The Mountain Water Reservoirs Influence on Meteorological Conditions of Coastal Area

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Abstract

Considering actuality of a problem of climatic factors influence on development of agricultural grades the results of the Nurek reservoir influence on meteorological parameters of three agricultural regions of Dangara, Fayzabad and Yavan of the Republic of Tajikistan are presented in this paper. In mountain districts, as usual because of the heights processes of reflection influence, a deviation of the directed movement of air masses are observed. Consequently, existence of the developed network of meteorological stations in mountain districts is pledge of receiving a real scenario of meteorological parameters dynamics. Timely establishment of the weather conditions variations and development of adaptation technology to the modern meteorological conditions and selection of agricultural grades steady against changes of climatic factors and stressful situations pledge of ensuring food security.

Keywords: Reservoir, Impact, Agriculture, Adaptation, Mountain.

1. INTRODUCTION

In the Aral Sea Basin, on the territory of which five states are located, water resources are used generally for an irrigation and hydropower. These water users demand the different modes of a river drain regulation. In interests of hydropower – the greatest power generation and, respectively, the use of the most part of the rivers annual drain in winter- the cold period of year. For an irrigation, the greatest volume of water is required in the summer, during the vegetative period. Regulation of a river drain thus is carried out by the large reservoirs. Thus, all largest hydroelectric power stations are constructed in the republics of a formation zone of a drain in upstream of the Amu Darya and Sir-Darya Rivers – in Kyrgyzstan and Tajikistan. The main areas of the irrigated lands are located in the republics of the rivers downstream – Kazakhstan, Turkmenistan and Uzbekistan.

The question of a river drain regulation in the region and construction of large reservoirs as Kayrakkum, Nurek (Tajikistan), Toktogul (Kyrgyzstan) and Tyuyamuyun (Uzbekistan) in Central Asia arose from the 1950th years in connection with development of the irrigated agriculture.

What are the possibilities of this problem solution? Cardinally resolution of conflict between an irrigation and hydropower is not restriction of activity some one of them or submission one another, and on the contrary, their greatest joint development by construction of new large hydroelectric power stations with reservoirs of large volume. For hydropower it means the increase in production of cheap and environmentally friendly energy, for an irrigation – the increase of depth of long-term drain regulation and water security of already developed lands.

Existence of several water-engineering systems with reservoirs will allow to resolve contradictions between hydropower and an irrigation. Today the conflict between them arises because in basins of each of two main rivers of the Region-Sir-Darya and Amu Darya the only one large water-engineering system with a reservoir is available: on Sir-Darya – Toktogul in Kyrgyzstan, on Amu Darya – Nurek in Tajikistan. The only a large water-engineering system on the river cannot carry out a drain regulation at the same time in two modes – irrigational and power.

Construction of one larger water-engineering system on each of two rivers will cardinally change a situation. In this case, the reservoir, top on a flow will be able to work in purely power mode; the lower reservoir of the same volume will be able to overregulate a drain up to restoration of its natural mode. Especially it can provide a drain regulation in interests of an irrigation. The presence of numbers of water-engineering systems with reservoirs will improve the situation even more [1].

The Republic of Tajikistan possesses 527 Billion kWt·h the general potential hydroenergy resources but now more than 5% are used [2]. Therefore, to expect that in near future not one tens averages and large hydroelectric power stations with reservoirs will be built. It means that at planning of the agriculture perspective development of coastal areas to reservoirs it is necessary to consider a factor of the water reservoirs influence in

transformations of meteorological conditions of the district and introduction of adjustments to norms of the corresponding cultures irrigation.

According to [3] direct influence of reservoirs on meteorological parameters of nearby areas is felt at distances some hundreds of meters and in the direction of a wind such influence can be registered at distances more than 10 km.

2. METODOLOGY AND BASIC DATA

The purpose of the present research is the retrospective comparative analysis of statistical parameters of 60-year temporary temperature ranks, atmospheric precipitation and humidity and monitoring of the Nurek reservoir influence on a trend of change of these parameters.

