INTEGRATED WATER RESOURCES MANAGEMENT AS BASIS FOR FLOOD PREVENTION IN THE KURA RIVER BASIN

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Background

This article is directed at review of floods in Azerbaijan and recommended by the authors suggestions on improved water(flood) management in Azerbaijan based on creation of IWRM oriented legal and institutional frameworks and implementation of flood prevention programs and satellite information at national level and for the whole Kura –Araz River Basin. This may be used to establish an institutional, legal and technical framework in order to overcome national level and trans-boundary water issues in the Caucasus region.

After the collapse of the Soviet Union, the countries of the South Caucasus gained their independence. However, they faced with the problems associated with national and trans-boundary water management. Transboundary water management remains one of the key issues leading to conflict in the region today.

Though Azerbaijan is an extremely water-poor region (the water supply of the Azerbaijan Republic territory situated downstream of trans-boundary rivers makes up about 100,000 m^3/km^2) there are often floods at mountain rivers that lead to huge damage to the economy of the country and human losses.

Flood formation at rivers of Azerbaijan is connected with snow melting, rainfall and also such characteristics of the basin as exposition of mountains slopes, elevation, forest and plant cover and etc.

Rivers of the Greater and Lesser Caucasus with average altitudes of the catchments area higher than 2500m main source of flood is melted snow (more than 70%). 80% of flood maximum is observed in June-July.

Rivers with average altitudes of the catchments area between 1500 and 2500m flood is formed mainly by snow melting and rainfall (mainly maximum flood discharges are observed in May-June).

Flooding at rivers of Greater and Lesser Caucasus with less altitudes and those of Lenkoran region mainly is caused by rains (90%). These rivers are called flooding regime rivers. Flood mainly is observed during the rainfall in spring and autumn. At rivers of Lenkoran flood occurs during the winter as well. The flood parameter for these rivers reach values about 20-30.

Often at the end of summer and beginning of autumn in result of intensive rainfall in most of rivers of South Slope of Greater Caucasus mud flow takes place. Absence of effective monitoring and early warning system, and data exchange at the transboundary and national level and also adequate technology don't allow to prevent resulted serious damages to the economy of the country. There is also no required legal, policy and institutional basis for effective flood management.

In the article results of studies on use of satellite information for flood management is also described

1. Introduction

a. Geographical location of the basin. The Kura River originates in the Kizil-Giadik mountain range in Ardahan province in Northeast Turkey at the altitude of 2740 m., winding its way through mountainous regions in Turkey, Georgia and the estuary is in Azerbaijan on -27m into the Caspian Sea. Tributaries flow northwards from Armenia and join the Kura in Georgia and Azerbaijan (Fig. 1).

On some morphological and hydrological characteristics the river Kura shares on three parts: 1) From Kizil-Giadik in Turkey up to the city of Borzhomi in Georgia, 2) From Borzhomi

up to Mingachevir in Azerbaijan, and 3) From Mingachevir up to Caspian sea in Azerbaijan. From the beginning up to the city of Borzhomi this river is mountain, after this point it is already rather flat river. After borjomi Kura pass between Great and Smal CaucasusIn Azerbaijan in people this river refers to «Mother Kur».

