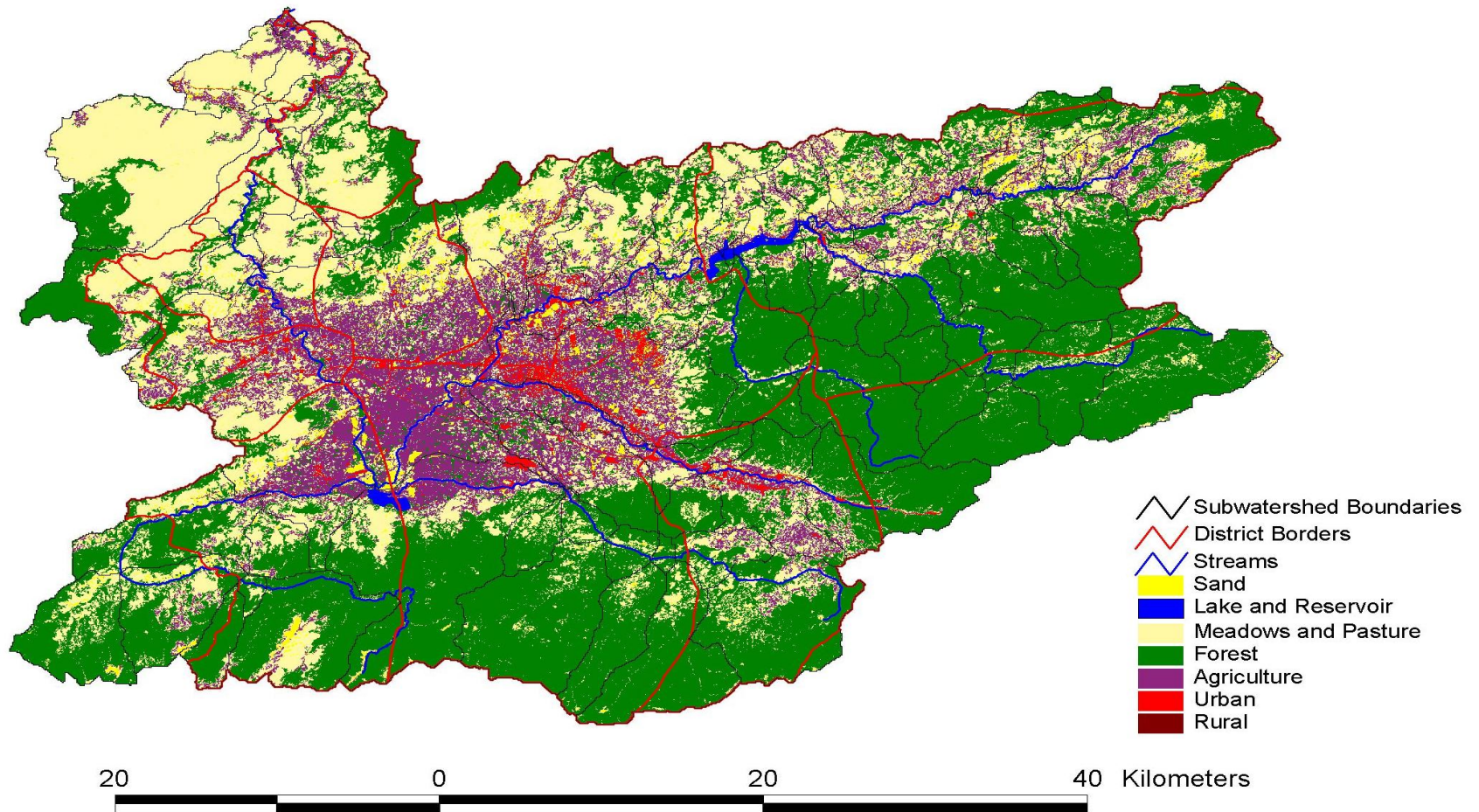


Land- use of year 1987

Land- use of year 2006



Land-use Distribution (2006)



Distribution of the Watershed among the Sharing Provinces

Düzce Province constitutes almost 80% of the watershed.

All the districts of Düzce are within the Melen Watershed except the Akçakoca District.

	Düzce	Sakarya	Bolu	Zonguldak	Total
Land (ha)	194.257	29.341	19.356	735	243.689
Distribution (%)	79,7 %	12,0 %	8,0 %	0,3 %	100,0 %

Büyük Melen Watershed

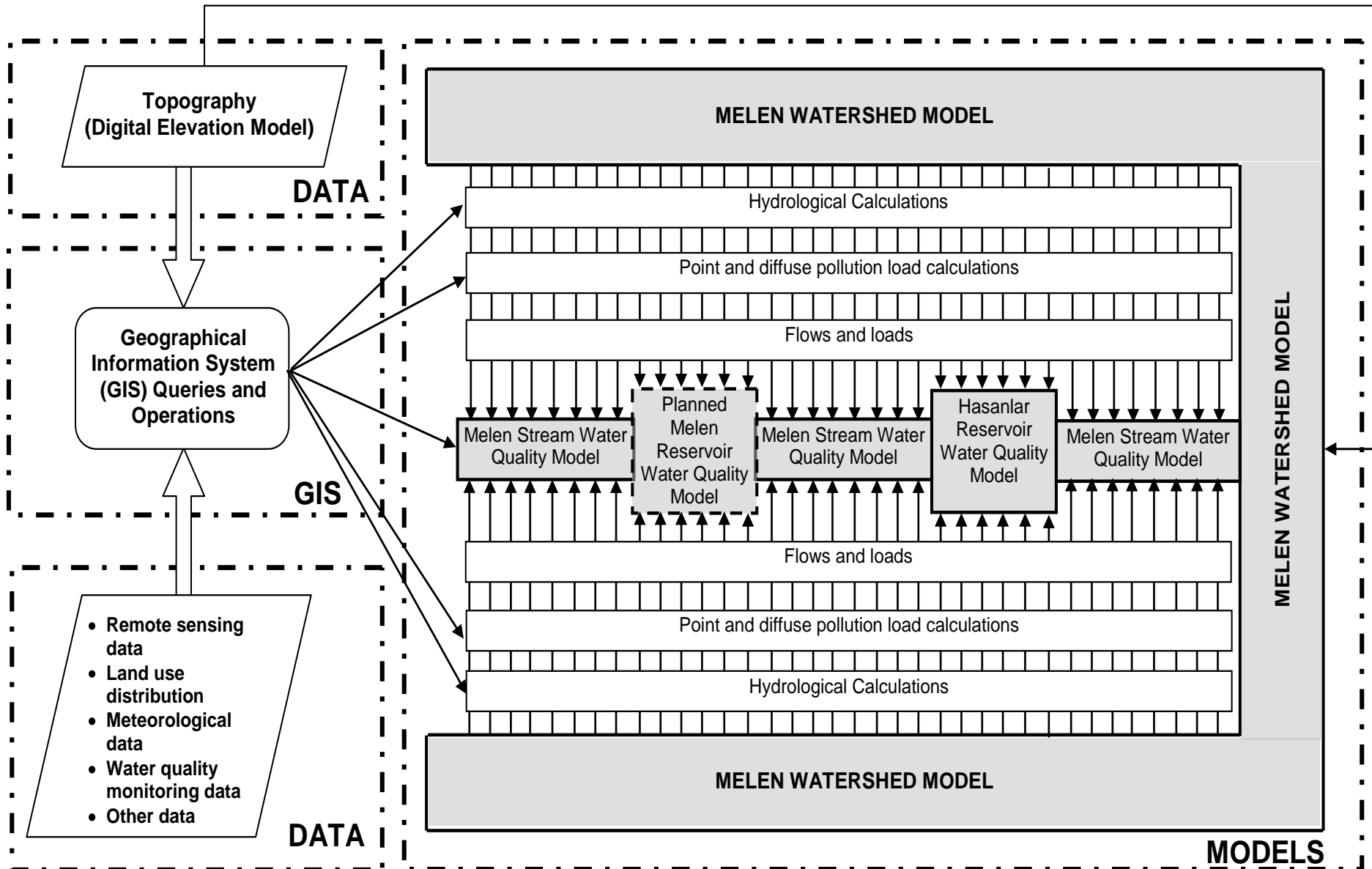


Province	Distribution %
Düzce	79,7
Sakarya	12,0
Bolu	8,0
Zonguldak	0,3

Land-use Distribution (year 2006)

Land-use (ha)	Düzce								Sakar.	Bolu	Zongul.	TOTAL
	Merkez	Akçakoca	Cumayeri	Çilimli	Gölyaka	Gümüşova	Kaynaşlı	Yığıl.				
Agriculture	17.378	968	1.825	3.379	3.715	2.638	2.772	6.433	3.351	371	16	42.823
Forests	31.442	2.687	1.810	2.348	12.436	1.553	13.732	28.315	13.392	18.016	642	126.365
Meadows & Pasture	13.846	3.637	4.859	3.098	5.367	3.373	3.975	11.477	12.044	913	70	62.697
Water	139	13	14	4	102	47	71	339	13	13	0	754
Urban Land	2.879	27	110	153	225	400	538	329	100	0	0	4.754
Rural Land	145	3	12	3	28	32	5	62	15	0	0	304
Sand	2.132	55	293	510	717	247	149	1.415	426	44	8	5.991
Total	67.961	7.389	8.923	9.494	22.590	8.289	21.242	48.369	29.341	19.356	735	243.689