For establishment of the mountain reservoirs influence on possible changes of Agroclimatic conditions we analyzed a trend of meteorological parameters of two regions of Dangara and Fayzabad of the Republic of Tajikistan with the developed agricultural branch coastal to the Nurek reservoir. The meteorological data of the 1950-2012 period of stations located in areas of researches are used.

Construction of the Nurek reservoirs begun in 1961 and in 1979 reached water level of 890 m. The mark of NPU of equal 910 m was reached in September 1983. Therefore, it is possible to consider that of a reservoir influence on meteorological parameters of the district has to be felt after the eightieth years.

For removal of other factors, a method of the analysis of spatial differences was used. If physiographic conditions do not change strongly, spatial differences between two couple's stations are steady sizes (in a long-term section). On change of spatial differences of two couples' stations one of which is located in the sphere of a reservoir influence, it is possible to estimate the effect its influence. An indispensable condition of the analysis - duration of the meteorological parameters number before and after construction of reservoirs.

3. RESULTS AND DISCUSSION

The studied areas coastal to Nurek reservoir are located in a radius up to 35 km around of reservoirs and at various heights from sea level and altitudes: Fayzabad (1215 m a. s. l, 38º15' N, 69º32' E), Dangara (660 m a. s. l., 38º10' N, 69º32' E), Yavan (632 m a. s. l., 38º 32' N, 69º05' E).

It should be noted that for the period 1950-2012 the change of temperature in all three areas has the increasing character without manifestation of any deviations or extreme after 80-their years testifying about influence of the Nurek reservoir.

Comparison of the temperature change before construction of the Nurek reservoir shows various trends of the temperature increase for the considered districts (Fig. 1). For example, if the temperature changes in the districts of Fayzabad and Dangara up to1980 is fluently but after 1980 increase of temperature gains abrupt character (Fig.1).

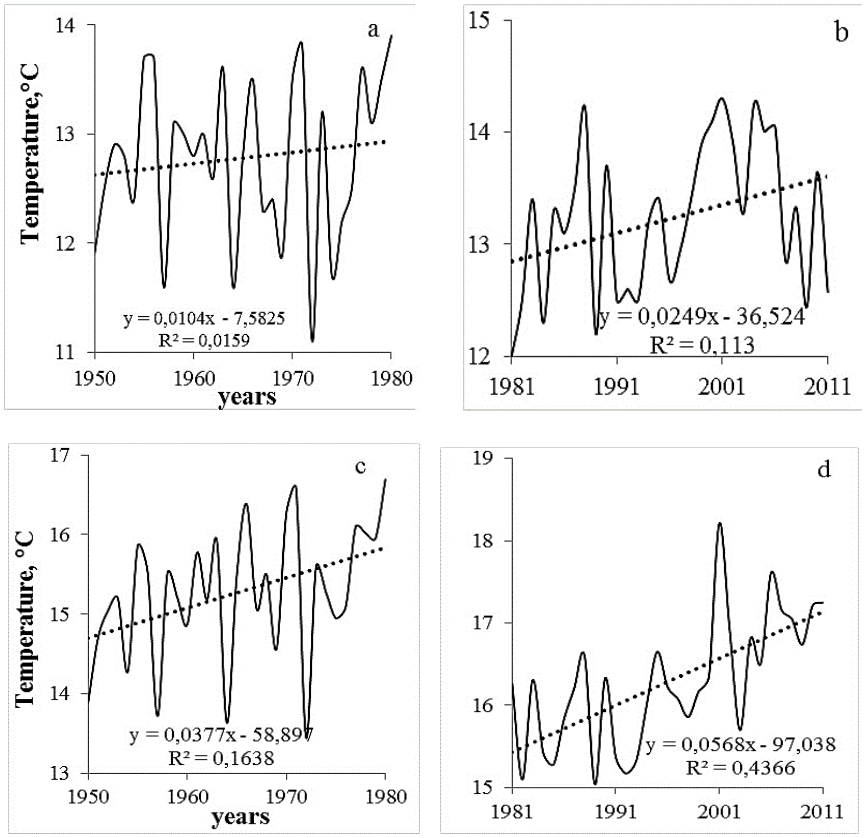

Figure 1. Trend of change of temperature of Fayzabad and Dangara districts before (a, c) and after (b, d) construction of the Nurek reservoir

