ANALYZING THE DRAINAGE POSITION OF DALAMA PLAIN IN AYDIN

ANALYSE DE LA SITUATION DU DRAINAGE DANS LA PLAINE DE DALAMA EN AYDIN

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ABSTRACT

Aydın Dalama Plain Project area is located at Great Meander River Basin. The Project area is surrounded by Dalama County in the east, Baltaköy and Aydın-Muğla state highway in the west, Great Meander River in the North and the settlements in the South covers the lands remaining between the mountains and hills. The study reported in this paper assesses the results of land investigations conducted during 1986 - 2000. The Project area where Meditarranean climate is dominant has low slope and in general is bottom land and between 28-60 m level. In this area field study was conducted in 2009 on salinity, ground water level and floods. Groundwater and flood problems have been solved to a large extent due to stabilization of the river bed, banks and construction of the dams on the tributaries of the Meander River.

Key words: *Drainage, salinity, ground water level.*

RESUME

Le Projet de la plaine Aydin Dalama se trouve dans le bassin fluvial de Great Meander. La zone du Projet est entourée du Comté Dalama à l'est, du Baltaköy et l'autoroute d'Etat d'Aydin-Mugla à l'ouest, la rivière Great Meander au nord. Les colonies du sud couvre le reste de la superficie entre les montagnes et les collines. L'étude évalue les résultats d'enquêtes menées sur le terrain durant la période 1986 - 2000. La zone du Projet où domine le climat méditerranéen possède une pente basse. Ayant une basse terre, le niveau varie entre 28-60 m. Dans cette région, l'enquête a été menée en 2009 sur les questions telles que la salinité, le niveau d'eau souterraine et les inondations. En raison de la stabilisation du lit de la rivière, des bords et de la construction des barrages sur les affluents de la rivière Meander, les problèmes relevant de l'eau souterraine et des inondations ont été largement résolus.

Mots clés : *Drainage, salinité, niveau de l'eau souterraine.*

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1. INTRODUCTION

Aydın Dalama Plain, located at "Great Meander River " basin has a general slope from east to west and south to north. The project includes Dalama county on the east, Baltakoy and Aydın-Mugla state highway on the west and Great Meander River on the north, besides inhabitated areas on the south and areas between mountains and hills.

Revised Detailed Area Classification Survey and studies in the Lower Meander Project at Akcay left coast plain carried out by the Planning Directorate of Aydın DSI was completed in October 1980. The two reports emanating from the study: "Akcay Project Akcay Left Coast Yenipazar Irrigation Detailed Drainage Report" in 1987 and "Akcay Project Akcay Left Coast Yenipazar Irrigation Planning Revised Area Classification Report" were printed in 1988. According to the studies carried out in 10607 ha area, irrigability classification puts 2329 ha under Class 1, 2 and3; 8133 ha under temporary non-irrigable (Class 5) and 145 ha area under Class 6. Of these, 2875 ha area including the area under development works was evaluated.

In accordance with 2008 working programme of DSI (State Hydraulic Works) 21st Regional Directorate, area classification and drainage studies were held at planning level aiming reclamation of 2866 ha land in Aydın Dalama Plain. In this study the results surveys held in various years were compared with a view to assessing the impact of channel improvement of the Great Meander and the current salinity problem taking into consideration the efforts of farmers and insufficient irrigation water resource.

2. MATERIALS AND METHODS

1 Study Area

1.1 Location: The study area is located at "Great Meander River" basin. It has a mild slope from east to west and from south to north. Project area includes Dalama cuonty on the east, Baltakoy and Aydın-Mugla state highway on the west and Great Meander River on the north, besides inhabitated areas (Gölhisar, Mesutlu, Armutlu, Kozalaklı, Dereköy) on the south and areas between mountains and hills. The over all Project area starting from 5 km south of Aydın province includes areas lying on the left coast of Great Meander River, which are located at 20 km distance from Dalama county. Dalama plain covers nearly 63 km2 area.

1.2 Topography: The highest mountains of survey area are Karabelen Mount (321m), Kurt Mount (355m), Düz Mount (385m), Kocaçöğür Mount (722m) and Tülübelen Mount (273m). The slope ranges 2-6% at sides. Ground areas consist of alluviums of Great Meander River and slope ranges between 0.5-1% and is situated at 25-40m amsl.