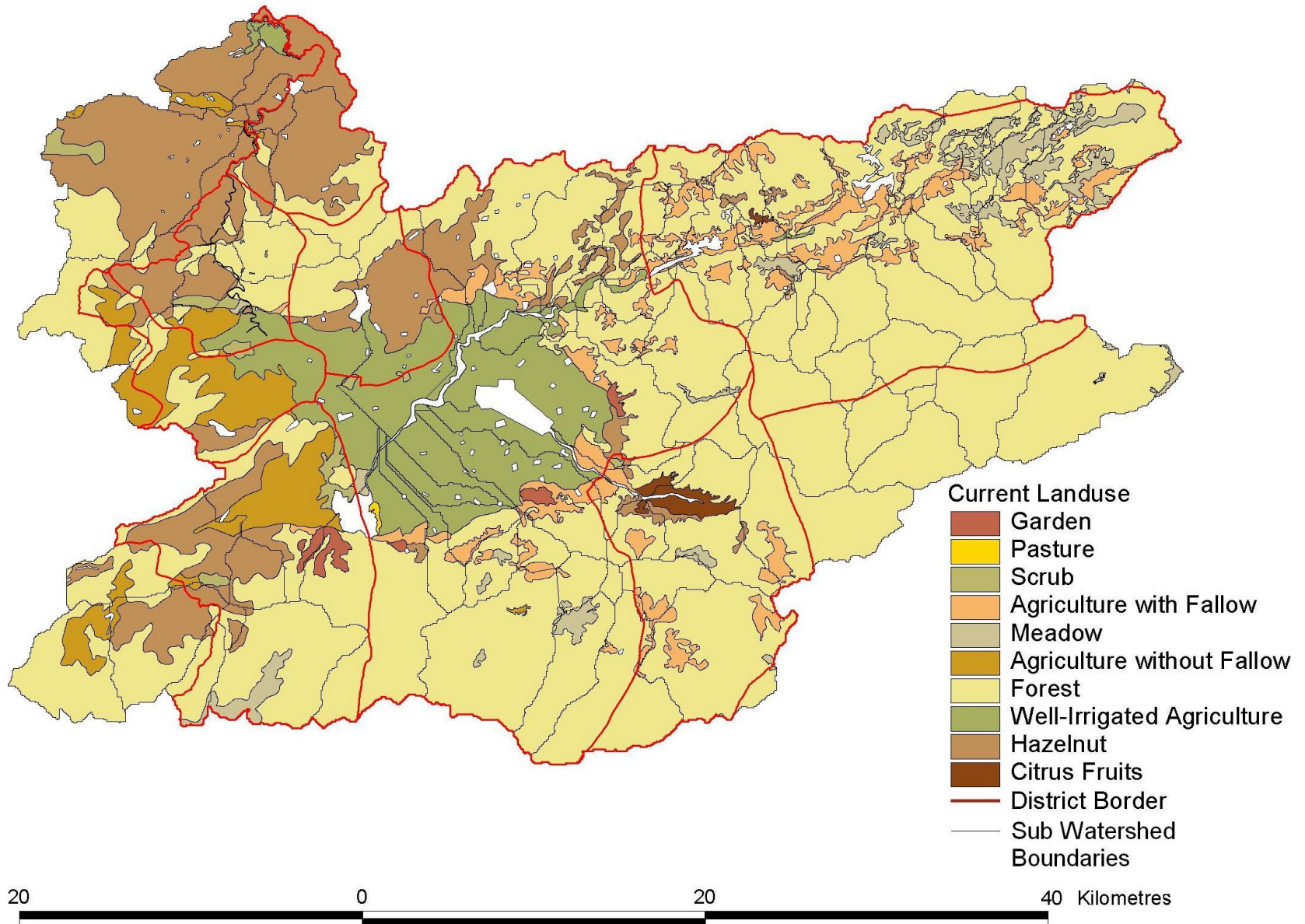
Melen Watershed Decision Support System Components

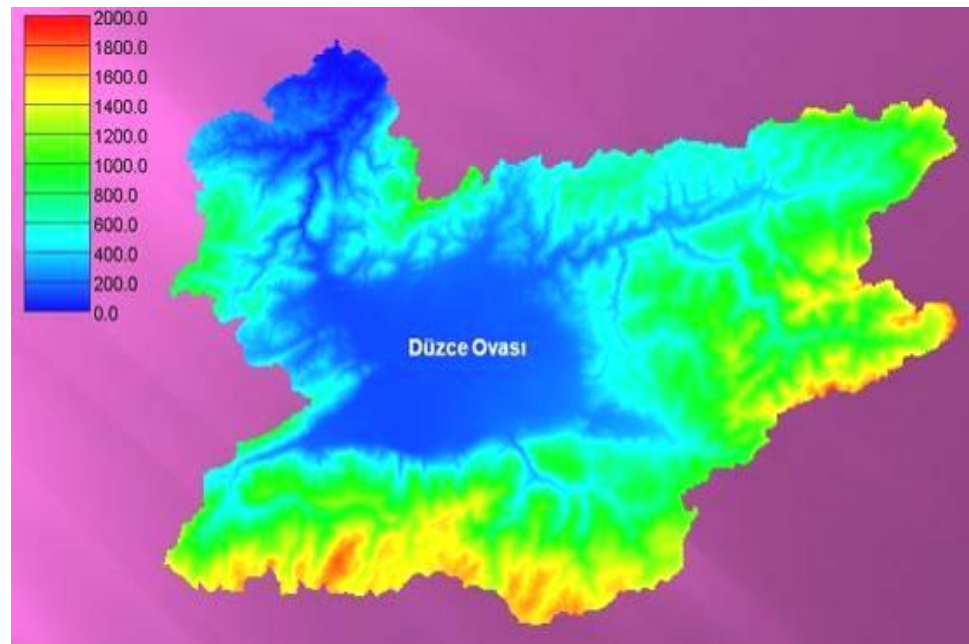
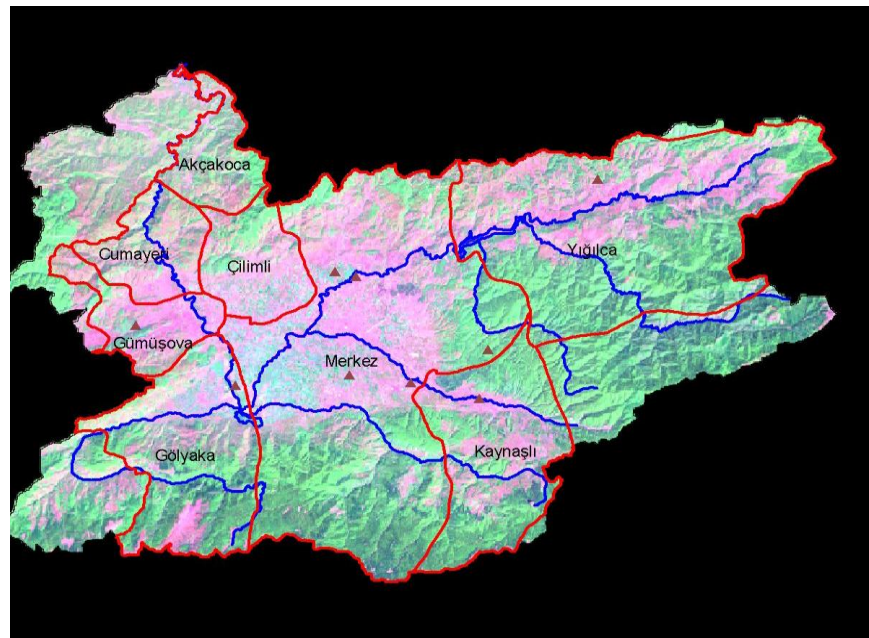
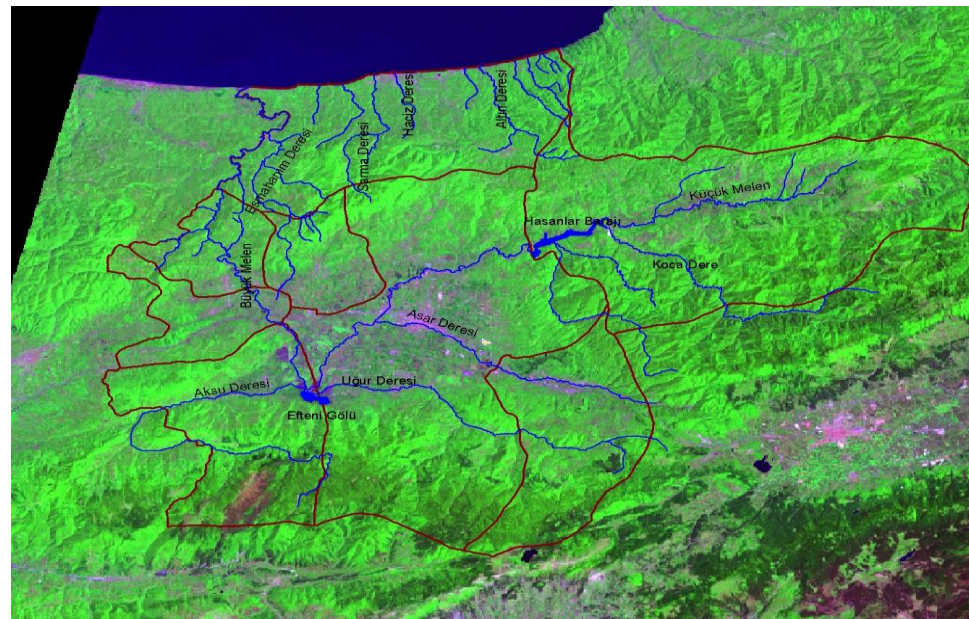
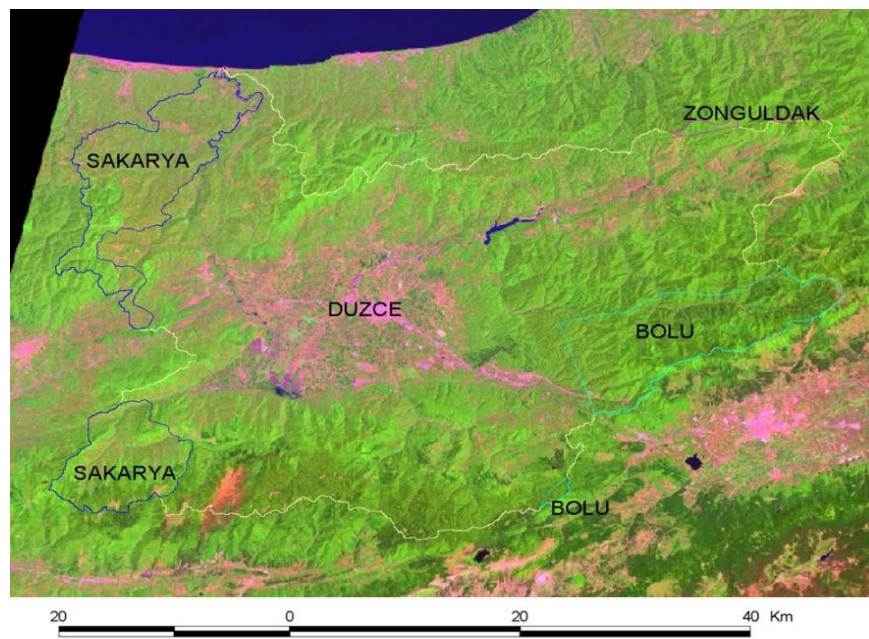