Thus, exactly the opposite temperature changes are observed in Yavan district. A trend of change of average annual value of temperature before construction of a reservoir more abruptly and replaced on fluently after 1980 (Fig. 2 a, b).

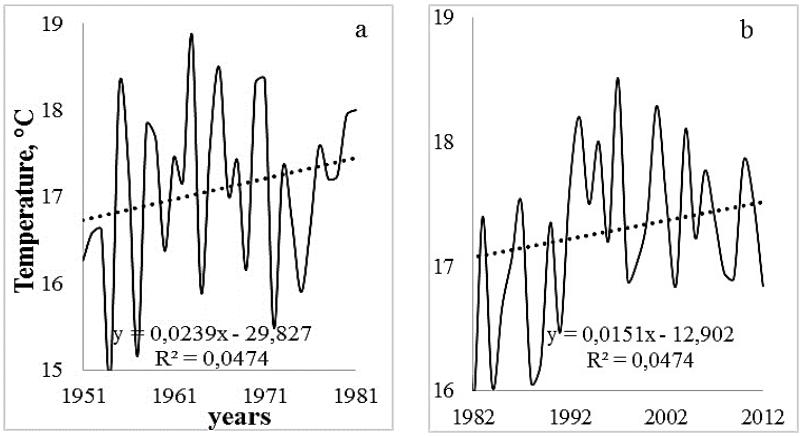

Figure 2. Trend of change of temperature of Yavan district before (a) and after (b) construction of the Nurek reservoir.

The explanation of the observed phenomena from the point of view of districts remoteness from Nurek reservoir is wrong as Fayzabad is at distance of 20 km, Dangara at distance of 35 km and Yavan on 30 km. On height of a situation of districts above sea level, Dangara (660 m) and Yavan (639 m) are closer to each other and it is logical to assume similarity of behavior of their meteorological parameters.

In addition, we carried out the monitoring spatially - temporary change of an atmospheric precipitation above the listed areas during 1950-2012 years. On the Fig. 3 (a, b) the average annual values of precipitation in Fayzabad district for the 1950-1980 periods and 1981-2011 are presented. A trend of change of an atmospheric precipitation Fayzabad both before construction of a reservoir and after it has the decreasing character. However, the change of humidity of the area for the considered periods is characterized by the increasing trend (Fig. 3 (c, d)).

Absolutely other nature of the humidity change and an atmospheric precipitation was revealed at monitoring of meteorological parameters of Dangara and Yavan. The humidity change of Dangara before construction of the Nurek reservoir is present on Fig.4. For the period after construction of a reservoir, i.e. after 1980 the humidity reduction tendency though its increasing trend up to 1980 is observed. The same transition from the increasing trend of the 1951-1979 period to the decreasing trend for the 1980-2011 period it was observed in change of precipitation also.

