II. Geology Conferences
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GIS Based Assessment Effect of Irrigation on Groundwater Level Changes in Agricultural Areas: A Case Study: Bismil plain in the Upper Tigris Basin.

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1. INTRODUCTION

- Groundwater has used for long time as an alternative source in landscape irrigation or when city water falls short.
- Initially for every city center, tap water and landscape irrigation requirements can be provided by groundwater sources, these sources should be observed regularly and databases should be created.

- Geographic Information System (GIS) is a computer program which is used as an extremely popular in recent years.

Static Water Level

- 1. Elevation or level of the water table in a well when the pump is not operating. 2. The level or elevation to which water would rise in a tube connected to an artesian aquifer or basin in a conduit under pressure.

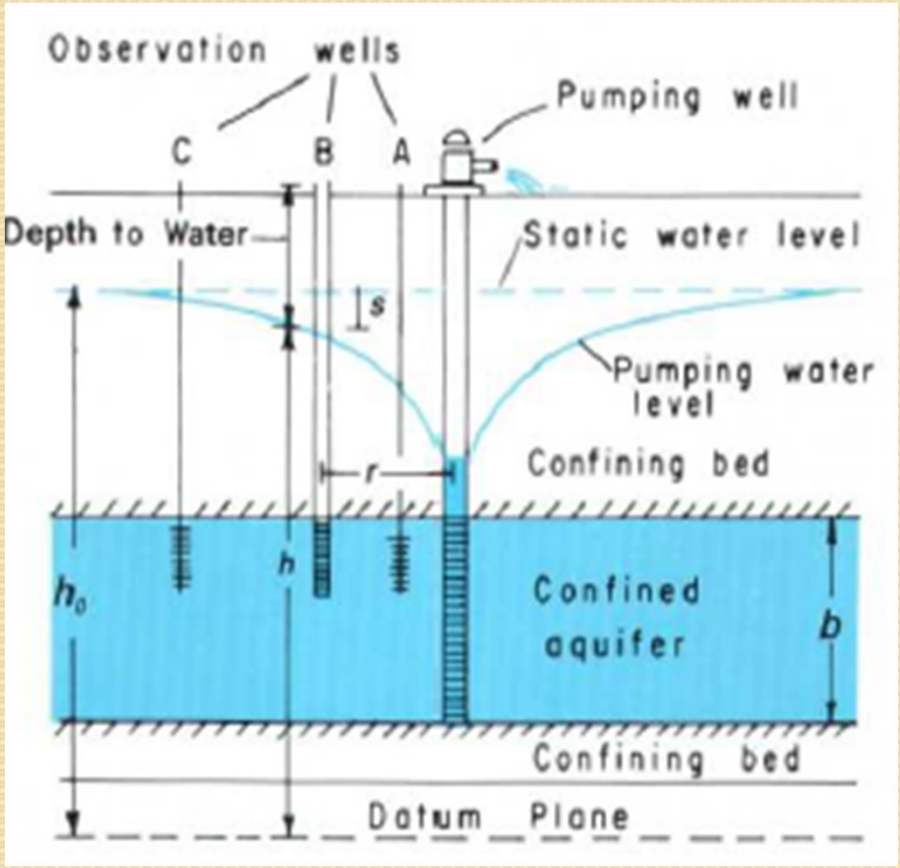

Fig.1: Well schema

- Economic activities at Bismil, a district of the Diyarbakir province, depend mainly on agriculture and animal husbandry in the Upper Tigris Basin.
- Tigris River lies through the middle part of the Bismil plain.
- Bismil plain agricultural irrigation obtain especially from groundwater by well.

- At coast of Tigris River irrigation provide from by pumping the water directly from the river during the irrigation session.
- However, as the consumption is more than feeding of the groundwater resources poses a serious threat for the groundwater resources..

2. MATERIALS

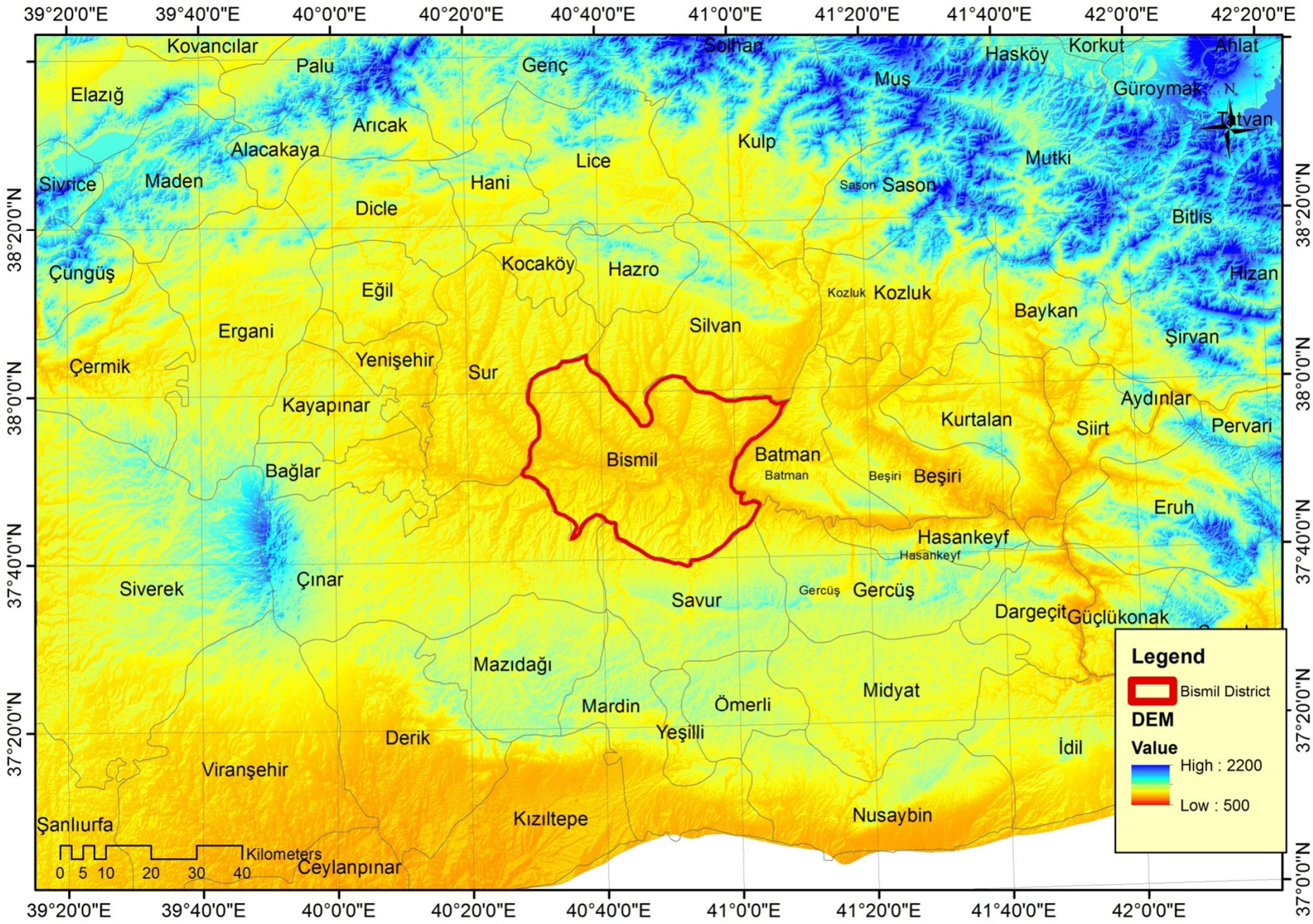

Figure 2. Study Area DEM map

- The geographical location coordinates of Bismil district centre is 37°50'45" N, 40°40'33" E, and Bismil is the second largest county in the province of Diyarbakir. It is located in the South eastern Anatolia region of Turkey. Settled on a flat land, it has fertile land of the Tigris plain. The Tigris River passes through Bismil. There are slight hills to its north and south. The South-eastern Toros Mountains are located on the south side of Bismil. Its distance from Diyarbakır is 55 kilometers

2.1.2 Rivers and Lakes:

- The Tigris River runs through Bismil, and many small and large streams and creeks flow into it. The most important ones among these streams are Pamuk, Göksu, Kurmuslu, Kuru, Ambar, Caferi and Salat streams. Not exactly blessed with many lakes, Bismil has only one, which is near the Çöltepe village.

