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Investigating the effects of agricultural best management practices on water quality of a surface water

ABSTRACT

Water is an essential component of the Earth's ecosystem; each freshwater body has its specific physical and chemical characteristics. High contents of nutrients in the water, such as nitrogen and phosphorus are the major issues in terms of water quality. Notably, excessive nutrient concentrations in surface waters cause eutrophication. This research examines some pollution parameters to determine the current pollution level of the Göksu River. The river passes through the Göksu Delta, which is the most important natural habitat of the Mediterranean region of Turkey. Agricultural best management practices were an important phase of this study. The main goal was to examine the effects of agricultural best management practices on water quality of the Göksu River. Soil and Water Assessment Tool (SWAT) was used for modeling the water quality of the Göksu River considering the agricultural best management practices. Water quality is the lowest in the watershed outlet. For this reason, agricultural best management practices have been evaluated by using SWAT program by considering watershed outlet water quality values. Results confirmed that agricultural best management practices retain large amounts of nutrient load in the Göksu River Watershed. SWAT simulation shows that in case agricultural best management practices were used, there could be a high decrease in BOD_5, NO_2^- *and Total P loads. Which means a higher water quality class according to the Surface Water Quality Management Regulations (SWQMR) of Turkey.*

Keywords: *Best management practices, Göksu Delta, modeling, nutrients, water quality.*

1. INTRODUCTION

Water is an essential component of the Earth's ecosystem; each freshwater body has its specific physical and chemical characteristics. Climatic, geomorphological and geochemical conditions prevail in the drainage basin and the underlying aquifer. The river is the body of running water; it has fresh water, parallel banks and a bottom slope in the direction of flow, and in a river, the flood waves are primarily progressive. Rivers are located in watersheds. A watershed is a catchment or drainage basin. The chemical quality of the aquatic environment varies according to local geology, the climate, the amount of soil cover, land use, etc. Freshwaters are subjected to increasing pressures and suffered quality degradation in many parts of the world. [1]. Anthropogenic activities cause excessive nutrients in the ecosystem.

Direct atmospheric deposition, landscape morphology, hydrological conditions, biogeochemical processes in soil, sediment and geological characteristics are additional sources but their contributions have less significance. Agricultural sources due to the increased use of manures and manufactured inorganic fertilizers in global agriculture are the single greatest causes of pollution degrading the quality of surface waters. The European water policy has undergone an important reconstruction process, especially through the new Water Framework Directive, which sets clear objectives of protecting European waters with certain deadlines and approaches. Water resources management should be conducted based on river basins according to the Water Framework Directive [2].

Watershed resources management is the most appropriate way to ensure the preservation, conservation, and sustainability of resources and for improving the living conditions of the people.

1.1. Research area

Göksu River Watershed is the research area, which is located in the Silifke district of Mersin province of Turkey (Fig. 1). Göksu River outlet

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passes through the Göksu Delta and it drains into the Mediterranean Sea. Göksu Delta is one of the five Turkish Wetlands under the protection of the Ramsar Convention, an international agreement held, in 1971 in the city of Ramsar, Iran. The main pollution sources in the city are the uncontrolled agriculture and unplanned constructions.

Figure 1. Geographical location of the Göksu Delta

Slika 1. Geografski položaj delte Goksu

Today there is a mass settlement around the Göksu River, land use is being changed, and it is highly urbanized due to the increase of the population of Silifke. The total population of the Silifke District is 119,565, and 57,327 people are settled in the town center [3]. There is a rapid increase in the Silifke population due to immigration from neighboring underdeveloped cities. The Council of Ministers identified and announced Göksu Delta as a Special Environmental Protection Area on January 18, 1990 (Fig. 2). Göksu Delta Special Environmental Protection Area consists of four towns and the seven villages of the Silifke District of Mersin Province.

Table 1. Coordinates of the sampling points in Göksu River Watershed

Tabela 1. Koordinate mesta za uzorkovanje u vodnom polju reke Gokse

Point	East	North	Sampling Location
1	33° 55' 23"	36° 24' 24"	Göksu River – Dam
2	33° 59' 4"	36° 22' 55"	Göksu River - City outlet
3	34° 2' 3"	36° 18' 56"	Göksu River – Menderes

Three sampling points are located before the mass settlement, in the middle of the city center and at the outlet of the river, respectively (Fig. 3, Table 1). In this study, the water quality classification of the Göksu River from 2014 to 2017 was, according to the Turkish Water Quality management Regulations (Table 2).