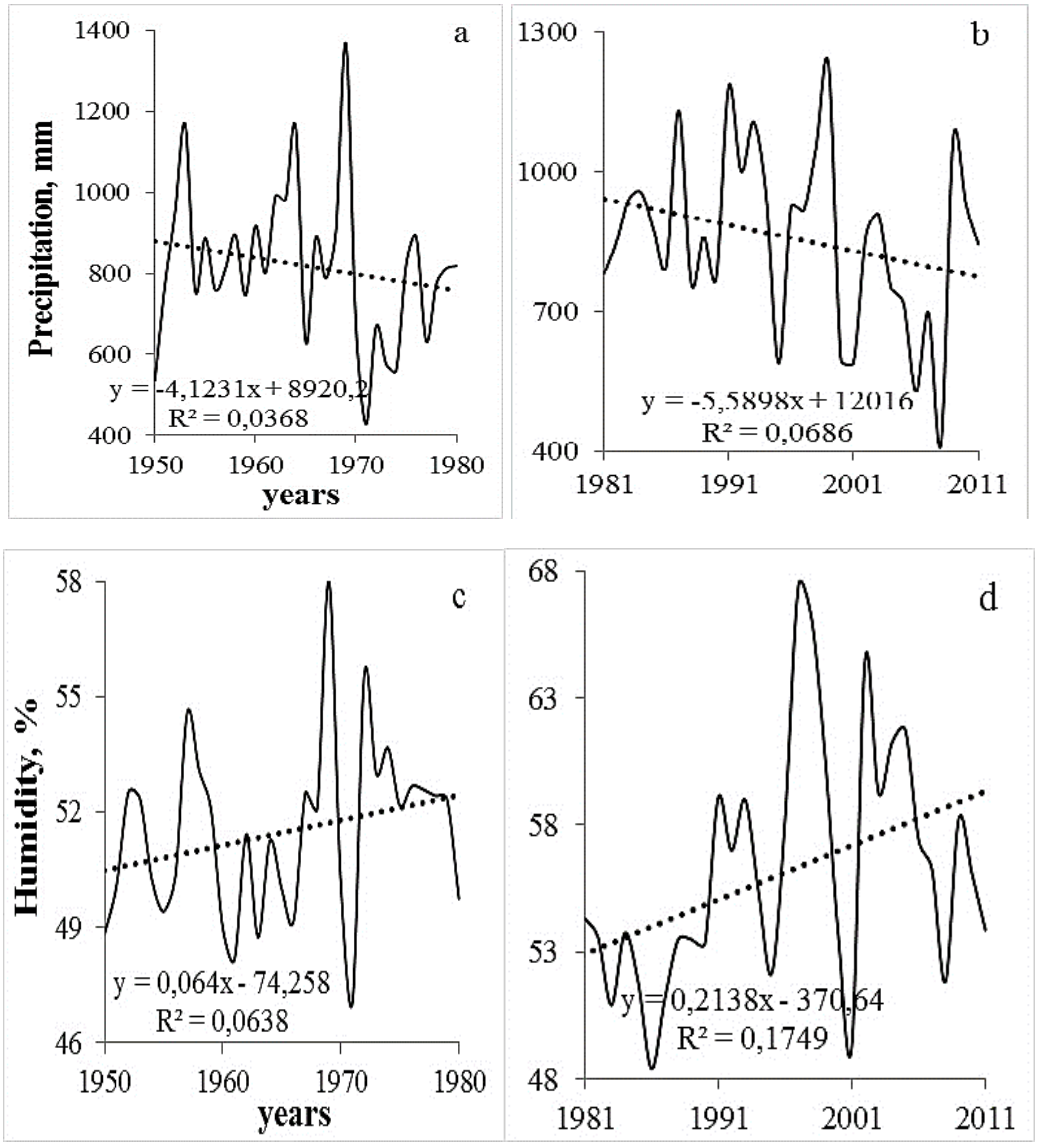

Figure 3. Trend of change of precipitation and humidity of Fayzabad district before (a, c) and after (b, d) construction of the Nurek reservoir.

