The Influence of Changes in the Jordan and Yarmuk Rivers on the International and Cadastral Boundaries (Part 1)

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Summary

International and cadastral boundaries are important for ensuring stable legal territorial matters. As such, they should be accurately defined. In certain cases, boundaries are defined on the dynamic earth's physiographic features, such as rivers, glaciers, lakes, and on dynamic land, moving due to tectonic activities.

This article deals with the long-term location and management of boundaries in rivers. A few countries have agreed that the boundary will not follow changes in the river (like in the Mongolia-China Border Treaty), whereas most agree that the boundary will follow slow, natural and gradual changes in the river (like is stated in the Israel-Jordan Peace Treaty).

The international boundary under the British Mandate between Palestine and Trans-Jordan in the Jordan and Yarmuk rivers was defined in 1922. The cadastral boundaries were defined in these rivers in the 1930s along the international boundary.

For more than 70 years, until the Israel-Jordan 1994 Peace Treaty, the rivers have changed their channels east and westward to distances up to hundreds of meters. During that period the mandatory boundaries in these rivers changed their political status to the armistice lines, the cease-fire lines, and to international boundaries between sovereign states.

These lines were usually delineated on topographic maps in the rivers, drawn by cartographers following contemporary map revision. During that entire period the cadastral boundaries were not changed in order to adapt them to the actual position of the rivers and to the delineated international boundaries.

Owing to large water works on both rivers, including the construction of dams and diversion channels in order to meet the increasing needs of the population on both sides, the water flow of the rivers decreased dramatically to less than one tenth of the original natural flow. The population today is more than ten times than it used to be under the British Mandate. The changes in the water channels during the last 20 years since the 1994 peace treaty are in the magnitude of 10 meters versus hundreds of meters in the past. In addition, intensive land cultivation adjacent to the river banks has stabilized them.

In 2000, due to the construction of a dam on the Yarmuk River, both sides jointly fixed coordinates of the relevant river boundary line according to the delineation in the peace treaty.

The accumulated artificial changes along both rivers have cancelled their natural behavior and have influenced the changes in the river channels. This may justify an initiative to fix the border lines in both rivers by coordinates according to the peace treaty delimitation, enabling the cadastral boundaries to be fixed according to the fixed international boundary line.

Part 1 of the article analyzes the theory and practice of boundary line management in light of changes in rivers from the time of the Romans until today. Part 2 analyzes the special case of the boundary line in the Jordan and Yarmuk rivers, and introduces a proposal for stabilizing this boundary line. Due to size limits only Part 1 is published here.

INTRODUCTION

The purpose of boundary demarcation is to increase certainty regarding delimitation of rights on both sides of a demarcated boundary. The absence of a clear boundary line contributes to ongoing friction between those who consider themselves as the rightful owners or those who claim rights in cases of insufficient clarity. Such friction may lead to disputes, confrontation and even violence. The territorial arena, where delimitation of ownership of the rights of use is required is an important example.

The main implementations of territorial boundary delimitations are as follows: demarcation of international boundaries and demarcation of internal boundaries in a state, including administrative boundaries of government ministries and agencies, boundaries between local government entities, boundaries defining land properties and rights of use.

In order to fulfill the specific requirements of boundary making in both cases, the law requires unequivocal, fixed, and unambiguous defining of the boundary lines. In order to preserve the stability of the boundary lines, they should be precisely documented in a way that enables their maintenance and restoration (Srebro, 2014).

In the past, the tendency was to define boundaries by verbal descriptions referring to prominent landscape features, especially natural impassable barriers that are seen from far away. Such boundaries, which are regarded as natural boundaries, were based on features such as mountain ridges, rivers, shorelines, valleys, swamps, and edges of deserts. The colonial powers were inclined to delimit natural boundaries. The British Empire adopted natural boundaries during the 19th and the beginning of the 20th centuries, when dividing the British Empire into protectorates. It was easy to implement such a division, saving a lot of field work. In the course of time, the system of defining natural boundaries, by utilizing descriptions of prominent landscape features, proved to be unsuccessful in the long run, creating international disputes as a result of unclear boundary lines (Srebro, 2005). Boundary delimitations, based on river boundaries, presented other difficulties, in addition to the basic disadvantages of using natural boundaries, since a river is not a steady natural feature, it continually changes with time. A chain of mountains or a valley usually lacks a precise geographic definition that is required for boundary demarcation; however, after the two sides overcome their disputes, they agree on a consensual line and define it by coordinates or demarcate it by physical markers. A river is not a consistent geographic entity, because it depends on water sources that often change. The water volume of its flow changes, and consequently, the water's intensity and the speed of the flow also change. The water level may increase or decrease. The river may erode its banks, may carry sediment along the stream, and may change its course. Since the

river changes and is unable to preserve its course, it is impossible to establish a fixed boundary line that passes through the flowing river.

This makes river boundaries leading members in the family of long-term unstable boundaries. This family also includes boundaries in changing lakes, boundaries over melting glaciers, and boundaries on unstable lands due to significant tectonic movements. Cases of unstable boundary rivers are much more frequent than the other cases of unstable natural boundaries. More than one third of the international boundaries throughout the world are river boundaries, the total length of which is about 77,000 km (Donaldson, 2011; IRBD, 2008). The longest of them passes along more than 2,000 km alongside the Rio Grande between Mexico and the U.S. A.