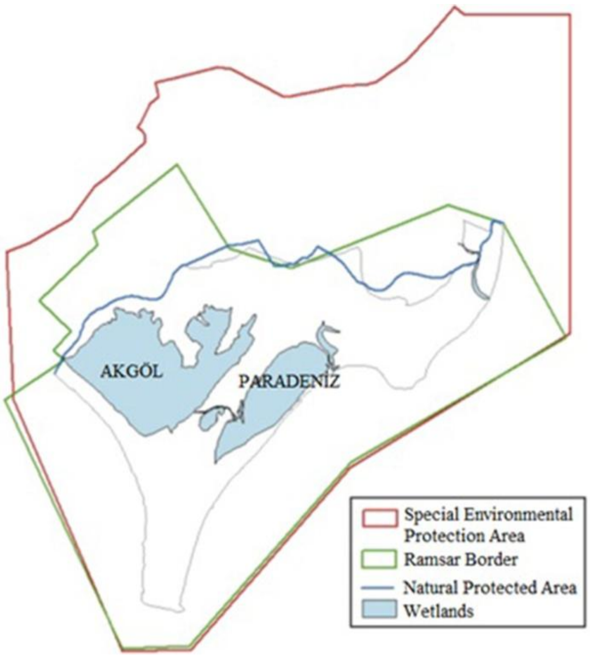

Figure 2. Protection area borders in the Göksu Delta

Slika 2. Granično zaštitno područje u delti Goksu

Figure 3. Sampling points in the Göksu River Watershed

Slika 3. Tačke uzorkovanja u vodenom koritu reke Goksu

Table 2. Water quality classes according to the Surface Water Quality Management Regulations (SWQMR) of Turkey

Tabela 2. Klase kvaliteta vode prema turskim pravilnicima o upravljanju kvalitetom površinskih voda (SWQMR)

Water Quality Class				
Parameter	**1**	**2**	**3**	**4**
Dissolved Oxygen (mg/l)	> 8	> 6	> 3	< 3
Ammonium Nitrogen (mg/l)	< 0.2	< 1	< 2	> 2
Nitrite Nitrogen (mg/l)	< 0.002	< 0.01	< 0.05	> 0.05
Nitrate Nitrogen (mg/l)	< 5	< 10	< 20	> 20
Total Dissolved Solid (mg/l)	< 500	< 1500	< 5000	> 5000
Total Phosphorus (mg/l)	< 0.02	< 0.16	< 0.65	> 0.65
BOD5 (mg/l)	< 4	< 8	< 20	> 20
Total Coliform (EMS/100 ml)	< 100	< 20000	< 100000	> 100000

1.2. Areas occupied by sub-basins

Göksu River flows through sub-basin 1, 2 and 3, respectively (Fig. 4 and 5). There is no settlement at sub-basin 1 since the area is roughly mountainous. Silifke district is located and there is a mass settlement at sub-basin 2. Sub-basin 3 is the last sub-basin of the whole watershed, and it is located around the outlet of the Göksu River and there is no settlement in this area due to the Ramsar Convention.

Göksu River, which collects the water from the surrounding highlands with high rainfall by feeding on the underground sources and streams, has a flow rate of 118 m^3/s (Minimum 26 m^3/s; maximum 1680 m^3/s). Akgöl Lagoon (820 ha) has a slightly salty water character. The lake has a depth of 0.5 - 1.0 m, and it is connected to Paradeniz Lagoon by a channel opened by the anglers and is fed by freshwater from the drainage channels. The Paradeniz Lagoon (492 ha) is slightly salty and a maximum of 1.5 m deep and is permanently attached to the sea by a canal [4].

The sand movement on the shores of the Silifke-Göksu Delta is mostly from the shore to the interior. The dunes, one of the most important habitats, are one of the sensitive habitats of the Göksu Delta. The dunes are especially in the western part of the Delta, near Akgöl and Paradeniz, and reach the sea in the southernmost area called Incekum. This formation also continues as shallow under the water. The sandy beaches have a very special value because of the Caretta Caretta and Chelonia Mydas, two turtle species living in the Mediterranean Sea. In Göksu Delta, there are also natural vegetation and cultural plants. It has been determined that natural vegetation is concentrated mainly in coastal dune plants. The most common dominant crops for the dunes near Akgöl are Ononis Natrix and Euphorbia Paralias. Göksu Delta is a very rich area in terms of biodiversity. The vegetation varies according to the different habitats in the delta (lagoons, saline wetlands, drainage channels, etc.). Delta fauna consists of 332 bird species out of the 450 found in wetlands in Turkey. Göksu Delta is a shelter to the Mediterranean seals, otters, mammals such as yew, reptiles. It is also one of the breeding grounds of sea turtles [5].