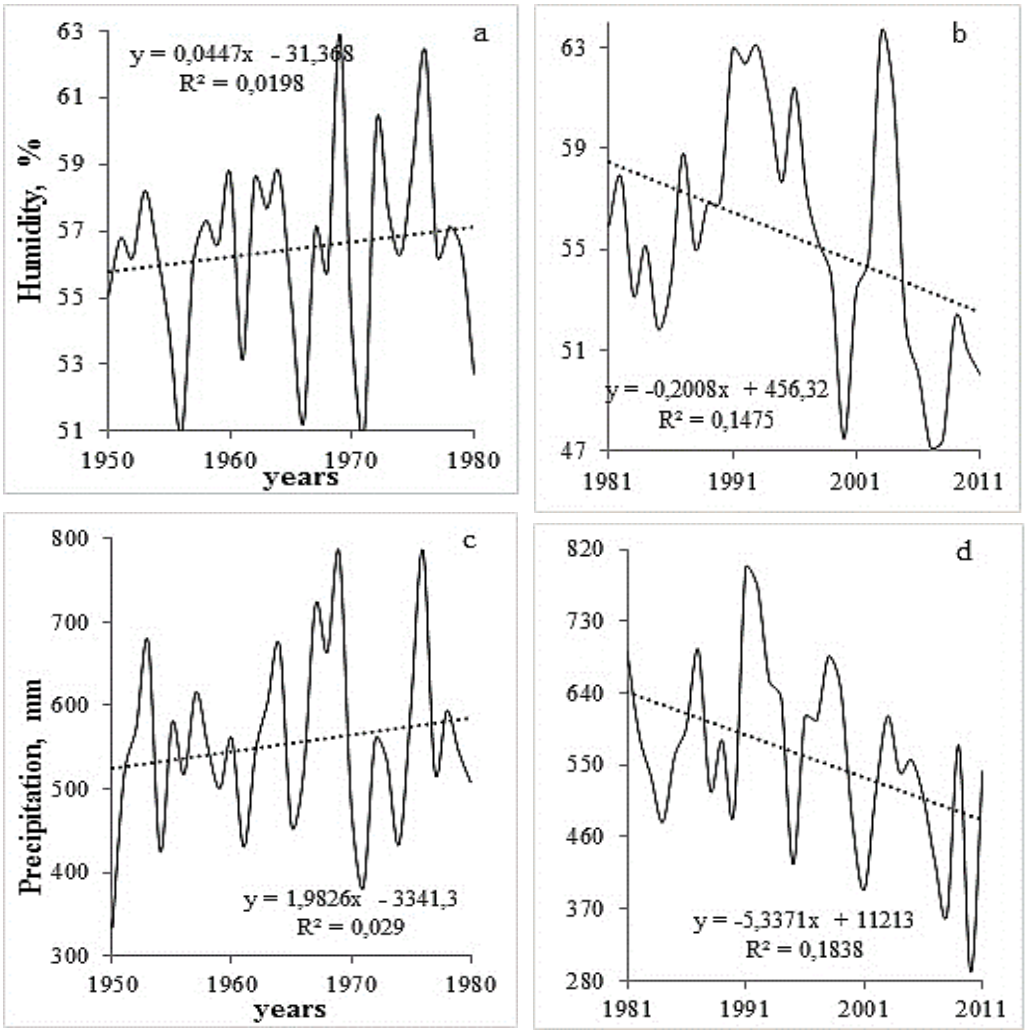

Figure 4. Trend of change of humidity and precipitation of Dangara district before (a, c) and after (b, d) construction of the Nurek reservoir.

Dynamics of the humidity change of Yavan is presented on the Fig.5 (a, b). From the Fig.5 (a, b) seems that humidity of this area had everything the reducing character up to 1980 and was characterized by moderate increase of precipitation. After 1980 sharp increase and humidity and an atmospheric precipitation is observed.