The main problems arise in cases where the boundary line has to be changed owing to a change in a course of a river. In the case of international boundaries, this often initiates disputes between states, causing national discontent in the state that loses lands to another state. In land property cases it harms land property owners who lose property, sometimes cultivated lands, and registered land rights. Other problems in land boundaries arise when the river's course changes and the boundary line does not change accordingly. This causes problems in preserving the stability of the boundary line and its precise definition. In spite of arguments regarding the boundary line, other kinds of disputes may also raise. The severest one refers to the problem in which one of the sides loses accessibility to the river in the area of change. This may be reflected in losing rights of using the river's water and may be more severe in navigable rivers. Between states, such a case could result in confrontation. This was one of the reasons for the confrontation between Iraq and Iran regarding the boundary in the Shat-Al-Arab River.

States may overcome such problems by signing supplementary agreements, to ensure their rights to use the river waters in such cases. States may take drastic measures, such as forcing the stream into a steady water course such as a concrete canal. This has been implemented along part of the Rio Grande between Mexico and the U.S.A. In addition to its high cost, especially in the case of wide rivers, this solution has caused ecologic problems down-stream.

Rivers around the world are diverse regarding their size, their flow, their behavior during various seasons, the use of their water and additional parameters. The basic distinction regarding this subject refers to whether the rivers are navigable or non-navigable. Legal principles regarding land boundaries in rivers in cases of changes in the water course have been established and implemented since the time of the Romans. During the Middle Ages and later on, the Roman principles regarding this issue were adopted. In the 18th century, the scholar Grotius expanded these principles, and applied them to land property boundaries between individuals and to boundaries between states.

These principles distinguish between two types of changes in the water course of a river: one is a natural, slow and gradual change during the accretion/alluvion process. It cannot be perceived when it occurs, when the water of a river carries away soil from one bank of the river to its other side (usually under different ownership). In the case of an international river boundary, the river often carries away soil, transferring a piece of land from one state to another. According to the accretion principle, in such cases the boundary line follows the changes in the course of the river, and the course of the boundary line is consequently changed to the new location of the river course.

The other case refers to a sudden and steady change in the water's course, in the case of a river (avulsion), which can be perceived when it occurs, either as a result of natural reasons or as a result of man-made activities. According to the principle of avulsion, such a change does not justify a change in the boundary line. This case should be considered as if a new river has been formed elsewhere. The boundary line remains in the former abandoned water course even if it is dry. In this case there is a break off between the course of the river and the course of the boundary, and one of the states loses its access to the river at this location.

In order to avoid situations of unstable boundaries that are predicted to cause future disputes, some countries have tried to fix the river boundary between them, with reference to the position of the course of the river on a jointly agreed date. In order to overcome the dynamic nature of the river, they have tried to physically force the river's flow into a rigid concrete canal. Usually this did not solve the problem because new problems arose. In other cases, countries agreed to fix the boundary line in coordinates. This option is much easier to implement today than in the past, since the use of satellite surveying, like GPS, is much more common. Even the International Court of Justice has adopted this method in its decision concerning the dispute between Benin and Nijer regarding the boundary line in River Niger, defining the boundary line in a list of coordinates (ICJ, 2005). The Israel-Jordan Joint Team of Experts (JTE) similarly fixed the boundary line in the River Yarmuk, following the construction of a dam on the river (Srebro, 2012).

The absence of one comprehensive method that can prevent river boundary problems and disputes is why, in spite of the development of law regarding this subject, including common law, in spite of decisions in courts and arbitrations, and in spite of many bilateral agreements between states that could support customary law, an obligatory international convention regarding defining and maintaining river boundaries has not been developed. This is unlike the UN Convention on the Law of the Sea 1982 (UNCLOS).

This argument was even used by the British administration in Palestine and Trans-Jordan to justify their decision in 1927 regarding the boundary in the Jordan River, following a flood that altered the water course of the river, consequently transferring a strip of land from Palestine to Trans-Jordan (Toye, 1989 pp 795-805).

This article deals with the international boundary between Israel and Jordan in the Jordan and Yarmuk Rivers, and with the land settlement boundaries of Eretz Yisrael (Palestine) and of the State of Israel along these rivers – in light of legal principles, court decisions, agreements, and customs regarding delimitation of international river boundaries and regarding the attitude to the delimitation in cases of changes in the river's course. The water's courses of both rivers have changed since the original definition of the boundary between Palestine and Trans-Jordan under the British mandate in 1922, owing to natural and man-made changes. Part of these changes resulted in fixing the boundary line in coordinates.

Part 1: River boundaries

Disputes over lands have been known since ancient times, as well as the requirement to settle land boundaries and manage and register land transactions, early before the development of international boundaries. Since an objective means of defining boundaries by coordinates did not exist in ancient times, boundaries used to be defined by describing them in reference to natural landscape features,

augmenting the descriptions by using physical man-made markers. Because of their nature, artificial markers were known to disappear over time, especially if there were interested people nearby. Therefore, some cultures sanctified such boundary markers and even ordered punishment and divine curses for offenders who damaged them (Solel, 1991). The use of landscape features in boundary descriptions used to be the first choice. This included roads, trees, rivers, constructions, and stone fences. Rivers were easy to recognize in the field and were natural obstructions and barriers. They were used as borders at the local, tribal, administrative, and international levels.

