# Up to the development of strategy on adaptation water measures due to the climate change

Shekarban Kapar, Almaz Toktasinovich Tleukulov, Zaurbek Karibaevich Auelbek, Issabek Zhanashevich Zhanashev

Kazakh National Agrarian University, Abay str., 8, Alma-Ata, 050000, Republic of Kazakhstan

**Abstract.** Extraction of minerals which includes water and land recourses grow from year to year thus grows anthropogenic burden on the depths of Earth, bedding rock, the system of open water, and geodynamics of geologic structures. Improved criterion by estimate of the environment condition and foundation of social-ecological-economic efficiency of water recourses usage are suggested. The National strategy of water delivery and logical sequence of problem solving on control of water recourses in Kazakhstan are worked out. But listed problems should be reconsidered due to the climate change.
[Kapar S., Tleukulov A.T., Auelbek Z.K., Zhanashev I.Z. **Up to the development of strategy on adaptation water measures due to the climate change.** *Life Sci J* 2014;11(11):512-516] (ISSN:1097-8135). http://www.lifesciencesite.com. 87

**Keywords:** Hay land, grazing, gross product, cross-border river, air and earth pollution, adaptation, index

## Introduction

Analysis of natural-resource potential and its use in the Republic of Kazakhstan. The climate of the Republic of Kazakhstan is highly continental as its territory is far away from oceans and seas. On the territory of Kazakhstan the difference in dates of snow coming is about 2-3 months. On the plain land the average temperature in January rises from minus 17 °C to minus 1 °C, in July – from plus 20 °C on the north to plus 30 °C on the south. The average temperature on the north is about 1 °C, and on the extreme south – plus 13 °C [1-3].

The sovereign and independent development of the state is provided when the economy of Kazakhstan successfully integrates in the world economy and it will take a worth place in the world economy system [4, 5 and others.].

In particular, the aim of implementation of adaptation measures to the national strategies and systems due to the climate change in Chuya-Talas trans-border basin is the reduction of risks safety connected with the climate change with the help of increasing of adaptation potential in the viewing trans-border basin [9, 10].

The general presumable warming climate consequences are as follows:

1. The annual water runoff at the beginning of global warming will increase a little. Till the rise of temperature will not be stopped or the resources of permanent snow cover or ice flow will not come to the end, the parameters of supreme and minimal outflow will change.

2. The needs in water of water consumers in particular irrigation agriculture will rise. It will be till the rise of temperature won't be stopped.

3. Here come other accompanied problems:

- For trans-border rivers (exhaustion and pollution, water apportioning, support of GTN, damages, water payment, new methods of social-ecological-economic efficiency of hydro economic and water protection measures end others);

- For the local outflow the problems are the same except water payment.

So it will be required the development of special measures on adaptation to the climate change. There exists the whole range of definitions to the term "adoption to the climate change" but all of them boil down to the following: adoption to the climate change means appliance of natural and anthropological systems in reaction to actual or waiting influence of climate or its consequences that helps reduce damage and use advantageous opportunities. [11].

According to the population size of the republic may be: 2018 – 17.13 million people and 2024 – 18.18 million people. In 2012 GDP of Kazakhstan was 21 815.5 bln. Run up of GDP in comparison with 2011 has reached 7.3 %. The farming lands utilized by land users on the 1st of November 2012 – 89 802.2 th.ga, of which arable land – 23 583.9 th.ga, hayfields and pasture land – 63 074.6 th.ga. The overall production of agricultural products was 1 442.6 bln. in 2012 in the whole republic. Of which products made of crop farming – 662.6 bln. In 2012 in comparison with 2011 was reached the rise of cattle population in all types of economy on 1.0% (2012 – 6 175.3 th. animal units), sheep and goats – 1.0% (2012 –17 988.1 th. animal units), horses – 1.1% (2012 – 1 528.3 th. animal units), camels – 1.1% (2012 – 169.6 th. animal units) and bird – 1.0% (2012 -32 .8 mln. animal units), pigs – 1.0% (2012 – 1 344.0 animal units) [11].