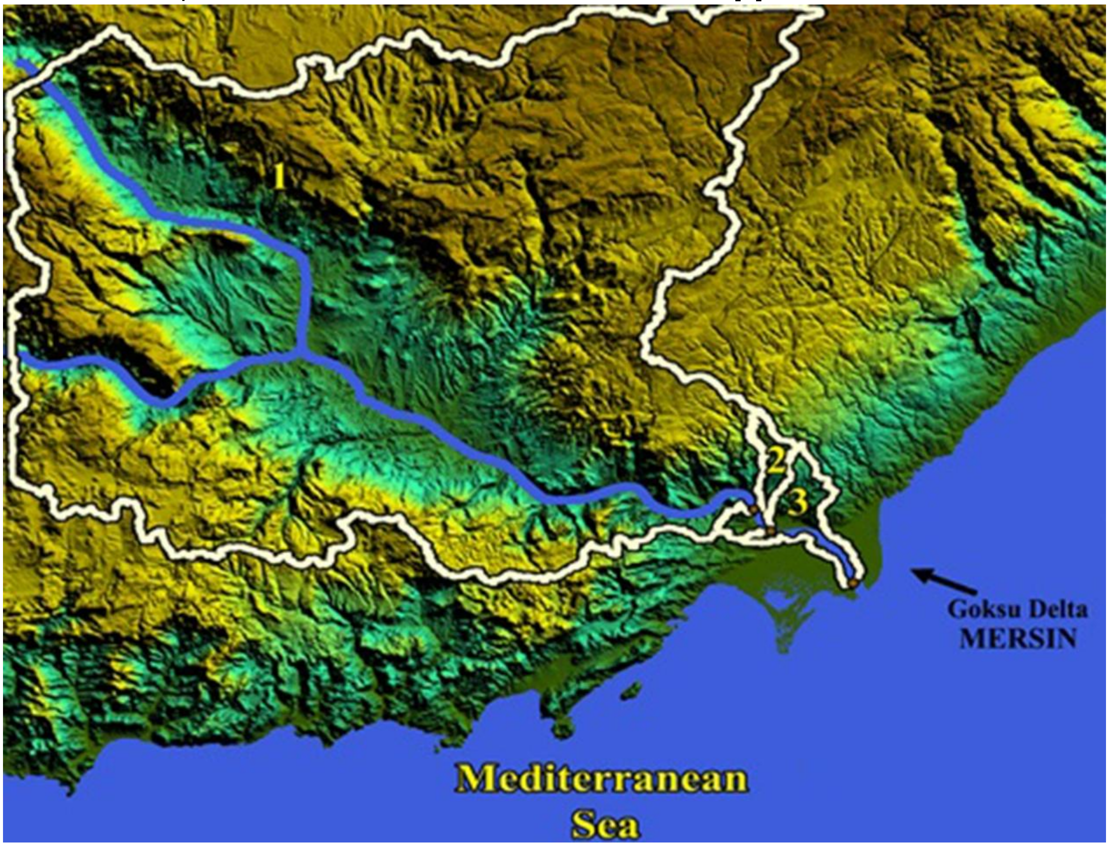

Figure 4. Delineated sub-basins of the Göksu River Watershed

Slika 4. Podbazeni sliva reke Goksu

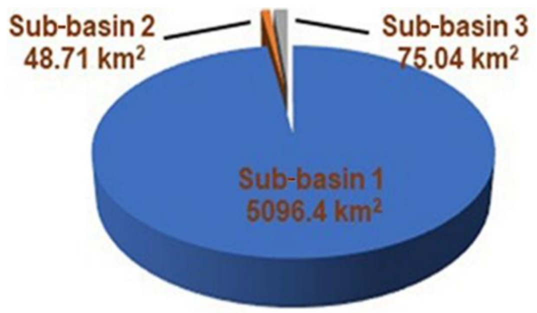

Figure 5. The shares of the sub-basins in the Göksu River Watershed

Slika 5. Udeo podbazena sliva reke Goksu

2. METHODOLOGY

SWAT is a complex, conceptual, hydrologic, semi-distributed model for modeling the river water quality of the Göksu River Watershed [6]. Previous studies are guidelines for us to develop a proper methodology for our study. According to Wickham et al. [7], anthropogenic uses promote higher nutrient yields compared to natural vegetation. Wickham et al. noticed that the variances of N and P concentrations among different land use within ecological regions were respectively six and three times greater than the variance among different ecological regions [8]. Nevertheless, the result of different ecological regions is less important compared to different land-use compositions.

