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FLOOD MANAGEMENT IN AZERBAIJAN

Summary

This report examines the issues of hydrological basis and methods of flood management in the rivers of Azerbaijan and presents a review of methods of flood management applied in Azerbaijan.

Key words: flood, flash flood, flood management, mud-flow, reservoir

INTRODUCTION

Floods and flash floods pose significant threat to the population of Azerbaijan. Floods are observed mainly in the basins of transboundary rivers of Kura and Aras. They generally come out of the shore and vast territories appear under the water. Economic loss caused by flood amounts to many million dollars (economical loss was 65 million dollars at the downstream of the Kura in 2003). [Imanov et al, 2009]

In the basins of mountain rivers often occur floods and mud-flow. For flood management with a view of minimizing the damage caused by them, data of long term cycling of maximal water flow is required. This work examines hydrological aspects of flood control in Azerbaijan. With this view assessment have been made of homogeneity of maximal discharges of water, established the patterns of cycling and synchronism, linear trends are revealed and combined method of maximal discharge computation was realized considering precipitation. [Burn and Hag, 2002; Imanov et al, 2009; Svensson et al, 2004]

For assessment of homogeneity of maximal discharges of water the criteria of Fisher, Student and Wilcoxon, and for assessment of sharply different extremes – criteria of Dixon and Smirnov Grubbs have been applied. Conducted analysis of statistical structure of long-term samples of Azerbaijan mountain rivers' maximal runoff has shown that for some samples (29%) hypothesis is refuted.

According to differential cumulative curve, analysis of cyclicity of maximal flow of rivers in Azerbaijan has shown that it is characteristic for explored layers almost same cyclic components with periods of 4-16, 30-50 years.

For examination of the level of synchronism of the long-term cycling of maximal river flows of Azerbaijan, integrated-difference curve was used and matrixes of paired correlation coefficient were calculated. It was identified that synchronism of maximal river flow in Azerbaijan is weakly expressed.

It was revealed that sum of maximal river flow through regions of Azerbaijan has a tendency to decrease.

Calculation of maximal flow is the basis of long term measures for preventing floods. As an example, basing on long term data of hydrological observations and rainfall of of rare recurrence time, calculation of maximal water flows for rivers of the basin of Ganikh, where maximal water flows are formed by rainfall was made. It was shown that similar approach is quite effective in calculation of maximal rain flows of mountain rivers.

Inadequate knowledge hinders full assessment and comprehensive analysis of the impact and the result of floods and mud flows. It is important to mention following reasons:

- Inadequate number of hydrologic monitoring stations,
- Inefficient share of data among country of Kura basin,
- Absence of reliable and effective prognosis of flood and mud flow,
- Use of an old technology and equipment.

FLOOD MANAGEMENT

In Azerbaijan as in other countries of Kura basin, flood prevention practice is made with the use of structural measures, that is engineering constructions (reservoirs, dikes, coast-protecting structures and others). Unfortunately very little attention is paid to other non-structural measures (system of early warning, flood prognosis, insurance against floods, afforestation and so on). [Imanov et al, 2008), *Flash floods in arid and semi-arid zones* (1999).]

RESERVOIRS

After the postwar years, with regulating flow and irrigating arid lands in Azerbaijan, more than 100 reservoirs were established. Total area of all the reservoirs is more than 1070 km^2. Bigger ones are Mingachevir, Shamkir, Aras, Yenikend, Sarsanq, Jeyranbatan. Reservoirs in Azerbaijan are mainly used for irrigation and irrigation-energy purposes.

Before the construction of Mingachevir reservoir, water was every year coming out of the banks and flood big agricultural households and settlements in

the spring-summer snowmelt flood period at the Kura-Aras lowland. Construction of big reservoirs on the rivers Kura and Aras and their tributaries have almost fully changed the Kura river at its downstream reach. Since the construction of Mingachevir (1953) and Shamkir (1982) reservoirs at the river Kura and Aras reservoir at the river Aras (1971) the flood scale has been significantly decreased. [Imanov et al (2008)]

The decrease of maximal flow, occurring at the cross section below the Mingachevir reservoir on the Kura river was 41-59%. The impact of Mingachevir reservoir has affected the flow regime also in mouse of Kura river (decrease of flow by 38%). A decrease of maximal flow at the cross section below Aras reservoir also appeared to be significant, constituting nearly 48-52% of the flow in natural conditions.

REGULATION OF RIVER BASIN

Regulation of the basin of river to decrease the surface of flow is one of the effective methods of struggle against flood. In Azerbaijan this method is not quite used. As an example we may note the avulsion at the mouth of the new course of Kura river.

