For cited: *Karataş, A. (2019). Water Management in Cross Back Transboundary Rivers: The Afrin River Case (Southern Turkey). Journal of Current Research on Social Sciences, 9 (3), 177-194.*

Journal of Current Researches on Social Sciences (JoCReSS)
www.stracademy.org/jocress
ISSN: 2547-9644

Year:2019
Volume: 9
Issue: 3

Research Article/Araştırma Makalesi

Crossref doi: 10.26579/jocress-9.3.12

Water Management in Cross Back Transboundary Rivers: The Afrin River Case (Southern Turkey)

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Keywords
Transboundary rivers, water management, Afrin River.

Article History
Received
10 Sep, 2019
Accepted
30 Sep, 2019

Abstract
International law has not been able to present clear arguments related to right of use and responsibilities in terms of water resources especially about transboundary rivers. One of these transboundary rivers -similar to many others in the world with its pattern of returning to its country of origin after passing through another country- the Afrin River and its basin were selected in this study as the field of practice for a water management and allocation model that may constitute a basis for new practices to solve these problems. According to the findings about surface runoff and sectoral water consumption of the basin, an equitable and reasonable allotment was established and it was found that 40.5% of the potential water in the upper catchment which is surplus could be forwarded to middle catchment while 48.1% of the surplus water from the potential that will collect there would be forwarded to lower catchment. This way, an allocation model that binds the dyads with mutual self interest was created between the areas that are in close proximity to the source where water is collected and the areas that are in close proximity to the estuary where water is expended.

1. Introduction

The building block of life, water, is the requirement and condition for life which we cannot do without and cannot compensate for. The amount of water decreases each day, but in return, it is needed more due to rapid population growth, industrialization, changes in life styles and global climate change. It is known that only 2.5% of the water resources in the world with approximately 1.4 billion km^3 mass is fresh water; that the amount of freshwater with potential use is only about 42000 km^3 when the proportions trapped in glaciers or underground are deducted and water per capita has decreased around 90% in the last two centuries (Beaumont, 1997; Gleick, 2000; Shiklomanov and Rodda, 2003; Xercavins i Walls, 1999). In addition, the distribution of the available water fairly limits the opportunities to exploit water. For instance while 1% of the world population lives in the Amazon Basin which has 15% of the surface water volume, China which accommodates 20% of the world population has only 7% of surface water potential (Gleditsch et al., 2006; Klop and Rodgers, 2008). On the other hand,

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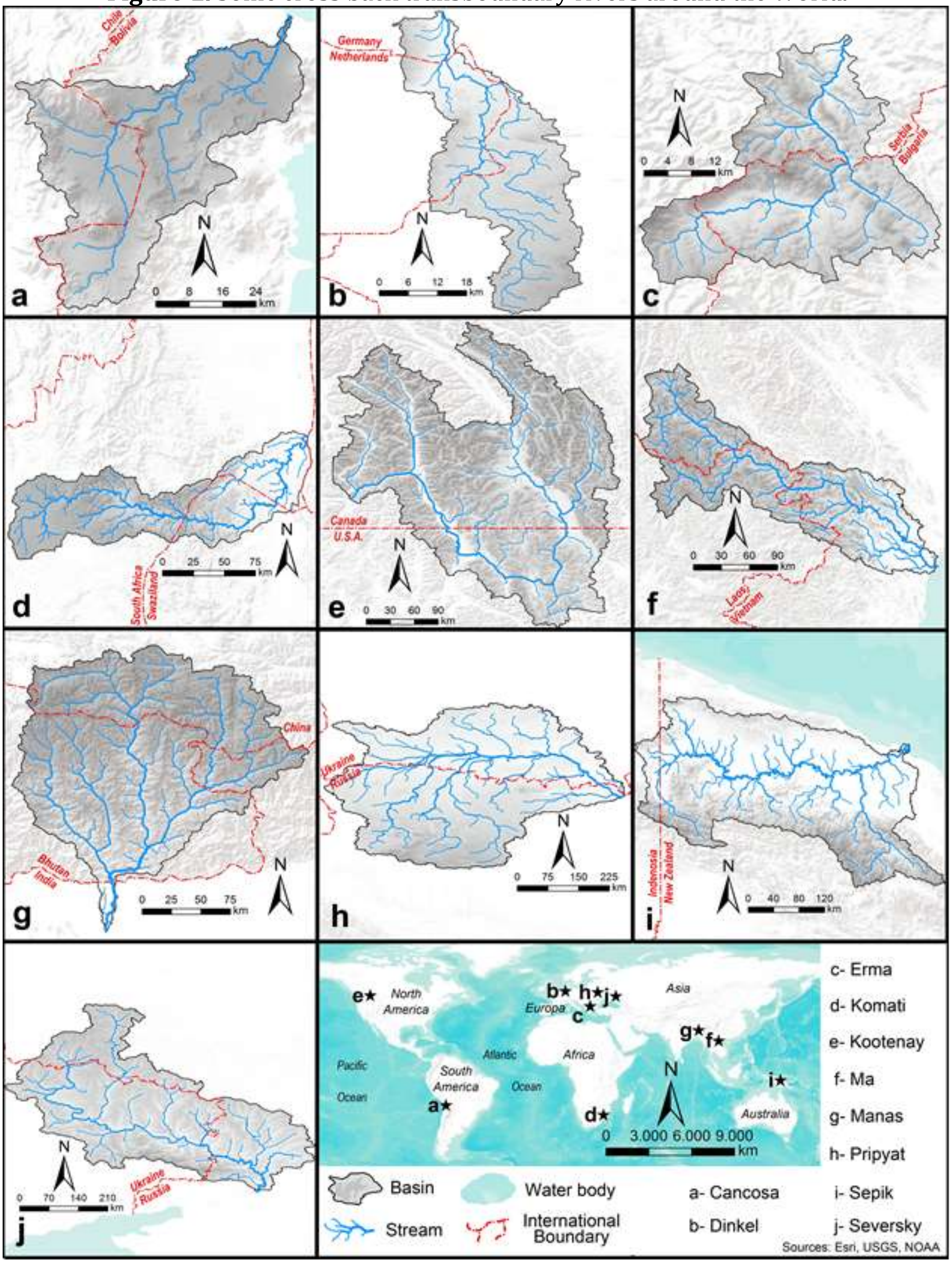
although there are regional differences, the share of rivers that are the most easily accessible and most widely used fresh water resources in the world water wealth is only 0.000029% (Shiklomanov, 2005; water.usgs.gov; wwf.panda.org). This situation increases the anthropogenic pressure on rivers. The majority of studies on water resources management also search for ways to make optimum use of rivers. However, this task which requires comprehensive observations and calculations due to the mobile nature of water equals an almost inextricable problem in cases where more than one stakeholder is involved.