The Republic of Kazakhstan has great natural resources. The territory of Kazakhstan is 272.49 mln.

ga, of which more then 222.5 mln.ga – farmlands or 81.6%. The square of arable fields during 2005 – 2012 years increased unessential from 21 968.1 th. ga to 23 583.9 th. ga, table 1.

**Table 1. Farmlands utilizing by land users on the 1st of November, th.ga**

| Years | Overall farmlands utilizing by land users | Including agricultural lands | | | | |
|---|---|---|---|---|---|---|
| | | Farm factories | Farm (peasant) holdings | In private hands | From them | |
| | | | | | Private holdings | Collective and individual yards and gardens |
| | | | | All farmlands | | |
| 2010 | 85 470.4 | 42 310.6 | 42 840.8 | 319.0 | 197.3 | 121.7 |
| 2011 | 88 165.3 | 42 700.1 | 45 140.4 | 324.8 | 201.8 | 123.0 |
| 2012 | 89 802.2 | 42 815.1 | 46 685.7 | 301.4 | 174.7 | 126.7 |
| | | | | arable | | |
| 2010 | 22 704.7 | 14 043.9 | 8 448.3 | 212.5 | 125.2 | 87.3 |
| 2011 | 23 407.8 | 14 399.1 | 8 791.9 | 216.8 | 128.1 | 88.7 |
| 2012 | 23 583.9 | 14 504.0 | 8 861.8 | 218.1 | 128.0 | 90.1 |
| | | | | Hayfields and pastures | | |
| 2010 | 59 386.5 | 26 905.0 | 32 425.1 | 56.4 | 52.6 | 3.8 |
| 2011 | 61 644.1 | 26 984.0 | 34 601.9 | 58.2 | 54.3 | 3.9 |
| 2012 | 63 074.6 | 26 959.1 | 36 083.2 | 32.3 | 27.2 | 5.1 |

Comparison of water availability over water economic districts shows that there are more provided regions (basin of the river Ertys), there are regions where water is in deficit, and for example Zhayik-Kaspiysky and Nura-Sarysuskiy basins on open waters, table 2.

**Table 2. Availability of the river basins with open water resources**

| Basin inspections | Total resources | | Forming on its own territory | |
|---|---|---|---|---|
| | for 1 km² | for 1 person | for 1 km² | For 1 person |
| Aralo-Syrdarjinskaya | 66.07 | 6.94 | 15.80 | 1.66 |
| Balhash-Alakolskaya | 65.91 | 8.07 | 36.26 | 4.44 |
| Yesilskaya | 10.58 | 1.32 | 10.58 | 1.32 |
| Zhayik-Kaspiyskaya | 20.02 | 6.05 | 6.44 | 1.95 |
| Irtyshskaya | 100.60 | 16.77 | 77.37 | 12.90 |
| Nura-Sarysuskaya | 4.55 | 1.15 | 4.55 | 1.15 |
| Tobol-Torgayskaya | 5.39 | 1.95 | 5.39 | 1.95 |
| Shu-Talaskaya | 26.35 | 3.94 | 10.24 | 1.53 |
| On the average over RK | 37.61 | 6.66 | 20.79 | 3.68 |

According to MEP RK in 2012 in comparison with 2005 the emission of harmful substances into the atmosphere reduced at 22.8%, gaseous and liquid substances – 26.3%.

The poorest in open and ground waters region is Yesilskiy. The dynamic pattern of water drawing from water sources in 2005-2012 years shows that the amount of water drawing decreased from 26 436 in 2005 to 21 538 mln. m$^3$ in 2012.

Along with that the usage of fresh water in RK during 2005-2012 years gradually increased (36.8%) and composed in 2012 – 20 856 mln. m$^3$, table 3.