Last years in the mouth of Kura 2 branches appeared: north-eastern branch and south-eastern branch. The main branch was fully silted and stopped its functioning. Main volume of flow in the period of snowmelt flood was running into the sea through narrow north-eastern branch (more than 50%). After 1993 high-water below the station of Mayak-1 avulsion of river appeared with several branches at the south-western direction near to the Zyud-Ostoviy-Kultuk.

Flow of the Kura river falls into Caspian sea through south-eastern branch and partly through the main channel into the gulf Zuyd-Ostoviy-Kultuk with the help of 12 branches, formed after flood in 2003. Through these branches, up to 30% of flow volume was passing in the period of snowmelt flood time . The remaining part of the water flooded the mouth area of river, spreading in the south-eastern and south-western directions.

As the result of rise of the level of Caspian sea and raise of Kura river flow, the branches were not able to deal with the passage of big amount of water flaws. That is why, in the mouth of the Kura river in the Neftchala region settlements, villages, and cultivation areas were being flooded. Furthermore, in connection to silting the main channel of the Kura river, the buffer area of the fresh water in the Caspian sea was decreased and valuable fish species were not able to come to spawning in the river Kura for spawning season. This was hindering the fishery.

As a result of no river dredging work being undertaken in the main course of the Kura river, decrease of flow speed and silting of the main course occurred.

To establish ecological balance in this area, there was a need for recovery and cleaning work in the main channel of river Kura. In this regard, to prevent the adjoining areas and cultivation lands from flooding and to ensure the safety of population, a project was offered. This project envisaged increase of the fresh water area of the Caspian Sea which could promote the further development of the fish sector. At the same time it could create conditions for restoration of ecological balance in this zone. There was suggested several variants of projects. At the result in 2006 there was realized one of these optimal projects. According to this project, there were envisaged floor deepening work at the main course, break of the new course from the left side of main course and deepening work in the sea.

Construction of reservoirs and dikes also aimed at flood regulation. At the river Kura Mingachevir reservoir allowed to promote the situation in this regard at the lowland regions of the Kura. Besides, at the downstream from the confluence with Aras floods occur often, which is caused by both the increase of water level in the Caspian sea and subsidence at the bottom of the river channel. Recovery and cleaning work in the main the channel of river Kura conducted in 2003 allowed to weaken the impact of the floods in Salyan and Neftchala regions.

For providing passage of the water in the spring 2004 there was made a channel 50 meter wide, with passage ability of 250-300m^3/s, parallel to the north-eastern channel as a first measure.

STRENGTHENING RIVER BANKS

The land resources in Azerbaijan require significant protection and improvement. In the mountainous and near-mountainous areas bottom lands are more subjected to the destructive impact of water erosion. Significant areas of the bottom lands are each year subjected to silting, water- and mud-flooding. Besides, there are many industrial and agricultural objects in the bottom lands, requiring engineering protection from flood and mud-flow destruction.

70000-hectare bottom lands and about 104 settlements are subjected to flooding. The length of the walls of bank protection buildings in the Republic is 555 km. Most of them are situated next to the rivers of the south side of the slope of Big Caucasus (42310 hectare of bottom lands and 48 settlements). Total length of the coast-protecting structures is 233 km, 130 km more is to be built.

As a result of activation of bed-movement, protective-regulative structures existing now in the mountainous areas of the Republic do not answer the high requirements in mastering flood-lands. Neither by number, by constructive characteristics, nor by the level of exploitation. Their traditional components and constructions with the use of critical metals and cement are considered to be

nonefficient, what requires scientific research and development of construction, components and technology of building using the local riverbed building materials.

Protection-regulation constructions reliably protect agricultural objects, settlements, industrial, agricultural, roads and other buildings.

CLEANING RIVERBEDS FROM SILTING

Because of the rise of the level of the Caspian Sea in 1978, the accumulation process of the river drift in the delta of Kura has accelerated while themaximal discharge of the water decreased during years 1995-2001. Due to that, the washout of the drift practically is not happening in natural way. To create conditions for shipping in the mouth area of Kura, prophylactic riverbed deepening works have been undertaken. In the end of 1980, these works ceased. For this reason, the process of accumulation was sharply enhanced in the mouth of the Kura river, silting in the main course incresed and the passing ability of the river from Salyan to the mouth decreased. Beginning from May 2002 the situation started to change – maximal discharge of water in the cross section in Salyan rose (800 m^3/s) and flooded the area surrounding the mouth. The flood in the downstream reach of Kura in May 2003 destroyed the protection dam and flooded the agricultural area in the Neftchala region.The cleaning work of the main bed of river started. In spring 2004 the situation in the mouth of the river was repeated on a smaller scale.