1.3 Climate data: The climate data (Tables 1 and 2) for 1986 partains to Yenipazar Plain. This and other meteorological data were taken from Akcay Project's "Akcay Left Coast Yenipazar Irrigation Planning Revised Area Classification Report". The climate data for 2009 are taken from "Aydın-Dalama Irrigation Planning Engineering Services Aydın-Dalama Irrigation Hydrology" Planning Report. When the climate data given in Tables 1 and 2 are compared, it is observed that in spite of 50mm increase in rainfall, there is 400mm increase in evaporation and there is not much alteration in the temperature and relative humidity.

Table 1. Average climate data – 1986 (Precipitation in mm; Temperature in ^{0}C; Evaporation in mm and Relative Humiduty in %)

Climate data	Months												Total
	Jan	Feb	Mar	Apri	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Precipitation	111	86.2	61	40	31.2	13.4	3.6	1.9	14.4	45	65.8	123.5	597
Temperature	8.0	9.5	11.6	15.6	20.7	25.4	28	27.4	23.3	18.3	13.5	9.6	17.57
Evaporation	25.38	34.35	57.37	108.3	180.4	244.04	285.12	259.53	180.45	112.18	51.95	32.13	1571.24
Relative humidity	78	76	71	67	61	51	46	50	56	66	75	79	65

Table 2. Average climate data – 2009 (Precipitation in mm; Temperature in ^{0}C; Evaporation in mm and Relative Humiduty in %)

Climate parameters	Months												Total
	Jan	Feb	Mar	Apri	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Precipitation	112.6	93.3	71.1	49.3	36.4	13	3.7	2.4	14	45.8	45.8	129.8	650.3
Temperature	8.3	9.4	11.7	15.8	21	25.8	28.4	27.5	23.5	18.5	13.5	9.6	17.75
Evaporation	31.20	45.00	95.70	138.1	208.80	285.90	343.00	322.40	232.30	151.40	69.80	31.90	1955.5
Relative humidity	83	83	78	75	77	69	60	65	67	75	80	84	74.7

1.4 Rainfall: Rainfall is of Mediterranean climate type and the natural vegetation is maquis and forests at Project area. Coniferous pine forests are noticed at higher altitudes of the basin and prevelance of Mediterranean maquis vegetation in lower parts. The summers are hot and dry, winters warm and rainy at Project area. Total measured rainfall is nearly 650.3mm at the basin annually. The highest rainfall in December is 129.8mm on an average and the least is in August that is 2.4mm on an average. Rainfall-duration-frequency of the survey area, taken from DSI are given in Table 3.

Table 3. Rainfall-depth-duration-frequency.

Duration, (hour)	Frequency, (year)					
	2.33	5	10	25	50	100
	Precipitation (mm)					
1	15.2	18.8	22	25	27.7	30.5
2	10.5	13.2	15.5	18	20.3	22.5
4	6.5	8.1	9.5	11.1	12.5	13.8
6	4.7	6	7	8.2	9.1	10.1
8	3.8	4.8	5.7	6.6	7.3	8.1
12	2.8	3.5	4.2	4.8	5.4	5.9
18	2	2.6	3	3.5	3.9	4.4
24	1.6	2	2.4	2.8	3.2	3.5

1.5 Rivers: The 584 km long Great Meander is the longest river in West Anatolia and is the main irrigation source of its basin. It rises at Suçıkan site near Afyon province Dinar county. Getting out of Işıklı Dam which gathers Işıklı and Küf'i Brooks, it passes Çivril, Çal and Baklan Plains and turning to the north from the east of Çal, it flows within a deep bed towards Bekilli and Güney county. Merging with Banaz brook which comes from Uşak and which is one of the biggest tributaries of Meander, it goes down Sarayköy Plain. Being fed with Çürüksü and Gökpınar Brooks which are within the borders of Denizli, it goes westward, completing its journey upon meeting the Aegean Sea in Söke county Dipburun Site after nourishing Nazilli, Aydın and Söke Plains. Meander River is pitched at the both edges. Moreover its bed regulation has been conducted recently. With the help of the studies which include precautions and dam constructions at subbasins and upperbasins, flow regime of Great Meander river has been modified.