At the local level, land was cultivated until the bank of the river. The edge of the cultivated land moved according to the high and low tides and according to the changes in the river's course. Village lands used to be limited by rivers, especially in cases of wide rivers, which were difficult to cross. At the tribal and national levels, the river was used as a defense line against aggressors, and therefore, it was used as a boundary. With the development of civilization and the construction of bridges over rivers in fertilized and populated valleys, rivers also acted as a bridge between populations living on both sides of the river. Owing to their easy visibility, being easily used as natural borders, rivers eliminated the need for field marking and surveying, and were still used for boundary delimitation in the 20th century.

In order to define a boundary in a river the two countries should make decisions regarding a few questions: Where should the boundary be delimited - in the river (in its center or elsewhere) or along its banks? How should the boundary maintenance be managed over time, considering that the river is a living dynamic entity that changes according to the flow of water from its sources? How should the rights of use be allocated and how should they be divided between the states on the two sides and along the river? The allocation of the rights to use the river's water is important because of the global developing water crisis as a result of the climate change and the warming of the Earth. This phenomenon dries water sources and significantly reduces the water volume and the flow of rivers. It is also important due to the rapid increase in the world's population and especially for populations living along rivers and using their water (Graiger and Conway, 2014). Exploitation of river waters influences boundaries in rivers, but this subject is not discussed here in depth.

Usually it is common that a boundary river between two countries is equally shared between them, and that the boundary is delimited in the center of the river. The case of the river boundaries between Germany and the Netherlands is an exception, however, because according to the agreement between the two countries, in cases where the international boundary between the countries follows a river, the closer bank belongs to the relevant country and the river is common to both countries. In certain cases, where a strong power or a strong country ruled one of the banks of the river, it was determined that the boundary line follows the bank of the weaker country and that the water is under the sovereignty of the stronger one.

There are a few methods of delimiting a boundary line in the center of a river. The main distinction is between navigable and non-navigable rivers. In the case of non-navigable rivers it is common to delimit the boundary in the geographic center of the river[1]. This is valid in land settlement boundaries inside a country where land properties are located on two sides and the boundary passes

[1] "Where properties are separated by a natural non-tidal river or a stream, the presumption is that the boundary follows the center line of the water (*ad medium filum aquae*) so that each owner has half of the bed." (UK Land Registry Guidance – Land Registry plans: boundaries (practice guide 40 supplement 3, updated 25 June 2015)).

in the center of the river. It is also valid in the case of a boundary line along the median line between two countries. There are a few methods of delimiting such a center line. One common method is the equidistance one, in which the center line is defined by connecting points along the center of the river, which are at the same distances from prominent points on the two sides (along the two banks) of the river (Boggs, 1940; Srebro, 2005). Where a river splits up into two water courses it is common to choose the main one (Boggs, 1940; Jones, 1945).

In navigable rivers, consideration is usually given to the access of each of the countries to the navigation course and preference is usually given to defining the boundary line along the main navigation course. The navigation course is usually defined along the course of deepest places (also called thalweg, though the meaning of the term is not unequivocal). The ICJ referred to this in the decision regarding the Botswana-Namibia dispute (ICJ, 1999), determining a leading rule, though not a decisive one, regarding the preference of the thalweg in navigable rivers. The ICJ repeated this in the decision regarding the Benin-Nijer dispute (ICJ, 2005)[2]. The Court adapted the boundary line to the existing islands along the river's water flow.

Boundary Maintenance in a River

Maintenance of boundaries in rivers is basically required because of the changing nature of river courses. This is one of the cases of changing boundaries caused by physical long-term changes in nature. Other cases are changes of boundaries due to changes in lakes, due to melting glaciers, or as a result of tectonic movement of the earth.

Rivers, by their nature, continually change with time. An increase in the water volume causes the tide to elevate and the extent of the river banks is governed by the side slopes of their banks. Sometimes the strong flow creates floods, sweeping the soil from the bed or the banks of the river. After heavy rains or melting snow, the flow of a river increases, and large amounts of eroded soils are carried away by the flow and sink as sediment along the stream. Sometimes the river overcomes obstacles in the course of the stream and cuts through a new water course, shortening the existing course, or meanders aside where the valley is wide, the slope is moderate, or the soil is soft. On the other hand, when the flow slows down and the weak stream does not have enough power to overcome the obstacles of silt that accumulate along the stream, and if the soil is soft and the land is flat, the river bypasses the obstacle. The width of the river and its water course changes if it passes through a wide flat valley and not through a narrow, deep rocky gorge.

The dilemma of maintaining a boundary line in a changing river concerns whether to keep the original boundary line in spite of the changes in the river or to move the boundary line to the new water course. In the past, the main legal and scholar discussions regarding this issue referred to river changes because of the transfer of soils from one bank of the river to the opposite one. In fact, often the river carries eroded soils from upstream out of the area of change, or from one of the banks, and

[2] "144. The Chamber would recall that, in the case concerning *Kasikili/Sedudu Island (Botswana/Namibia)*, the Court observed that: "Treaties or conventions which define boundaries in watercourses nowadays usually refer to the thalweg as the boundary when the watercourse is navigable and to the median line between the two banks when it is not, although it cannot be said that practice has been fully consistent."" (*I.C.J. Reports 1999 (II)*, p. 1062, para. 24).

the sediments sink downstream, sometimes on the bank of the same state from which the soil has been taken.

