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SAFIDRUD

SAFIDRUD (lit. White River), the Amardos of the Classical sources, the largest Iranian river discharging into the Caspian Sea, which it reaches in Gilan Province after flowingthrough the southeastern part of Azarbaijan. The largest part of Iran is characterized by internal drainage patterns, that is, by drainage basins that do not have any connection with the world oceans. Only the western and southern fringes of Iran and their specific drainage areas discharge their waters into the Persian Gulf and the Sea of Oman. A very specific case, however, is the internal drainage basin of the Caspian Sea, of which the Safidrud River is an important source (Figure 1a).

Out of more than 1,300 watercourses of different size discharging into the Caspian Sea in Gilān, Māzanderān, and Golestān, the Safidrud is not only the largest, but also the one with the broadest catchment area and the highest annual discharges. These features are the preconditions not only for deeply incised erosional features, but also for remarkably wide valley flanks and basins. Thus, the Safidrud and its tributaries are an important connecting link between the highlands and Zagros mountains of northwestern Iran and the Caspian lowlands. What is more, the valleys and the estuary of the river constitute one of the most fertile agricultural areas of the country, and its deltamarks the core area of the province of Gilān.

With a length of 670 km the Safidrud is the second largest river of Iran. Its headwaters are located in the Zagros ranges of northwestern Iran in the province of Kordestān. Originating in the mountain range of the Kuh-e Čehel Čašma (Mountain of the forty springs), the very name of the humid headwater

region indicates already the specific ecological conditions and function of the comparatively moist and rainy Zagros ranges. According to Beaumont (1973), the northern parts of the Zagros ranges are characterized by an annual surplus of water of more than 800 mm per year. This explains the abundance of surface water and the fact that the Safidrud, fed by a great number of tributaries, is the only river of Iran that penetrates the main Alborz ranges and drains into the Caspian Sea. All other rivers debouching into the Caspian Sea have comparatively small catchment areas, correspondingly short river courses, and small stream discharges. This is due to the steep and high northern mountain front of the Alborz, which separates the interior basins of Iran from the steppe and desert regions of Central Asia.

Topography and oro-hydrography thus make the Safidrud an important gateway and corridor between northern Iran and its central parts, especially in a historical dimension, but also in a climatological perspective. In strong and snow-rich winters the Safidrudpass provides the only open road connection between Tehran and the Caspian lowlands. But the breakthrough of the Safidrud through the main chain of the Alborz is also a major meteorological phenomenon. The low-lying pass at about 300 m above sea level allows moist air masses from the Caspian Sea to enter the central highlands of Iran all year round. This crossing, also known as the “Manjil Gate” after the name of the nearby city,is connected with steadily blowing northerly winds and cloud formations, which, however, dissolve rather quickly over the central plateau (Figure 1b and Figure 2, at label “Sefid Rud dam”]).

The headwaters of the Safidrud in the northwestern part of the Zagros and up to its junction with the Šāhrud River are known by the name of Qezel Uzan “Red River.” After a course of approximately 280 km in a predominantly northerly direction into East Azarbaijan Province, the river turns near Miāna,first in an easterly and, after a short distance, in a southeastern direction. More or less perfectly adjusted to the geological structures of the Zagros system and the northwestern extensions of the Alborz, the Qezel Uzan/Safidrud follows the basin-range structures of both mountain ranges with deeply incised valleys of the main river and its tributaries. However, reaching Miāna, located at an elevation of approximately 1,100 m above sea level, and the region of Ābbar/Ṭārom (elev. 620 m), the river becomes part of the central highlands of Iran before it receives its second, but most important, affluent, the Šāhrud (Figure 1b). L. S. Fortescue (p. 310) argued that Qezel

Uzan and Safidrud are basically the same river, and thatthe difference in name is “due to the different colour of the river at different seasons of the year. It is red when swollen with the snow melting on the Persian Highlands in spring and early summer, whereas when running low in autumn it changes to a grey or milky blue.”

The Šāhrud Riverflows west from northern Tehran Province and across Qazvin Province with far less volume of water than the Qezel Uzan, a comparatively small catchment area, and a correspondingly small number of tributaries. Ithas its origins in the Alamkuh (Taḵt-e Solaymān) group as well as on the southern slopes of the Alborz near Ṭālaqān. TheŠāhrud’s headwaters are located on the southern side of the Alborz watershed, and its discharges are distinctly smaller than those of the Qezel Uzan/Safidrud. However, they do coincide in regard to their annual regime of river flow and water discharges. Based on historical records of the ten-year period 1955-1965, Peter Beaumont (1973, p. 10) calculated the annual discharge of the Qezel Uzan at Ostur (lat 37°31′00″ N, long 47°58′00″ E) at slightly more than 2.1 million cubic meters (mcm) with a maximum mean discharge in the month of Ordibehešt (April/May) and a minimum in Mordād (July/August). The corresponding figures for the Šāhrud at Lošān (lat 36°37′46″ N, long 49°31′07″ E) are approx. 400,000 mcm with its peak also in Ordibehešt, its minimum in Šahrivar (August/September).