Although the rivers with runoff in beds have actual surfaces i.e. a polygonal geometric structures, they are regarded as linear routes/lines in practice (Zăvoianu, 1985). However, drainage areas which feed rivers and therefore which may be regarded as their raison d'être are actual areas in all cases, i.e. polygons. Supervision of such two variables and the different behaviors they reveal on the basis of basin or bed generate the main problem in the studies that are geared towards both the identification and management of water potential. While feeding and consumption are shaped according to areal parameters, the existence and transport of resources presents a linear view. There are serious contradictions in determining whether the management models -for especially transboundary rivers- should be undertaken based on production and consumption areas or based on resource distribution (Dinar, 2006; Furlong, 2006; Gleditsch et al., 2006; Brochman and Gleditsch, 2012; Beck et al., 2014). International law is not able to make models or present opinions regarding the use of right or responsibilities clearly (Dinar, 2006; Mitchell and Hensel, 2007). As a result of the gap created by this unclarity, use of transboundary rivers is regulated by theories that can be summarized as "the law of the powerful".

It is possible to examine the theories that have international applications on transboundary rivers in four groups (Dinar, 2006). The first of these theories is *the absolute territorial sovereignty theory* which formed the basis for USA's claim to use Colorado River at will by accepting USA as an upstream country and disregarding downstream Mexico. The opposite is of this theory is the *absolute territorial integrity theory* where downstream Egypt has total control by disregarding upstream countries. *Equitable and reasonable utilization theory* that regulates allocation among equal powers aims to create a management system that does not harm the dyads (UN, 2014). Use of Danube River in Europe is shaped based on these principles. Conventions like ILA (1967), UNECE (2013) and UN (2014) are considered just in the conditions have this kind of sharing. It is necessary to add *hegemonic stability theory* to these theories. This theory foresees that regardless of conditions, the hegemony does not suffer as a result of management. For instance, while the agreement between USA and Mexico in 1973 allows upstream USA to utilize Colorado River in any beneficial way, the responsibility of cleaning the salinization of the river is given to Mexico (Lowi, 1993). Of course it cannot be denied that each transboundary basin is a specific example in its own dynamics but this fact does not eliminate the need for a model that can be applied in any basin to minimize the discussions about sharing transboundary rivers.

Figure 1. Some cross back transboundary rivers around the World.



In addition to being natural resources, rivers also form benchmarks in landscape. With this characteristic, rivers are taken as references during the formation of administrative and political borders (Seifert, 1997; Karataş and Korkmaz, 2012a). Hence, rivers build lines that determine international borders. While explaining the relationship between rivers and borders, Toset et al. (2000) reported three categories: border creator, through border and mixed model. The topic of this study, transboundary rivers, which pass the border at two directions i.e. which return back to its origin after leaving the country, can be added to these three categories because these type of rivers have both upstream and downstream country locations. Many researchers (Wolf et al., 1999; Bernauer, 2002; Wolf et al., 2003; Gleditsch et al., 2006; Brochmann and Gleditsch, 2012; Dinar et al., 2015) agree that being an upstream or downstream country is one of the most important parameters in terms of conflict and cooperation in the management process of transboundary rivers. Therefore, developing a management model that will neutralize geographical impact by benefiting from the cohesiveness of location and use based on the river itself is a reasonable and effective preference. The model in question refers to a river-border relationship which can be exemplified in many transboundary rivers in different regions of the world (Figure 1). This model will also form the basis for comprehensive, equitable and sustainable models that can be applied to all transboundary rivers with good outcomes that will be obtained in its practice.

2. Method

It is known that national interests act as determinants in international relations and therefore ethical rules are ignored most of the time. Relationships between countries are shaped according to the demands of powerful countries and principles such as mutual interdependence (Hoffmann, 1981). The fact that essential resources are not shared equitably under the conditions that reduce the chances for weak and helpless nations to survive lays the groundwork for major disasters. In this context, presenting a principal methodology that will ensure equitable sharing of water resources is also a humanitarian responsibility in addition to being a scientific requirement. Since the power balance differs between the countries that are situated in the same basin and that share the same river, it is vital to develop a systematic to ensure equality by generating mutual interdependence rather than meeting the demands of the more powerful country. In this sense, cross back transboundary rivers provide suitable conditions to present a sample that will allow dyads to have equal provisions. Countries that are situated in basins that house these types of rivers are both upstream and downstream countries. Therefore, they are both at the disposal over the resources in terms of affecting them and being affected by them. This study set out to develop a model of allocation for countries based on protecting the interests of the other party in order to protect their own interests by turning this situation into an opportunity.