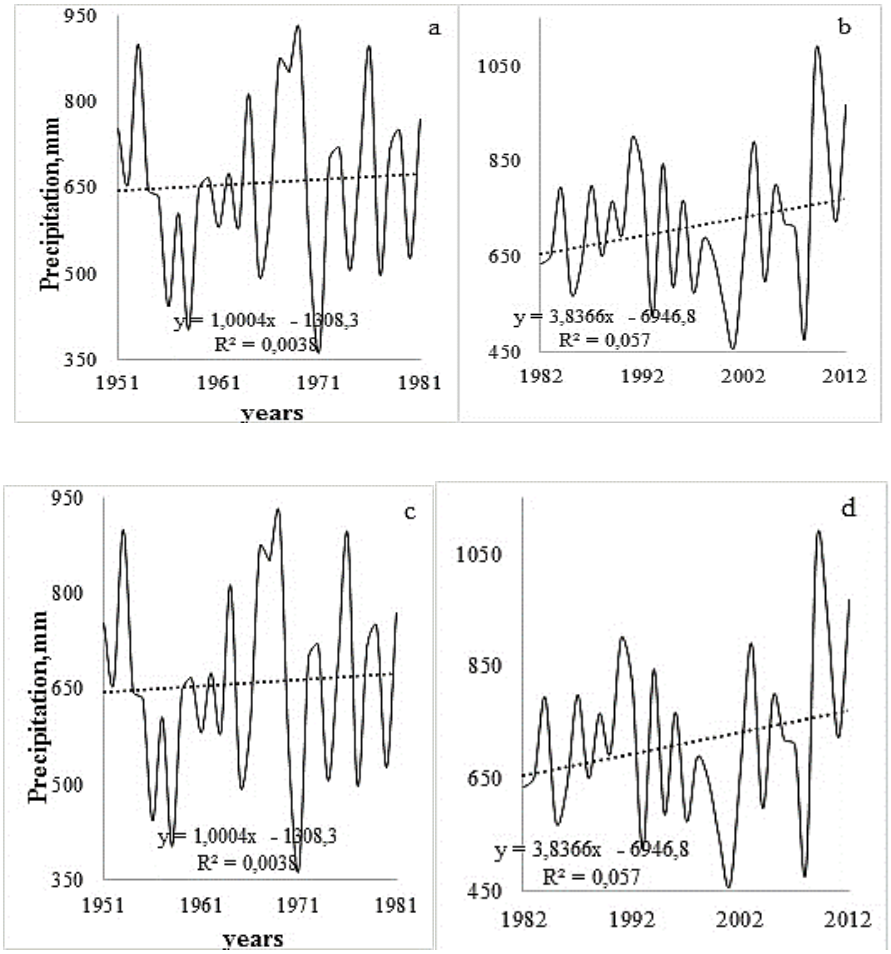

Figure 5.Trend of change of humidity and precipitation of Yavan district before (a, c) and after (b, d) construction of the Nurek reservoir.

The reduction of an atmospheric precipitation of Yavan for the periods 1950-1979 on 4.7 mm and increase for the period 1980-2011 on 443 mm is calculated (in comparison with 1979 makes about 30%). The temperature change of Yavan for the period 1980-2011 equals 1.1 C against his increase on 0.97 C for the period 1950-1979.

According to our opinion, the behavior of meteorological parameters of coastal to Nurek reservoir areas in winter and the summer periods represented a considerable interest. For example, on Fig. 6 a trend of the temperature change of Dangara in winter and the summer periods before and after construction of a reservoir is presented. Before construction of a reservoir the temperature change corresponds to the natural mode is reduction of their values in the winter and increase in the summer. After construction of a reservoir the return to the natural course of temperature the following phenomenon is observed- temperature increases in the winter. The Fig. 6 demonstrated that after construction of a reservoir on a curve of temperature change the deep minimum of the covering period 1982-2012 years testifying about influence of a reservoir on temperatures of Dangara district.