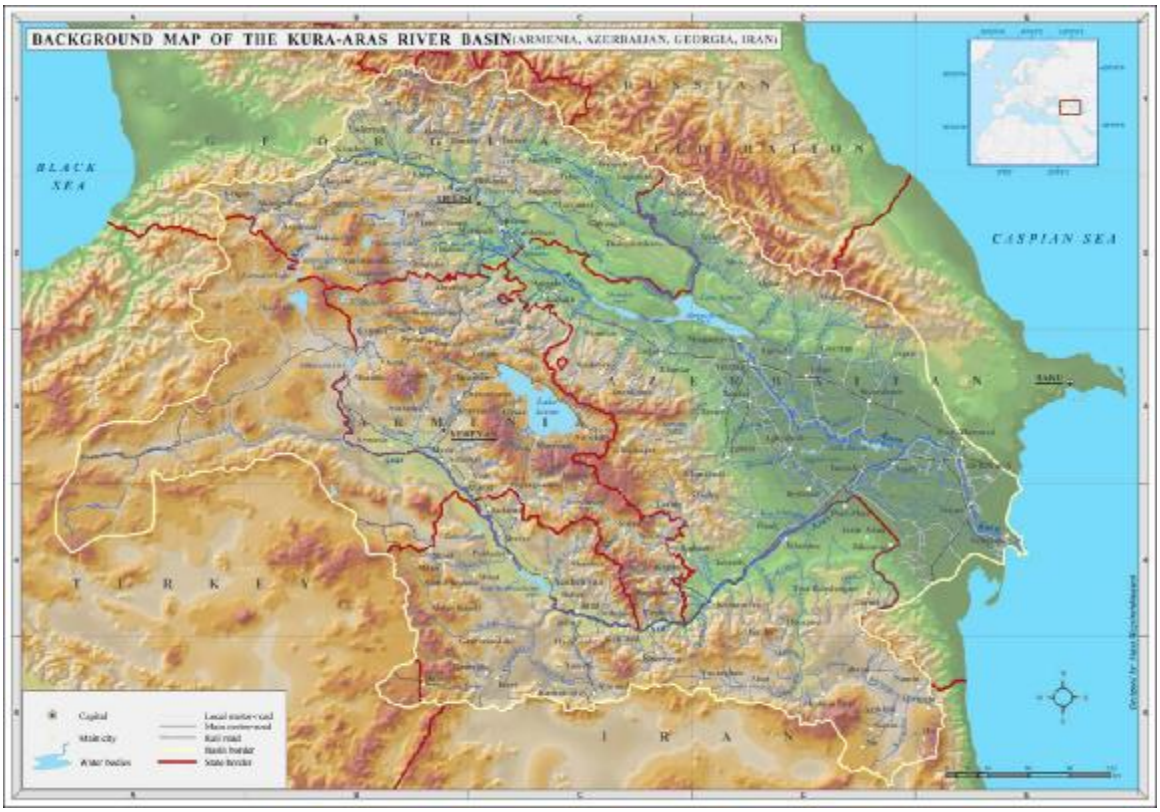

Fig. 1. Kura-Aras river basin. Light line is border of the basin

A Kura River main tributary is Aras. The Aras River also originates in eastern Turkey in Erzurum province. It flows along the Turkey-Armenia border, along the Iran-Armenia border, along the Iran-Azerbaijan border, before flowing into Azerbaijan where it joins the Kura near the Caspian. Tributaries from Armenia flow south into the Aras. The Aras divides just before meeting the Kura, and one branch flows directly into the Caspian. The total length of the Kura river is 1515km and the total area of the Kura-Aras basin 188 000km^2, occupying the greater part of the South Caucasus. This area is distributed amongst the five countries as follows: Iran – 40 000 km2; Turkey – 28.900 km^2; Azerbaijan 52.900 km^2; Armenia – 29.800 km^2; and Georgia – 36.400 km^2 (R.Mamedov, M.Mansimov, Kh Ismatova.R. [4]) The population in this largely mountainous area is approximately 7 million.

The Kura-Aras river system is an internationally significant river system, which is seriously degraded and continues to be threatened. Water scarcity is an issue at many points in the river system. Water quality and quantity constraints are already leading to use conflicts, and the trans-border aspects of these conflicts are likely to increase in the baseline scenario. Integrated, multi-country, trans-boundary responses are necessary to address the threats to the river system, and to address their underlying causes.

The rivers and their tributaries cover almost all of Armenia and Azerbaijan, and a sizeable part of the populated and urbanized parts of Georgia. The waters in the rivers are therefore essential to sustainable development of these three countries. Whereas they are less crucial, at a national level, to Iran and Turkey, they are nevertheless important to the economy and communities living in the catchment areas. The South Caucasus have been identified by Conservation International (CI) as one of the world's 25 biodiversity hotspot, and the area identified by CI corresponds closely to the Kura-Aras river system. This demonstrates the

ecological importance and fragility of this area. Notably, the Aras is home to one of the last natural sturgeon breeding grounds, there are important and unique dry-land riparian forests along the Kura, and the delta where the Aras and Kura rivers flow into Caspian contains many important wetland sites. The Caucasus region is also well known for its diversity of natural landscapes, climate, unique and ancient cultural heritage, archaeology and ethnography.

b. Types of floods, examples of recent flood events and vulnerability factors. In territory Azerbaijan exists various types of flooding. The larger river systems of Azerbaijan include the Kura, Araz, Qanix, Rivers of theKura-Araz Basin, and the main rivers of the Samur and Astara River Basins. Their floodplains can be categorized as having flat gradients and meandering, relatively stable, waterways. Their natural floodplains are extensive and flooding prior to flood protection works would be prolonged for periods of weeks and months. Many of the tributary rivers in Azerbaijan also have large catchments and extensive natural floodplains and these are characterized differently by their steeper floodplains that have a network of diverging waterways and relatively active alluvial processes. The headwaters of these tributaries rise in the mountain ranges and are termed mountain streams. Their floodplains are characterized by very steep slopes, diverging waterway networks, highly active and unstable waterways and incorporate the distinctive convex debris cones where the upper streams join their alluvial plains.