The confluence of the two rivers is within Gilān Provincenear Manjil (lat 36°44′31″ N, long 49°24′57″ E). Here, however, the natural flow of the Safidrud, as it is definitely called from here onwards, is interrupted by a huge dam site, the Safidrud Dam (Sadd-e Safidrud). Completed in 1962, the almost 420 m-long and 106 m-high dam is constructed for the purpose of power generation and control of the Safidrud’s river flow for irrigation schemes downstream. The installation of five turbines with 165 m^3 per second capacity, generating more than 85 megawatt of electricity, serves the one purpose. The other purpose is served by its potential as an instrument of controlled irrigation development to meet agricultural as well as urban water demands during seasonal water shortages. However, this massive dam is also a potential danger for the lower lying parts of the dam site, that is, the lower Safidrudvalley, its floodplains, and itsdelta. Constructed in a highly fragile, tectonic environment with frequent seismic activity, the dam has experienced severe stress situations as a result of heavy earthquakes. In particular, the disastrous Manjil earthquake of 20 June 1990 with a magnitude of 7.3 on the

Richter scale, which resultedin more than 12,000 victims in the immediate neighborhood of the dam site, is a warning. The dam itself was also heavily affected by the earthquake and showed many cracks approximately 18 m below the crest of the dam, but the structure withstood (Hassanzadeh, p. 152).

It is not only the geological situation that makes the Safidruddam a potential hazard for the densely settled areas of central Gilān; it is also its function as a major obstacle to the natural flow of the river and its fertile loads of sediments. The reservoir created by the dam was originally planned for a storage capacity of 1,800 million m^3 of water. Located at the confluence of the Šāhrud and Qezel Uzun, the reservoir covers, according to Hassanzadeh, 13 km of the lower Šāhrudvalley and 25 km of the Qezel Uzan valley. However, due to the heavy sediment loads of the rivers and the dam's function as a trap for the great amounts of suspended material in the river waters, sedimentation of the reservoir has, not unexpectedly, developed into a major problem for a number of reasons.

First, accumulation of the suspended material in both the Qezel Uzan and theŠāhrudleads to a permanent siltation of the reservoir: "During 20 years of operation, the quantity of sediments amounted to 800 million m^3 or 45 percent of the total storage capacity (at an average rate of 40 million m^3 per year)" (Hassanzadeh, p. 153; see also, Moḥāmed, pp. 169-73, 246-48). Thus, there is the necessity of regular removal of reservoir sediments. According to older measurements, the sediment load of the Qezel Uzan is recorded to be almost 10 million tons, corresponding to 2.2 tons per ha for a catchment area of approx. 42,000 km^2. That of the Šāhrud is much smaller, given its smaller catchment, but with 3.3 tons significantly higher per hectare (Bhimaya).

Second, the deposition of the fertile sediments behind the barrage deprives Gilān's irrigated agriculture of natural fertilizers, which formerly used to support rice cultivation in the floodplains of the Safidrud and its delta region. Especially the fact that the finer components of suspended materials are caught in the reservoir is a major concern. Measurements have shown that clay constitutes 11 percent and silt 26 percent of the sediments, while sands and gravels make up the remaining 63percent of the deposited materials. Finally, in late summer, due to the decrease of river flow and increased outflow of water for irrigation purposes, the water table of the reservoir sinks, and the fertile deposits, accumulated during flooding time, are blown out by the steady northerly winds, causing sandstorms and hazy weather conditions, especially in and around Qazvin.

The Manjil Gate and the location of the Safidrud dam mark a distinct ecological dividing line between the upper reaches of the Safidrud tributaries and the main branch of the river right down to its deltaic estuary into the Caspian Sea. While the headwaters are part of the central Iranian climate-dominated ecological regime, the situation of the lower Safidrud proper is an entirely different one. This holds true not only for the valley morphology, but also for its climatological situation, its vegetation cover, and especially for its land use and settlement structure. The Safidrud enters the Caspian lowlands after crossing the extended Lake of Safidrud Dam (Daryāča-ye Sadd-e Safidrud) and flowing through the Sadd-e Safidrud at an altitude of approx. 300 m above mean sea level. The valley bottom widens until the river breaks up into a broad floodplain with a great number of branches debauching into the Caspian Sea. Before dam construction and regulation of the water flow, the suspended sedimentation load of the Safidrud was a major provider of natural fertilizers, andit also caused remarkable loess and sand deposits along the floodplain, blown out of the braided riverbeds (Frechen et al; Kehl). These deposits form a major landscape feature of the Safidrud valley north of Rudbār. More important, however, is the development of a huge alluvial fan, accumulated over long geological periods and influenced by the fluctuations of the Caspian Sea level since the Pleistocene by the sediments of the Safidrud. This alluvial fan is more or less identical with the core area of Gilān—the administrative units of Bandar Anzali, namely Ṣawmaʿa Sarā, Fuman, Rašt. These areas owe their form, structure, and also their fertility to the Safidrud and its many affluents, which have created mighty deltaic deposits (Figure 3).