First of all, the river basin that is the subject of allocation was approached as a whole, the river bed of the main river -from the source to estuary- was identified and river-border relationship was established. Although many different forms are possible at this point, the framework was generated with a basic principle that stated that the water collected in a country was included in the borders of another country as a result of runoff. Later, the country located as the basin of accumulation became the source basin and fed the runoff that reached the country which acted as the source basin at the beginning. In such environments, hydrographic parameters related to water source were identified at first and country based distributions were calculated (Table 1). Later, in order to prepare the basic design, basin area and river length were identified for each basin section to present the basis for right of dominance between upper, middle and lower catchments. These data will be later utilized in correlations to identify the unit value of the amount of flow in the basin outlet in area/bed-discharge relationship. To these parameters, it is also possible to add data that are determinants on water use such as land use and population data in each basin section. Reliability of the results will increase when this process is undertaken with the help of field research provided by a joint commission between the dyads. The aim in this process is to ensure that dyads face the fact that when they become downstream countries, they will have to endure the outcome of the resource hegemony and water use policies that they have implemented when they are upstream countries. In this way, it will be possible to create the conditions to conserve the resource indirectly and to remove the obstacles in using the resources equitably and righteously. As a summary it can be said that the model will ensure that the amount of water use in the country located in the source part of the river for the prescribed area (or population, irrigable land etc.) according to the determined parameters based on the specific conditions of the basin will be used in the same ratio by the medium catchment country and hence the amount of water that will be transmitted to downstream land will be identified. This can also be interpreted as a responsibility or right for a medium catchment country to transmit the same ratio of water that is received from upstream country to downstream country.

Table 1. Morphometric and hydrometric characteristics of some cross back transboundary rivers.

Basin	**Main Basin**	**Total Area (km^2)**	**Total Main Channel Lenght (km)**	**Upper Catchment Country Basin Area (km^2)**	**Middle Catchment Country Basin Area (km^2)**	**Lower Catchment Country Basin Area (km^2)**	**Upper Catchment Country Main Channel Lenght (km)**	**Midle Catchment Country Main Channel Lenght (km)**	**Lower Catchment Country Main Channel Lenght (km)**
Afrin	Asi (Orontes)	3943	181.4	1190.5	1957.3	795.2	64.4	76.4	40.6
Cancosa	Cancosa	2340	143.2	444.5	704	1191.5	29.6	32.6	81
Dinkel	Zwarte	1858.9	133.8	1135	569.8	154.1	62.9	52.3	18.6
Erma	Danube	1508.7	93	205.2	811.8	491.7	16.1	39.6	37.3
Komati	Rio Incomati	13895.1	528.4	7775.2	3226	2893.9	278.5	129.3	120.6
Kootenay	Columbia	118452.2	1141.6	49996.6	28223.4	40232.2	522.5	377.8	241.3
Ma	Ma	28366.2	546.5	7767.2	8781.3	11817.7	161.6	99.5	285.4
Manas	Brahmaputra	37102.1	323.3	3145	33460.1	497	108.6	152.7	62
Pripyat	Dnieper	306136	1202.3	146452.4	132769.3	26914.3	393.5	709.6	99.2
Sepik	Sepik	80563.7	1048.8	4509	3432.7	72622	146	65.7	837.1
Seversky	Don	233392.2	1415.2	47780	126790	58822.2	392.9	603	419.3

While designing the equation described above, base parameters should be identified by taking specific conditions of each basin as a whole. For instance, in basins with no settlements or irrigable cultivated areas, it will be sufficient to form ratios only between area and/or bed length and discharge in basin outlet. However, in basins with large populations or with large areas for irrigable cultivation, it is imperative to include these characteristics to the equation as well. It is possible to formulate this in the following manner:

Upper Catchment Country				Middle Catchment Country		
Total main channel length, Basin area, Population, Land use	/	*Mean runoff at the border of middle catchment country*	=	*Total main channel length, Basin area, Population, Land use*	/	*Mean runoff at the border of lower catchment country*

On the other hand, it is not possible to make any planning without identifying the rate of runoff in the basins where regular flow measurements are not taken or specific records are not kept for basin sectors or tributaries. The method implemented in Afrin River Basin Case to get rid of these problems is utilisable to generate data that will form the basis for planning in terms of proportioning and sectoral distribution although it is open to discussion in terms of numerical value. In this context, temperature and precipitation data of meteorology stations in the basin that are indexed to Thornthwaite water balance (Thornthwaite, 1931; Thornthwaite and Mather, 1957) calculation system formed by taking the balance between precipitation and evapotranspiration and basin runoff distribution map generated by interpolating the Digital Elevation Model (ASTER GDEM v2) (NASA&METI) integrated according to Schreiber (1904) method to CoKriging method (Esri, 2014) within ArcGIS Geostatistical Wizard provided the opportunity to generate a surface flow model for the basin with standard parameters. It was preferred to utilize data obtained according to the method described above, free from human impact and based on the whole basin instead of using estimated flow values based on insufficient empirical data.