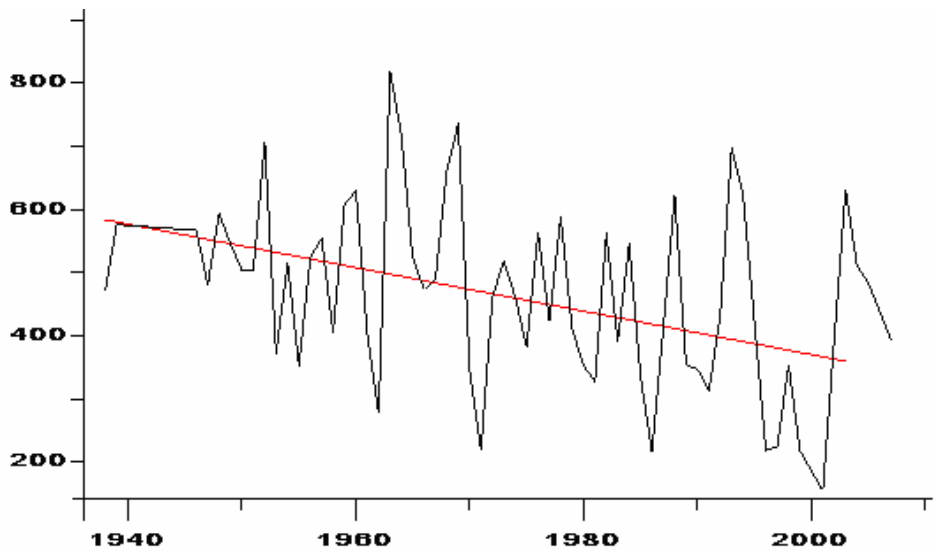

Fig. 2. Yearly flow (m^3/sec) and tendency of Kura river (Salyan st.).

Features of a hydrological mode of the rivers of republic are in detail investigated by S.Rustamov [5]. Conditions of formation of the maximal charges of water of the rivers not only Azerbaijan, but also all Caucasus have been in details studied by M.Mamedov [2].

Peak flows of the large rivers and their larger tributaries are caused by combinations of snow melt and widespread rainfalls in the upper catchments and occur typically in late spring from April to June. Mountain stream and tributary floods which occur mostly in the period from April to October can coincide with Kura floods but this is not always the case. The total catchment of the Kura-Araz basin is approximately 198,300 sq. km (USAID, 2006) and Azerbaijan, including occupied territories, occupies approximately 33.2 % of the area of this basin. In the figure 2 is yearly flow (m^3/sec) and tendency of Kura river.

In the beginning of April of 2003 year, as a result of intensive snow thawing, accompanied loss of rains, charges of water on the river have sharply increased and flooding was observed. On 6-th of May, in the lowlend watercourse (in area Neftchala, fig.3.) water has overflown banks and having broken through a protective dam, has flooded agricultural fields. In May of 2006 year as a result of flooding the city of Shirvan in the bottom watercourse of the Kura has been flooded

Fig. 3. Flooding village in mouth area of Kura river

According to stationary hydrometric measurements outstanding floods in river basin Araz took place in 1936, 1938, 1946, 1951, 1963, 1968 and 1969 years. In April, 1968 the catastrophic flooding caused intensive snow thowing and loss of showers was observed. For April, 16-18th in pool Araza 50-100 mm of deposits have dropped out. The peak of a high water has been fixed on April, 18th and 19. Low sites поймы by width up to two km as the channel was unable pass a plenty of water have been flooded.

In various references it is underlined the flooding which are taking place in floodplain Araz in the last century. There are data on flooding 1858, 1868, 1879, 1896. During strong flooding the river Araz changed the channel. Such changes were observed during flooding in 1858 and 1896. The figure 4 shows situation in the end of 19 centuries Is New-Araz lake - river systems.

Figure 4. Situation in the end of 19 centuries Is New-Araz lake - river systems

Flow frequency information for large rivers was derived from project reports and is included in Table 1. The Kura River “flood of record” in recent memory was a flood in 1969 and is assessed by the above analyzes at close to the 1 in 100 year flood in both the Araz and Kura Rivers. Following some improvements in 2003, the Kura River dike system downstream of the Araz junction has a design capacity of 2000 m^3/sec or between a 1 in 20 and a 1in 50 year flood. However, this system has not been tested against such a large flood. The capacity of the Kura River dike systems upstream of Sabirabad is stated to be between 700 and 1,000 m^3/sec (Source, AAIC) and the probability of occurrence of these flows is not available.

Additional information on the flood hydrology of the mainstream rivers is presented in Figure 5 and table 1. This figure shows the basic variability of the hydrology of the Kura River on a monthly basis and how tributary inflows, reservoir operation, extractions for irrigation, and Araz inflows combine to form the total flow at Salyan.

Table 1: Available Flood Data and Analyzes for Large Rivers

	Peak Flow (m3 sec-1)								
Average Return Period (years)				**4**	**10**	**20**	**50**	**100**	**1000**
Annual Exceedance Probability, %				**25**	**10**	**5**	**2**	**1**	**0.1**
Year		**1969**	**2003**						
Location		**Catchment area (sq km^2)**							
Kura River									
Qiragkesemen	37,000	na	1715						
Inflow to Mingechevir	a	na	na	1,900	2,200	2,400	2,620	2,780	3,500
Before Mingechevir (1953)									
Kura R at Surra (before Mingechevir)				2,130	2,480	2,710	2,990	3,190	na
Kura R at Salyan (before Mingechevir)				2,150	2,580	2,870	3,220	3,470	
Kura R at Surra		2680	1,648						
Kura R at Salyan	188,000	2,350	1,600	1,280	1,606	1,862	2,150	2,458	na
Kura R at C.B. Bank		2,160							
Araz after Araz headworks									
Araz River at Karala (1)	46,000 approx.	1,690	na		769	1,187	1,349	1,509	
Araz River, Araz headworks inflow					1,100	1,260	na	1,650	2,260
Araz River at Giziwang (1)		2,230	na	na	1,298	1,577	1,784	1,990	
Araz River, Saatli	100,000	2,600/ 2,700	869	604	803	950	1,170	2,071	2,545

na- information not available, (1) from Nespak, (2) approximate

In Azerbaijan flooding are observed basically on the rivers the Kura and Araz Figure 6 shows records of Kura and Araz Rivers for April and May 2003 during a period of significant flooding. The extended duration of large flows is highlighted and is claimed to be the cause of drainage difficulties and associated flooding during those months. It is indicated that for a considerable part of the time, the flow was below the peak value that occurred in early May 2003 and there was opportunity to discharge external accumulated floodwaters or more tributary flows, had suitable works been in place. Examination of the data reveals:

- discrepancy between the Surra and Salyan flows late in May 2003 is noted (Salyan minimum flow is less than Surra minimum flow). Part of the difference may be irrigation abstractions but the more likely cause is a change in the rating curve during the flood event or errors in the rating curve for one or both locations for lower flows (Salyan too low or Surra too high);
- volumes recorded at Yevlakh in April and May of 1,900 km3 compared with 4,900 km3 crossing the Georgian border. The large difference highlights a significant data deficiency that will need to be addressed in flood forecasting. Data is not available for tributary inflows downstream of the border, the change in storage volume of reservoirs (Mingechevir has an active volume of 8,220 km3) and outflows through the irrigation system of the Shirvan and Garabakh canals (potentially 1,300 km3);
- tributary inflows between Yevlakh and Surra, excluding Araz River at Novruzlu, of some 1,800 km3, which must have originated from inflows from mountain streams, drainage return flows and possibly groundwater seepage. The need for inclusion of these inflows in analyzes and forecasting is indicated.

However, not all from annually observable high waters lead to the destructive consequences, many of them do not cause flooding. Catastrophic character of a high water or a

high water can be caused by excessive intensity snow thawing, aggravated by loss of the rains imposed on thawed snow, and also loss in the summer or autumn of short-term storm and intensive rains. In both cases in channels of the rivers the waters which have accumulated from all reservoirs which break through coast do not hold or are poured through them, flooding coastal spaces and bringing frequently a serious material damage to economy.