Great Meander Basin is one of the agriculturally most productive regions of Turkey and covers very large plains starting from Denizli and lying along the coast of Aegean Sea. Cotton, vegetables and fruits are produced in these plains. The basis area is 3.5% of the geographical area of Turky borders with Denizli in Çivril county. Also within its borders there are Aydın, Uşak city centers and county centers such as Sarayköy, Söke, Nazilli, Çine, Yatağan, Tavas, Buldan, Eşme, Banaz, Çal, Honaz, Dinar, Sandıklı. Great Meander Basin due to its ecological characteristics contributes much to Aegean Region and Turkey's agriculture. The water of Great Meander River is very clean within Denizli Çivril Plain. It flows clean since industrial waste did not mix yet. The people living in Çivril treat the river tenderly and pay attention not to pollute it by domestic and industrial waste. They must be congratulated for their sensitivity. Because especially other areas do not pay attention that much to these developments and empty every kind of domestic and industrial waste including their sewages.

While passing through other regions, Great Meander River is, however, subjected to pollution due to disposal of domestic and industrial waste water and pesticide residues from the agricultural lands. On the basis of an aereal view it is found that the water usage designs of areas are insufficient; that there is severe soil erosion and degradation due to the excessive use of agrochemicals to boost production. This has adversely affected local flora and fauna as well, causing a disbalance in the ecological equilibrium of the region. There are 20 types of industrial enterprises which didpose their waste water to The Great Meander River without treating, in Denizli, Uşak and Aydın provinces. The number of Municipalites is 165 but proper sewage treatment facilities are availablein only 6 of them. The pollution is intensified at subbasins and the prestine river ecosystems are about to vanish.

1.6 Mendear river amelioration studies and measures: Amelioration studies of river system starting from the intersection of Feslek Brook 15km of which is within the border of Aydın is brought to the Çine Brook section as of the end of May 2007. On two sides of 115km of the river, which is within the borders of Aydın province a total of 230 km long banks were constructed. This ensured that the irrigable lands got adequate water in time from Işıklı Lake, Adıgüzel and Kemer Dams when irrigation is at its peak. The possibility of damage to the plantation areas was prevented by flood control measures (river banking, river bed cleaning, etc) in the Great Meander River and its tributaries. All these activities have stabilised plantation activities giving a boost to the national economy. Drainage of the area improved as a result of amelioration studies and measures for the Great Meander River system and basins. The

high banks constructed in both sides of the river helped in flood prevention and provided service roads for transport of traffic and goods, which helped the producers.

1.7 Irrigation water characteristics: According to Aydın–Dalama Irrigation Planning Engineering Services Aydın-Dalama Irrigation Hydrology Report irrigation water's class is determined as C3S1 (T_3A_1) and C2S1 (T2S1) and it is safe for irrigation. Kemer dam's water will be used as irrigation water resource at the project site. The water getting out from Kemer dam will be sent to project site through Akçay left coast irrigation main channal from Akçay regulator which is constructed on Akçay.

1.8 Permeability: The land permeability is rapid due to coarse soil texture. The region comprises sandy, gritty, little clayey and silty lands which Meander carried and got deposited. In this structure silty and clayey series are seen at upper profiles while sandy and gritty series are encountered down below. Permeabilities increase from the top to bottom.

1.9 Groundwater: Groundwater at the study area corresponded with river water fluctuation. No salinity or sodicity problem was noticed in groundwater.

1.10 Surface Water: The main surface water resource is supplied by Great Meander River. In addition there are many tributaries to the river that contributes to the flow.

1.11 Floods: Spring floods occur in April and May when the rains are heavy. Taking into consideration that the vegetable growing continues through the year, it is required to provide enough exit to tributary streams to avoid flooding of adjacent vegetable growing lands.

1.12 Dams Under Operation: Aydın: Kemer (Bozdogan-Akçay-SET), Topçam (Çine-Madran Stream-ST), İkizdere (İncirliova-İkizdere Stream-İK), Yaylakavak (Karpuzlu-Kocaçay-S), Çine Adnan Menderes (Çine-Çine Stream-SET).

Denizli: Adıgüzel (Güney-B.Menderes River-SET), Işıklı Lake (Çivril- B.Menderes River-S), Gökpınar Governor Recep Yazıcıoğlu (Center- Gökpınar Stream-İKS), Cindere (South-B. Menderes River-SE), Tavas – Yenidere (Tavas – Yenidere Stream-S).

Muğla: Mumcular (Bodrum-Kocadere-İKS), Geyik(Milas-Sarıçay-İKS), Marmaris (Marmaris-Kocaalan Stream-Sİ), Bayır (Bayır-Sarıinler Stream-S), Akgedik (Milas-Sarıcay-S).

1.13 Dams Under Construction: Aydın: Karacasu (Karacasu-Dandalaz Stream- for Irrigation).

Denizli: Akbaş (Honaz-Çaykavuştu Stream- for irrigation).