The general flow chart of this study is shown in Fig. 6. Along with the field studies, several references were taken into consideration to observe spatial and temporal data [3-5; 9-11].

2.1. Water pollution

Pollution sources in the region are mostly diffuse/nonpoint sources. Pollution that comes from many sources, across large areas is diffuse pollution. Pollutants due to diffuse sources are difficult to monitor, and they usually move to the land with the effect of stormwater [12].

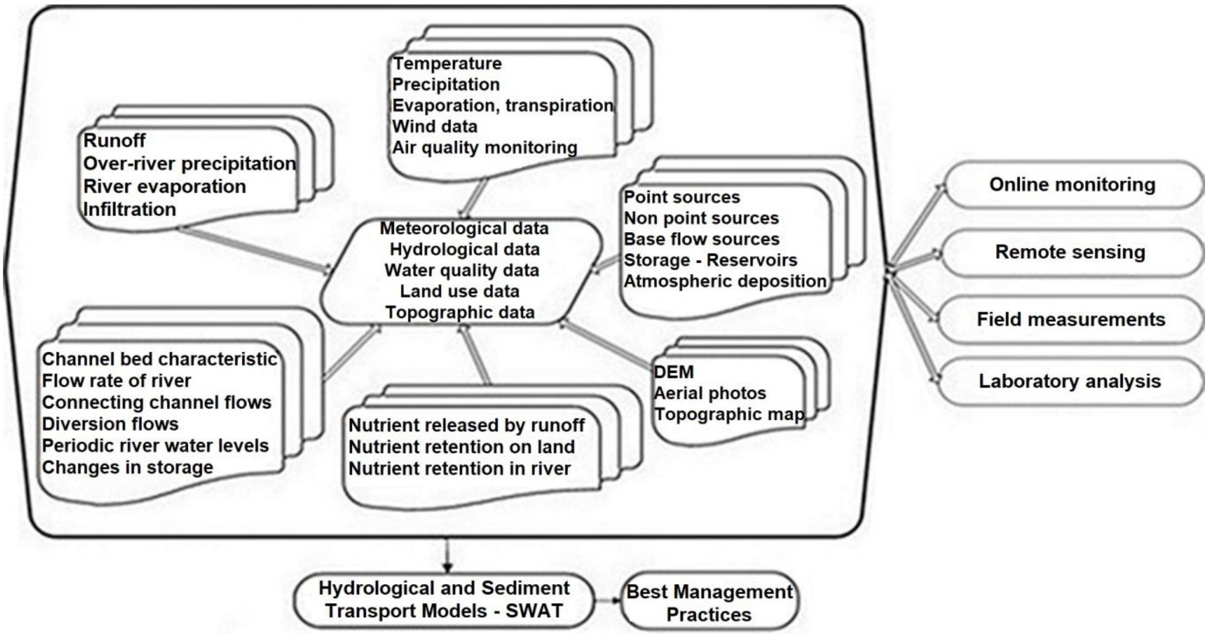

Figure 6. General flow chart of the proposed study

Slika 6. Opšti dijagram toka predložene studije

2.2. Diffuse pollution

Discharges diffusely enter the receiving surface waters at intervals depending on the meteorological formations [13, 14]. The effective area of the diffuse pollution changes year after year due to some uncontrolled climate events and geological conditions that differ from one place to another [14]. Common nonpoint sources (NPS) are agriculture, forestry, urban, mining, construction, dams, channels, land disposal, and city streets. Campbell et al. categorized diffuse pollution from rural lands as increased erosion and soil loss, chemical pollution, irrigation and livestock [15].

In the absence of local data, the runoff models and water quality data reported in the literature were chosen to estimate the likely range of diffuse pollution load generated from a catchment [16]. There is no single solution to diffuse pollution. The treatment train concept is based upon the combination of a series of complementary treatment techniques to achieve enhanced water quality or Best Management Practices (BMP) [17].

The effects of nutrient enrichment in rivers likely occur when high concentrations of bioavailable nutrients are present during the periods of algal or plant growth [18].