2.2 ***Diyarbakir's Hydrogeological Features***

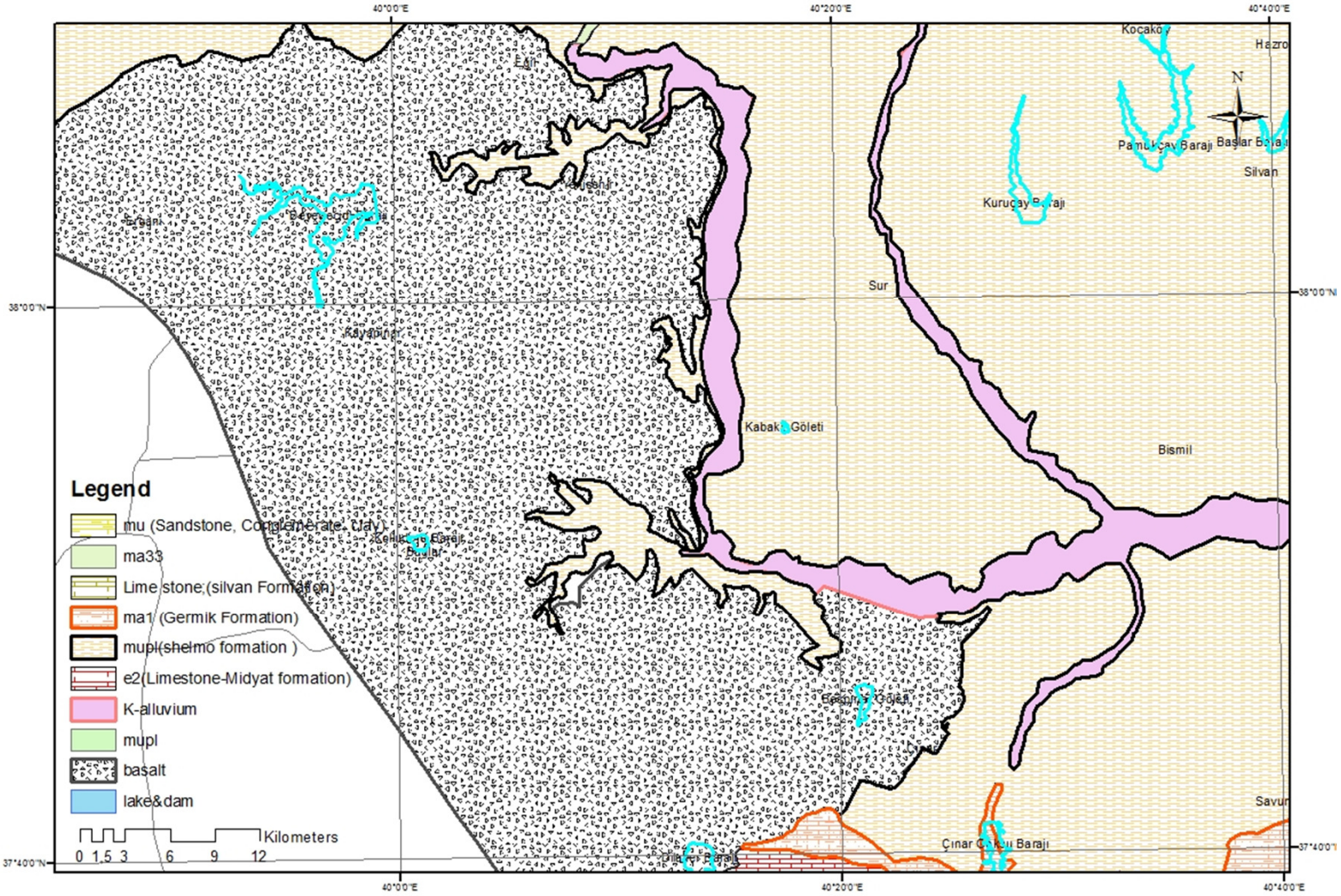

Figure 3. Diyarbakır city Geological map

- Geological formations that are rich by groundwater are formations that contain limestone, pebble and sandstone (Figure 3).
- Paleoasen old, limestone, clayey and marl formations don't have groundwater.
- Bismil's main water table spring is Midyat aquifer.
- Midyat aquifer's general construction is limestone and has two different flux units. First unit is 160 meter depth, low permeable and second unit is 90 meter depth and is more permeable then first unit.

3. METHODS

- In the study, 316 wells drilled by public institutions such as DSİ, District Governorships, Special Provincial Administration, as well as private persons for watering purposes between the years 1996-2011 have been examined.
- The drilling data was ranked via the Microsoft Excel software, and the coordinates have been arranged accordingly. These data was run on the ARC Map software. The data that have been converted to Shape (shp) format have been modelled through Spatial analyse extension Interpolation “IDW” tools.

- In the following maps, a basemap has been prepared through “Open Street Maps and Contributes” found under the Arc Info software. UTM Datum 1950 37 has been used as projection.
- Static water level maps relevant to the years

I. 1996-2000 (Figure 4),
II. 2001-2004 (Figure 5),
III. 2005-2008 (Figure 6),
IV. 2009-2011 (Figure 7)

have been obtained through all these processes.

- Changes in the groundwater levels relevant to the nominated years have been detected using these maps.
- The settlement examples and groundwater graphic changes of the Bismil district and its villages have been drawn (figures 7, 8 and 9) with these maps.
- In the light of this data, results have been obtained.
- Otherwise all term of groundwater changes raster data had been analysed with spatial analyst local cell statistics menu. Results figure shows in figure 13.