Muğla: Akköprü (Köyceğiz-Dalaman Stream- for Irrigation and Hydropower).

1.14 Area Type Divisions: The types of areas are given in Tables 4 and 5, respecively, for 2009 and 1986.

Table 4. The area classification as on 2009.

Class	Irrigable area					Temporary non-irrigable area	Non-irrigable area	Grand Total
	1	2	3	4	1+2+3+4	5	6	
ha	845	679	593	-	2117	207	542	2866
%	29,49	23,69	20,69	-	73,87	7,22	18,91	100

Table 5. The area classification as on 1986.

Class	Irrigable area					Temporary non-irrigable area	Non-irrigable area	Grand Total
	1	2	3	4	1+2+3+4	5	6	
ha	781	577	-	-	1 358	1441	76	2875
%	27,17	20,07	-	-	47,24	50,12	2,64	100

From the above Tables, it is seen that the increase in the Class 6 non-irrigable area is the result of the increase of the settlements in project site and the decrease in the Class 5 land is the result of the drainage canals, the improved river beds and the washing away of salts.

1.15 Cropping Pattern: Total cotton cultivated area -1134 ha- in 1986, was 40.51% of the total irrigable area. It is estimated that the cotton had further replaced at least 612 ha area under other crops. Thus, Cotton farming is currently carried on 1746 ha i.e., in more than 60% of the irrigable land.

According to the ranking of the cultivated products in 2009, cereals (approximately 800 ha) and vegetables (approximately 800 ha) ranks at the top. Corn (approximately 150 ha) and clover (approximately 120 ha) are also cultivated. The cropping pattern under the existing conditions based on the investigation is given in Table 6.

Table 6. Cropping pattern in the project area.

1986		2009	
Veg.	**Area (ha)**	**Veg.**	**Area (ha)**
Meadow-pasture	55	Meadow-pasture	34
Grain	13	Grain	270
Grain-veg.	36	Grain-veg.	135
Grain-olive	46	Grain-olive	50
Fruit-veg.	19	Grain-trefoil	23
Cotton-veg.- viney.-sesame-olive	150	Grain-veg.-fruit-trefoil-pea	207
Cotton	1134	Corn	66
Cotton-melon-sunflower	41	Cotton-Grain	47
Cotton-melon	73	Vegetable	125
Cotton-corn	218	Vegetable-grain-corn	201
Cotton-veg.	202	Vegetable-grain-fodder plant	43
Cotton-veg.-fruit	176	Vegetable-grain-trefoil	74
Cotton-veg.-corn	12	Vegetable-grain-	593
Cotton-veg.-olive	24	Vegetable-grain-olive	9
Cotton-olive	39	Vegetable-fruit	67
Vegetable	37	Vegetable-fodder plant	73
Vegetable-grain	49	Vegetable-trefoil-corn	21
Vegetable-grain-cotton	17	Vegetable-olive-fruit	55
Vegetable-fruit	35	Sugar beet-grain	38
Vegetable-fruit-corn	71	Trefoil-veg.-grain	36
Vegetable-fruit-cotton	24	Trefoil-grain	109
Vegetable-corn	30	Trefoil-veg.-fruit	48
Vegetable-cotton	81		
Olive-almond-vineyard	61		
Olive-vineyard	21		
Olive-grain-corn	55		
Olive-veg.-viney.-garden	80		
Total	2799	Total	2324

According to the “Aydın-Dalama Irrigation Planning Engineering Services Aydın-Dalama Irrigation Agricultural Economy Planning Report”, the Project area for 2009 takes the first place among the cultivated products in the existing conditons with its cereal and cotton farming on 20% of the area. The next is vegetables, which occupy 15% area. Corn and clover is extensively grown for livestock, with corn occupying 20% area. This is followed by the other products special for the vicinity. Table 7 gives the Agricultural Economy in brief.

Table 7. Agricultural economy

Type of the Plant	% Cultivation Rate	Yield (in kg)
Cereals	25	450
Wheat	20	375
Barley	12	400
Cotton	5	400
Vegetable	11	3500
Potato	1	3000
Silage Corn	6	5000
Corn	6	1000
Vetch	9	400
Clover	3	1100
Fruit (M)	1	1200
Olive (M)	1	450
Aftercrop	18	4500
Melon	-	-
Fruit (YT)	-	-
Olive (M) (Y)	-	-
Total	100+18	

1.16 Temporary non-irrigable areas: The Class 5 land comprising the temporary non-irrigable areas determined for 1986-2009 are given in Tables 8, both for 2009 and 1986.