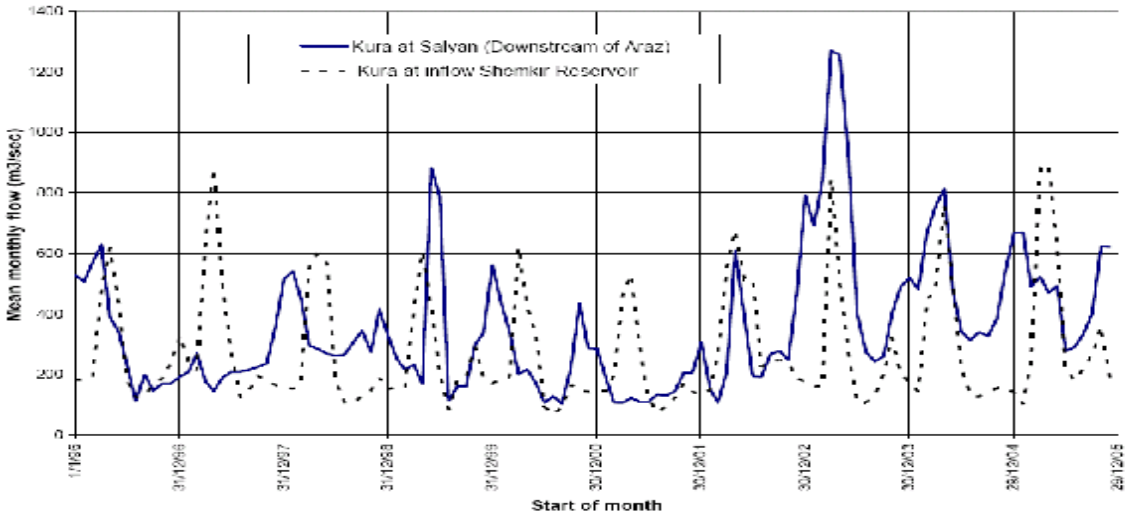

Figure 5. Kura River Monthly Flows

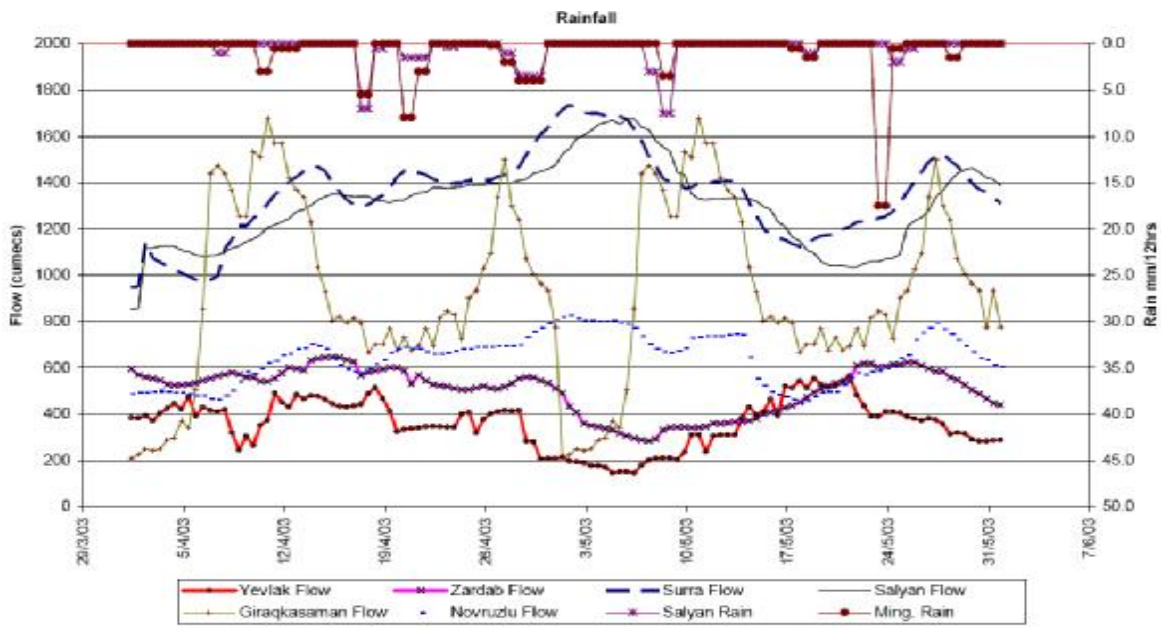

Figure 6. Kura Flood Flows- 2003

Major flooding of the Kura floodplains outside the dikes, as recently as 2003, is believed to have been caused by a combination of local rainfall runoff, seepage through the dikes, accumulated groundwater and possibly some surcharging of the abovementioned spillways that overload the normal drainage system. Based on an examination of flow data and advices received, it appears that there has not been any substantial collapse or overtopping of the main dikes during the 2003 or subsequent floods. Local floodplain drainage is impeded by high river levels in the Kura causing during non-flood conditions and these are caused by combinations of high Caspian Sea levels, channel siltation and regulated flows to supply irrigators in the Water

Farms in the Lower Kura area. Persistent flooding causes damage to agricultural lands and urban areas.

The flood capacity and morphology of the mouth of the Kura River has recently been greatly impacted by a rise in Caspian Sea levels 2.5 meters during 1978-1995 years [3]. Surveys that can indicate the extent of recent situation are not available but situation caused by the sea level rises is likely to be located near to the mouth. Other situation may have occurred along the Kura River due to natural processes.

Fig. 7. Examples of flooding coastal zone in result rising Caspian Sea level.

Apparently the aforesaid, in territory of Azerbaijan there is other type the flooding, connected with rise of a level of Caspian Sea. So during 1978-1995 the level of Caspian sea has risen on 2.5 meter and 400 km^2 of territory of a coastal zone have been flooded (examples are shown in figure 7). The Material damage as a result of this rise and flooding has made 2 billion USA dollars. There were ecological refugees on coastal zones of Caspian Sea.

c. Institutional responsibilities and counterparts across borders. Ministries with the greatest responsibility for water resources management in Azerbaijan are:

- Ministry Ecology and Nature Resours
- Azerbaijan Amelioration and Irrigation Company (AAIC)

These organizations have administrative divisions as well as scientific-research institutes which carry out monitoring of water resources condition, execute scientific-research works and undertake other specified activities and investigations.

Other agencies are involved in devising plans and programs related to water resources protection and use and these include:

1. Ministry of Industry and Energy (water use for power generation)
2. AzerSu (drinking water supply company)
3. Ministry of Health (drinking water quality – health and hygiene)
4. Water User Associations (Irrigators and farmers).

4. The following organizations participate in implementation of scientific-research and other works related to water resources protection:

1. Geography Institute of Academy of Sciences;
2. Azerbaijan Hydraulic and Amelioration Science-Production Unit
3. Azerbaijan Science and Research Water Problems Institute
4. National Committee on International Hydrologic program UNESCO;
5. Environmental NGOs

5. Overall, organizations bearing responsibility for water resources management work in cooperation with NGOs to achieve an integrated approach and involve the public in decision making for water resources management.

6. The main organization in Azerbaijan dealing with control on water use for irrigation is AAIC.

d. Role of water basins in reduction flood risk.

In spite of the fact that during Soviet time solid means for protection against high waters were allocated, still it is not possible to prevent a significant material damage from flooding. Construction of water basins, dams and embankments has improved protection against flooding and has reduced their scales, but other kinds of intervention of the person, such as alignment river floodplains and irrational land tenure have caused strengthening risks and probabilities of the undesirable phenomena. Building and settling in downstream, some of which are located in zones where high waters are frequent, also does many settlements vulnerable for flooding.

