A Study on the Possibilities of Measuring and Assessing Water Resources with Remote Sensing Methods in Integrated Basin Management

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Abstract— Water resources should be planned, projected and operated with a holistic approach on basin basis. It is very important to measure water resources at the desired time and accuracy in both planning and operation processes in order to develop and operate water resources projects effectively with a holistic approach on basin basis. When the water resource is not measured accurately and at the desired time intervals, providing the necessary data for new projects to be developed and determining whether or not the water amounts allocated for water, energy and other sectors are used during the operation phase according to the prepared basin water plan, calculation will not be possible. The only way to solve this question is to use remote sensing or other advanced methods, and the preparation and rapid implementation of draft studies, plans and proposals on this issue is the most important element of holistic watershed management. In this study, Büyük Menderes basin where agriculture, industry and tourism potential is high in our country; How should a measurement system be required to accurately measure and record basin water resources at desired time intervals for integrated basin-based planning and operation of irrigation, energy, drinking and utility, flood and ecology projects, and a draft, preliminary study that will form the basis for the establishment of this system. or what are the basic elements of planning were investigated, and suggestions were made regarding the importance of this system for holistic basin management and how it should be implemented.

Index Terms— Integrated Basin Management; Water Resource Measurement System; Remote Sensing; Scheduling; Irrigation and Energy Management

I INTRODUCTION

Planning, projecting and management of water resources; It covers all activities that will ensure the most efficient use of water resources within the framework of the desired purpose and prescribed criteria. Today, the management of water resources is a matter that requires as much care as the planning stage. Management of water resources should be evaluated on basin basis and together with other natural resources. This management method is also called integrated basin management. The main purpose of integrated basin management is to recognize the basin not only by the amount of water, but by all its aspects and resources, thus making more consistent management decisions [1]. For the successful implementation of integrated basin management, it is very important to measure water resources accurately at the desired time and point, and to operate water-related facilities in real time [2]. In our country, the data of water resources are measured by flow observation stations (AGI) established at certain points on the stream. For this reason, when a planning regarding water resources is desired, most of these data are missing. Among the reasons for this; Failure to ensure the security of the measurement stations, the insufficient number of measurement points, especially the failure of the flow measuring mechanisms of the stations due to sediment transport in floods [3].

Thanks to today's developing satellite technology, a lot of data can be obtained by remote sensing method. Using this technology, it is possible to measure water resources accurately [4]. By collecting such a system to be established under the main data collection center with computer connections, it will be possible to collect and evaluate the data at the center in real time.

In this study, in Büyük Menderes basin, which is one of the important basins of our country and has completed irrigation, energy, flood and ecology projects to a great extent, the operation of the projects that will be newly developed and in the operation phase at the desired performance levels, the provision of accurate water measurement data, which is the basis for the basin general water resources planning, In order to provide accurate and sufficient data to the projects at the stage of integrated basin management in the context of integrated basin management, the measurement facilities to be established in the determined points (irrigation, flood, ener-

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gy) with the geographic information system and remote sensing methods, and the data points determined to be compatible with the planning basis measurements and It is aimed to make a planning study that will form the basis for the establishment of the system that will transfer the measurement amounts to a monitor.

II Material And Method

A Material

Büyük Menderes River in western Anatolia in Turkey's south-western part of 6'-37 ° 38 ° 55 'north latitude and 27 ° -30 ° 36' is located between east longitude. The boundaries of the surface area of the 3.2% turkey area, Aydin, Istanbul, Istanbul, Istanbul, opium, Isparta, Burdur and includes a portion of Izmir. Figure 1 shows the position of the basin and the basin in Turkey.