Table 8. Use of Class 5 land (2009) (1986)

5th Classes		Areae(ha)	Area (%)	5th Classes		Area(ha)	Area (%)
Temporary Non-Irrigable Area	5s	101	48.79	Temporary Non-Irrigable Area	5s	95	6.59
	5d	106	51.21		5d	1167	80.99
	Total	207	100.00		5sd	179	12.42
					Total	1 441	100.00

1.17 Needs for Irrigation Water: The need for irrigation water as in 1986 and as in 2009 are given in Table 9 for both the years.

Table 9. Need for irrigation water (1986) (2009)

Months	Need for Water in Plant Irrigation	Need for Water in Farm Irrigation	Months	Need for Water in Plant Irrigation	Need for Water in Farm Irrigation
June	1*103	1*171.67	May	1x66	1x79
July	2*103	2*171.67	June	3x66	3x79
August	2*103	2*171.67	July	3x66	3x79
September	1*103	1*171.67	August	3x66	3x79
TOTAL	618	1030.02	September	1x66	1x79
			October	1x66	1x79
			TOTAL	792	948

1.18 Areas requiring improvement: Areas requiring improvement (groundwater – salt – alkalinity – permeability) are detailed in Tables 10 and 11, respectively for 1986 and 2009.

Table 10. Areas requiring improvement (1986)

Symbol	W_5	aW_5	fW_5	AW_5	ApW_5	Ap	a_1	a_2	a_3	a_1 A	a_2 A	a_3 A	A
ha	1011	19	51	170	57	52	432	232	50	59	19	36	223
%	35.16	0.66	1.77	5.91	1.98	1.81	15.02	8.07	1.74	2.05	0.66	1.25	7.76

* (2875 ha) rates are given for the general area.
The total of **a_1, a_2, a_3** is 714 (24.83%) ha; **A** 223 (7.76%) ha.

Table 11. Areas requiring improvement (2009)

Symbol	w_2	W_3	W_5	P_2	P_3	a_1	a_{1A}	A
ha	100	135	106	180	419	313	21	80
%	3,49	4,71	3,7	6,28	14,62	10,92	0,73	2,79

*(2 866 ha) rates are given for the general area.
A is determinde as **80** ha; **a_1** is determined as 313 ha.

1.19 Drainage

—1986: On the Project area, 1144 ha of 2799 ha area was planned to be implemented surface drainage; 233 ha farm drainage and 1422 ha project deep drainage. According to the Report, the discharge channel newly proposed to be opened in this area, the existing carrier drain proposed to be improved, the tributary rivers, the existing banks and the existing discharge channels proposed to be improved are showed on the map.

—2009: On the Project area, 2117 ha area has been taken to the surface drainage system and in a total of 207 ha area requiring subsurface drainage, the same has been provided in

106 ha for water table control and another 101 ha for controlling sodium hazard.

At the project site, 1084 ha area was provided with open dtainage trenche system considering slope, soil constraint, naturel drainage, other topographic factors and the route of Botaşpipe line and it was indicated that the 0.45 cm channels to be opened in these sites would be suitable for surface drainage and these would be done using farmers' own resources.

It was also stated that the surface carrier drain proposed to be opened should have 500 m gap, 0.75 m depth, 0.5 m base width and 1:1 slope in 1033 ha of the Project area to be taken to the surface drainage system and because of the value of the area in the Project site, the consolidation processes and the avoidance of open channels by the citizens, it was decided to keep them minimum.

According to the Report, the offtake canals proposed to be opened newly, the tributary streams to be reclaimed and the existing offtake canals are given on the maps of Figure 1.

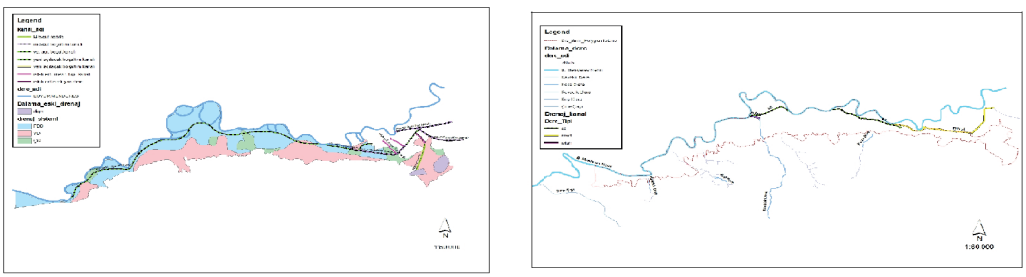

Fig 1. Drainage system map: Left Figure for 1986 and right Figure was proposed and commissioned open drains in 2009.