In territory of Azerbaijan on the rivers Kura and Araz five large water basins with the purpose of development of the electric power have been constructed (Table 2)

Table 2. Main Characteristics of Reservoirs on the rivers Kura and Araz in Azerbaijan

No.	Names of Water Storage	Built	River Basin	Total capacity, mln.m3	Surface Area SA (km2)	Dam Height DH (m)	Location
1	Varvara	1952	Kura	62.00	21.40	12.00	Yevlakh region
2	Mingachevir	1953	Kura	15,730.00	605.00	80.00	Mingachevir city
3	Shamkir	1983	Kura	2,677.00	115.00	70.00	Shamkir region
4	Yenikand	2000	Kura	158.00	22.61	24.00	Shamkir region
5	Araz	1971	Araz	1,350.00	145.00	40.00	Nakhchivan AR

From time of construction Mingachevir of a water basin at Kura (in 1953) and Araz on the river Araz (in 1970) scales of flooding were considerably reduced. However intensive regulation of a drain does not rescue the population from danger of flooding. The increased frequency of flooding and strengthening of superficial erosion in pools of the rivers the Kura and Araz accelerate filling these water basins and reduces them again flooding effect. So, maximal depth Mingachevir of a water basin has decreased about 83 m. up to 63 m.

Because of absence of the necessary hydrometeorological information from other countries of pool of the Kura, large water basins are maintained inefficiently to what results of flooding in the bottom current of the Kura in 2003 testify

After construction water basin of Araz on border with Iran frequency of flooding has considerably decreased. Construction dam of Xudaferin below on current from Araz dams, probably, has reduced risk of flooding further downstream, but the problem of coastal erosion has remained, and moreover, became even more significant. Approach of the river, especially on plains, has caused intensive coastal erosion. Supervision has shown that there was a displacement of a channel of the river in several places. According to results of researches, the channel was displaced by places on 1 km, causing serious erosion of the grounds on Iranian I protect.

2. Joint flood risk management planning and implementation

a. Information model for the delta of the river Kura.

The natural water volume changes in large intervals (as mentioned above, the water level in 2003 was very high) and additionally the anthropogenic factors in the last years have created great changes in the delta of the river Kura. But for all that, the delta of the river Kura is traditionally registered in the previous maps with three main arms (fig. 5a - map of 1982), which does not meet the actual situation. Aerial views of 1998 and 2000 demonstrate, that the bed of the river Kura, in the lowermost part of the delta (fig. 8, - the space image of 1998), has now changed considerably. Therefore, for observations and analysis of the factors influencing the changes of the bed of the Kur-delta, the information set model «Delta of the river Kur » was constructed by us. The significant part of the model is the possibility of integrating the data of remote sensing, the geographic and cartographical information, to obtain the reliable information about the conditions of the delta in different periods of time and to forecast for the future. The

Methodology of the model is shown in the figure 9, its detailed definition is given in article (Mamedov et all., 2003.). All data are submitted in the base cartographic projection (UTM, WGS 84, zone 39). For this reason they are comparable in time-space aspect.

Fig. 8. Aerospace filming of a delta of the river Kura in 1998

Analysis of the information. The lowermost region of the Kur in structural relation corresponds to the homonymous synclinal basin and the relief is characterized by the accumulative forms of relief. Subregion of lower part of the delta of the river Kura is completely accumulative formation. Now, the volume of a firm sink is no more than 10 million tons a year. After intensive rise of the Caspian Sea level begun in 1978, ¼ of the delta was affected by aggradation.In the last years, as a result of abrasion and flooding of low parts of the delta, its area was reduced almost twice. At the present, the process of abrasion is continuing in the front part. And half of the northern shore (Fig.8) is also subjected to abrasion. Except the deficit of drift deposits, this influences the depth of the bottom (a lot). Naturally, the intensive raising of the sea level has aggravated dynamic processes.

In 1980, as a result of prolonged abrasion and the rise of the sea level about 0,5 m, a small strait was formed at the narrowest part of the spit (Fig. 10; a and b.).

At the present, the most part of the southern half of the fading was flooded by the sea. One third of the part of its area was kept/ is left . A small amount of material entering here from the abrasive area accumulatesin the shallow-water zone. At the beginning, the width of the strait was equal to 2 km, but now the width of the strait is more than 10 km. The depth is 3,5 km (Fig. 10; a) and b).

The fact shown in the figures 10 a and b is a result of intensive rise of the sea level and wash of its shores by currents running through the strait into the Gizil-Agach gulf. Because of the weak current of sediments in the area of the spit-shore, the reunification of its two parts is unlikely the result of a 1-2 m sea- level fall.