Annual riverbed deepening works in the Bala Kura branch and the sea were undertaken (2008, 2009) for prevention against silting of the new course of the Kura river by the Joint Stock Company of Melioration and Water Economy. These works are planned to be undertaken also in 2010-2013. Also, in the riverbeds deepening works and reconstruction of protecting embankments are planned for 2009-2012.

FLOODWATERS TRANSFER

The main aim of transferring flood waters to special places is to decrease flood peak**.** This method is not used in Azerbaijan.

UNIFIED MANAGEMENT SYSTEM

Unified system of control decreases the adverse influence of floods and partly prevents them.

Ministry of Emergency Situations (MES) is executing functions resulting from emergency situations in Azerbaijan. This Ministry was established on the base of the Commission for Emergency Situations at the Ministry. Its functions

also include ensuring the control of floods in emergency situations. Currently MES's functions include: development of local flood warning system, assistance according to local conditions, planning of reconstructing works after flood and others.

According to new law, MES responsibilities during floods and after them include control of work during emergency situation. Decrease of the cycle of floods with the help of reservoirs in emergency situations is one of the measures of flood prevention. Adopted structure of regulation of emergency situations in Azerbaijan is almost the same as SFCHQ in China, FEMA in USA and EMA in Australia. That is, all of serious forms of emergency situations are considered at national level, calculation is done with consideration of maximal risk and according preparation is undertaken.

DEVELOPMENT OF SYSTEM OF FORECASTING AND MANAGEMENT

Developing a system of forecasting and management is one of the important non-engineering methods. It is considered to be the cheapest method in struggle against natural disasters.

In National Department on Hydrometeorology forecast of snowmelt floods and floods are given based on snow stocks and precipitation. These forecasts are delivered to all the interested and state bodies.

The short-term forecasts of heavy rainfalls are of great importance for a prediction of rain floods and flood phenomena. This forecast is necessary for the timely warining to the population and corresponding state bodies about dangerous natural disasters. Existing methods of forecast are not sufficient to solve this problem with enough reliability.

The automatic control system (ACS) of radiolocation observations was formed in the Agstafa experimental polygon by the National Department on Hydrometeorology of the Ministry of Ecology and Natural Resources with the use of a MRL-5 radiolocator with application of modern programmes. ACS can contribute to traditional methods of forecast of precipitation and will enable to solve this challenge on the basis of modern technological means.

An advantage of the method is the opportunity of simultaneous supervision over all flood reservoirs and flash flood areas, located in the range of ACS-MRL. The system performs a round-the-clock work of automated MRL and when a significant threshold quantity of precipitation is reached, it can notify the population and the state bodies about floods of downpour origin very early.

For the period 2001-2008 there were made forecasts according to this method of powerful floods and flows in most of river basin of the southern slope of the Big Caucasus and a north-east slope of Small Caucasus with high precision (80-90 %) and earliness (3-6 hours).

AFFORESTATION

It is possible to reduce the flood threats and erosion by means of afforestation. Forest plays important role in formation of flood. Deforestation is one of the factors promoting frequency of flooding and the maximal discharges. Afforestation of a basin can reduce flood peakflow, what results from decrease of intensity of snow melting and increase of concentration time. The impact of forests on the maximal discharge of water is not studied, because of lack of water-balancing and experimental stations at the studied territory.

In all countries of the Kura basin intensive deforestation occurred.

FLOOD INSURANCES

Azerbaijan is one of the countries of the world where natural disasters cause loss to the economy about 20-30 million US dollars, and in some extreme years (2003-2004) - more than 60 million US dollars. The damage caused is partially covered by the state. Although the state partially covers the damage caused to citizens as an assistance, it cannot compensate completely all losses. Unfortunately, natural disasters in Azerbaijan, emergency situations and damage caused by them draws little attention of insurance companies.

CONCLUSIONS

The main conclusions are following:

– Annually observed flood, flooding and mud-flow cause significant material damage to the economy of Azerbaijan;

– There is a hydrological base for flood management.

– There exists a developed infrastructure created for flood management.

– Non-engineering methods of reduction of flood risks are practically not developed.

– It is necessary to establish a modern system of flood control, including both engineering and non-engineering methods.

Assessment and development of institutional and technical systems at national and regional levels are a significant step towards development of long-term flood prevention strategy in Azerbaijan

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