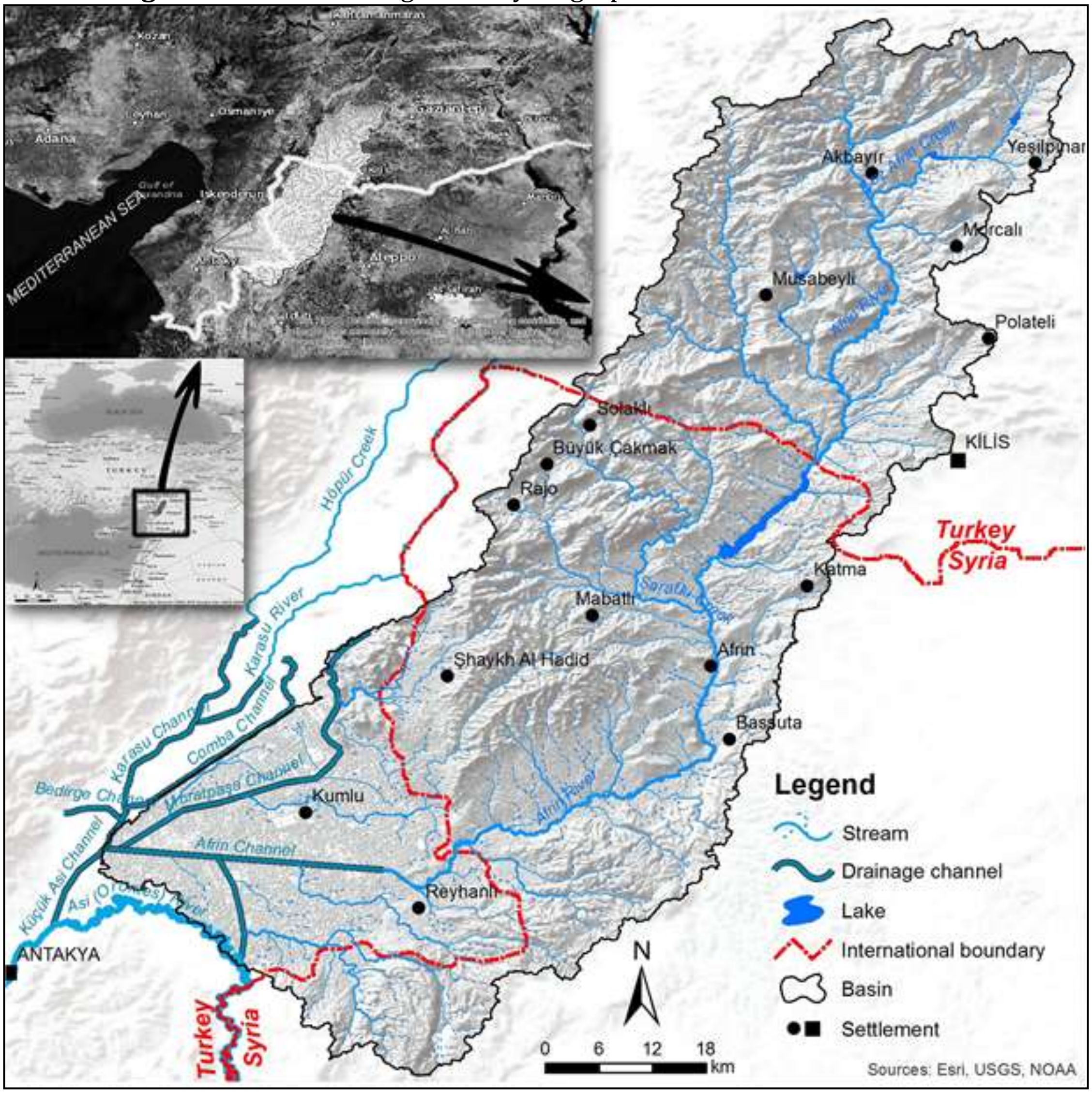
In order to render the implementation more comprehensible, a pilot implementation was undertaken in Afrin River Basin which incorporates many of the parameters discussed above and about which the author of the study has detailed information. In addition, cases in different parts of the world with variations based on morphometric and hydrometric characteristics were observed and methods to follow in cases of different river-border relationships and basin/bed distribution conditions were pointed to within the scope of applications.

Although the necessity for much higher sensitivity in real applications is not ignored, the measurements in this study were analyzed by using ArcGis 10.3 package program (Esri, 2014) for ASTER GDEM (METI&NASA) digital elevation model data since it is a case study. data such as population, land use and water infrastructures for Afrin River Basin were obtained from the literature sources and official institutions referred to in the text.

3. Results

Afrin River, formed with the union of Boz Afrin Creek born from Sof Mountains in the west of Gaziantep and Kara Afrin Creek whose source is Kartal Mountains passes into Syrian soil by growing more with the addition of Deliçay and Kınacık Creeks in the west of Kilis where it leaves Turkish borders (Figure 2). Just then, the river merges with Sabun Suyu whose source is again located in Turkey. Later, the river fills Meydanki dam reservoir and joins Sarafki Creek at dam outlet and passes through Afrin Town. In this region, the river changes its direction which is roughly north-west to northeast-southwest and after a while enters into Turkish soil again. Starting with the north of Reyhanlı, the river forms Afrin Channel River bed with the east-west direction until Küçük Asi Channel where it ends. 64.4km (35.5%) of 181.4km main bed forms the upper catchment in Turkish borders, 76.4km (42.1%) forms the medium catchment located in Syria and 40.6km (22.4%) forms the lower catchment again in Turkey (Table 1). Similarly, 1190.5km^2 (30.2%) of the 3943 km^2 total basin area is upper catchment and located in Turkey, 1957.3km^2’ (49.6%) is medium catchment located in Syria and 795.2km^2’ (20.2%) is lower catchment again in Turkey.