2.3. Main nutrients and water quality standards

Two main plant nutrients are nitrogen and phosphorus. Although nutrient levels in nature are low, human impacts can lead to high levels, resulting in excessive growth of water plants (algal blooms). Blue-green algae blooms are toxic to plants, animals and humans, cause reduced animal and plant diversity, and reduce dissolved oxygen levels, which lead to fish kills. According to the Turkish Water Quality Management Regulations, sources of nutrients are fertilizers, animal wastes, decaying organic matter, industry, sewage, soil erosion, and phosphate-based detergents [19]. Nitrates, phosphates, are nutrients associated with fertilizers, manure, and sewage.

2.4. SWAT as a hydrological and sediment transport model

Hydrological and sediment transport models are essential tools to simulate the diffuse/nonpoint loading from land surfaces to the river and out of the basin. Soil and Water Assessment Tool (SWAT) is one of the most popular processes based, a mathematical model developed for the US Department of Agriculture (USDA) [20].

The ArcSWAT proposed by Olivera et al. to assist SWAT simulations in the ArcGIS environment [21]. ArcGIS provides both the GIS computation engine and a common Windows-based user interface within this system. ArcSWAT is organized in a sequence of linked tools as follows: (i) Watershed Delineation; (ii) Hydrological Response Units (HRU) Definition; (iii) Weather Station Definition; (iv) SWAT Databases; (v) Input Parameterization, Editing and Scenario Management; (vi) Model Execution; (vii) Reading, Mapping and Charting Results; and (viii) Calibration tool.

2.5. Best management practices

Novotny and Olem state that Best Management Practices (BMPs) are methods that lead to the reduction of nonpoint source pollution until the level of pollution reaches to permitted levels specified by water quality standards [13]. There is a need for guidance that offers practical prevention options, also there is a need for the best practice rather than ill-defined individual interpretations of what are required [13]. Applying BMPs are important to control or limit the transport of agricultural pollutants to surface and groundwater. The selection of BMPs depends on the objectives and priorities of the parties involved [22]. Viable solutions to reduce nonpoint source pollutant loads are; buffer filter strips, parallel terraces, grade stabilization structures, grassed waterways, residue management, strip cropping, and contour cropping. The utility of mathematical models provides an effective tool for the evaluation of the long-term performance of BMPs. Several studies deal with the effectiveness of BMPs in the reduction of sediment and nutrient yields [23-27]. There are various watershed and field-scale models to simulate the effectiveness of BMPs [28-30].

3. RESULTS

The observed water quality status of the Göksu River was tabulated in Table 3. The status of the river was indicated according to the Turkish Water Quality Management Regulations.

Table 3. Water quality classes for the sampling points between the years 2014 and 2018

Tabela 3. Klase kvaliteta vode za tačke uzorkovanja između 2014. i 2018. godine

YEAR	Point	Discharge (m^3/s)	Dissolved Oxygen (mg/l)	Ammonium Nitrogen (mg/l)	Nitrite Nitrogen (mg/l)	Nitrate Nitrogen (mg/l)	Total Nitrogen (mg/l)	Total Dissolved Solid (mg/l)	Total Phosphorus (mg/l)	BOD_5 (mg/l)	Total Coliform (EMS/100 ml)
2014	1	-	9.16 (1)	0.05 (1)	0.01 (2)	0.42 (1)	1.17 (1)	347.08 (1)	0.14 (2)	6.69 (2)	1060.00 (2)
2014	2	87	8.56 (1)	0.06 (1)	0.01 (2)	0.64 (1)	1.45 (1)	355.27 (1)	0.17 (3)	7.56 (2)	1483.33 (2)
2014	3	89	7.45 (2)	0.08 (1)	0.01 (2)	0.81 (1)	1.54 (1)	516.00 (3)	0.23 (3)	7.93 (2)	1778.87 (2)
2015	1	-	7.67 (2)	0.05 (1)	0.03 (3)	0.49 (1)	1.19 (1)	279.73 (1)	0.04 (2)	4.00 (1)	1544.44 (2)
2015	2	83	7.49 (2)	0.13 (1)	0.04 (3)	0.72 (1)	1.41 (1)	285.88 (1)	0.06 (2)	4.00 (1)	1692.33 (2)
2015	3	86	6.37 (2)	0.13 (1)	0.04 (3)	0.73 (1)	1.43 (1)	398.98 (1)	0.08 (2)	4.33 (2)	1798.38 (2)
2016	1	-	6.75 (2)	0.06 (1)	0.02 (3)	0.54 (1)	1.21 (1)	920.38 (2)	0.12 (2)	4.00 (1)	1910.00 (2)
2016	2	74	6.42 (2)	0.07 (1)	0.02 (3)	0.57 (1)	1.30 (1)	936.93 (2)	0.12 (2)	14.00 (3)	2390.00 (2)
2016	3	78	6.25 (2)	0.07 (1)	0.03 (3)	0.60 (1)	1.35 (1)	2216.00 (3)	0.14 (2)	29.8 (4)	2530.00 (2)
2017	1	-	9.40 (1)	0.05 (1)	0.01 (2)	0.54 (1)	1.20 (1)	779.73 (2)	0.03 (2)	5.00 (2)	1384.00 (2)
2017	2	81	8.51 (1)	0.07 (1)	0.02 (3)	0.57 (1)	1.31 (1)	898.73 (2)	0.05 (2)	5.10 (2)	1488.33 (2)
2017	3	85	8.04 (1)	0.08 (1)	0.02 (3)	0.81 (1)	1.48 (1)	967.67 (2)	0.07 (2)	5.22 (2)	1905.00 (2)