The history of the Safidrud delta is closely connected with the geological history of the Caspian Sea and cannot be disconnected from that of the lower Safidrudvalley. According to R. N. Annels et al. (pp. 53-54; Figure 3):

The present Sefid Rud delta appears to date from the late Pleistocene, though it is probable that its position coincides with that of many similar deltas of Quaternary and perhaps late Pliocene age whose deposits have been since eroded or buried. The following sequence of events is suggested in explanation of the sedimentary and erosional features exhibited by the present delta. During the late Pleistocene, the delta was probably confined by an almost continuous barrier of beach deposits extending from Rasht to Lahijan, just as the present delta is delimited by a beach and dune barrier. The subsequent (Recent) fall in sea level led to the destruction of the Pleistocene beach barrier and to a rapid northward expansion of the delta over a gently seaward-sloping surface of marine alluvium, the principal distributary channels developing levees on their banks. The northward-flowing distributaries were then abandoned in favour of one flowing to the east then northeast to an outflow near Dastak, and this was in turn abandoned in favour of the present more northward-flowing channel which enters the Caspian Sea near Zibakenar. During the later evolution of the delta, the main channel has become incised in the apical part, causing several streams which originated as

distributaries to reverse their drainage southwards back into the main channel.

As was already mentioned, the Manjil Gate and the Safidrud dam mark a distinct ecological divide between climate, vegetation, and land use of the central Iranian plateau, and the natural and cultural landscapes of the Caspian lowland. Indicators of these differences are, above all, the growing density of forest cover that accompanies the higher slopes of the Safidrud valley. While in the Rudbār region there are still last remnants of comparatively light and open juniper forests of the Alborz, the forest cover changes farther down into what H. Bobek (1951, pp. 14-42; Idem, 1968, p. 285, fig. 88) has called "semi-humid oak-juniper forests" (also: Caspian mountain forest) and then into the periphery of the densely wooded extensions of the so-called "Hyrcanian Forests." It must be noted, however, that most of the natural vegetation has been destroyed by human interference, and the land has been transformed into pastures or agriculturally used land.

A remarkable feature of this human interference is the more or less complete conversion of Gilān's natural environment through human interactions. A review of the scientific literature of the 19th and early 20thcenturies reveals the deep impacts that population growth and modernization have exerted on the vegetation and hydrology of Gilān and the Safidrud delta region. Especially since the 1920s and even more since World War II, land reclamation and intensification of land uses, land reform, urban growth, and the development of all kinds of infrastructure (highways, road network, ports, tourism) have profoundly changed the inherited features of the Safidrud valley and central Gilān. An impressive example of these changes is the comparison of today's landscape features with those of a historic past. Thus, 200 years ago Camille Trezel (p. 248) described Rašt, the capital city of Gilān, as a town more or less covered by trees and surrounded by dense forests (see also Curzon, I, pp. 360-66, esp. p. 361; Fraser, p. 361). But it is not only the destruction of the natural vegetation but also its transformation into an economically important agricultural landscape that makes the Safidrud valley and central Gilān so important for Iran.

While the olive plantations of Rudbār at an altitude of approximately 250 m above sea level are possibly a heritage of an ancient past, in the downstream sections of the Safidrud, where the valley bottom becomes broader, irrigated rice cultivation begins to prevail. The valley bottom in the upper part of the Safidrud is still irrigated by the gravity flow of the river, but the densely populated and intensively cultivated delta region is covered by a network of

irrigation channels and drainage facilities. With the completion of the Safidrud dam, however, a large irrigation scheme for central Gilān was implemented, covering an area of almost 2,500 km^2. Besides the main barrage at Manjil, four distributor dams and more than 520 km of water channels were planned and completed in order to irrigate the fertile plains of central Gilān. Designed to ensure a sufficient water supply for rice cultivation, but also to enlarge the irrigated areas and to include other crops like tea, peanuts, and different kinds of vegetable, the Safidrud and its tributaries have gained crucial importance for the agricultural development of the province and, in fact, for the wholecountry. Besides rice, Gilān is also the main producer not only of olives and tea, but also, together with the neighboring Caspian provinces of Māzanderān and Golestān, of different grains, cotton, tobacco, and a wide range of fruits and vegetables.

The Safidrud and its tributaries are one of the main reasons for the fact that central Gilān is probably the most densely settled part of Iran. Besides Rašt, with population of over 500,000 people, there are a number of large conurbations with more than 50,000 inhabitants (Bandar Anzali with more than 100,000 inhabitants, Lāhijān, Langarud) and smaller township centers. But more important are the great numbers of rural communities that are distributed more or less evenly over the central part of the province. They all depend on the availability of irrigation water, for which the Safidrud is a prime provider and a guarantor of its more or less even flow. Altogether, it is appropriate to call the Safidrud not only the vital line of communication between the central Iranian plateau and the Caspian lowlands of Iran, but also the very heart of the province of Gilān.

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