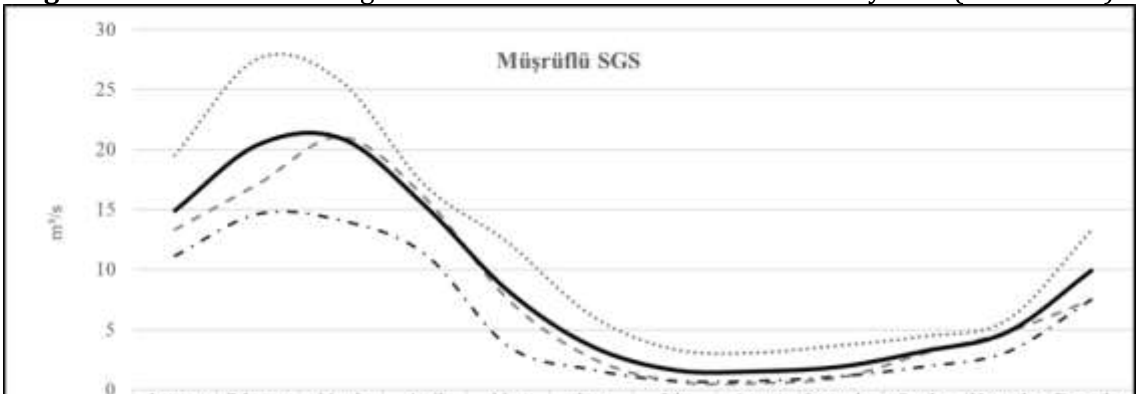
Figure 2. Location and general hydrographic view of Afrin River Basin.



The tectonic structure of the basin which is controlled by the eastern segments of the Dead Sea Fault Zone in general presents a morphological view with a rift valley located between Sim’an in the east and Kurt Mountains in the west and with flat hills completed with faulted steep slopes. Fluvial embodiment which is especially more dominant in valley slopes where the incline increases continues in coordination with limestone, marn, clay, dolomite and conglomerate in medium catchment and alluvial in lower catchment as opposed to basalt and marn in the upper catchment and designates the load weight of the river with the incline that approaches 1% in average (Karataş and Korkmaz, 2012b). Although parallel drainage is observed in faulted slopes usually found in medium catchment, dendritic drainage is dominant in general. However many drainage channels opened in lower catchment have created a superficial drainage network in this part (Figure 2). Drainage pattern and sediment load are important parameters for both water quality and quantity.

Based on the rainy Mediterranean flow regime that is dominant in the basin, maximum flows in January February and March decrease in the beginning of summer and are placed with minimum flow values in July, August and September. Müşrüflü Stream Gauging Station, which is the only station where long term regular measurements of the river are undertaken, is located in the north of Reyhanlı at the area where the Afrin River enters Turkey. Although General Directorate of Water Management (DSİ) has 2.1m^3/s measurement value for Sabun Suyu in the west of Kilis before it leaves Turkish soil for the period of 1987-1999, this value does not represent the total flow of the river in the upper catchment. According to the only regular and reliable data of Müşrüflü SGS, the flow in lower catchment throughout the year changes between 1.5 (August) and 20.9m^3/s (March) with an average value of 8.8m^3/s (Figure 3) (DSİ, 2015). However, the mean maximum and minimum flow of the river was identified for long years as 26.8m^3/s and 1.2m^3/s respectively. In this case, coefficient of disarray with a high value such as 21.8 presents the dimension of change in the flow throughout the year (Karataş and Korkmaz, 2012b). On the other hand, it was found that flow has consistently decreased until today since 1950s when the first flow measurements were undertaken. As a matter of fact, comparison between the period of 1950-1960 and the period of 2000-2010 shows more than a 60% decrease in the total flow of the river (DSİ, 2015).

Figure 3. Mean flow and regime of the Afrin River in the north of Reyhanlı (1950-2010).