From the legal point of view, the distinction is between slow, gradual, and natural changes in the water course and between sudden sharp changes, whether natural or man-made. Such an example regarding land property law, reflecting common law, can be seen in the British Land Registration Law (LRA, 2002). According to this law, a boundary line that follows a river or a stream between two registered land parcels is located in the center of the water course and changes according to the change in the river, if the change is natural and gradual over time (UK Land Registry, 2015)[3]. Changes of that type – alluvion, accretion, diluvion or erosion – are recognized in land property law within the common law as changing borders of parcels, in spite of the fact that the boundaries are delimited in registered plans. The British Land Registry law even specifies that if the owners on both sides of the river want to deviate from this rule and agree on it, they must register that agreement in order to receive recognition by the Registry.

On the other hand, if the change in the water course is a result of man-made activity, the changes in the course are not recognized by common law as leading to a change in the boundary line. In the case of a sudden and steady change in the water course, whether natural or as a result of man-made activity, the boundary line remains in its former place, before the change in the water course (UK Land Registry, 2015)[4]. In case of wide rivers that are subject to high and low tides, the land settlement boundary bordering the water is located at the front line of the mean high and low tides. It is common that the water space beyond that line belongs to the state.

The legal grounds of the accretion/alluvion doctrine evolved in the Roman laws, which had determined that a slow gradual change in the water course causes the boundary line to follow the river to its new course[5], but that a sudden and continuous change does not change the boundary line. In time, this legal custom took root and found expression in the theory of law and in the studies of law during the Middle-Ages and in modern times. In the 13th century the British jurist Bracton clarified that the legal principle of adding land as a result of river accretion is valid when the process is slow and unperceivable, but if the process of change is perceivable, then the land transfer is not legally valid (Bracton, 1883 according to Donaldson, 2011). Bractons attitude had a significant influence on the development of common law.

[3] "The doctrine of accretion and diluvion recognises the fact that where land is bounded by water, the forces of nature are likely to cause changes in the boundary between the land and the water. We would expect these changes to be gradual and imperceptible. As the watercourse changes naturally and progressively with time, so the land boundary follows it. There may be some gain, there may be some loss. The law accepts this and considers it to be fair."

[4] "If a violent flood wrenches the watercourse suddenly but permanently into a different direction so that a substantial and recognisable change in the boundary has taken place, then the doctrine of accretion does not apply. Neither does it apply if the changes are man-made." And elsewhere: "Where there is a sudden, but permanent change in the course of the stream, whether or not it is due to natural causes, the boundary will remain along the center line of the former bed."

[5] The Roman law says: "what the river adds to your field by alluvion, becomes yours by the law of nations" (Donaldson, 2011). The Justinian Institutes, that catalogued the Roman legal tenets remarked: "20. The law of all peoples makes yours any alluvial accretion which a river adds to your land. An alluvial accretion is one which grows on so gradually that you cannot tell at any one moment what is being added. 21. If the river's current rips away a piece of your land and carries it down to your neighbor, it clearly remains yours (Birks and McLeod, 1987 cited by Donaldson, 2011).

In the 18th century the Dutch scholar Grotius expanded the legal principle of changing the boundary line as a result of accretion, from the land property domestic law to international boundaries in rivers. In his work: *Of the Rights of Wars and Peace* he determined that rivers are natural boundaries that used to serve as natural barriers, defending from enemies, and they define legal limits between states. His view was that the Roman law regarding the boundaries of private property in the case of alluvion should also be valid in the case of boundaries between kingdoms. A river that defines a boundary defines it in a specific course, and if the course is changed slowly and gradually in a natural process, while transferring soil from one side of the river to the other side, it changes the boundary of the territory. However, if a river changes its course suddenly from one place to another, this is not considered any more as the old river in a new course, but as a new river, and it does not change the boundary of the territory (Grotius, 1715).

The views of Grotius were adopted and later on developed by Vattel (1787), who held the view that the alluvion principle that had been developed regarding private land property rights is also relevant for defining international boundaries in rivers. He expressed this view in 1758 in his publication: The Law of Nations (Droit de Gens).

There is analogy between the doctrine applied to land boundaries and the doctrine applied to international boundaries. The similarity is greater in cases of non-navigable rivers and streams. In these cases, delimitation of the boundary line in the center of the water course is considered most justified regarding the two states. Nevertheless, delimitation of international boundaries is more common in wide navigable rivers, flowing between countries, since such rivers had usually separated between tribes and peoples and had served as barriers, defending them from invasion.

The historic use of rivers for boundary delimitation has taken root and it left its mark on many river boundaries existing today. Some of them are domestic, separating districts, sometimes autonomic ones. Such examples are river boundaries between states in the US, like the Missouri River between Nebraska and Iowa; along the Mississippi River between Missouri and Illinois, Kentucky and Tennessee (and between additional states along its course). Other examples are the boundaries along the Huang He River in China between Shaanxi province and the Henan and Shanxi provinces. Parts of these river boundaries follow rivers that pass between countries, like along the Rhine River between Germany, France, and Switzerland. Some examples are the boundaries along the Danuba/Donau/Donev/Donaria/Doni/Dona between Bulgaria and Romania, and between many other countries along its course, and for example, the boundaries along the rivers Argun and Amur/Heilong Jiang between Russia and China, and along the Shatt-al Arab between Iraq and Iran.

Wide international rivers are usually used for sailing. Therefore, navigation is an important parameter that is considered when choosing the center or the main course of navigation for delimiting the boundary line. There is no obligatory international convention regarding river boundaries, similar to the convention regarding delimitation of maritime boundaries (UNCLOS 1982). Therefore, one usually relies on the decisions of ICJ and of international arbitration tribunals, on customary practice in agreements between countries, and on the written opinions of scholars.