4. RESULTS

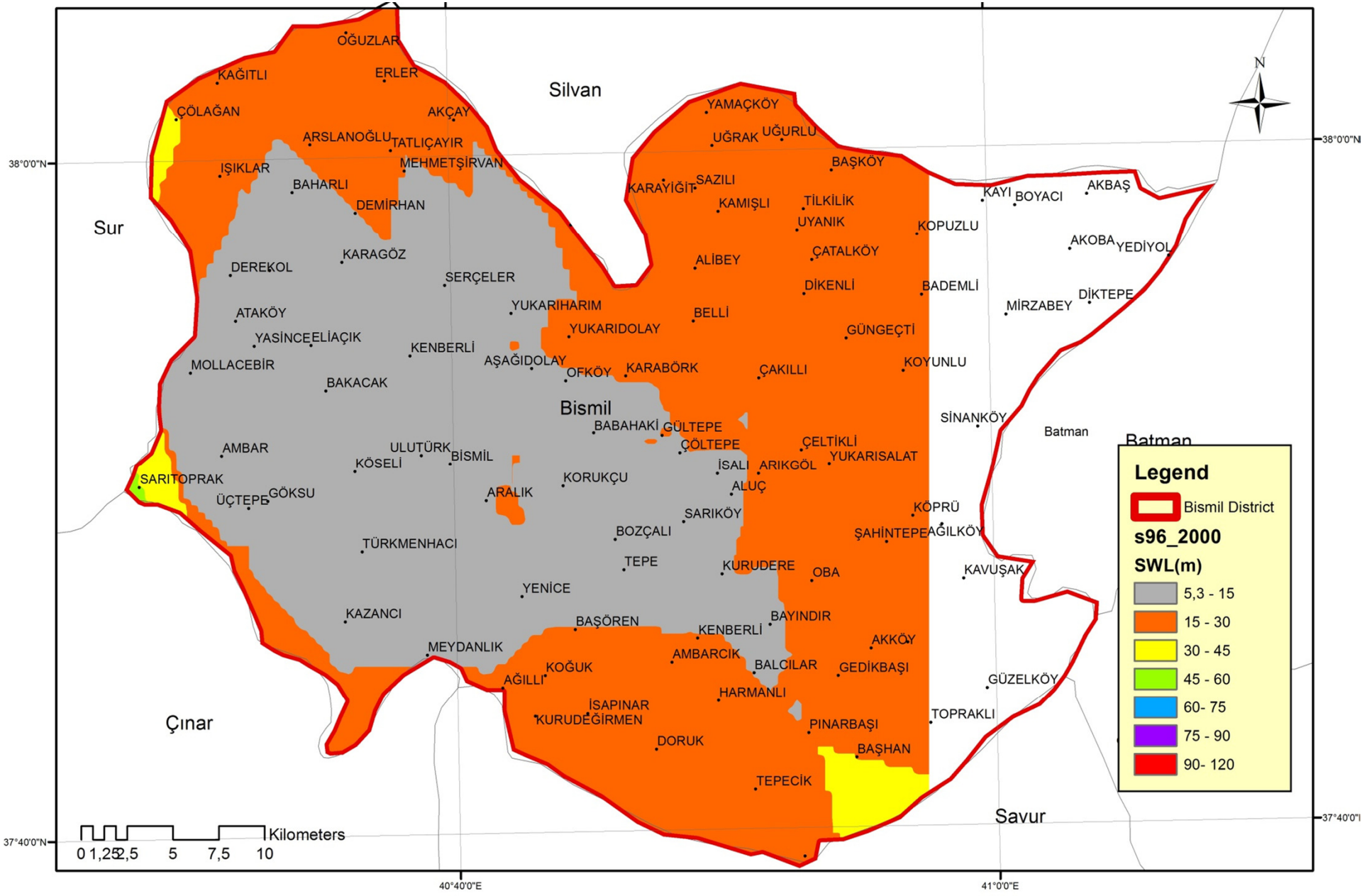

Figure 4. 1996-2000 years Tigris Bismil region Static Water Level (SWL) Thematic Map

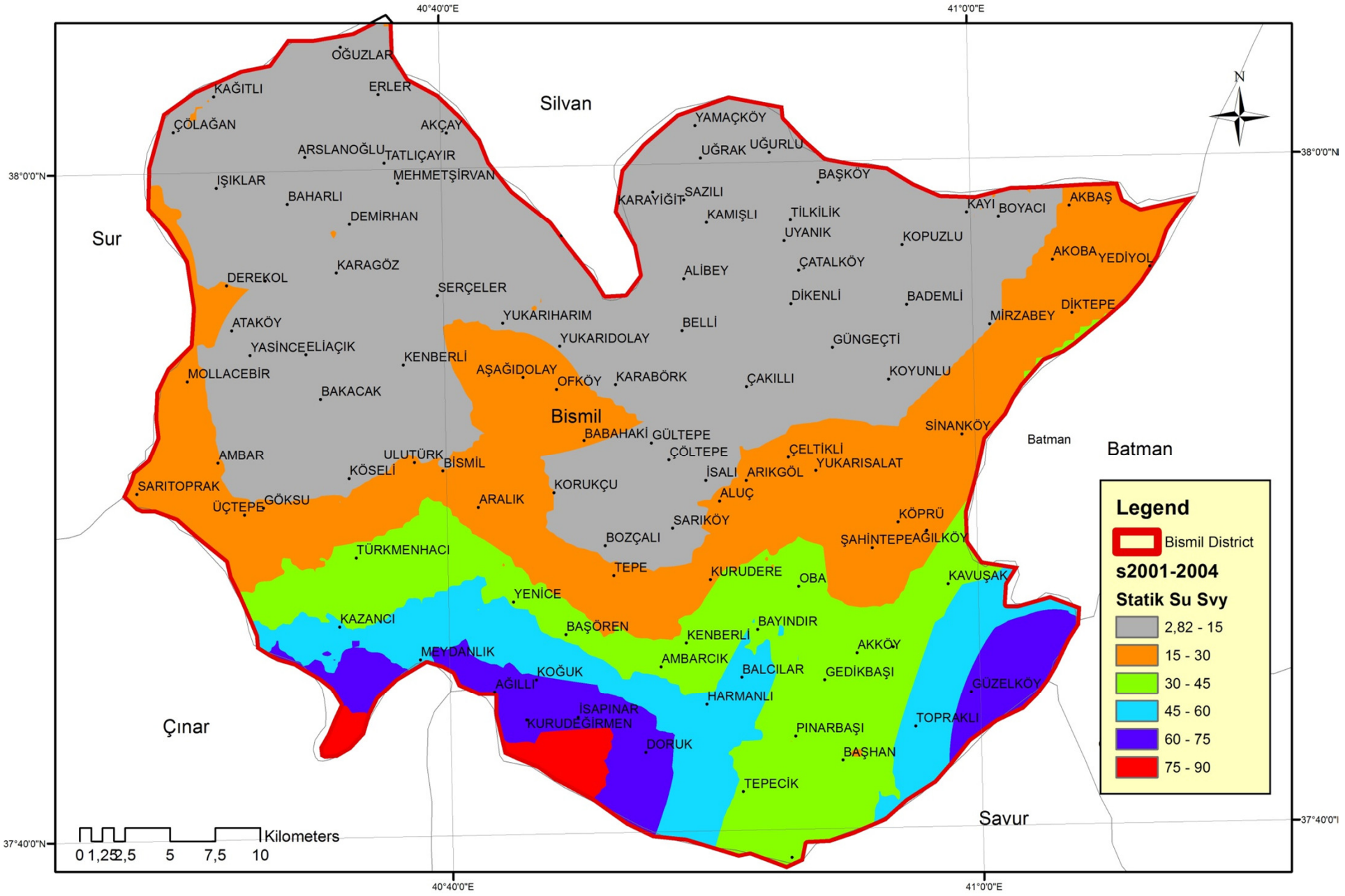

Figure 5. 2001-2004 years Tigris Bismil region Static Water Level (SWL) Thematic Map