1.20 Ground Water

—1986: The most critical groundwater levels on the area were determined as: the deepest in January, the shallowest in October.

—2009: The groundwater table in the area responds to the water elevation of Great Meander River. The groundwater rises in February and April when the water elevation of the river rises and falls with the fall of the water elevation of the river.

1.21 Problems and Recommendations Indicated In the Reports

—1986: Problems Indicated In the Report

It was indicated that the water table rise and salinity poblems were associated with:

- Already shallow water table regions and when groundwater salinity was in the range of 3000-6000 micromhos/cm and in its most critical case groundwater encroached the crop root zone.
- There were floods in Great Meander River whose water level gets higher during the winter months.

- There were rains and heavy irrigation by the farmers.
- Flood water mixed with groundwater due to a lack of drainage system.
- Salty ground water caused sodification in the areas where soil permeability was low,
- Inadequate outlet conditions.

—2009: Recommendations

Realizing the benefits of the implemented Project would take at least several months. Neverthelss, some positive changes are expected even during the initial post-project period. There are also recommendations on adopting the gypsum amendment, if necessary, for controlling the salt and sodium in the project operation period.

- Some of the citizens intervene in the stream beds for using the water coming from the upper basin and even engage in agriculture in the stream beds or prevent stream improvements. As regards the recommendation, stream (tributary) beds should be connected to the river in a way that there is no impediment of the tributary discharging its water into the river.
- Many tributary streams flows to the offtake canal or to the B. Menderes River after finding a suitable way. But it is necessary for the Kovacı stream to be discharged by beaching its bed.
- Many dry streams in the Project site flows its winter water into the Great Meander River via existing beds. But the bed of Başmakçı stream that has stream bed inadequacy should be opened and be arranged for the incoming waters to arrive to the Great Meander River in time. With this aim, river water should be prevented from leaking to the farming lands in its highest periods by putting a gate to the outlet of the canal to be opened in the proposed improvement programme.
- The surface drainage flow is hindered especially during the spring months because of the lack of culverts on Great Meander River on parts where the slope is low on the site. This can be solved by opening proposed surface offtake canals.

4. CONCLUSIONS

In 2009, there was a a decrease in salinity, stream bed interference and floods on the study site. Stream bed and flood problems largely decreased due to the bed improvement on Menderes River, banking and cleaning studies and the dams constructed on the tributaries. By cleaning the existing drainage canal and taking it to the proper depth, the deep drainage inadequacy would decrease. Discharging and the improvement of the Kovacık stream to the Menderes River, opening of the proposed drainage canals, choosing the suitable irrigation system and a good irrigation would help solving the problems. By protecting the irrigation water, the efficiency would improve with suitable irrigation type, irrigation system and water allocation as necessary.

REFERENCES

DSİ, 2011. Akçay Project Dalama Plain Irrigation Area, Revision Planning, Area Classification and Drainage Report. (not published yet)

DSİ,1987. Detailed Drainage Report of Akçay Project Akçay Left Coast Yenipazar Irrigation, Aydın.

DSİ,1988. Planning the Revised Area Classification Report of Akçay Project Akçay Left Coast Yenipazar Irrigation, Aydın.

MUNSUZ, N. İ.ÜNVER and G.ÇAYCI,1999. Waters of Turkey, AÜZF edition no:1505

Toprakoğlu.H., 1974. "The Examinig Book of the Classification of Irrigated Farming"-04.02-04."

Soil and Drainage Expert Consultancy, 1976. "The Area Classification and Drainage Report Used in Irrigated Farming Conditions"

DSİ Investigation and Planning Department, 1984. "The place of Area Classification and Drainage Studies in Planning"

DSİ Investigation and Planning Department, 1984. "Soil and Drainage Branch Office Publications"

DSİ Investigation and Planning Department, 2002-2003. "Soil and Drainage Seminars"

Great Meander River Basin Characterisation Report, 2009. Prepared according to the 5th item of the Directive of European Parliament and Ministerial Board (SÇD2000/60/EC) dated 23 October 2000 constituting a frame for the group activities on the area of water policy.