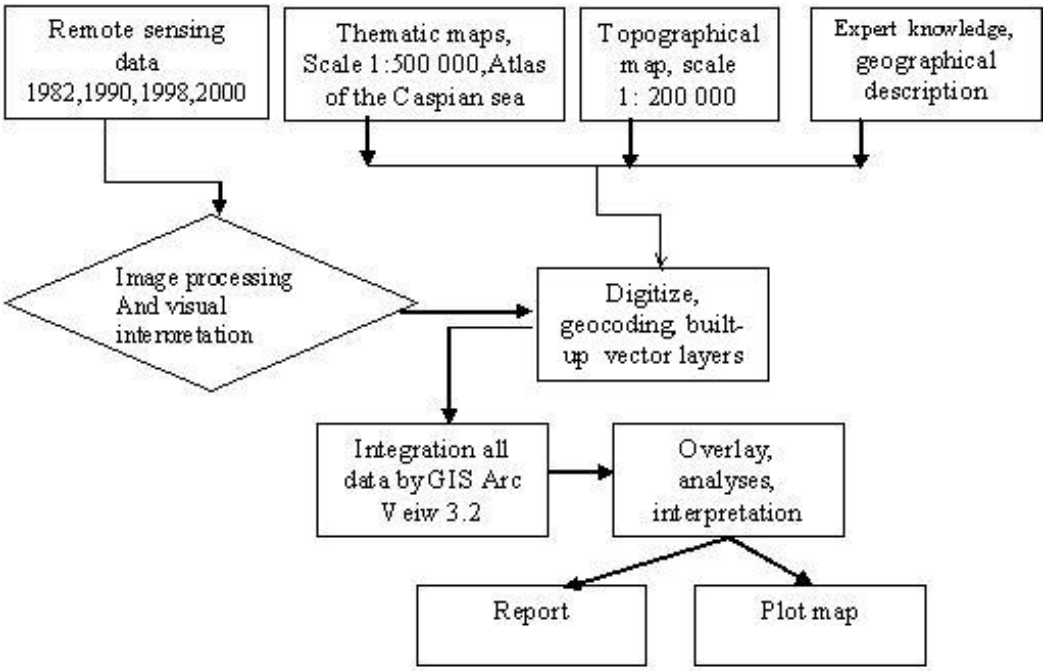

Fig. 9. Methodology of information model of a delta of the river Kura

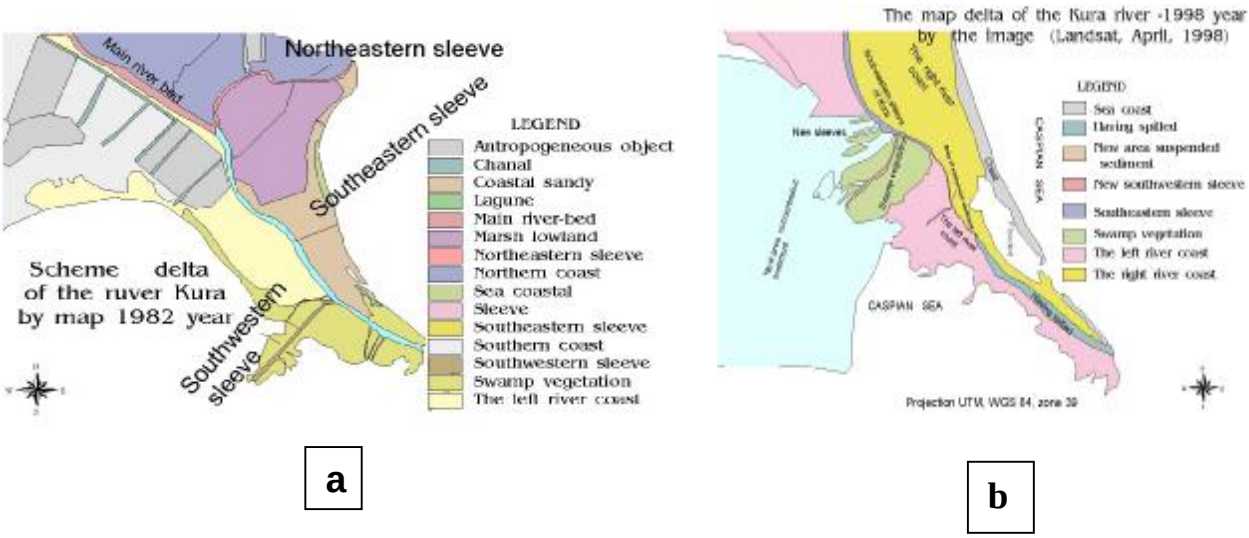

Fig. 10. The scheme of change of a water area of a near-shore area of a delta of the river Kura: a) and b) layers accordingly imaging the information on a condition of basin of a delta of the river Kura as of 1982 and 1998 years.

b. Internal activity for reducing flood risk.

Lack of knowledge does not allow to make a full estimation and the universal analysis of influence and consequences of flooding. It is necessary to note especially mentioned below:

Insufficient amount of stations of hydrological monitoring and inefficient data exchange between the coastal countries;

Absence of the authentic and effective forecast of flooding. Existing approaches do not meet modern requirements. The out-of-date technologies and the equipment are used.

Absence of data about frequency and scale of the flooding which have happened for last twenty years in view of an inefficiency of systems of hydrological monitoring, i.e. it is impossible to estimate influence of global warming;

Flooding is a natural phenomenon which will happen and in the future even if anthropogenous influence will be shown to a minimum. The unique way to cope with this phenomenon consists in creation of effective system of the warning which will allow to lower damage from flooding and to soften their influence on an environment.

For warning of flooding and their reasons investments which should be directed first of all on rehabilitation existing systems are required. In addition to it is necessary to develop strategy on management of risks of flooding, and also national and regional plans on universal rehabilitation противопаводочных systems in all pool of the Kura.

In Azerbaijan, as well as in other countries of pool of the Kura, there is an experience of prevention of flooding by means of structural measures, i.e. engineering constructions (water basins, dams, coast constructions, etc.). Unfortunately, not enough attention is given not structural measures (an early warning system, forecasts of flooding, insurance upon flooding, etc.).