In the middle of the 19th century, the reference to the accretion/alluvion doctrine became standard in legal materials discussing river boundaries in international law (Donaldson, 2011). The decisions

and customary practices regarding the issue in the 20th and the beginning of the 21st centuries reflect significant reliance on the decisions of the US Supreme Court from 1892 and later in disputes between states in the USA regarding river boundaries between them (in addition to previous cases in 1875 and 1890 that were not between states). The relevant decisions referred to the influence of natural and gradual or sudden changes in rivers on the boundary lines. In 1892 the US Supreme Court decided that the boundary between Nebraska and Iowa in the Missouri River would not follow a change in the course of the river, because it had been a sudden change (US Supreme Court, 1892, Iowa vs Nebraska). Similar decisions of this court regarding river boundaries in the US followed this decision.

The most famous arbitration decision regarding this subject, which is used even today as precedence for a decision of an international court or tribunal regarding the legal acceptance of the accretion and avulsion principles in international law, was given in 1911 regarding the US-Mexico dispute (the Chamizal Case). The arbitrators decided that the piece of land that had been transferred from the Mexican side to the American side, as a result of changes in Rio Grande water course, belongs to Mexico. The arbitrators accepted the Mexican argument regarding sudden changes in the water course and rejected the American claim that the changes were gradual. However, the US did not comply with the decision. In 1963 the disputed area was divided according to an agreement between the two countries. Following this arbitration decision, the principle of accretion/alluvion was established regarding accepting the principle that the boundary line follows changes in the water's course of a river, if these changes are slow and gradual, but when the change in the water's course is sudden, in an avulsion process, there is no change in the boundary line and it remains in its former course (Shaw, 2014). The arbitrators in this case determined, for the first time in an international decision, that the principles of accretion and avulsion are known principles in international law[6].

The Shatt-al-Arab case between Iraq and Iran was another early known dispute. The 1937 agreement regarding the boundary line in the river determined that the boundary line will follow the deepest course of the river. Various methods regarding delimitation of the boundary line have been adopted in different sections along the river.

Many scholars have described methods to delineate a median line, every point of which is equi-distant from prominent points on the opposite banks (Boggs, 1940; Jones, 1945; Bouchez, 1963; Srebro, 2005). A 1934 decision by the US Supreme Court delimited a boundary line in the thalweg of a river. According to the Iran-Iraq agreement the deepest water course is decisive. Lauterpacht (1960) discussed the choice between the deepest course and the deepest navigation course. The definition of thalweg is more complicated when an island splits up the stream into a few channels. In such cases the main possibilities are: to choose the main water course or to draw a line through the island. The 1924 Norway-Finland agreement shows an early example of such a case. Bouchez

[6] The arbitrators in the Chamizal case gave significant weight to relevant decisions of the US Supreme Court regarding accretion and avulsion. They also referred to the early comments in this regard of the US Secretary of the Interior in 1856 Cushing, who was considered an authority on international law, at the time of drafting the US-Mexico boundary treaty (Donaldson, 2011). The arbitrators quoted Cushing's comment: "If the river deserted its original bed and forced for itself a new channel in another direction, then the nation through whose territory the river thus broke its way did not lose the land so separated; the international boundary in that case remaining in the middle of the deserted river bed" (IBC, 1911).

(1963) and Biger (1988) emphasized that a navigation channel has width and it is not a line. However, agreements define boundary lines and the width is taken care of by supplementary agreements.

Unilateral artificial changes in a river are forbidden. In any case of a change in the course of a river as a result of man-made activity, the boundary line does not change. It will remain in its former course, even if the result of it is that the boundary will pass out of the river. In any case, two countries that come to an agreement regarding their boundary line in an international river (when no other country is involved) are sovereign to agree as they desire regarding its place, on the method of delimitation, and on the way of maintaining the boundary line in case of changes in the river. Examples of different approaches are reflected in the following: the 1963 China-Mongolia agreement (Department of Commerce, 1971) says that in case of a change in the river bed the boundary remains in its place unless otherwise agreed[7], whereas the 1994 Israel-Jordan peace treaty says that in case of natural changes in the course of the river (accretion or erosion) the boundary line will follow the changes unless otherwise agreed.

Part 2: The Boundary in the Jordan and Yarmuk Rivers

Note: This part, except the headings is not published here

Geographical background

Historical background regarding the boundary line

The course of the boundary line in the Yarmuk and Jordan rivers

Land settlement boundaries along the rivers

The influence of changes in the Jordan River course on the international boundary

Conclusion and recommendations

There is no obligatory international convention regarding river boundaries similar to the UN Convention on the Law of the Sea. As a result, states rely on decisions of ICJ and international tribunals, on customary practice of agreements between countries, and on studies of scholars. The doctrine that a boundary line in a changing river follows the changes in the case of accretion, when the changes are natural, gradual and not perceivable when they are formed and does not follow the changes when they are sudden or when they are a result of man-made activities – has not been accepted as an obligatory principle in international law. This doctrine has been adopted in many cases and fulfils many criteria that check the qualification of principles to be considered as international law. Such cases include the 1911 decision of the tribunal of arbitrators in the Chamizal case, many bi-lateral agreements, including the Israel-Jordan Peace Treaty, and many law books

[7] "If, for natural reasons, the bed of the main course of the boundary river should change, the original boundary line shall be retained, unless the two parties decide otherwise." [7]

and scholarly works. However, ICJ did not decide on it unequivocally, and there are countries that do not adopt these principles in their agreements in order to avoid local complications.