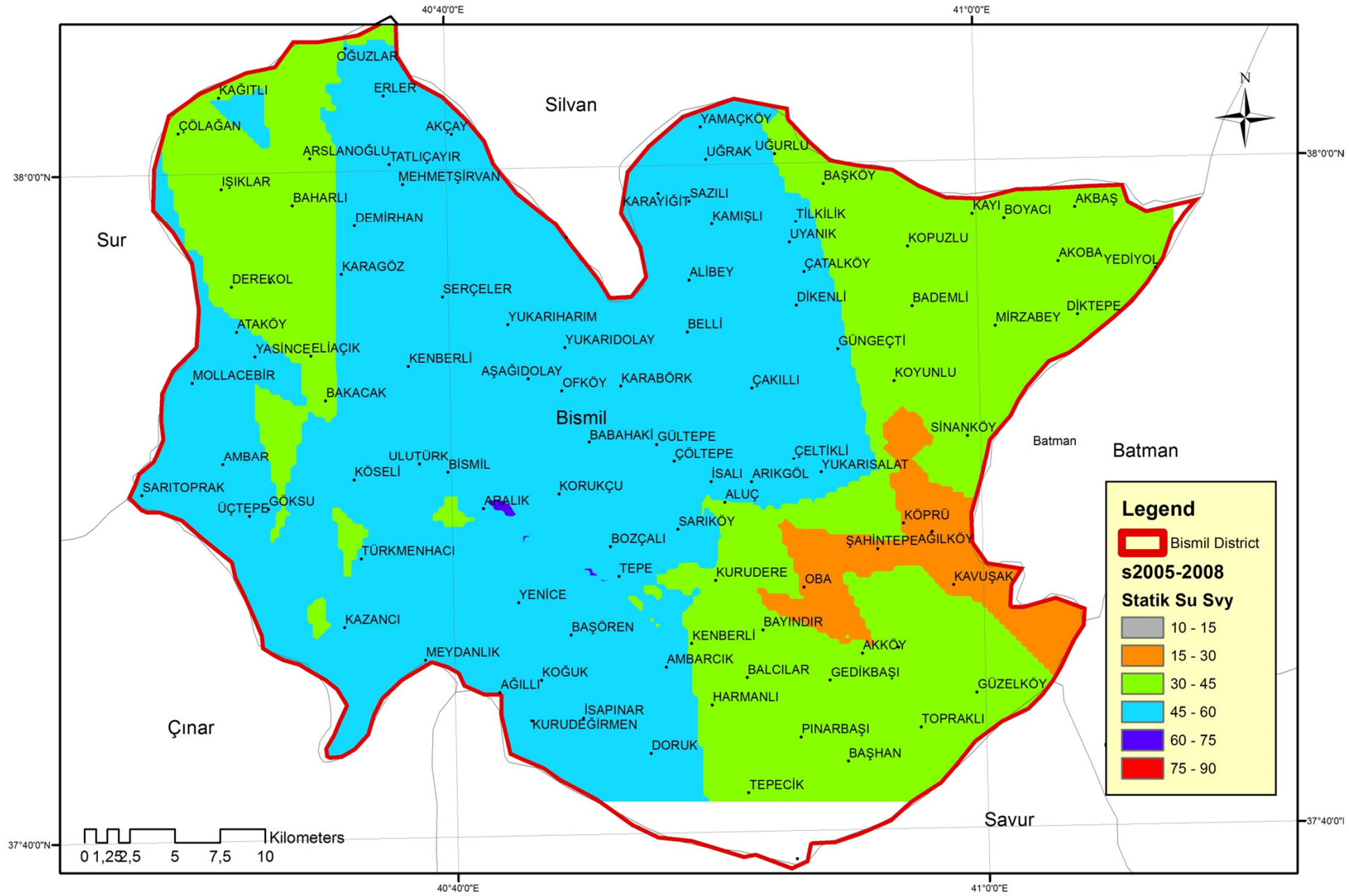

Figure 6. 2005-2008 years Tigris Bismil region Static Water Level (SWL) Thematic Map

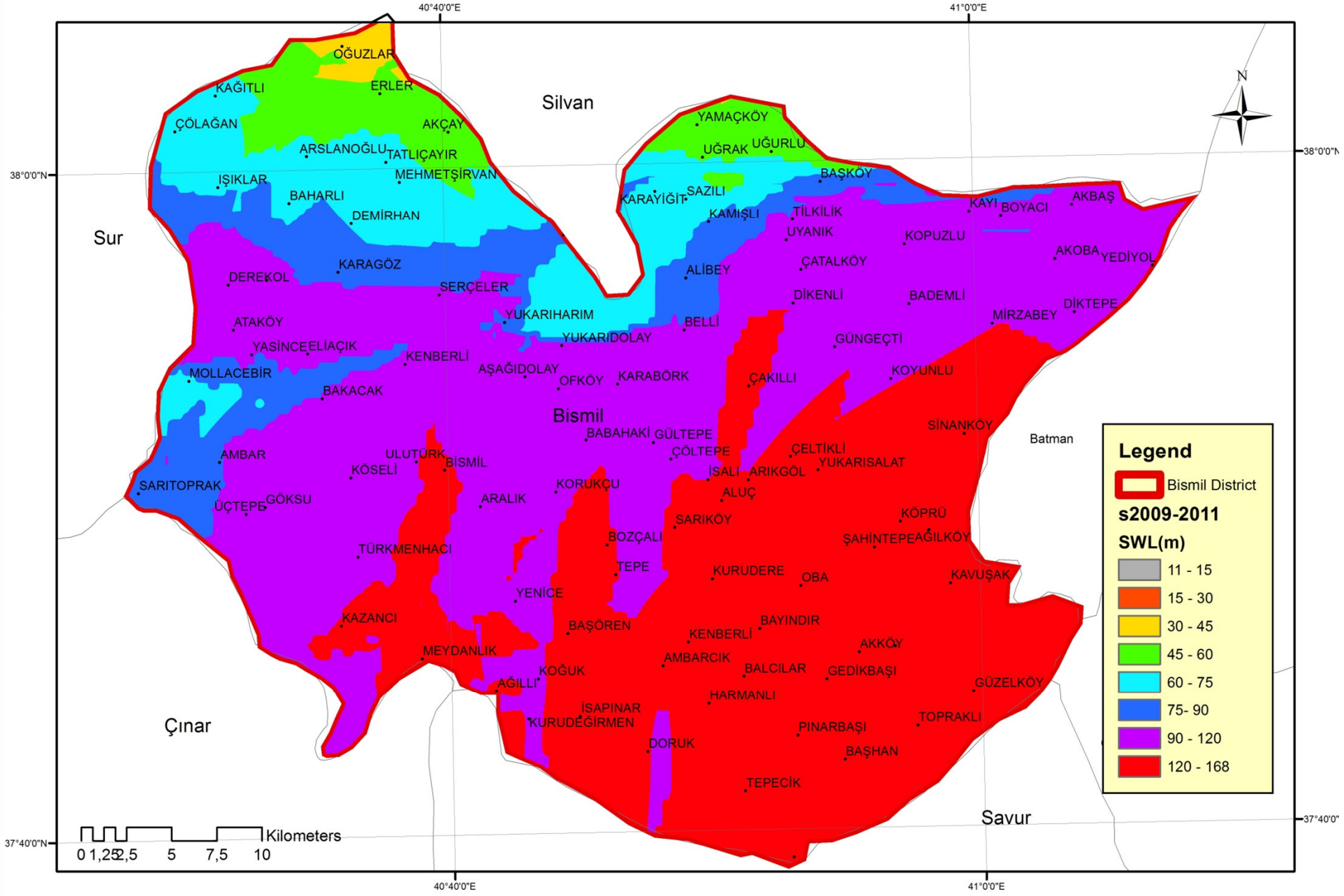

Figure 7. 2009-2011 years Tigris Bismil region Static Water Level (SWL) Thematic Map