3.1. Best management practices by SWAT

Simulation modeling assesses the impacts of conservation practices on water quality in watersheds [31]. SWAT simulates the majority of conservation practices with straightforward parameter changes. The study of Douglas-Mankin et al. [32] demonstrated the application of the SWAT model to predict the effectiveness of several management practices at HRU, sub-watershed, and watershed levels. The SWAT model simulates the hydrological and water quality processes in the Bosque River Watershed as affected by a variety of agricultural BMPs. The BMPs simulated included streambank stabilization, gully plugs, recharge structures, conservation tillage, terraces, contour farming, manure incorporation, edge-of-field filter strips. Usually, the BMPs achieved significant reductions at the HRU, sub-watershed and watershed levels, compared with a baseline scenario [32, 33]. Implementing these BMPs individually resulted in sediment reduction ranging from 3% to 37% and TN reduction ranging from 1% to 24%. The TP increased by 3% due to conservation tillage. The P-factor, CN, Manning's n, channel cover, and filter width were sensitive to sediment output, in that order. The TN and TP were sensitive to the parameters such as P-factor, CN, and filter width that influence the overland processes and relatively less sensitive to Manning's n and not sensitive to channel cover [32].

Lee et al. [34] conducted a SWAT Modelling study for Cedar Creek watershed, located southeast of Dallas, Texas. According to the results of their study, the total TP reduction at the outlet after simulating eight selected BMPs was expected to be more effective than the initial reduction estimation because those practices were simulated in the top-ranked sub-basins based on TP loading. These BMPs are; filter strips, grade stabilization structures (GSS), Critical pasture planting, terraces, WWTP Level II (annual reduction for TN and TP are 1.6 and 4.6 percent, respectively), cropland to pasture, prescribed grazing, and 2000 ft buffer. See Table 4 for SWAT representations of

BMPs. Values in Table 4 are subject to change under different flow regimes, slopes, soil properties, etc. Arabi et al. supply an invaluable source about how to represent BMP applications and how to adjust parameters for this aim [35].

Table 4. BMP representation in the SWAT model (adapted from Lee et al. [34])

Tabela 4. BMP reprezentacija u SWAT modelu (prilagođeno od Lee i dr. [34])

BMP	SWAT Representation
Terrace	For all croplands with slope >= *2%.* USLE_P changed to 0.5 and CN2 was reduced by 6
Contour farming	For all croplands with slope >= *2%,* USLE_P changed lo 0.5 and CN2 was reduced by 3
Filler strips	15 for FillerW in .mgt
Critical pasture planting	Manning's *n* of channel on *.sub changed from 0.014 to 0.15
Prescribed grazing	USLE_C in crop.dat is changed from 0.007 to 0.003
Cropland to pasture	CN2 changed appropriately from cropland depending on the soil class appropriate to pastureland (roughly -5), NROT changed to 2, and husc in mgt1.dbf changed to 0 for scheduling by heat units
Riparian buffer strips	Channel cover factor changed for channels above 0.1 to 0.1
Graded stabilization structures	HRUs with slope greater than 3% were changed to 3%
Pasture planting	USLE_C in crop.dat is changed from 0.007 to 0.003
2,000 ft buffer around lake	No fertilizer in the sub-basins around the lake
WWTP level II	Replaced point source inputs with WWTP level II data

3.2. Model calibration

Model calibration is a procedure to adjust or fine-tune model parameters to represent observed conditions in as much as possible, while validation is testing of the calibrated model results with an independent data set without any further adjustment at different spatial and temporal scales [36]. In water quality modeling, Neitsch et al. suggested a three-step calibration procedure, first starting with water balance and streamflow followed by sediment and nutrient consecutively [36]. However, the availability of the observed data set determines whether to perform the calibration on all or part of the procedures suggested. Calibration of the SWAT Model for the Göksu River Watershed uses the following parameters (See Table 5). The Göksu River Watershed consists of three sub-basins and a couple of hundred Hydrological Response Units (HRUs). The sensitive parameters in Table 5 are average values specified for the whole watershed. However, there is a little difference between identical sensitive parameters for each of the HRUs.