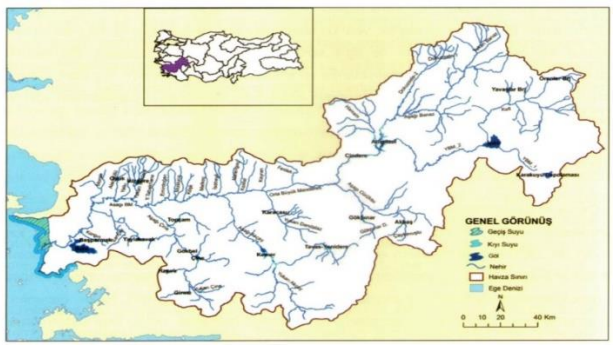


Figure 1 Location of Büyük Menderes River Basin in Turkey

Büyük Menderes River Dinar born into the source of the limestone formations near and westward flowing in the Büyük Menderes Delta is located 115 km south of Izmir before reaching the Aegean Sea, 584 km from the intention of giving Turkey's southwest, drains 24 873 km2 area. There are many meanders along the flow route of the river. Its main branches are Çine, Banaz, Çürüksu and Akçay. Most of the small arms are dry during the summer period. It is an important river system that includes wetlands such as Büyük Menderes River, Işıklı Lake, Bafa Lake and Büyük Menderes River delta. It is also a very important river basin in terms of biodiversity. Important data of the basin are given in Table 1.

Table 1. Important data of the Büyük Menderes River Basin [5]

Basin Characteristics	
Coordinates	37°6'- 38°55' N - 27°- 30°36' E
Area	24.873 km^2
Population	Aprox. 2.4 million
Main tributary length of river	584 km
Ratio of country area	3,2 %
Average annual precipitation	649,9 mm (263,9-733,1)
Area of the delta	98 km^2 (16,7 km^2 National Park)
Landuse	44% Agriculture 33% Semi-natural areas 20% Forest 2% Rural and urban areas 1% Surface waters

B Method

Flow measurement methods used in stations in our country are generally based on determining the stream level and creating key curves or using propeller instruments (muline) that measure stream velocity. The basic principle in determining the flow rate with level measurements is accepted as the level and the stream velocity change in direct proportion, and depending on the rise in the stream level, the linear velocity of the stream is passed. Assuming that the cross sectional area of the bed of the stream whose linear velocity is determined does not change, the flow rate of the stream is passed from the product of the linear velocity and the cross section area. Thus, hydrograph curves are formed that show the change of flow versus time of rivers whose flows are determined. However, there are many factors that will affect the measurements both in determining the speed and the cross-sectional area. Depending on these factors, there is a high probability of error in the measured flow rates. In particular, the use of maps in determining the level or the use of float systems increase the sources of error. In addition to this, flow measurements used in stations are more dependent on manpower, but they also pose great dangers in rivers with high flow rates. In addition, systems are not suitable for automation, data are entered one by one on the computer for use in simulation, etc. In addition to its disadvantages, the fact that it is high in human error requires the use of more technological measurement methods. In this study, measurement locations were determined at important points in the basin using remote sensing technology. (Figure 2).

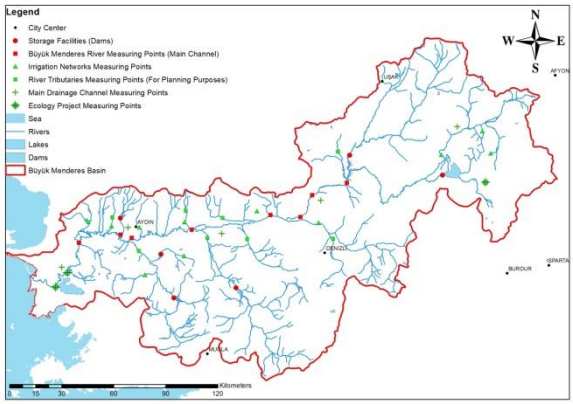
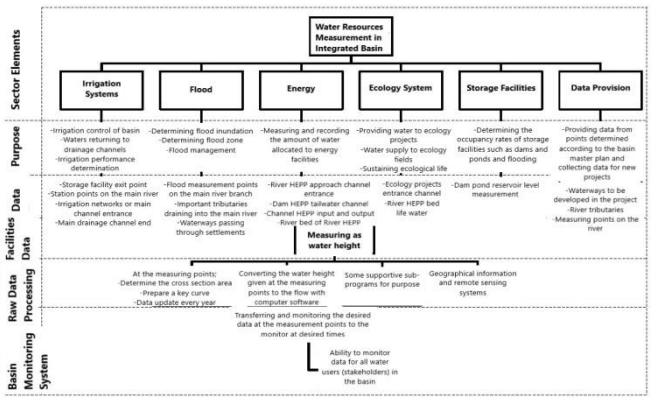


Figure 2. Points planned to be measured with remote sensing

III Research Findings

Many factors such as irrigation systems, flood process, energy management, ecology system, storage facilities and data provision play an important role in the integrated management of the Büyük Menderes Basin. In order to evaluate these factors in the most accurate way, first of all, the water resources of the basin must be measured with the least error. Remote sensing technology can reduce the errors that may come from the land and human factors to zero. Establishing such a system provides continuity in the system as well as accurate measurement (Table 2).