RESULTS

Figure 8. Bismil Centre SWL changes

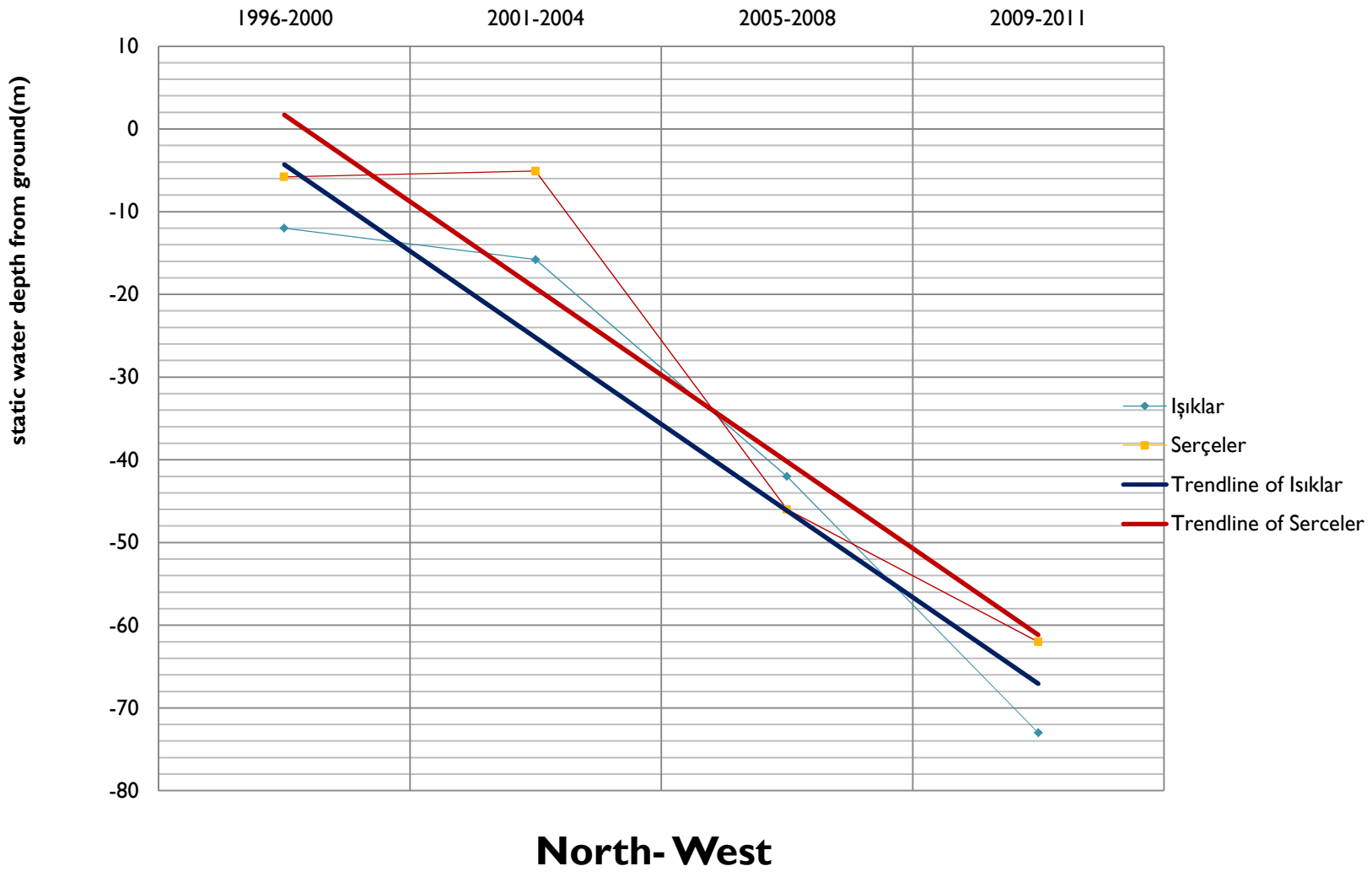

Figure 9. North-West Region SWL changes

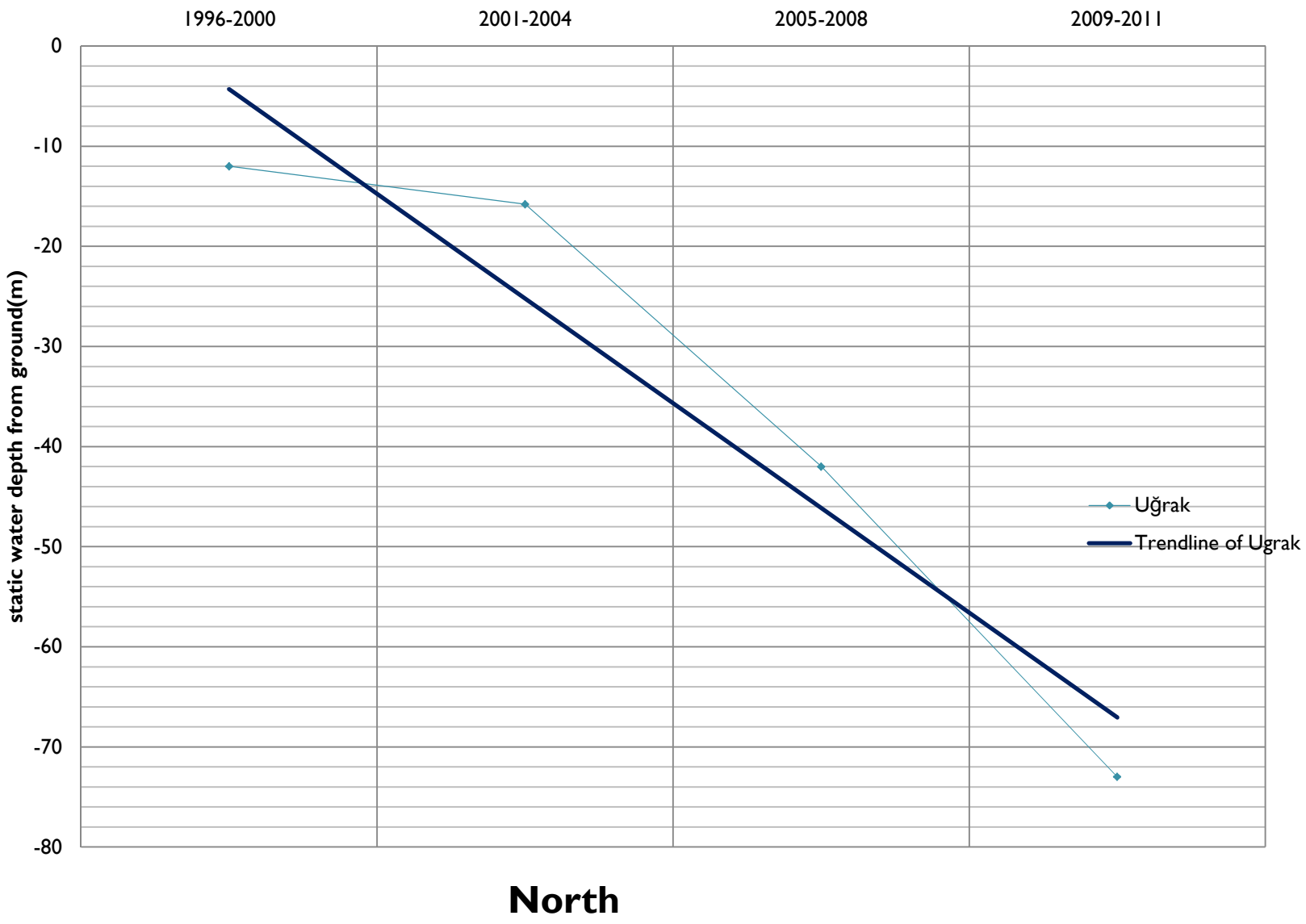