A change in a course of a boundary line transfers land from one country to another. This is harmful to the population of the losing side, to the stability of the boundary and to the relations between the two countries. On the other hand, breaking off the connection between the course of the river and the course of the boundary prevents the accessibility of the residents of one of the countries to the river, thus affecting their use of this essential resource. Even if it is concluded that for the sake of stability and legal clarity it is recommended that countries should avoid delimitation of boundary lines in rivers, and with reference to geographic landscape features that are not precise and unequivocal, one cannot ignore the fact that river boundaries make up one third of the international boundaries throughout the world. A relevant global phenomenon that influences the situation of rivers is the dramatic population growth during the last century, which has sharply increased the use of rivers and their pollution. Other influential global developments include climate changes that damage water sources, increasing irregularity of river flows, especially in areas that are on desert edges, characterized by seasonal floods. Lack of water caused many countries, sometimes under the framework of multinational projects, to regulate the flow of water in rivers, to stabilize it by constructing dams and artificial water reservoirs, to stabilize the river banks or to canalize the river bed. Projects of water collection and water use, including pumping out water before it gets to the river, or sometimes along the course of the river, contribute to the drying out of rivers, and are considered artificial human intervention in the natural flow of rivers, so that most of the boundary rivers cannot be considered as preserving their natural behavior. These artificial changes, rule out the rationale of referring to the natural behavior of the river that stood as the basis of the principle of accretion. If the transfer of soil by the river is influenced by man-made activities, it is not right to grant a country the right to unilaterally influence the flow and course of the river, and as a result to change the boundary line in favor of that country, adding lands to the country's territory on the account of another country.

In light of this situation, it is often right to fix the boundary line in the river between two countries, according to the course of the river on an agreed reference date, and to deal with separate accomplishing agreements regulating other issues connected to the river. Such issues may include accessibility and rights of use of the river waters by the two countries, covering the issue of possible local changes in the river course in reference with the boundary line.

The Israel-Jordan Peace Treaty states that the boundary line in the Jordan and Yarmuk rivers will follow natural changes (accretion or erosion) in the course of the river unless otherwise agreed. Here we have reviewed the courses of the two rivers during the last century, focusing on the changes in the river courses as a result of natural and artificial intervention, including constructing dams and diverting water by canals and pipes under the framework of national water projects. We have shown how these projects have influenced the drying up of the two rivers during the last decades. In addition to blocking the natural water flow of the two rivers, the banks of the courses in which the rest of the water, which is mainly based on sewage and local drainage, are stabilized by farmers who cultivate the adjacent lands and construct fences along the river banks in order to prevent the cultivated lands from flooding.

In principle, the artificial works have created a situation that has turned the relevant peace treaty paragraphs, dealing with changes in the river course (accretion or erosion) into inapplicable conditions. Under the existing circumstances only the peace treaty option of setting the boundary line according to artificial changes is applicable. As a result it is recommended to fix the boundary line in the two rivers by coordinates according to a mutually agreed upon reference line. The existing reference line is the boundary line delineated in Annex I to the October 26, 1994 Peace Treaty. Both sides have already agreed to fix the boundary line along its main section in the Yarmuk River between Hamat-Gader/Al-Hama and Ashdot-Yaakov/Adassiya in 2000, following the construction of a dam on the Yarmuk at Adassiya. The JTE of the JBC set coordinates to the line in this section according to the delineation of the boundary line on the orthophoto of the 1994 Peace Treaty. The JBC formally approved these coordinates and considered them to be part of the annex to the peace treaty. A similar procedure is recommended for the rest of the boundary line in the Jordan and Yarmuk rivers.

From a practical point of view, the changes in the course of the Jordan River decreased from hundreds of meters, when the river behaved as a natural river, to ten meters with several exceptions of up to 15-20 m since the 1994 Peace Treaty. This decrease has occurred gradually since the 1960s, following the construction of large water supply projects on both sides. The consequence of that is that fixing the boundary line will have almost no influence on the reference between the boundary line and the river course.

On this basis it is recommended to fix the boundary line in coordinates according to the delineation of the line in the 1994 Peace treaty in a joint Israeli-Jordanian process, following the process of fixing the boundary line in the Yarmuk in 2000[8]. This will enable fixing the cadastral boundaries along these rivers, by adapting the land settlement boundaries to the agreed and fixed international boundary. Until such mutual agreement on fixing the international boundary line occurs, it is recommended to delimit a line indicating the rage of changes in the Jordan water course (about 10 m) in order to adapt the cadastral blocks to this line, and to leave a border strip, several meters wide, to be defined as a flexible border block, limited by the center of the course of the river, depending on the changes in the course of the river as agreed upon by both sides.

***Note**

The views expressed in this article are the author's and do not necessarily reflect the views of the Government of Israel including the Survey of Israel, or the view of the Israel-Jordan Joint Boundary Commission.

Biographical notes

Dr. Haim SREBRO is an international consultant on boundaries and mapping. He received his BSc and MSc degrees from the Technion, Haifa, in Civil Engineering and Geodetic Engineering and his PhD from Bar-Ilan University. He teached at the Technion and at Tel-Aviv University; He served during the years 2003-2012 as the Director General of the Survey of Israel and as Chair of

[8] Following the construction of the Adassiya dam on the Yarmuk River

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References

Almog R., (2012) Geomorphological Review and Hydrological Systems, in: The Jordan River and its Surroundings – from Naharayim to Nahal Bezek, an ecological survey, editors: Gal A. and Perlberg A., Deshe Institute. Final report prepared for the Southern Jordan Drainage Authority, pp 25-42 (in Hebrew).