The estimation and development институциональных, technical systems at a national and regional level is the major step to development of long-term strategy of prevention of flooding in Azerbaijan.

c. Regional cooperation and joint activity

The total available water resources from rivers in Azerbaijan averages 31.23 km³/year, whilst in a drought year (95% probability, or 1 year in 20), the available water is reduced to about 20.3 km³. However, only about 10 km³ (30% of this water) originates within Azerbaijan, whilst the remainder is obtained from trans-boundary inflows.

Azerbaijan is concerned about its position relative to other countries sharing the Kura-Araz river basin. The Government has signed a number of international conventions covering international watercourses and water bodies (lakes), but has not developed specific agreements with neighboring countries on freshwater in recent years. An agreement, dating from the Soviet period applies to the Araz River between Azerbaijan and Iran, and a further agreement has been made between Azerbaijan and Russia for the Samur River.

Azerbaijan became a signatory to the UN ‘Convention on the Protection and Use of Trans-boundary Watercourses and International Lakes’ in March 1992, but neither Georgia nor Armenia are signatories because of the potential implications from the “Convention for Upstream Pollution”.

Table 3. List of Regional Projects Related to Water Management in Kura river basin

Title of project	Organization	Period
South Caucasus Regional Water Management Project	USAID	2000-2002
Synergy	USAID	began in 1998
Joint River Management Programme	TACIS	2001-2003
Regional Environment Center	EU-TACIS, USEPA	began in 1999
Kura-Araks Coalition NGO	Giorgi Dzamukasvili	began in 1997
Cooperative River Monitoring among Armenia, Azerbaijan, Georgia and the USA	NATO Science for Peace Programme	2001-2005
Reducing Transboundary Degradation of the Kura-Aras River Basin	GEF	2005-2007
Supporting River Basin and Flood Management Planning Project	Asian Development Bank, Republic of Azerbaijan	2007-2008

It is proposed that Azerbaijan seek to establish working agreements with all neighboring countries, using the WFD and RBD principles as the basis for dialogue and the mutual introduction for good governance of shared water resources. Appeals should be made through international water management organizations to help bridge the divide between countries, by stimulating technical discussion and cooperation, as a prelude to concluding eventual political and internationally recognized agreements for effective management of internationally shared water resources.

d. Conclusions and suggestions:

The flood hazard may be changing due to a combination of complex factors but in places the data is insufficient and the available data has not been comprehensively analyzed to indicate the most likely cause of the changes or to identify options for their rectification. Dikes have been raised since the last major flood in May 2003 but this has not addressed the issue of dike leakage during prolonged floods and difficulties in draining the floodplain outside the main dikes still exist. Development on the floodplains has increased and no data is available to indicate which areas are at risk what would be the consequences of potential failures of the dike and reservoir systems. The vulnerability of some existing communities is unknown but it could be very high given a potential lack of awareness to the real flood risks.

It is suggested that effective solutions to flooding problems along the Kura River cannot be addressed unless and until the above issues and others are resolved. This is not to advise that all improvement works should cease but to advise that expenditure on investigation and analyzes should be greatly increased to better inform future decisions.

The following recommendations are made to progress the interests of Azerbaijan in relation to international watercourses. In the short term in relation to Georgia, initiate establishment of cooperation forum at political level with view to develop an agreement on water resources of the Kura River;

- establish forum with ministers as representatives,
- agree with Georgia on forum support arrangements,
- identify supporting unit in Azerbaijan,
- present issues of concern for further discussion,
- initiate data and information exchange arrangements

In the short term in relation to Armenia, investigate monitoring requirements and act to strengthen monitoring capacity for water quality in the lower Araz River and western tributaries of the Kura River.

In the longer term in relation to Georgia, continue cooperation arrangements as follows:

- establish coordinating arrangements at technical and operation level,
- develop real time warning systems as required,
- agree notification procedures,
- develop agreement on waters of the Kura River.

In the longer term in relation to Iran, if assessment of flood impacts shows potential for significant further flooding in Azerbaijan:

- propose cross-border flood study,
- agree study results to be used as benchmark for further action,
- agree principles for further flood protection schemes, based on minimization of impact by both parties.

Literature

1. ADP, Technical Assistance Consultant's, Report Republic of Azerbaijan: Supporting River Basin and Flood Management Planning Project, Project Number: 3508102 (TA 4301) January 2008, p.75.
2. Mammadov M.A., Estimate of maximal discharge of the mountain rivers. Hydrometeoizdat, 1989, p. 184.

3. Mammadov R.M., Hydrometeorogy changebility and ecogeoraphical promlems of the Capian Sea, 2007, Issue Elm, p.474.
4. Mammadov R.M., Mansimov M.R., Ismatova Kh. Transboundary water problems in the Kura – Araks basin, NATO Advanced Research Workshop "Transboundary water resources: strategies for regional security and ecological stability, Novosibirsk, 2003, p.93-108.
5. Rustamov S.G., Kashkay R.M. Water resources of Azerbaijan, Baki, «Elm», 1989, 182 p.
6. USAID, South Caucasus Regional Water Management Project report, 2006.