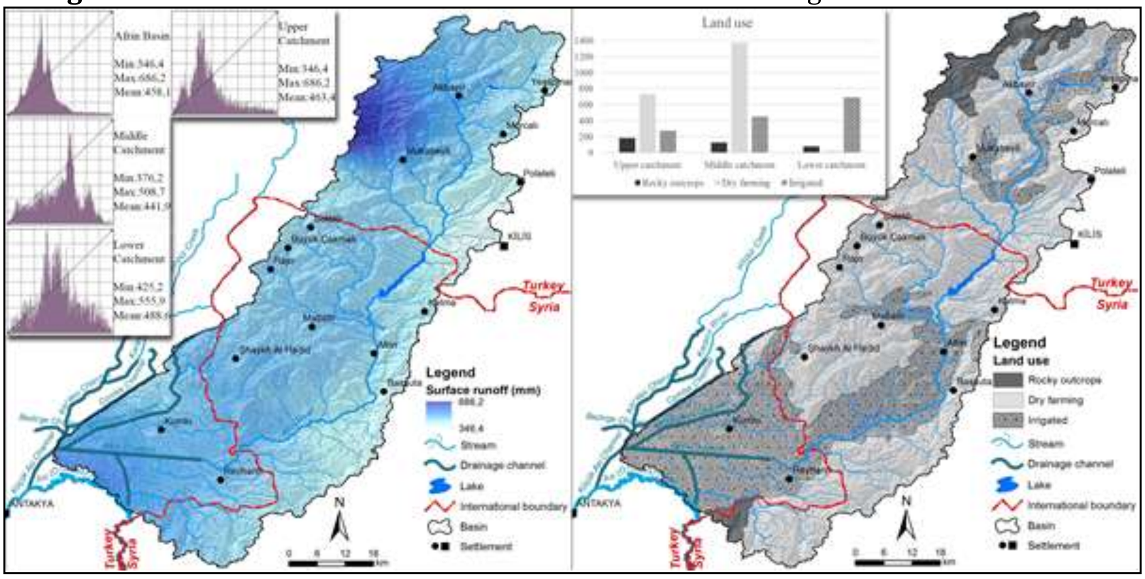


	January	February	March	April	May	June	July	August	September	October	November	December
1950-70	19,5	27,55	25,65	17,05	12,25	6,2	3,35	3,1	3,7	4,45	5,85	13,25
1970-90	13,35	17,15	21,05	16	7,5	2,65	0,7	0,55	1,05	3,05	4,85	7,5
1990-10	11,15	14,65	14,1	11,3	3,6	1,65	0,7	0,7	1,1	1,9	3,15	7,5
50-2010	14,9	20,4	20,9	15,3	8,2	3,6	1,6	1,5	1,9	3,2	4,8	9,9

Another dimension of the problem points to the need for more comprehensive and standard applications in the place of already inadequate empirical data by considering the changes in water quality, the impact of established water infrastructures to the water potential in the basin and data deformations based on political concerns and strategic expectations along with all the negative aspects discussed before.

With this aim in mind, basin sectors flows were measured with a standard value according to distribution map based on Thornthwaite water balance (Thornthwaite, 1931; Thornthwaite and Mather, 1957) for Afrin River Basin as a whole (Figure 4). Based on this flow value which was measured according the relationship between total precipitation and potential evapotranspiration, the total mean flow of the basin is57.3m^3/s. 17.5m^3 (30.5%) of this flow originates from upper catchment, 27.5m^3/s (48%) from medium catchment and 12.3m^3/s (21.5%) from lower catchment (Table 2). Undoubtedly, this measurement without taking some parameters such as seepage, consumption and evaporation from water surfaces into consideration provides a value that is over the real value. However, it provides a useful data since it establishes a foundation that can be agreed upon due to subjecting all sectors to an equal evaluation. In this sense, it at least allows performing percentage based assessments on the same scale.

Figure 4. Distribution of mean surface flow and land use design in Afrin River Basin.



Land use design for the basin which features population and water use for agricultural purposes -another data set regarded as a criterion- in developing the water management model for the basin was identified based on current literature and field studies (Korkmaz and Karataş, 2009; DSİ, 1975; worldpopulationreview.com; tuik.gov.tr; water-security.org). In this context, the total population of the basin is comprised of 171846 individuals, 11.3% is located in upper catchment, 28.3% in medium catchment and 60.4% in lower catchment (Table 2). Therefore, the number of individuals per km is 43.6 in the basin in general and the number of individuals in upper, medium and lower catchments were identified respectively as follows: 16.3, 24.9 and 130.5. High population density in lower catchment increases the importance and impact value of the changes in medium and upper catchments. Likewise, the conditions for the land use design for the basin are similar. When rocky and bare areas and dry agricultural areas which are mostly used to cultivate olives are disregarded, it is observed that 36% of the land in the basin in general is irrigable agricultural land (Figure 4, Table 2). The fact that 19.5% of this land is located in upper catchment, 31.9% in medium catchment and 48.6% in lower catchment shows that lower catchment has a critical location in the basin general in terms of increased water need for agricultural irrigation as is the case in the destitution of population.

Table 2. Distribution of some parameters in Afrin River Basin water management according to basin sectors.

	Area (km^2)	**Population**	**Land Use**			**Runoff (mm)**	**Runoff (m^3/year) (x10^6)**	**Runoff (%)**
			Rocky outcrops (km^2)	*Dry farming (km^2)*	*Irrigated (km^2)*			
Afrin Basin	3943	171846	392.6	2129.1	1421.3	458.1	1806.3	100
Upper catchment	1190.5	19345	182.7	731.2	276.6	463.4	551.7	30.6
Middle catchment	1957.3	48693	129.3	1374.7	453.3	441.9	865.1	47.9
Lower catchment	795.2	103808	80.6	23.2	691.4	488.6	388.5	21.5

On the other hand, contrary to the increase in the need for water, it was found that, other than some exceptions, the river has completely dried until it reached Müşrüflü Station in the months of July, August and September of the last thirty years in the lower catchment (DSİ, 2015). When the changes in water quality due to dense agricultural irrigation and savage discharge of urban wastes are added to this problem (Karataş and Korkmaz, 2012b; UN-ESCWA and BGR, 2013), there are risks to lose the current potential. Also, Syria built 17 Nisan (April 17th) (Meydanki, Afrin) Dam in 1997 to increase it control power over the river and has started to use the water resources to match her own planning by extending irrigable agricultural areas in the basin. Although it is disregarded most of the time, it is known that factors such as degradation in water quality, decreases in productivity based investments in terms of water infrastructure and increase in production have immense impact on the conflicts over water resources (Gleick et al., 2011). All these negative components aggrandize the problems related to water resources planning and management in Afrin River Basin and increase the need for studies in this area.