Angell J.K., (1854) *A treatise on the law of watercourses*, Fifth edition. Boston: Little, Brown and Co.

Biger G., (1988) 'Physical Geography and the Law: The Case of International River Boundaries', *GeoJournal* 17 (3), 341-7.

Biger G., (1994) River and Lake Boundaries in Israel, in: The Middle East and North Africa, *World Boundaries* volume 2, edited by Clive Schofield, Richard Schofield, IBRU 1994, Routeledge London.

Boggs S.W., (1937) Problems of Water Boundary Definition: Median Lines and International Boundaries through Territorial Waters, *Geographical Review* 27, 445-456.

Boggs S.W., (1940) *International Boundaries: A Study of Boundary Functions and Problems*, Columbia University Press, New York.

Bouchez L. J., (1963) The Fixing of Boundaries in International Boundary Rivers, *International and Comparative Law Quarterly*, Volume 12, 1963, 3: 789-817.

Bracton H. de, (1883) *Legibus et Consuetudinibus Angliae*. Edited by T. Twiss. London: Longman & Co. (cited by Donaldson, 2011)

Brawer M., (1968) The Geographical Background of the Jordan Water Dispute, in: Essays in *Political Geography*, edited by Charles A. Fisher, Methuen, London.

Brawer M., (1988) *The Boundaries of Israel* (in Hebrew), Yavne Publishing House.

Cukwurah A.D., (1967) *The Settlement of Boundary Dispute in International Law*, Manchester.

Department of Commerce, (1971) Sino-Mongolian Border Protocol, Translations in Communist China, no. 131, Joint Publications Research Service, Washington D.C.

Dinshtein Y., (1972) *The Internal Authority of a State* (in Hebrew), Shoken publishing house and Tel Aviv University, p. 37

Donaldson J., (2009) Where Rivers and Boundaries Meet: Building the International River Boundaries Database. *Water Policy* 2009, 11:629-644.

Donaldson J., (2011) Paradox of the Moving Boundary: Legal Heredity of River Accretion and avulsion. *Water Alternatives* 2011, 4:155-170.

Eritrea-Ethiopia Boundary Commission (EEBC), (2002) Decision on delimitation of the border between Eritrea and Ethiopia, Permanent Court of Arbitration, The Hague, 13 April 2002.

FIG: International Boundary Making, (2013) Editor: Haim Srebro, The International Federation of Surveyors: *FIG Publication NO 59*, Copenhagen, Denmark.

Graf W., (1983) Flood-Related Channel Change in an Arid Region River, *Earth Surface Processes and Landforms*, 8:125-139.

Grainger S, and Conway D., (2014) Climate change and IRBs: fixed points in shifting sands, Wiley Interdisciplinary Reviews: Climate Change Volume 5, Issue 6, pages 848-835, November/December 2014.

Grotius, H., (1715) Of the rights of war and peace (three volumes). London: Printed for D. Brown, T. Ward and W. Meares. Available online at: Gale, Eighteenth Century Collections Online http://find.galegroup.com/ecco/ (cited by Donaldson, 2011))

Holtzman R., Shavit A., Segal M., Vangush A., Farber E., Gabrieli I., Glazman H., (2002) Sufficiency measurements in the southern Jordan River, *Water and Irrigation*, monthly no. 423, the organization of water workers, pp. 14-17 (in Hebrew).

International Boundary Commission (IBC), (1911) Award before the International Boundary Commission, enlarged by the Convention between the United States and Mexico of June 24, 1910, In the matter of the international title to the Chamizal tract – section Fixed Line Theory. *American Journal of International Law* 5(3): 791-805.

International Boundaries and Water Commission (IBWC), (1933) Rectification of the Rio Grande, Convention between the United States of America and Mexico, 1 February 1933. Treaty Series No. 864, www.ibwc.gov (accessed 22 October 2015).

IBRU: Centre for Borders Research, (2008) International River Boundaries Database (IRBD), Durham University, https://www.dur.ac.uk/ibru/resources/irbd/search. (accessed 22 October 2015).

International Court of Justice ICJ, (1992) Case concerning the land, island and maritime frontier dispute (El Salvador/Honduras, Nicaragua intervening) judgment of 11 September 1992. General List No. 75: 351.

International Court of Justice ICJ, (1997) Case concerning the Gabčíkovo-Nagymaros Project (Hungary/Slovakia) Judgment of 25 September 1997. ICJ Reports 1997.

International Court of Justice ICJ, (1999) Case Concerning Kasikili/Sedudu Island (Botswana/Namibia). Judgment of 13 December 1999. General List No. 98 (13). ICJ Reports 1999.

International Court of Justice ICJ, (2003) Application for revision of the judgment of 11 September 1992 in the Case concerning the Land, Island and Maritime frontier dispute (El Salvador/Honduras, Nicaragua intervening) (El Salvador v. Nicaragua) judgment of 18 December 2003. ICJ Reports 2003.

International Court of Justice ICJ, (2005) Case Concerning the Frontier Dispute (Benin/Niger). judgment of 12 July 2005, General List No. 125. ICJ Reports 2005.

International Court of Justice ICJ, (2009) Case concerning the dispute regarding navigational and related rights (Costa Rica v. Nicaragua) judgment of 13 July 2009. General List No. 133.

International Court of Justice ICJ, (2010) Case concerning pulp mills on the river Uruguay (Argentina v. Uruguay) Judgment of 20 April 2010. General List No. 135.