Figure 10. Bismil North Region SWL changes

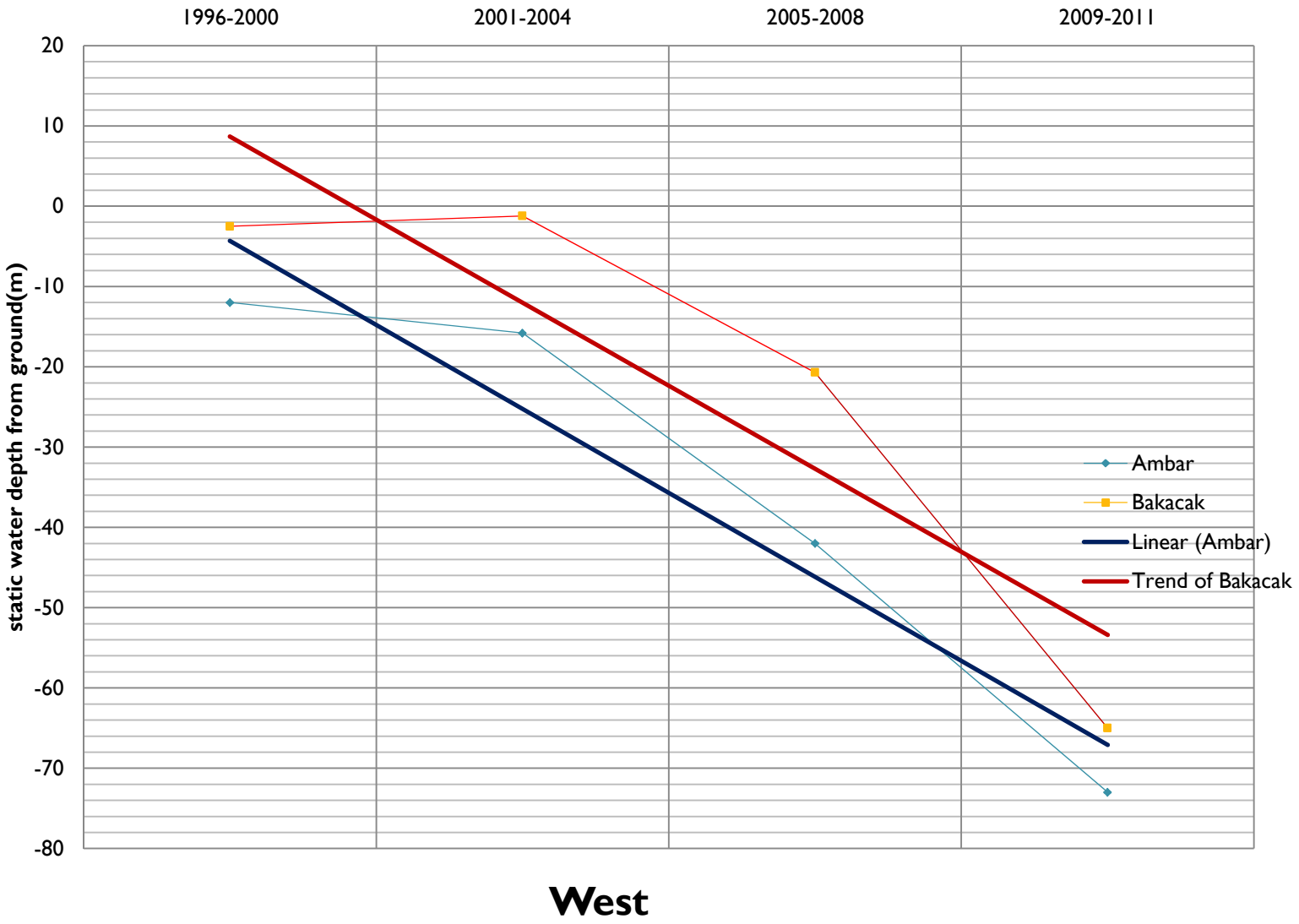

Figure 11. Bismil West Region SWL(changes)