Table 5. Parameters for calibration in the SWAT Model

Tabela 5. Parametri za kalibraciju u SWAT modelu

Parameter	**Description**	**Optimized Value**
Parameters from sensitivity analysis		
CN2	Curve number	83 (71-86)
Ch_K2	Effective hydraulic conductivity in main channel (mm/hr)	6-25
Sol_Awc	Available soil water capacity (mm H_2O/mm soil)	0.22
Ch_N2	Manning's *n* value for the main channels	0.05
Sol_Z(MX)	Maximum rooting depth of soil profile (mm)	500
Sol_K	Soil hydraulic conductivity (mm/hr)	460
Surlag	Surface runoff lag coefficient	4
Usle_P	USLE equation soil erodibility factor	0.7
Usle_C	Minimal value of USLE equation cover and management factor	0.001-0.03
Nperco	Nitrate percolation coefficient	0.9
Ch_Cov	Channel cover factor	0.595-0.95
Additional parameters adjusted for calibration		
ESCO	Soil evaporation compensation factor	0.95
GW_Delay	Groundwater delay time (days)	50

The implementation of BMPs in SWAT means that adjusting parameters in the model. The model uses these new values to simulate an outcome. It depends on which BMP is simulated. For instance, the FILTERW parameter is regarding the filter strips along the edge of a field. FILTERW is the width of the edge of a filter strip. Paper of Arabi et al. is such guidance on SWAT parameters to change to simulate BMP implementation [37].

Implementation of parallel terraces in a field will result in a reduction of surface runoff volume and reduction of the peak runoff rate by reducing the length of the hillside and reduction of sheet and rill erosion by increased settling of sediments in surface runoff, reducing the erosive power of runoff, and preventing the formation of rills and gullies [37]. Reducing curve number value (CN) by seven units from its calibrated value (83) represents the impact of parallel terraces on surface runoff volume. CN has a range from 36 to 100 for SWAT; lower numbers indicate low runoff potential while larger numbers are for increasing runoff potential. The adjusted USLE P-value was 0.12 where its calibrated value was 0.7. Besides, 30 m. filter strips mean adjusting the FILTERW value to 30.

Contour farming and riparian buffer strips are other possible BMPs to apply. However, the change in CN and USLE P values are higher for terracing BMP compared to them. This situation does not let us see the effects of all these three BMPs together by adjusting the parameters in SWAT. For instance, to see the effect of contour farming or riparian buffer strips, the curve number should be decreased three units from the calibrated value. However, for terracing BMP, it was decreased by seven units. A similar situation exists for USLE P modification. For the land slope between 1-2 %, it is necessary to decrease USLE P to 0.6 for contour farming, also 0.3 for riparian buffer strips. However, USLE P was 0.12 for terracing applications. The effect of terracing is much higher than contour farming and riparian buffer strips BMPs. See Table 6 for the simulated BMPs. In addition, Table 7 shows the effects of BMPs.

Table 6. List of BMPs simulated

Tabela 6. Lista simuliranih BMP-sova

Background	Up and downhill planting with conventional tillage
BMPs	Parallel terraces with conventional tillage, 30 m. filter strips

Table 7. Water quality class at the outlet of the watershed (measuring point number 3) based on BMP implementation

Tabela 7. Klasa kvaliteta vode na izlazu iz sliva (merna tačka br. 3) na osnovu primene BMP

Year	Pollution parameter	Discharge (m^3/s)	Average annual pollution load (kg)	After Best Management Practices (kg)	Concentration (mg/l)	Water Quality Class (Before/After) BMP
2014	BOD_5	89	22,257,120	14,689,699	5.2310	(2/2)
2015	BOD_5	86	11,743,300	7,750,578	2.8623	(2/1)
2016	BOD_5	78	73,302,249	48,379,484	19.6647	(4/3)
2017	BOD_5	85	13,992,445	9,235,013	3.4402	(2/1)
	% reduction		34			
2014	NO_2^-	89	28,067	14,626	0.0052	(2/2)
2015	NO_2^-	86	108,483	56,535	0.0205	(3/3)
2016	NO_2^-	78	73,794	38,456	0.0137	(3/3)
2017	NO_2^-	85	53,628	27,947	0.0096	(3/2)
	% reduction		35			
2014	Total P	89	645,541	404,037	0.1449	(3/2)
2015	Total P	86	216,967	136,689	0.0503	(2/2)
2016	Total P	78	344,373	216,954	0.0882	(2/2)
2017	Total P	85	187,639	118,212	0.0441	(2/2)
	% reduction		37			