International Court of Justice ICJ, (2013) Press Release "Certain Activities carried out by Nicaragua in the Border Area" (Costa Rica v. Nicaragua). General List No. 35. 2013.

International Court of Justice ICJ, (2013) Press Release "Construction of a Road in Costa Rica along the San Juan River" (Nicaragua v. Costa Rica). General List No. 39. 2013.

Jones S.B., (1945) *Boundary Making A Handbook For Statesmen, Treaty Editors and Boundary Commissioners*, Washington D.C Carnegie Endowment For International Peace.
Lauterpacht E., (1960) River Boundaries: Legal Aspects of the Shatt-Al-Arab Frontier, *International and Comparative Law Quarterly*, vol. 9, 1960, p. 222.

Kalvo R. and Ben Tsvi A., (2005) Spatial Analysis of the drainage basin of the lower Jordan and estimating its ground flow into the Dead Sea, Report GSI/17/2005 (in Hebrew), Geological Survey, Ministry of Infrastructure, Jerusalem.

Klein M., (1990) A River as a system in a dynamic balance, or: what happened to the bed of the lower Jordan? (in Hebrew), *Mada*, 2, Witszman Institute publishing house.

Klein M., (1996) The Water Balance of the Jordan River – Sources, Accuracy and Reliability of Data (in Hebrew), *Horizons in Geography*, 44-45, pp 83-90.

Klein M., (2000) Floods in the Zor (of the Jordan river) and their influence on land uses (in Hebrew), *Horizons in Geography*, 52, pp 89-101.

McCaffrey S., (2007) *The Law of International Watercourses*, 2nd edition, Oxford, UK: Oxford International Law Library; 2007, 41-47.

Prescott J.R.V. and Triggs G., (2008) *International frontiers and boundaries: Law, politics and geography*. The Hague: Martinus Nijhoff Publishers.

Riquélme A., (1849) *Elementos de derecho público internacional* tomo I. Madrid: Imprenta de D. Santiago Saunaque.(cited by Donaldson, 2011)

Salman S., (2000) International Rivers as Boundaries – The Dispute over Kasikili/Sedudu Island and the Decision of the International Court of Justice. *Water International* 2000, 25:580-585.

Salman S. M. A., (2006) International Water Disputes: a new breed of claims, claimants, and settlement institutions. *Water International* 31(1):2-11.

Schattner I., (1962) The Lower Jordan Valley, A study in the fluviomorphology of an arid region, *Scripta Hierosolymitana*, publications of the Hebrew University, Jerusalem Volume XI, The Magnes Press, 1962.

Shaw M. N., (2014) *International Law*, Seventh edition, Cambridge University Press.

Solel A., (1991) *The Geographic Delimitation of the Land Rights in Israel*, Survey of Israel (in Hebrew).

Srebro, H., (2005) A Process Driven Boundary Making Model: Generalizing the Case Study of the Gulf of Aqaba and the Arava Valley. Ph.D. Thesis, Bar Ilan University.

Srebro H., (2012) *The Boundaries of Israel Today*, Survey of Isarel.

Srebro H., (2012) International Boundary Making – Methodology and Practice: The case of the Israel-Jordan Boundary, *FIG WW 2012*, Rome, Italy, 6-10 May 2012.

Srebro H., (2014) *International Boundaries – The Israel-Jordan Boundary*, private publishing (in Hebrew).

Rubinstein E., (2004) On the Boundary and on the Israel-Jordan Boundary (in Hebrew), Parashat hakat, 170, Ministry of Justice, Department of Hebrew Law

The Palestine Order in Council, (1922) *Official Gazette of the Government of Palestine*, 1 September 1922.

Toye P., (ed.) (1989) *Palestine Boundaries 1833-1947*, Farnham Common: Archive Editions.

Treaty of Peace between the State of Israel and the Hashemite Kingdom of Jordan, 26 October 1994.

UK Land Registry, (2015) Land Registry Plans: Practice Guide 40, Supplement 3, updated 25 June 2015. https://www.gov.uk/government/publications/land-registry-plans-boundaries/land-registry-plans-boundaries-practice-guide-40-supplement-3 (accessed on 22 October 2015)

UN, (1978) Register of International Rivers, Prepared by the Centre for Natural Resources, Energy and Transport of the Department of Economic and Social Affairs of the United Nations, Pergamon Press, Oxford.

U.S. Department of State, (1969) *International Boundary Study* No. 94: Jordan-Syria Boundary Study, The Geographer, December 30, 1969.

U.S. Supreme Court, (1875) County of St. Clair v. Lovingston. 90 US (23 Wall). 46.

U.S. Supreme Court, (1890) Jefferis v. East Omaha Land Company. 134 US 178-198.

U.S. Supreme Court, (1892) Nebraska v. Iowa, 143 U.S. 359-370.

U.S. Supreme Court, (1918) Arkansas v. Tennessee. 246 U.S. 158-177.

U.S. Supreme Court, (1972) Nebraska v. Iowa. 406 US 117-126.

Vattel E. de, (1787) Law of nations: or Principles of the Law of Nature: applied to the Conduct and Affairs of Nations and Sovereigns, Book I. translated from French. Dublin: Printed for Messrs. Baerry and Rogers. (cited by Donaldson, 2011)

Woolrych H.W., (1853) A treatise of the law of waters; including the law relating to rights in the sea. Philadelphia: T. & J.W. Johnson. (cited by Donaldson, 2011)