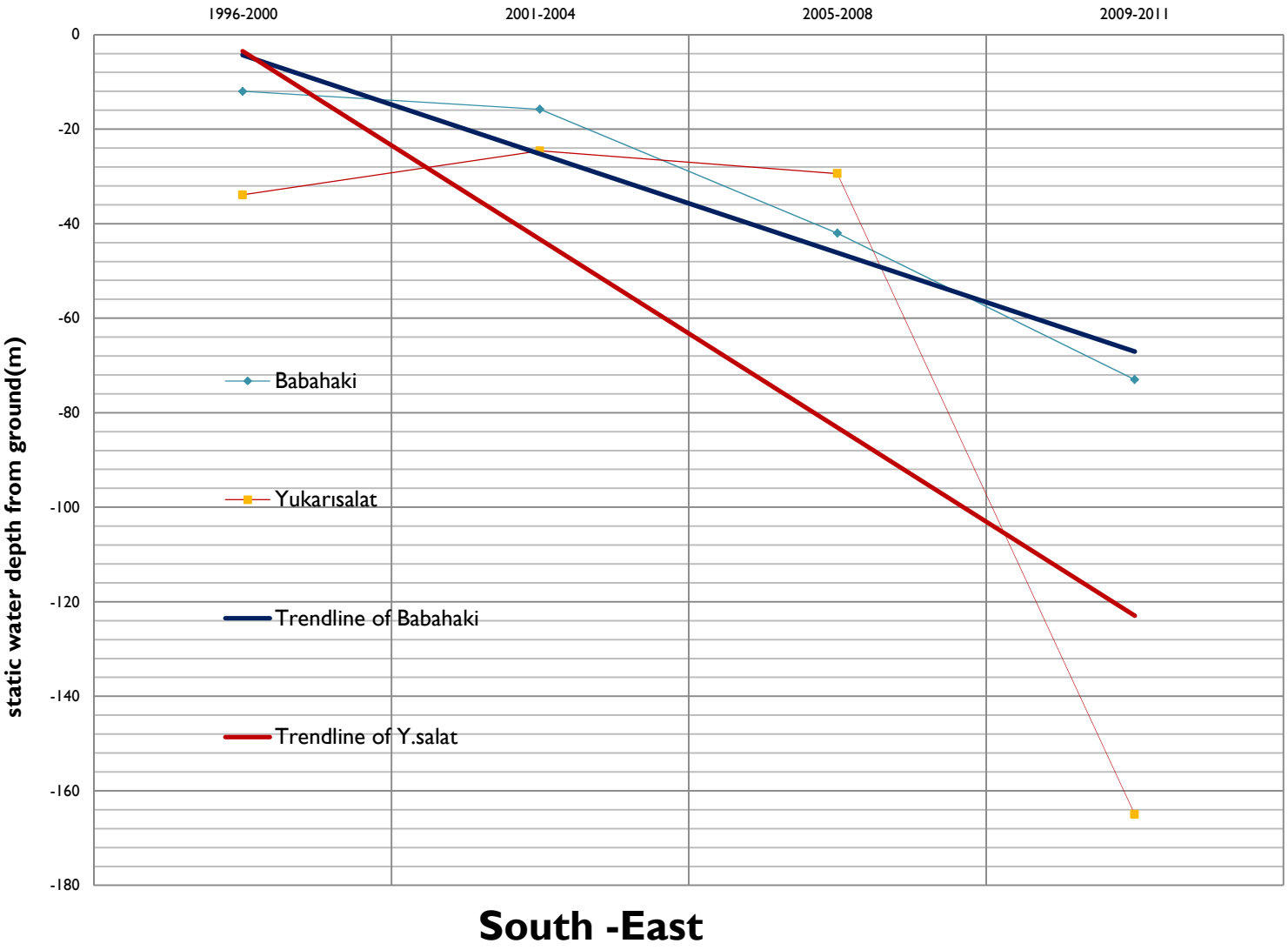

Figure 12. Bismil South-East Region SWL changes

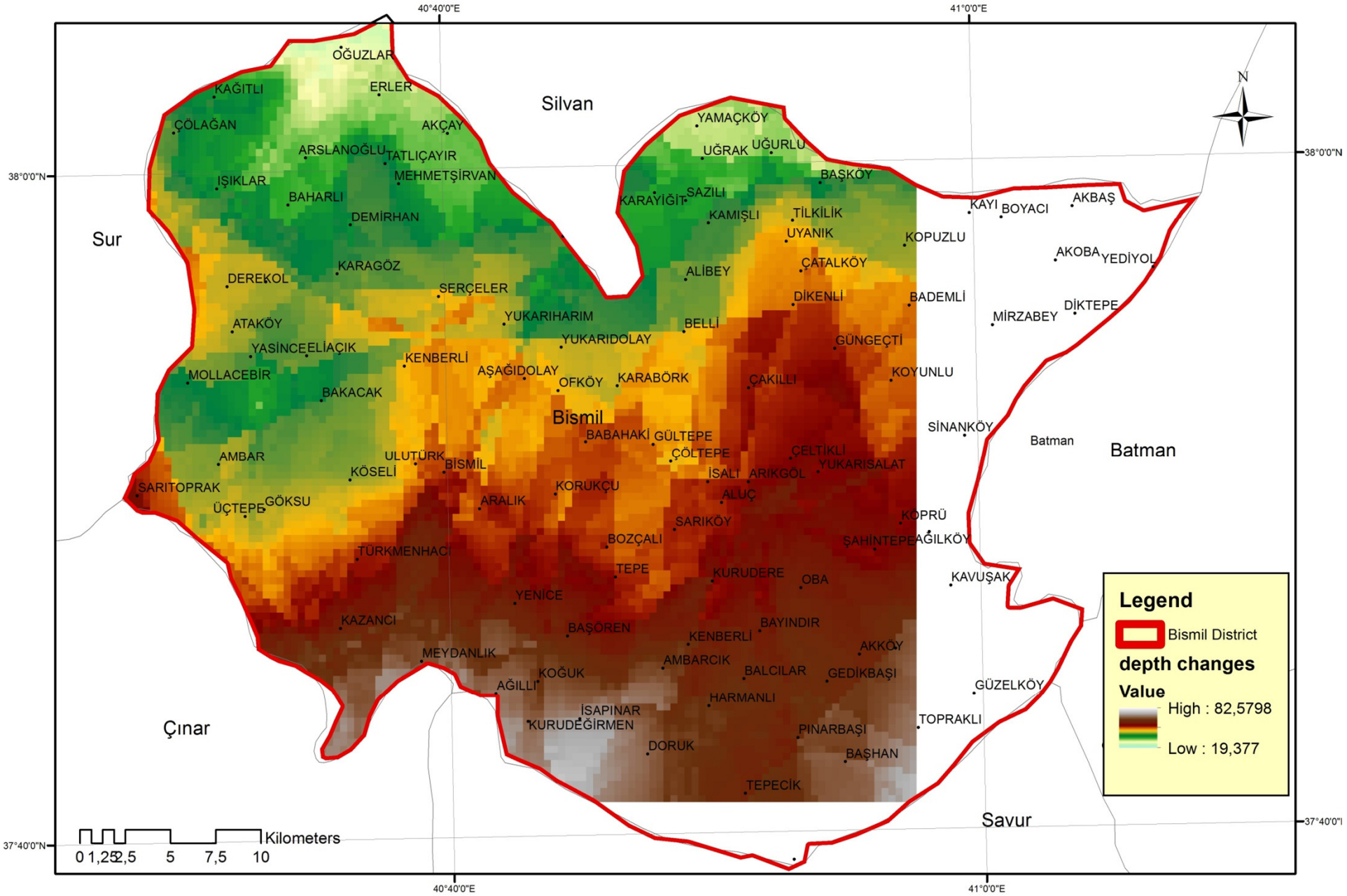

Figure 13. Bismil 1996-2001 terms mean SWL value changes

- Following conclusions have been obtained from thematic maps groundwater changes are classified relevant to urban centre (Figure 7), North-West(Figure 8), North (Figure 9), West(Figure 10), South, South-East, East and South West region.

- The groundwater levels in all other regions show a significant dropped. Even though it is known that groundwater levels have some small seasonal changes.
- In the Bismil settlement area the static water levels have dropped by over 55-60 meters. Especially after the year 2005, the groundwater levels have started to decrease increasingly. For example, in the Türkmenhaci village it has dropped from 4.8 meters in 1996-2000 to 15.1 meters the years between 2001-2004

- It has further dropped from 47 meters between 2005-2008 down to 103 meters between 2009-2011.
- Such changes are also found in other areas of the settlement as well. The main reasons for this were the insufficient precipitation during the years 2009-2011, and the use of the groundwater resources more than their feeding.