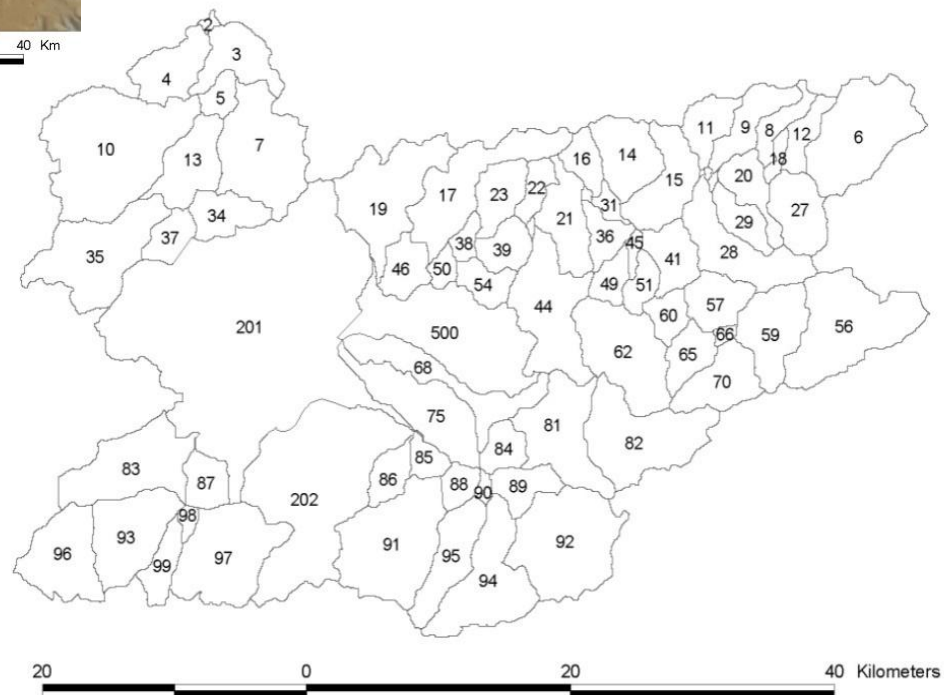
Geographical Information System (GIS)

- GIS is an important tool used extensively to manage spatially distributed data such as land use, administrative boundaries along with other geo-referenced data.
- GIS has two basic subsystems (maps and data) therefore useful as a data storage system and can generate self explanatory dynamic and thematic maps which are powerful visual aids for engineers and managers.
- GIS outputs are used in modelling studies especially for generating model inputs and visualizing model outputs.