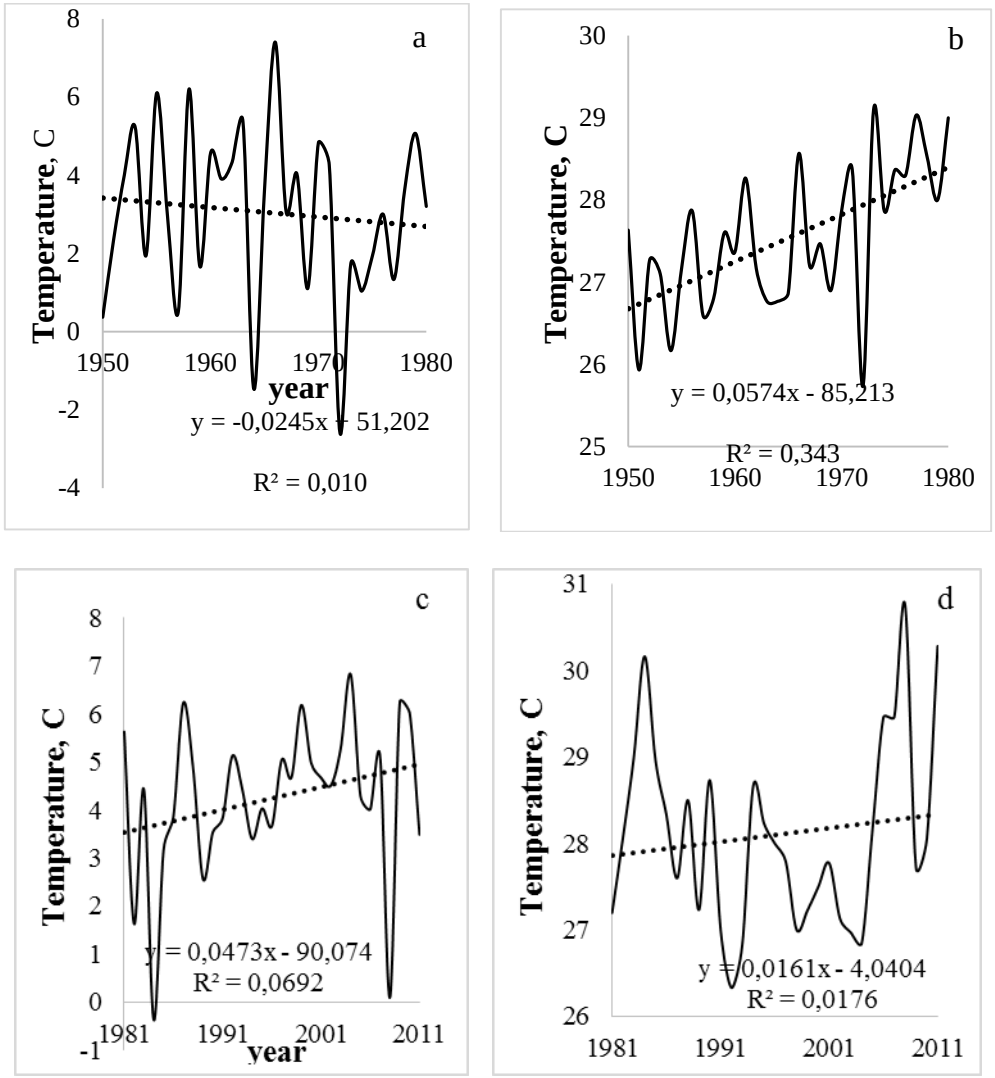

Figure 6. Change of temperature of Dangara in winter (a, c) and the summer (b, d) before and after a reservoir construction r respectively.

4. CONCLUSIONS

Thus, the analysis shows the ambiguous reservoirs influence on meteorological conditions of coastal areas. It first is caused by that the considered areas are characterized by a mountainous terrain. In mountain districts, as usual because of influence of heights processes of reflection, a deviation of the directed movement of air masses is observed. Consequently, the existence of the developed network of meteorological stations in mountain districts is pledge of receiving a real scenario of the meteorological parameters dynamics.

It should be noted that continuous monitoring of meteorological parameters of large water reservoirs is important from the point of view of agriculture development. Timely establishment of weather conditions variations and development of adaptation technology to the modern meteorological conditions and selection of agricultural grades steady against changes of climatic factors and stressful situations pledge of ensuring food security.

5. ACKNOWLEDGMENT

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