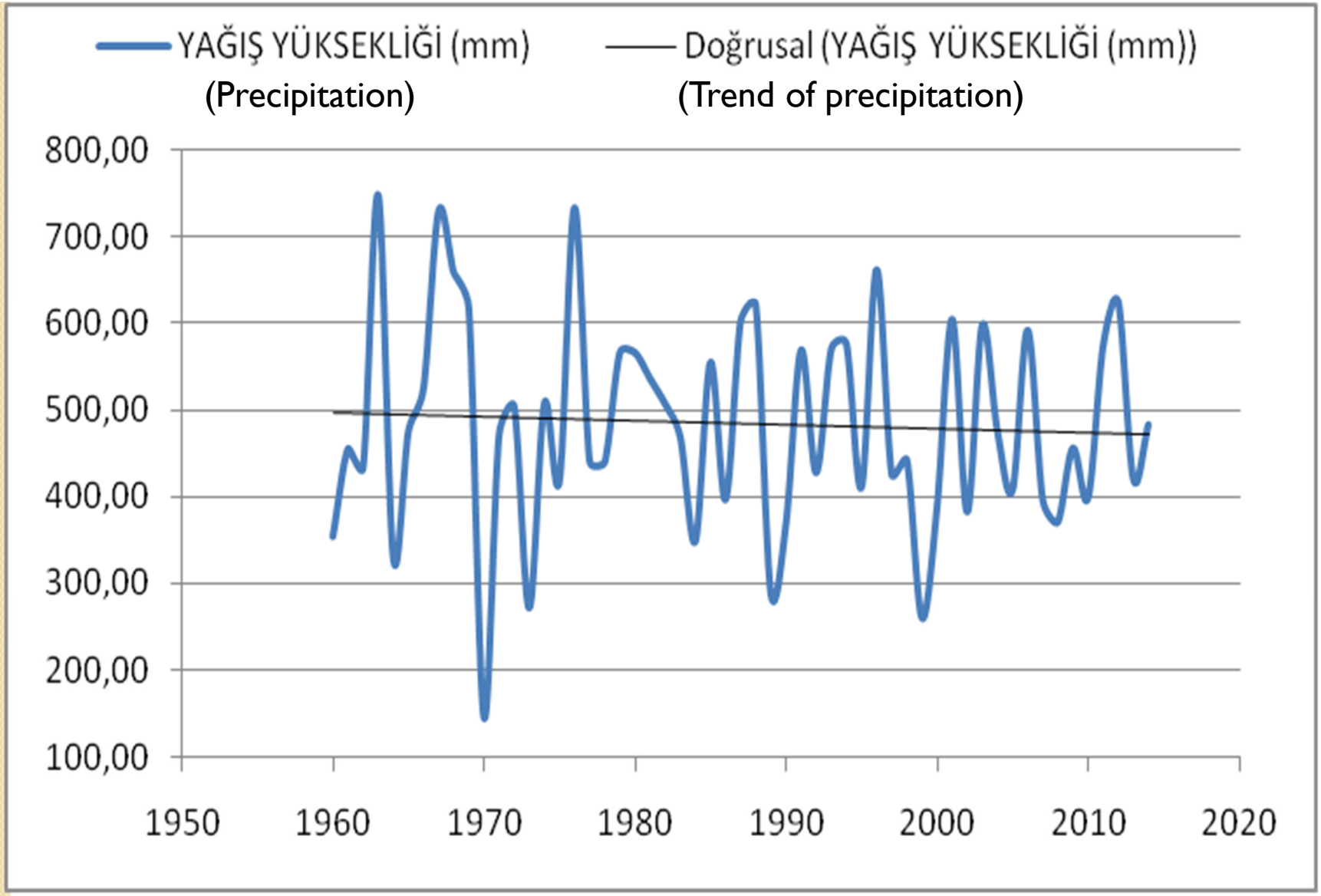

Figure 14. Bismil Precipitation changes last 50 years

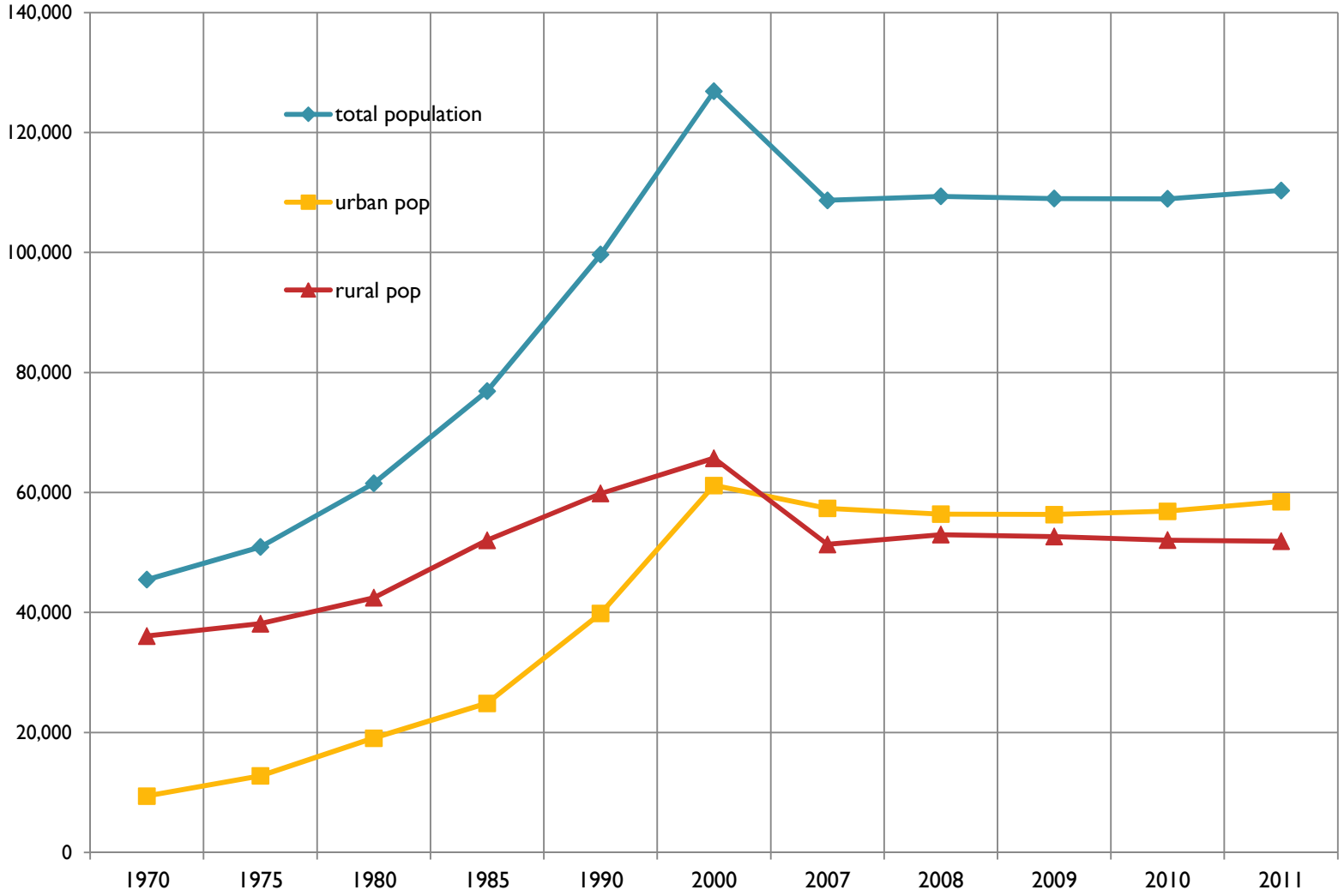

Figure 15. Bismil population changes last 40 years

- It can also be claimed that the unauthorized water wells drilled in the area have an important effect on these dramatic changes in groundwater levels. The groundwater level in Central Bismil that was at 12 meters between the years1996-2000 decreased up to 73 meters between the years 2009-2011.
- The groundwater level in Isıklar village was 17 meters between the years1996-2000 has gone down to 73 meters between the years 2009-2011.

- From the 2000 years, rural and urban population of Bismil is steadily. Whereas as seen Figure 7-12 groundwater level change is decreased after 2005-2008 period sharply. So *effect of population growth on groundwater is low.*

- In Bismil region, 60,000 decares of cotton, 2,500 decares of tobacco are cultivated (TUIK 2011). These crops needs more water. Besides, production of other field crops also carried out using groundwater. That would be main effect of groundwater level decrease.

- According to DVCSIM 2013 report, In Bismil groundwater used 0,92 hm3/years water for drinking, *85.47 hm3/year water for irrigation*. While it seeding groundwater average is 31,25 hm3/year. There is huge negative budge about groundwater consumption and seeding. That would be main reason groundwater decrease.

Conclusion

- Groundwater level dropped average 50-60 meters in Bismil central, Northern and Western Region.
- South, southwest and south-eastern regions of the groundwater static level dropped average 82 m (figure 13).
- This change occurred especially after 2005 years.

- Population and climate effect is very low rather than groundwater using for irrigation effect. So that the main reason of groundwater level decrease is using water for irrigation unconscious in the semi arid region.

There would be *main 3 factor effect the groundwater change(Table 1)*;

I. Population growth,

II. Climate effect on precipitation

III. Groundwater use for irrigation unconscious.

Table 1: Potential effects on groundwater level changes

Criteria	Criterian Weight	Effect rating	results
Population	0,15	1	0,15
Precipation	0,45	3	1,35
Irrigation Use	0,4	8	3,2

- Population and climate effect is very low rather than groundwater using for irrigation effect.
- Precipitation affect is more effective than population growth rate.
- So that the main reason of groundwater level decrease is using water for irrigation unconscious in the semi arid region.

Suggestions:

- In the agricultural area, using groundwater must be under control. (The using groundwater must be reducing at least %70 for irrigation in the Bismil plain.)
- Additionally special watering projects such as GAP Projects should be executed as soon as possible.
- The need to use groundwater resources should be eliminated. In this manner the groundwater resources can reach at a balanced acceptable level by the time passes.

THANK YOU