Table 2. Plan Chart of Measurement of Water Resources with Remote Sensing Method in Integrated Basin Management



IV Results And Discussions

Flow measurement for different sector elements (irrigation, flood, energy, ecology, storage, data provision) in integrated basin management serves different purposes for each sector.

- In irrigation systems; Measurement data should be obtained at the exit points of the storage facilities, station points on the main river, irrigation networks at the entrance of the main channel, at the main drainage channel, and at the end of the main drainage channel in order to control the general irrigation planning of the basin, to detect the water returning to the drainage channels and to determine the irrigation performance.
- During the flood; In order to determine the flood spreading area, to determine the flood formation area and to make the flood management, measurement data should be obtained from the flood purpose measurement points on the main river branch, important tributaries discharging into the main river and waterways passing through settlements.
- In energy management; In order to measure and record the amount of water allocated to energy facilities, measurement data must be obtained from the river HEPP approach channel entrance, dam HEPP tail water channel, channel HEPP entrance and exit and river HEPP river bed.
- In the ecology system; In order to provide water for ecology projects, to supplement ecology areas and to maintain ecological life, measurement data of the inlet channel of ecology projects and the bed life water of the river HEPP should be obtained.
- In storage facilities; In determining the occupancy rates of storage facilities such as dams and ponds and in deferring floods, elevation measurements from dam reservoirs are required.

Finally, in the data acquisition phase, it is necessary to make measurements from the waterways, river tributaries and measurement points determined on the river in order to provide data from the points determined according to the basin master plan and to collect data for new projects.

It is possible to measure all these measurement data as water height by remote sensing method. After the determination of the water height, it will be possible to process this raw data with the computer software to be made. At this stage, determining the cross-sectional area at the measurement points, preparing the key curve and updating the data every year is done by the software to be used. It is ensured that the height of the water given at the measurement points is converted to the flow (Q) with computer software. In addition, it can be ensured that the data requested at the measurement points are transferred to the monitor at desired times and the data can be monitored up-to-date and continuously. As a necessity of integrated basin management, it is aimed to provide the opportunity to monitor these data on the same monitor with all water users (stakeholders) in the basin.

References

[1] Harmancıoğlu B. N., Gül A., Fıstıkoğlu O., 2002., Entegre Su Kaynakları Yönetimi, Türkiye Mühendislik Haberleri, Sayı: 419-2002/3.

[2] Algancı U., Coşkun G. H., Eriş E., Ağıralioğlu N., Cığızoğlu K., Yılmaz L., Toprak F. Z., 2009., Akım Ölçümleri Olmayan Akarsu Havzalarında Hidroelektrik Potansiyelin Belirlenmesine Yönelik Uzaktan Algılama ve CBS ile Hidrolojik Modelleme, 12. Türkiye Bilimsel Harita ve Teknik Kurultayı Özet Kitabı, 144-145, 11-15

Mayıs, Ankara.
[3] Güce H., Bakan G., 2009, Sürdürülebilir Su Kaynakları Yönetimi Açısından Uzaktan Algılama Ve Coğrafi Bilgi Sistemlerinin Önemi, TMMOB Coğrafi Bilgi Sistemleri Kongresi, İzmir.
[4] Bastiaanssen, M. G. W., 1998., Remote Sensing in water resources management: The state of the art, International Water Management Institute, ISBN: 92-9090-363-5., Colombo, Sri Lanka.
[5] T.C. Tarım ve Orman Bakanlığı, 2018. Büyük Menderes Nehir Havzası Yönetim Planı, Havza Koruma Eylem Planlarının Nehir Havzası Yönetim Planlarına Dönüştürülmesi için Teknik Yardım, Available online: https://www.tarimorman.gov.tr/SYGM/Belgeler/NHYP%20DEN%C4%B0Z/B%C3%9CY%C3%9CK%20MENDE-RES%20NEH%C4%B0R%20HAVZASI%20Y%C3%96NET%C4%B0M%20PLANI.pdf [accessed 10.11.2020].

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