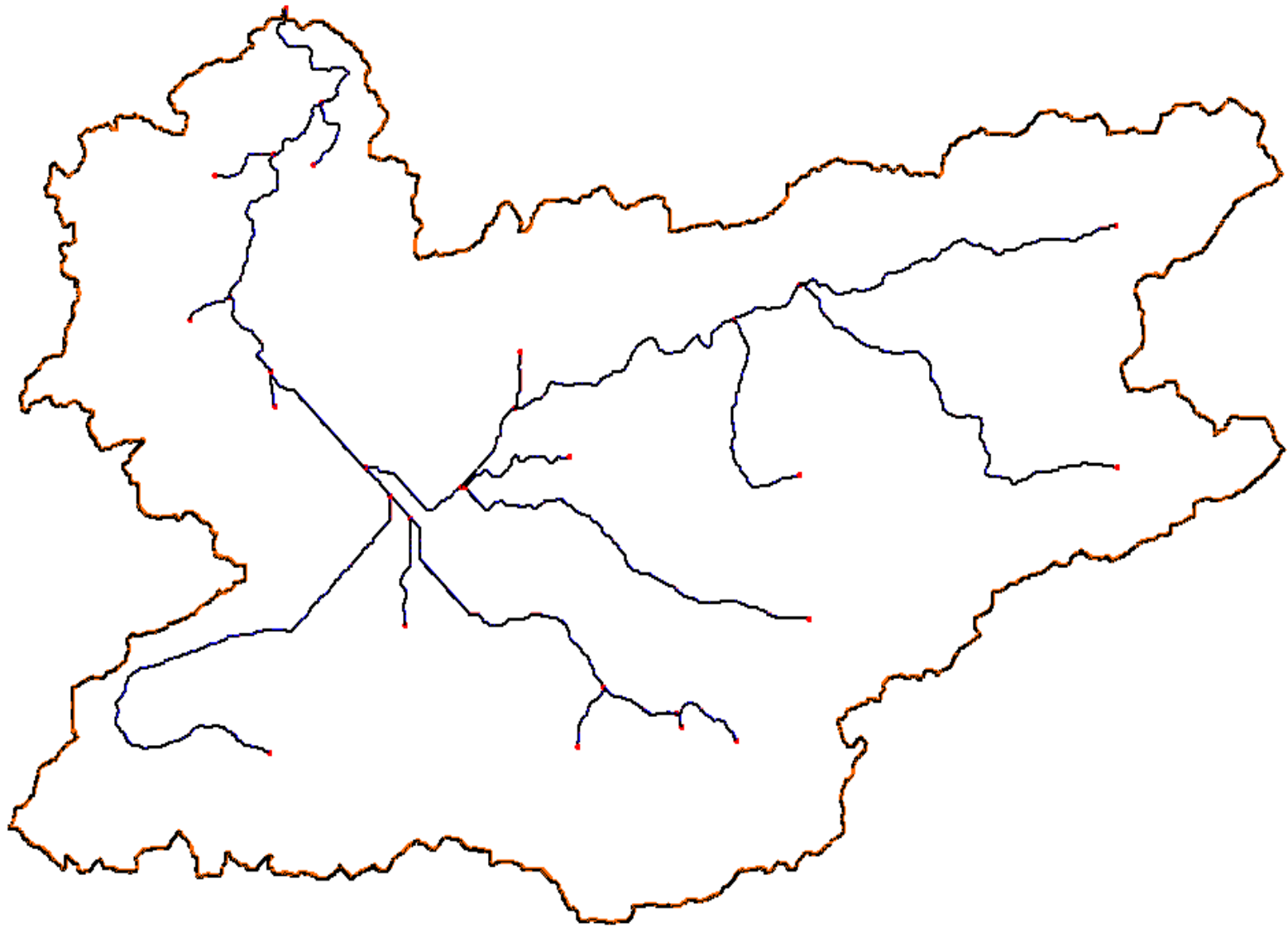
GIS Outputs



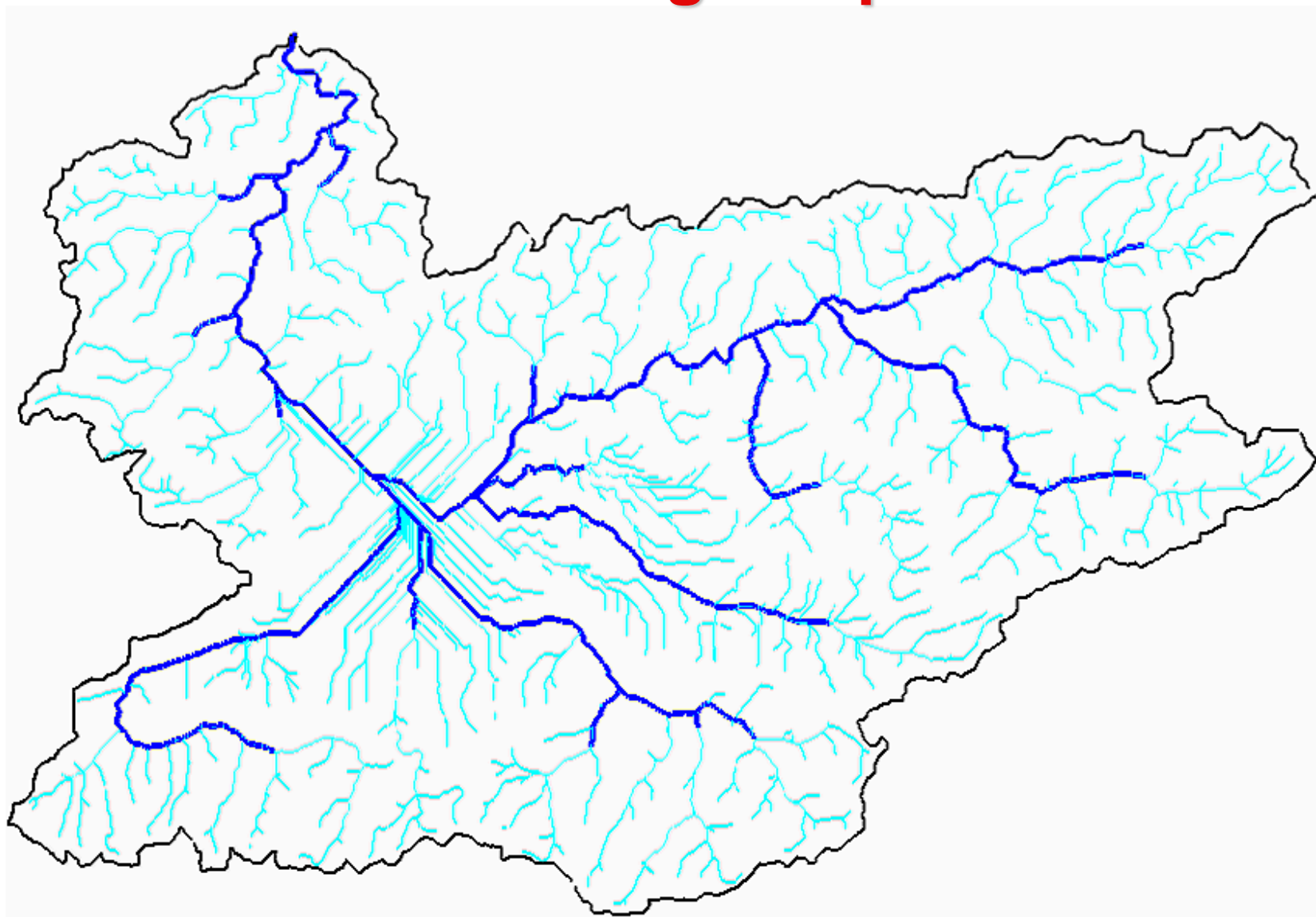




Stream Network



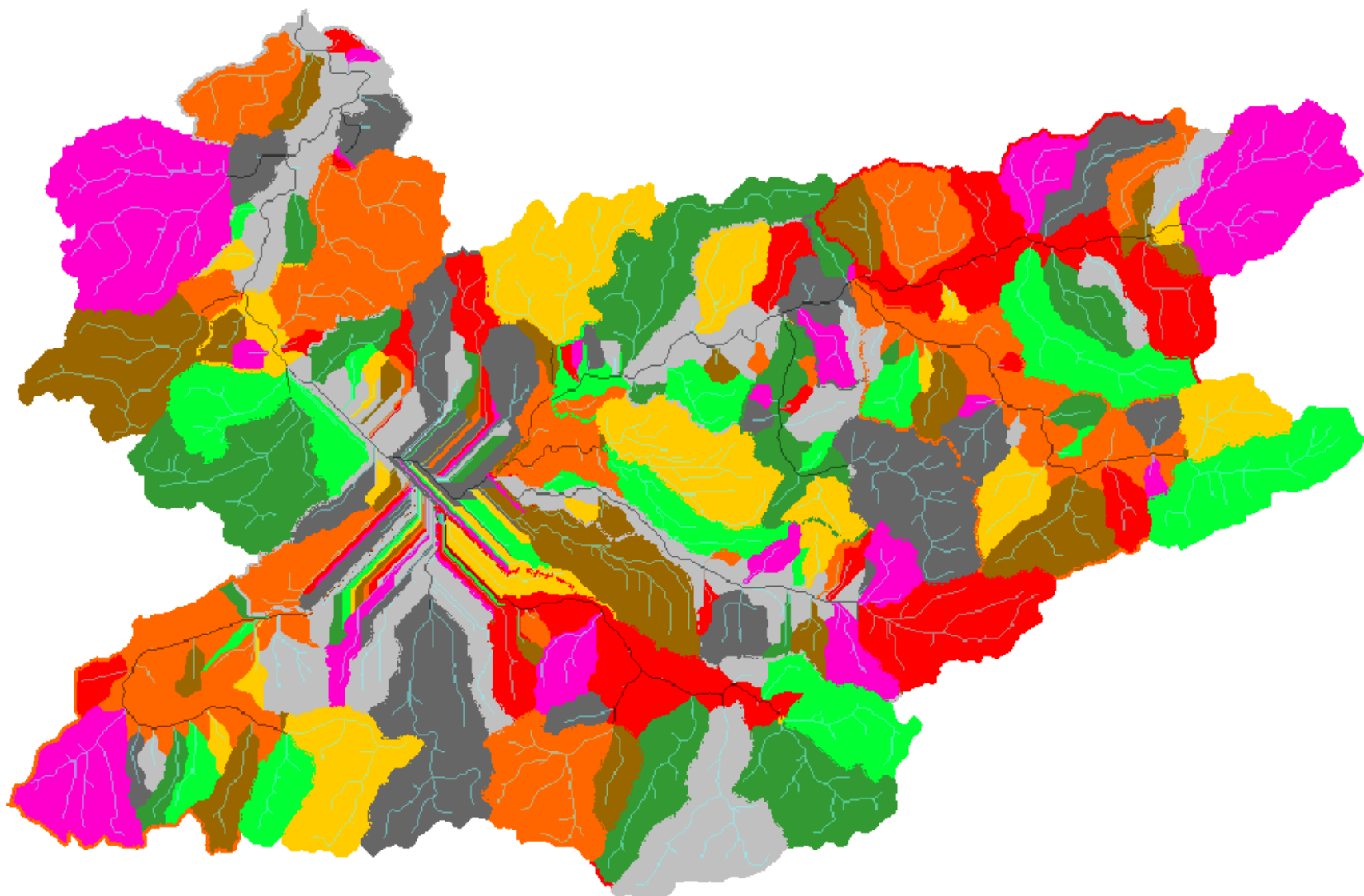
Drainage Map

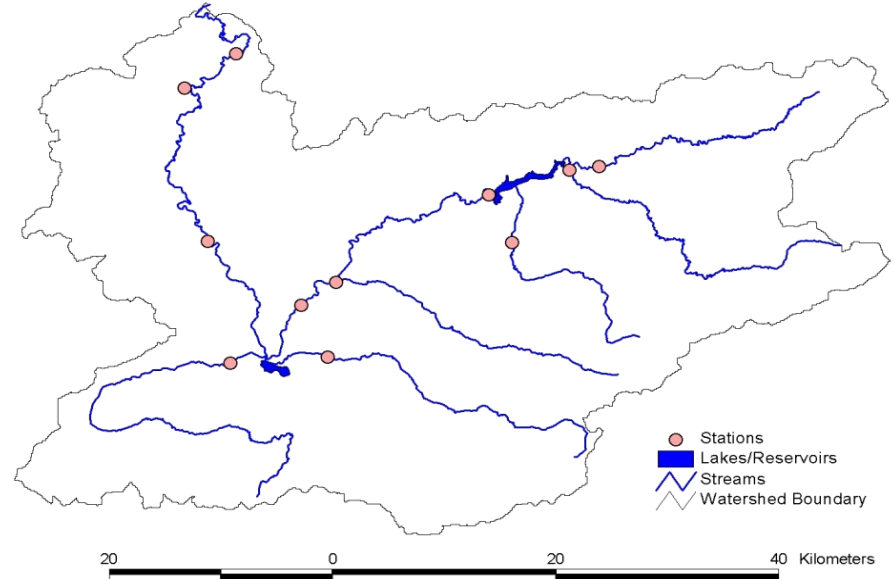
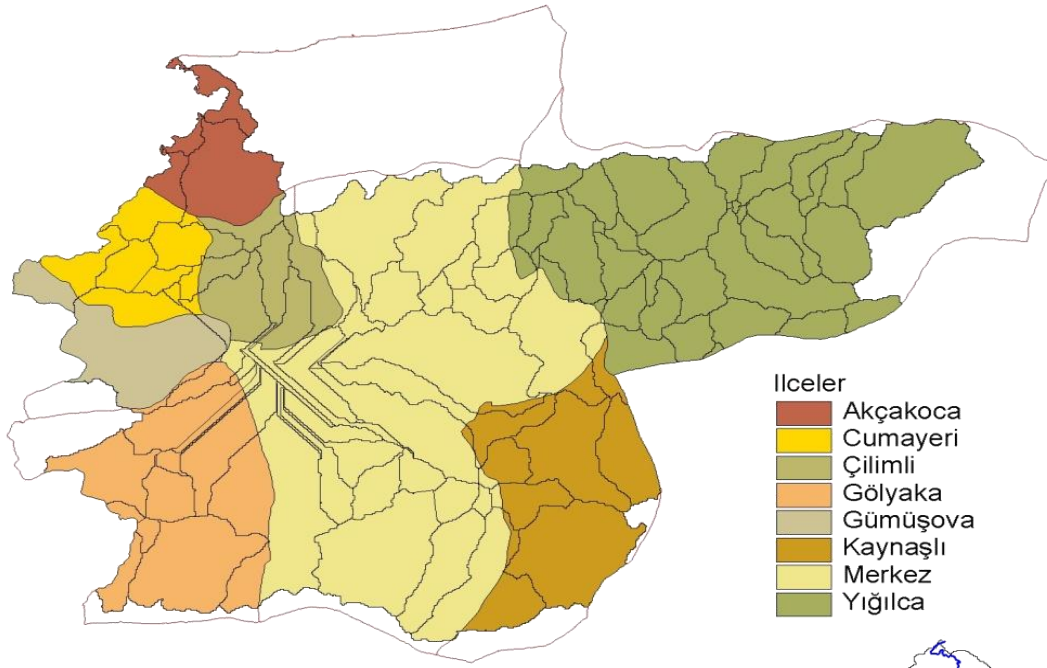


Sub-watersheds

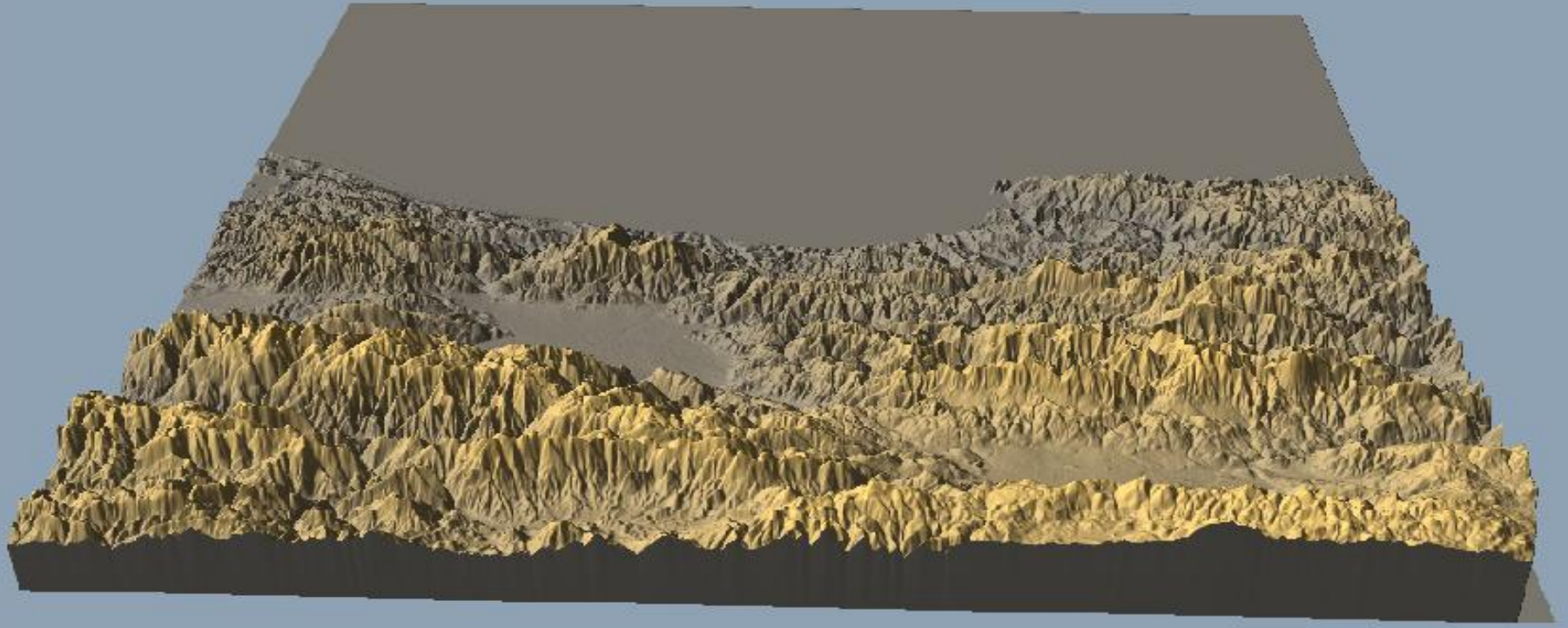
- The sub watersheds are hydrological units, which will be used in hydrological calculations, diffuse nutrient emissions, and load estimations.
- Dividing a watershed into sub watersheds decreases the uncertainty that occurs when diffuse loads are entered into water quality models as input data.

Sub watersheds





Digital Elevation Model (DEM)