4. CONCLUSION

Turkey has a wide range of soil types and land use characteristics. Similarly, the Göksu River Watershed area has specific land use and soil characteristics among all soil classifications in Turkey. This situation affects hydrologic processes since land use and soil classification have a significant influence on that. Göksu River Watershed was delineated into three sub-basins. It was observed that the concentrations of the measured water quality parameters were higher near the basin outlet. The conservation of riparian and aquatic habitats of watersheds has to be the primary task to balance natural and socio-environmental interactions. Measures to protect the Göksu River Watershed can only be sustainable if governments promote economic development while at the same time raising the living standards of the region's people. Sustainable development is a pattern of resource use that aims to meet human needs while preserving the environment. Best management practices (BMPs) are methods designed to reduce pollution. Several agricultural best management practices (BMP) can be evaluated using the SWAT model to determine the best management system to reduce nutrient loads in a watershed. Background BMP was considered as "up and downhill planting with conventional tillage". BMP scenario modelled using SWAT was "parallel terraces with conventional tillage and 30 m. filter strips", which was applied to agricultural land in order to reduce the diffuse pollution in Göksu River Watershed. Results show that there is a considerable decrease in nutrient pollution exerted from agricultural lands to the channel water. For example, a decrease in BOD_5, NO_2^- and Total P loads of up to 34%, 35% and 37% is expected. When the simulated values were evaluated according to the Surface Water Quality Management Regulations (SWQMR) of Turkey, it was observed that these three important parameters have decreased to the levels corresponding to the upper quality class interval. For example, if the BOD_5 value of 2017 was taken into account, the water quality may increase from the second class to the first class if the proposed BMP is applied. Likewise, the modeling of the BMP scenario through SWAT has shown that NO_2^- and Total P load values can be reduced enough to increase water quality to upper class.

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IZVOD

ISPITIVANJE UTICAJA NAJBOLJIH UPRAVLJANJA POLJOPRIVREDNIM PROJEKTIMA NA KVALITET POVRŠINSKE VODE

Voda je bitna komponenta ekosistema Zemlje; svako slatkovodno telo ima svoje specifične fizičke i hemijske karakteristike. Visoki sadržaji hranljivih materija u vodi, kao što su azot i fosfor, glavna su pitanja u pogledu kvaliteta vode. Posebno, prekomerne koncentracije hranljivih sastojaka u površinskim vodama uzrokuju eutrofikaciju. Ovo istraživanje ispituje neke parametre zagađenja da bi se utvrdio trenutni nivo zagađenja reke Goksu. Reka prolazi kroz deltu Goksu, koja je najvažnije prirodno stanište mediteranskog regiona Turske. Najbolje poljoprivredne prakse upravljanja bile su važna faza ove studije. Glavni cilj bio je ispitivanje uticaja najboljih poljoprivrednih praksi upravljanja na kvalitet vode reke Goksu. Alat za procenu tla i vode (SWAT) korišćen je za modeliranje kvaliteta vode reke Goksu uzimajući u obzir najbolje poljoprivredne prakse upravljanja. Kvalitet vode je najniži u slivu. Iz tog razloga, najbolje prakse upravljanja poljoprivredom su ocenjene korišćenjem SWAT programa uzimajući u obzir vrednosti kvaliteta izlazne vode. Rezultati su potvrdili da najbolje poljoprivredne prakse upravljanja zadržavaju velike količine hranjivih sastojaka u vodnom koritu reke Goksu. SWAT simulacija pokazuje da bi u slučaju da se koriste najbolje poljoprivredne prakse upravljanja moglo doći do velikog smanjenja opterećenja BOD_5, NO_2- i ukupni P. To znači višu klasu kvaliteta vode prema turskim pravilima o upravljanju kvalitetom površinskih voda (SWQMR).

Ključne reči: *najbolje prakse upravljanja, Delta Goksu, modeliranje, hranjive materije, kvalitet vode.*

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