4. Discussion

Resource based problems in areas where natural resources are subject to allocation are based on two main causes: scarcity of renewable resources and disappearance of non-renewable resources (Le Billion, 2001). On the other hand, it is also possible to talk about conflicts independent of resources. These types of conflicts are directly or indirectly management based (Hensel et al., 2006; Gizelis and Wooden, 2010). Although the advantages of upstream countries are discharged in terms of navigation about which the first legal foundations were established on transboundary waters (Allouche, 2005), it can be argued that the dominant actors in today's transboundary water based problems are countries located in upper and lower catchments (Dinar, 2006; Brochmann and Gleditsch, 2012). Just at this point, conditions that allow planning which is free from catchment based advantages and disadvantages become crucial in transboundary basins where dyads are both downstream and upstream countries as is the case in the Afrin River. The outcome of a planning that is independent from the location impact which acts as the basis for conflicts will be instrumental in developing planning models for basins similar to Afrin basin and will also present the dimensions of the impact of location on conflicts over transboundary waters. If the model that will be applied on back transboundary rivers provides successful outcomes, it will be comprehended that taking measures to free transboundary rivers from the impact of location by identifying them and making them effective in planning will generate opportunities for more reasonable allocation. Of course it should be noted that despotical practices without regard for rights or laws are not problems that can be solved with planning.

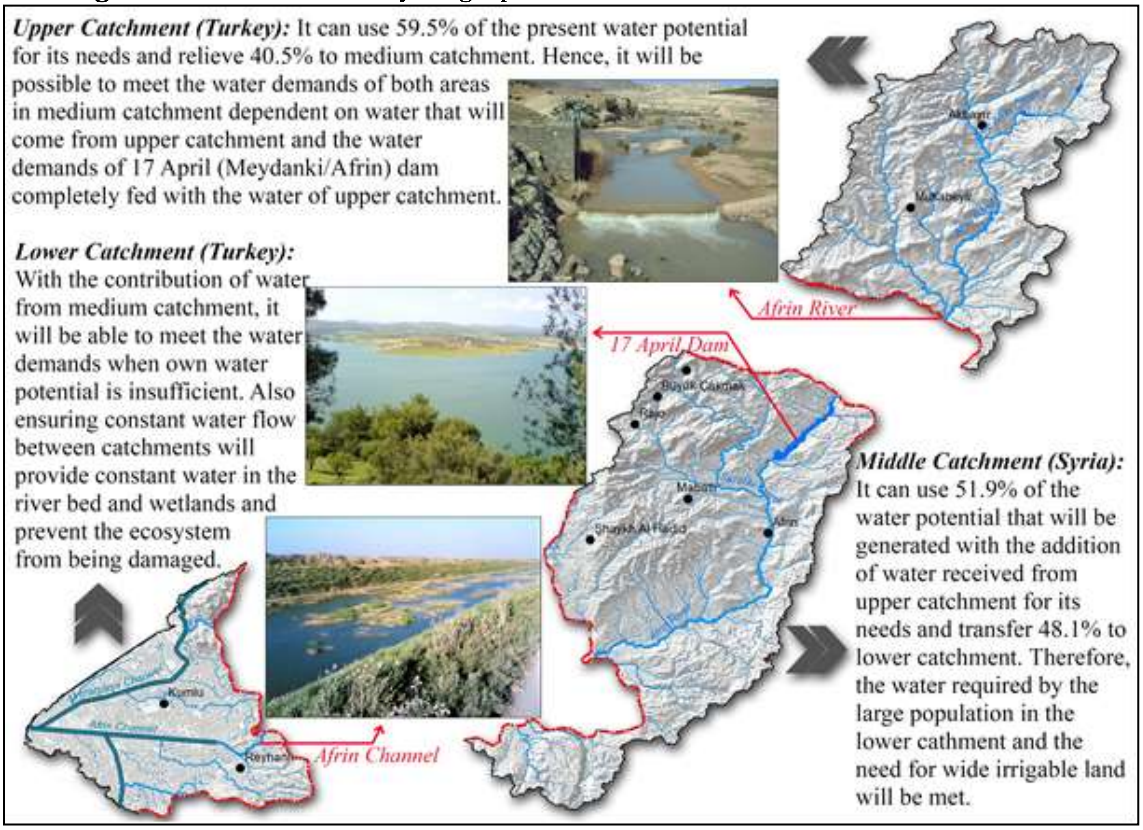
In the light of all these discussions, first it should be decided which parameters to consider when allocating the surface runoff amount identified by equal criteria on the basis of basin in order to ensure equitable and reasonable allocation of Afrin River basin water potential as pointed in UN convention 1997 (UN, 2014). In the basin, where industrial facilities are scarce and therefore industrial water consumption is little enough to be disregarded, the main components of water consumption are agricultural irrigation and domestic use. Hence, data on total water need were proportionally determined by identifying the need for agricultural irrigation by taking irrigable agricultural land into consideration and the need for domestic and daily use was identified by using population values (Table 3). As a result, it was found that there were more irrigable land in medium catchment compared to upper catchment (37.9% as opposed to 2.1%) and there were more irrigable land in lower catchment compared to medium catchment (68.1% as opposed to 39.6%). Similarly, it was also observed that medium catchment had higher values in terms of population distribution compared to upper catchment (71.6% as opposed to 28.4%) and lower catchment had higher values in terms of population distribution compared to medium catchment (68.1% as opposed to 31.9%). Although it is possible to determine the potential water need in terms of catchment for many parameters from industrial facilities to forest wealth based on structure and characteristics of basins, it will b sufficient for Afrin River Basin to consider the two elements for water consumption cited above. The coefficients needed to represent irrigable agricultural land and population which have different units were identified with the amount of water annually consumed by one individual and the amount of water needed per km^2 for irrigation. Even though these values are identified by U.S. Geological Survey as $150m^3$/year per person and 500.000 m^3/year per km^2 (https://water.usgs.gov), the values that are representative of regional conditions and identified by İller Bankası A.Ş (The Bank of Provinces) and DSİ were used in this study: $80m^3$/year per person and 533.000 m^3/year per km^2 (Tülücü, 2002; İlbank, 2013; http://www.dsi.gov.tr). According to these rates, it was found that the mean total runoff in Afrin River Basin is 277 million m^3 and the amount of water used for irrigation and daily use is 89 million m^3. When we consider that about 50% of current water potential is used in Turkey (http://www.dsi.gov.tr) and there are decreases in river discharge in recent years, it becomes clearer that reasonable figures are provided. However it is also known that mean minimum flows can drop below 40 million m^3 (DSİ, 2015) and problems related to allocation reach serious dimensions especially during these periods since water resources become severely inadequate. It should be remembered that this is a problem inclusive of the whole basin and it should be aimed to provide equitable and reasonable allocation under all conditions regardless of the amount of potential water. This allocation should ensure optimum use of the water potential in the basin in line with the needs in basin sectors without creating unjust treatment. Otherwise, a management plan which is far from being sustainable and which can generate conflicts will be born.