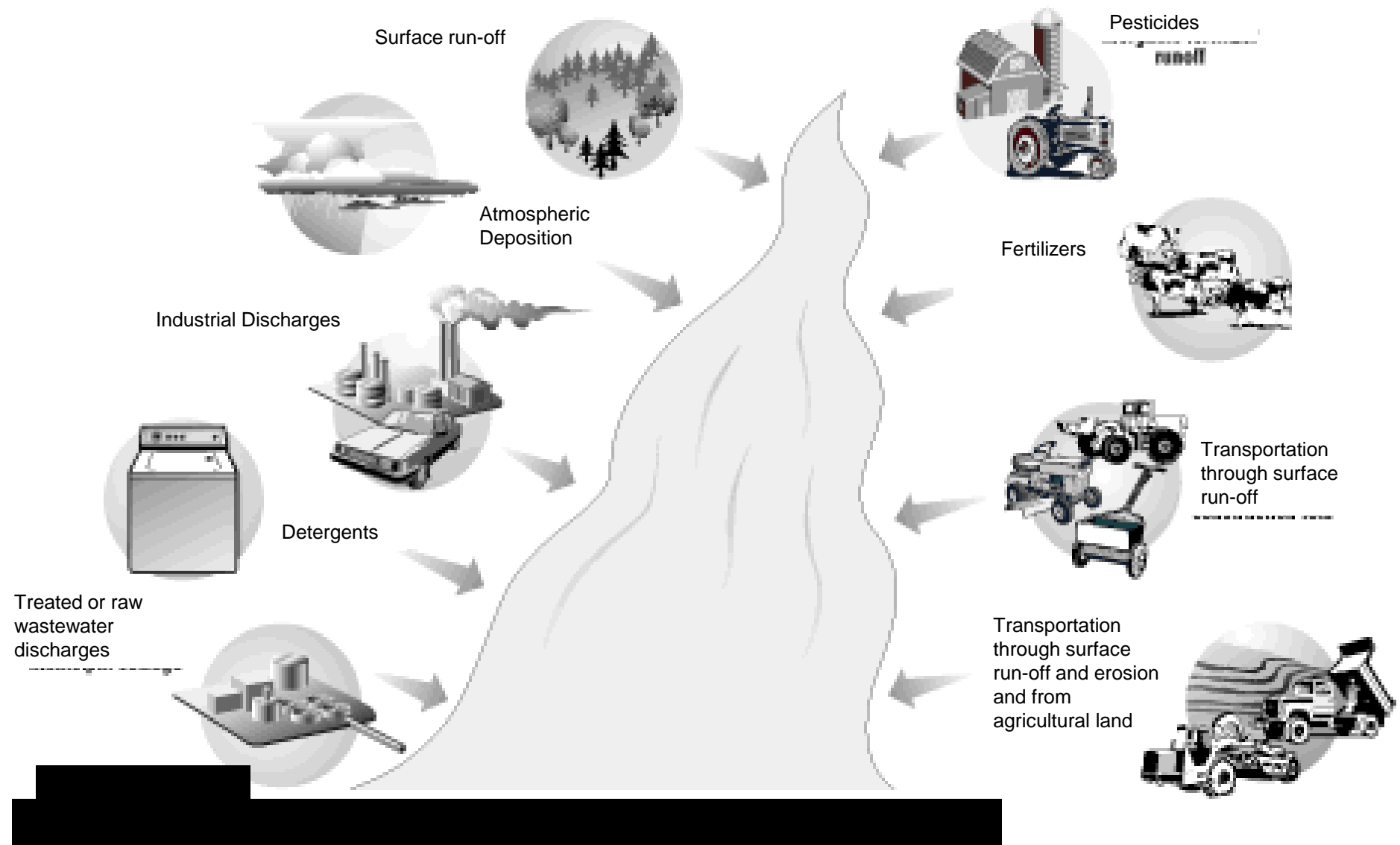
Identification of Polluting Sources

- **Point Polluting Sources**

- ✓ Domestic wastewater discharges,
- ✓ Industrial wastewater discharges,
- ✓ Urban drainage system discharges,

- **Non-point polluting Sources**

- ✓ Surface run-off from agricultural land, forests and farmyards,
- ✓ Storm water drainage,
- ✓ Run-off and infiltration from recreational areas,
- ✓ Aquatic products production areas,
- ✓ Solid waste disposal areas (unsanitary),
- ✓ Atmospheric deposition.



Melen Watershed Protection Studies

- Various Field Trips (individual, team) for data collection from the various stakeholders, meetings with authorities and stakeholders throughout the Project Time (**June 2006-January 2008**).
- 3 teams (water quality management and modeling, wastewater management, solid waste management) of almost 30 experts.

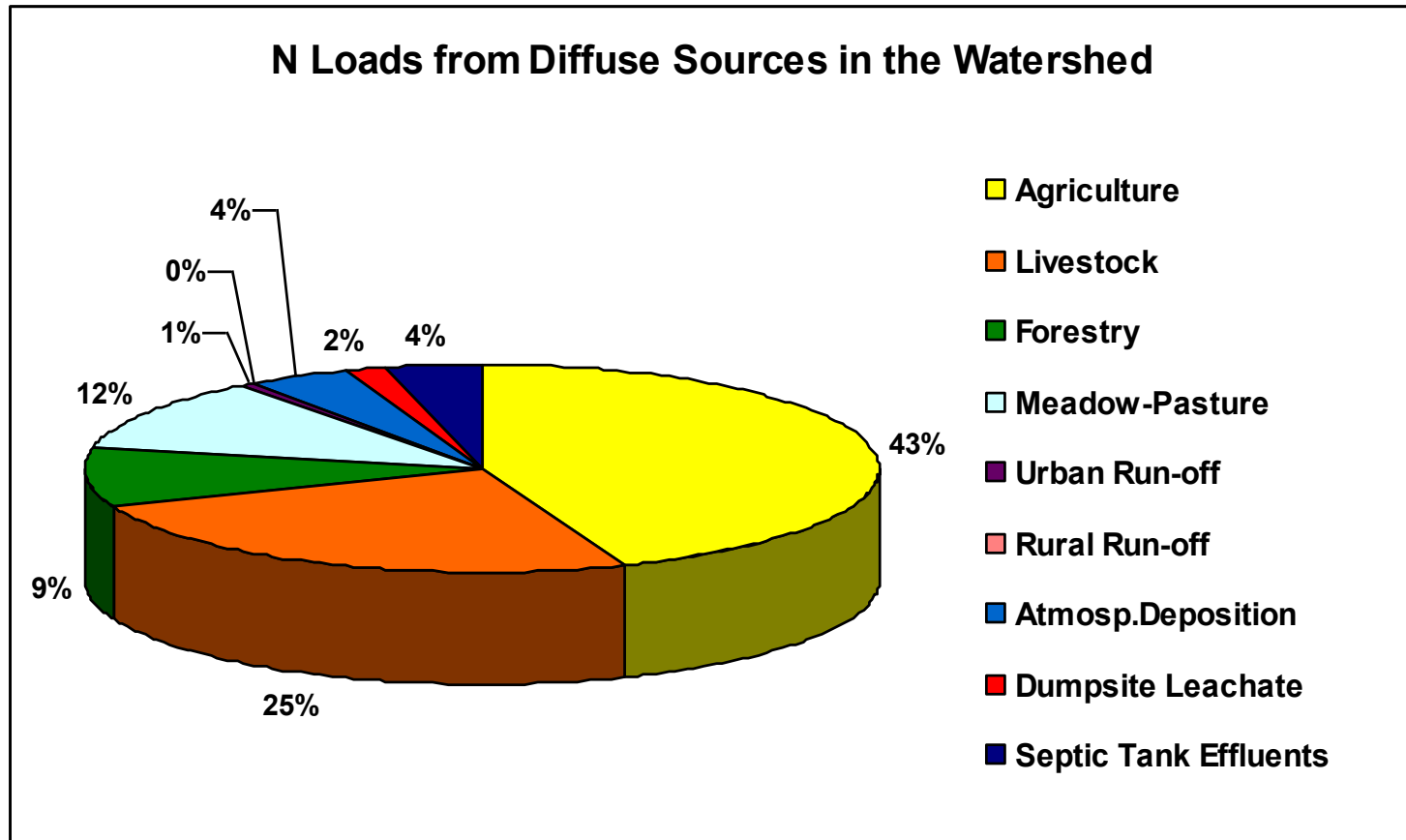
DELIVERABLES

- **September 2006**: Existing Situation Reports; Water Quality, Wastewater and Solid Wastes.
- **November 2006**: Design Criteria Reports
- **November 2007**: Final Feasibility Reports
- **January 2008**: Melen Integrated Watershed Protection and Water Management Master Plan

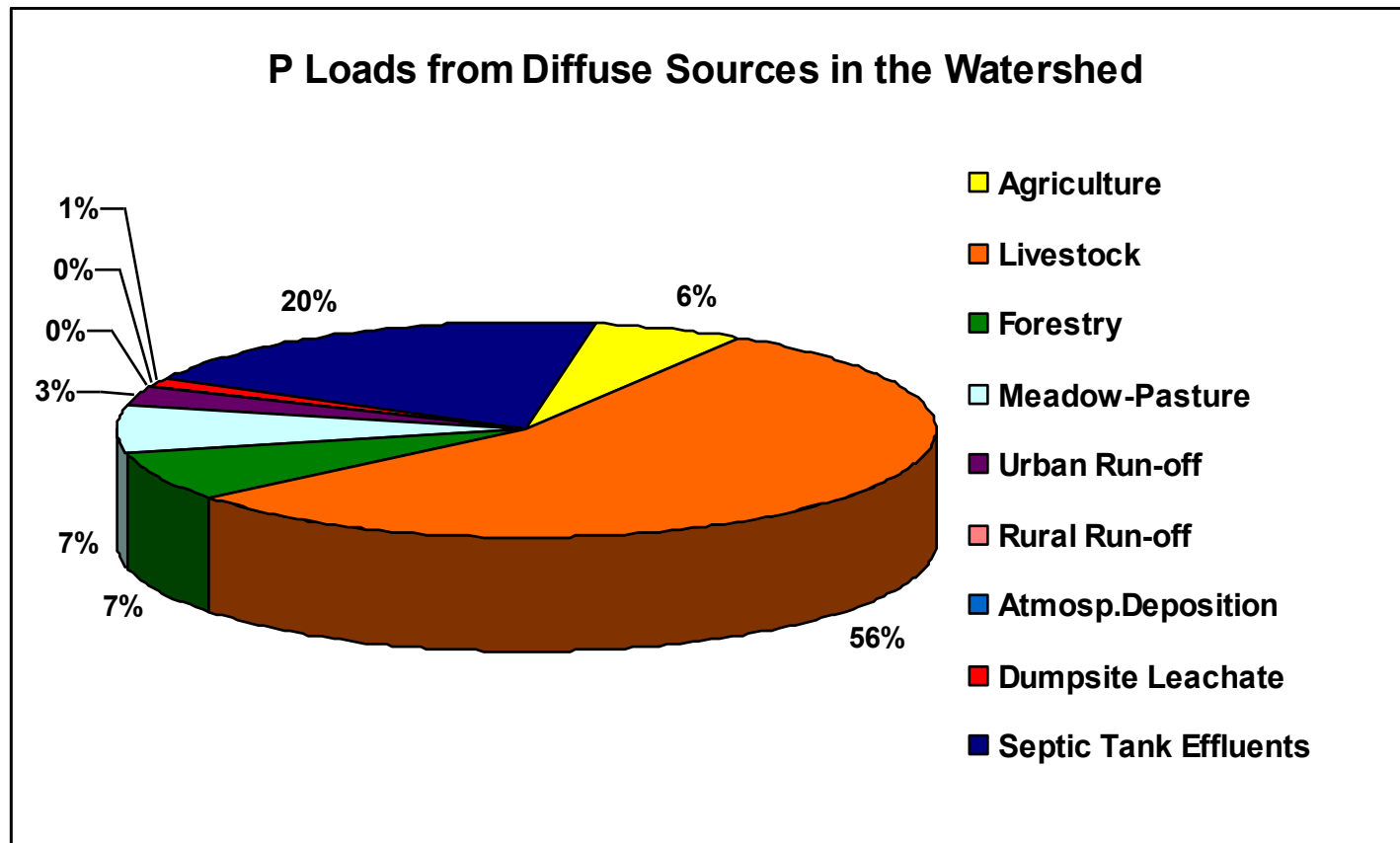
Distribution of N and P loads

(%) N		(%) P	
Diffuse source loads	Point source loads	Diffuse source loads	Point source loads
72.0	28.0	38.5	61.5

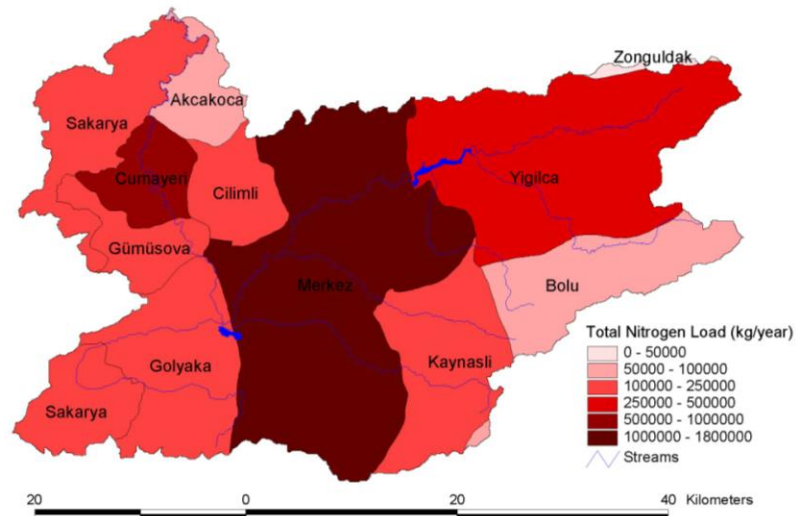
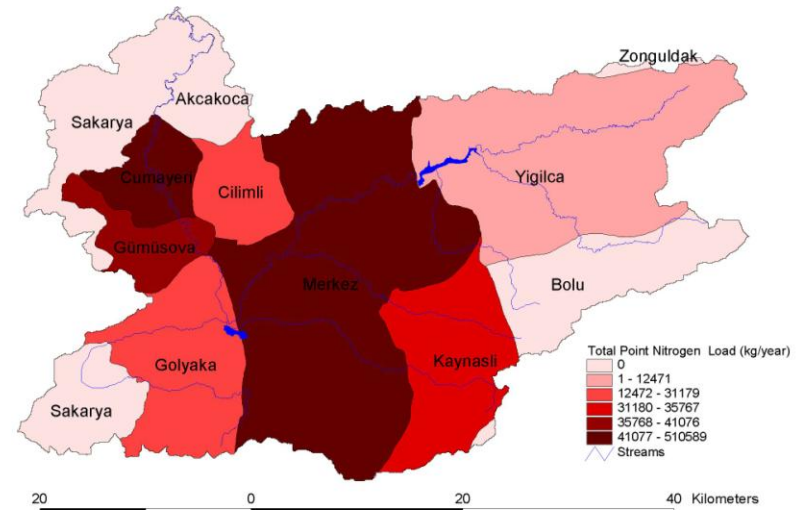
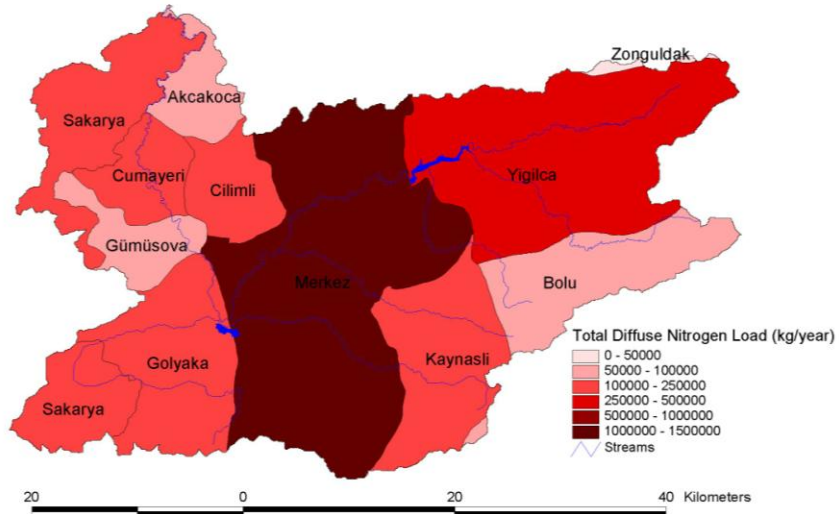
Distribution of Diffuse Pollution Loads



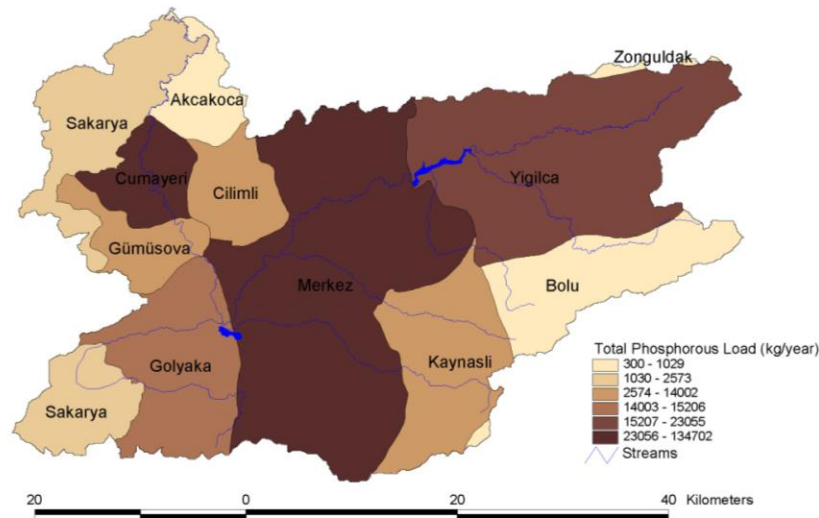
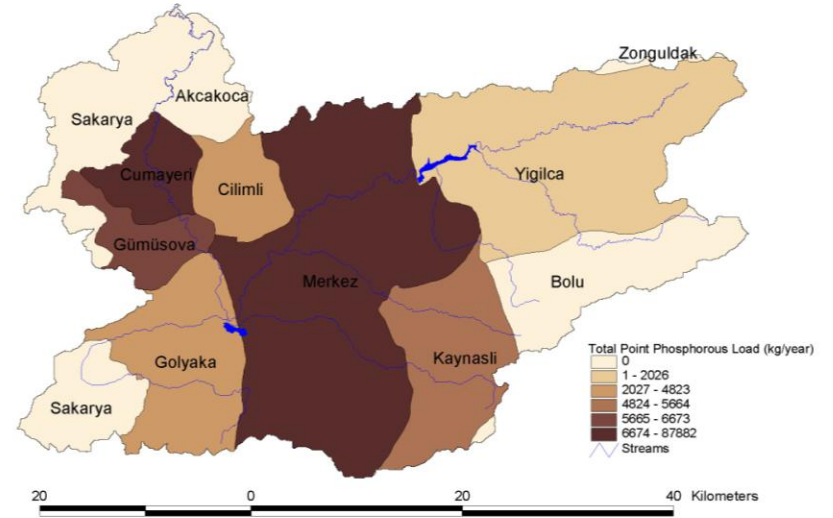
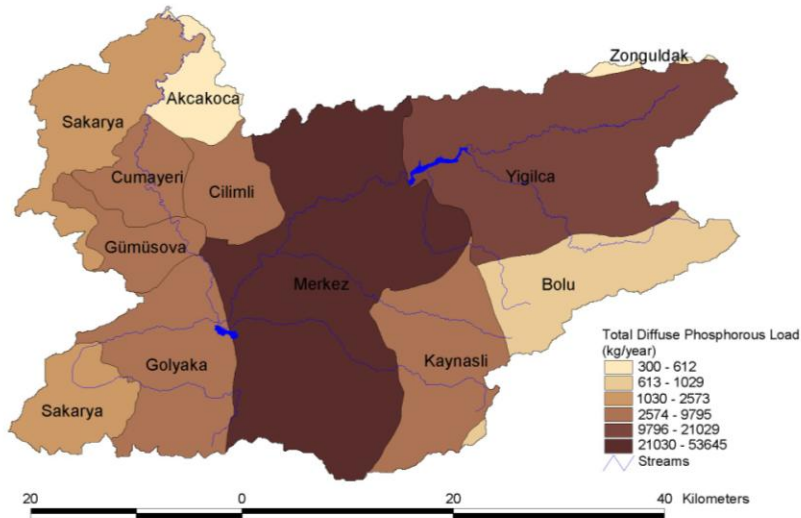
Distribution of Diffuse Pollution Loads