Table 3. Values that will be the basis for water allocation among sectors in Afrin River Basin.

	Household water demand (m^3/year)	Irrigation water demand (m^3/year)	Total water demand (m^3/year)	Water demand ratio in basin (%)	Sector runoff deal ratio in basin (%)	Water release ratio to next sector (%)	Water release ratio according to sector supply (%)
Afrin Basin	13747680	75328900	89076580	100	100	100	100
Upper catchment	1547600	14659800	16207400	18.2	30.6	12.4	40.5
Middle catchment	3895440	24024900	27920340	31.3	47.9	29	60.5
Lower catchment	8304640	36644200	44948840	50.5	21.5	0	0

According to resource and need chart for Afrin River Basin which is identified based on equivalent parameters, 18.2% of the total water in the basin is needed in the upper catchment, 31.3% in medium catchment and 50.5% in the lower catchment (Table 3). The water available in the upper catchment which amounts to 30.6% of the basin water potential should be directed in accordance with the needs of basin sectors, the amount of water that corresponds to 12.4% of total water in the basin and the amount of water that corresponds to 40.5% of the water in upper catchment should be transferred to medium catchment (Figure 5). (At this point, real values that correspond with percentiles should be identified based on measurement at border crossings of the river and constant flows that can be used as a basis in allocation processes can be presented). In medium catchment, 31.3% of the 47.9% of the basin total can be used for sectoral needs and the remaining 16.6% can be transferred to lower catchment. This amount corresponds to 34.7% in the contribution of medium catchment to total basin water potential. On the other hand, when the water which will be set free from the upper catchment to reach medium catchment is added to the total, the ratio of water that will be set free from medium catchment to be included in lower catchment to total basin water will be 29% and its ratio to total water that will be generated in medium catchment with the addition of the water from upper catchment will be 48.1%. Thus, problems generated from setbacks in constant water supply will be prevented with the water that arrives both from the parts of medium catchment that are in close proximity to upper catchment and in the dam reservoir with the help of the water that arrives from upper catchment. Hence, 50.5% water needed by the lower catchment will arrive in this sector of the basin. At the same time, it will be possible to create amenable conditions that will ensure that the dyads will take equal reasonability in solving problems by making similar sacrifices to the degree of their contributions to basin water potential.

Figure 5. Distribution of hydrographic resources and needs in Afrin River Basin



5. Conclusion

According to planning model that have produced in the study, it will be possible to take the basin as a whole and the existing water will be equitably and reasonably distributed by taking the needs of each segment into consideration. Hence, extensive consumption that causes damage to the other elements of the ecosystem will be prevented and it will be possible to supply water more regularly. In addition, it will be ensured that none of the basin sectors will be deprived of the water it needs and no single segment and therefore no single country will have to make sacrifices. From another perspective, this model of allocation will strengthen dependency among countries and will create a network of relationships in which they will have to face the consequences of their won negative practices. For instance, if Turkey, an upstream country in terms of Afrin River Basin, does not transfer water to medium catchment country Syria according to allocation, Syria will not be able to or will not provide the water needed in the lower catchment located in the borders of Turkey. Or not providing the necessary from the basin sector in the medium catchment by Syria to Turkish segments in the lower catchment will be reciprocated by Turkey with lowering the flow from the upper catchment to medium catchment. Hence, with the awareness that each country is serving its own needs by acting in accordance with the allocation plan, countries will strive to minimize the problems. It is evident that a sustainable transboundary water resource management model with better results will be created if follow up and supervision are undertaken with a commission formed in cooperation of involved countries. However, it should be remembered that this process does not serve to find resources for all at choice, but to ensure equitable distribution of existing resources. This practical reminder means that this model can only be implemented by countries that desire equitable allocation. Otherwise, it is unquestionable that there will always be risks for despotic and hegemonic practices.

Acknowledgement

ASTER GDEM is a product of NASA & METI.

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