Total Nitrogen Load (year 2006)



Total Phosphorous Load (year 2006)



Distribution of Polluting Loads in the Future

Domestic and industrial wastewater treatment plants are alternatively put forth and the most feasible ones are selected.

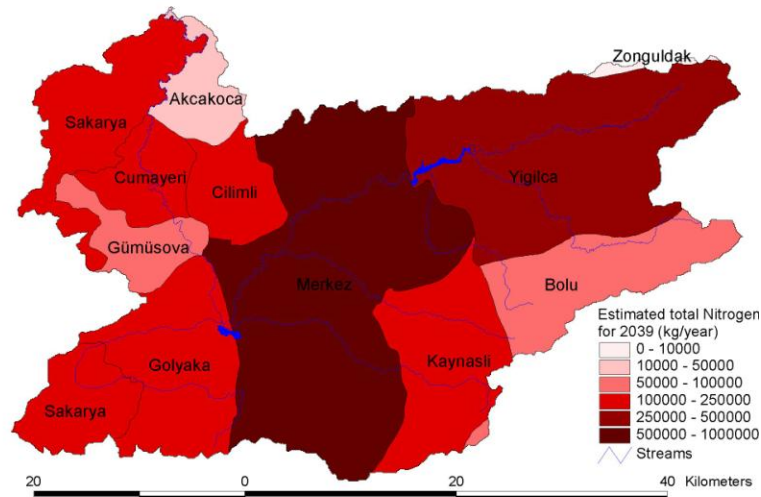
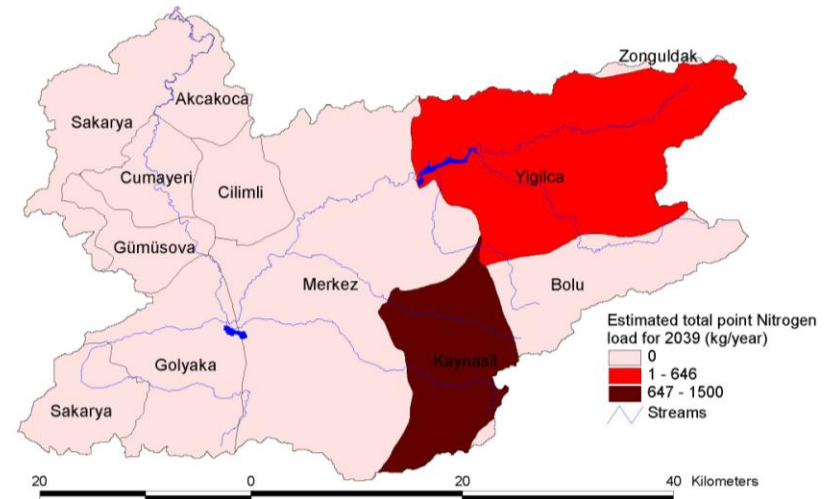
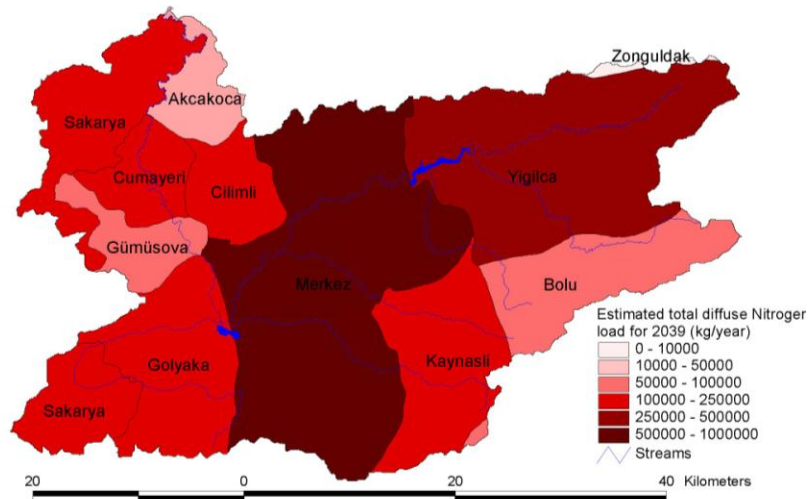
Sanitary landfills are planned.

Various measures are foreseen for especially agricultural and animal breeding activities for reducing diffuse pollution (30% decrease in year 2024 and 40% in year 2039).

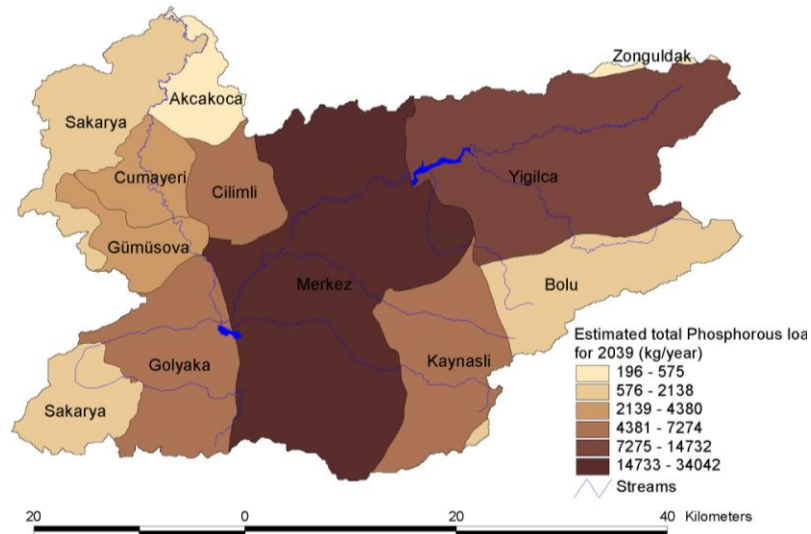
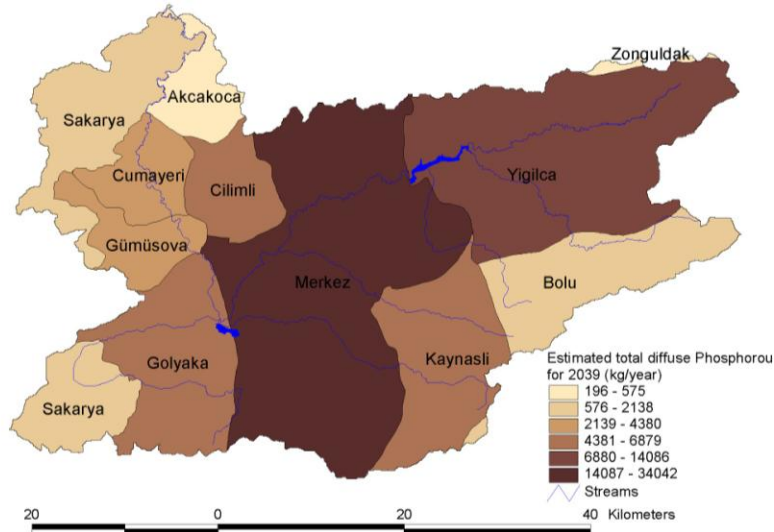
Within the next 30 years, it is predicted that 50% of the estimated N and 75% of the P loads will be reduced.

Years	Total loads (tons/year)	
	N	P
2006	3804	313
2024	2134	93
2039	1928	81

Total Nitrogen Load (year 2039)



Total Phosphorous Load (year 2039)





Lahana Creek

**Küçük Melen
Stream**



THANK YOU FOR YOUR ATTENTION