**Table 3. The usage of fresh water in RK, mln. m$^3$**

| Name | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|
| all | 15242 | 20204 | 21422 | 18442 | 19906 | 18 034 | 19 259 | 20 856 |
| in particular: | | | | | | | | |
| a) irrigation, water supply and farming water delivery; | 10573 | 12021 | 11329 | 10897 | 11512 | 10 002 | 10 932 | 11 703 |
| b) production needs; | 3983 | 4442 | 4062 | 4419 | 5019 | 5 199 | 5 104 | 5 632 |
| c) household-drink needs | 601 | 621 | 694 | 698 | 709 | 735 | 742 | 751 |

The main priorities of an agricultural development. During all the periods of its existence people live on the ground and in spite of separate crisis the situation was always stable. The development of

social system and scientific and technological advance improved the living conditions and thus became the terms of survival, having preserved the living and balanced terms.

In the foundational document [12], in which it was underlined that the problems of environmental protection should not be considered out of the usage of natural resources.

For example, GDP per capita of RK expressed in U.S. dollars in 1995 was 1 052.1, with its following growth in 2010 it was 9 070.0 in U.S. dollars. The lifetime of the population of Kazakhstan in 1991 was 67.6 years; the list meaning was 63.5 years in 1995, and then followed a slow rise in 2012 when its meaning reached 68.4 years. The same indexes which are observed in economically stable Kyrgyzstan Republic show that HDI was decreasing from 0.908 – in 1990 to 0.676 – in 1995, slowly increasing to 0.719 – in 2000 (while GNI was decreasing from 1160 -in 1991 to 300 - in 1999, at present it is approximately 800 $). The lifetime of Kyrgyzyan population was practically at the same level within 68.5 years. Here comes the conclusion that the lifetime and the morbidity of population depend more on the condition of the environment then from its income. All the information reported is illustrated at the picture 1.

Contradiction between the production of wealth and its distribution between the members of the company has already existed for a long time, before the creation of the theory of surplus exchange value. This is the reason of increasing propaganda of consumerism. That's why the producer can't stop and even understanding that natural resources come to an end, land degradation, the plant life runs down, water objects and the atmosphere are intensively polluted.

The analysis of the level of natural resources' usage shows that occur both exhaustion, and their pollution.
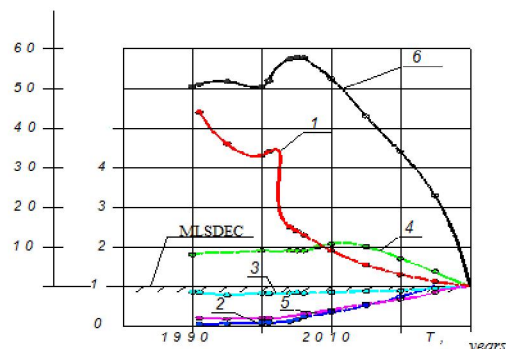


**Figure 1. It shows the dynamics of HDI changing and its components during 1990-2006 years along with the forecast on distant view to reach the marginal level of stable development and environmental control (MLSDEC).**

*1-infant mortality; 2-GPD per capita, U.S. dollars; 3- lifetime; 4-quantity of beds per 10 th. people; 5-HDI; 6-deseasewith a newly determined diagnosis per 100 th. people.*

It is necessary to predict the following steps: the existing order of subsidizing needs to be reconsidered.

The market is focused not on production of social and necessary goods, and on satisfaction of inquiries of those who has money. The offer on need of introduction of the special differentiated tax on each worker according to the sizes of a salary and creation of special charity foundation deserves attention.

Technique. Methodological prerequisites on rational use and protection of natural resources. Long-term task is ensuring social and economic development of the state and thus preservation of possibility of reproduction and quality of water, at the level of requirements of standard quality of waters – "steady water use".

In the solution of tasks in the field of rational use of natural resources, priority is approaches in which problems are solved in common, that is, the problems of economy don't come off an environmental problem. Thus have to proceed from a condition that society gives preference to environmental protection questions [12-14]. So far in the concept of development of water management studies which bases are accepted: full use of internal sources and partial attraction of Yertys, Volga and Zhayik resources. Then, the irrigated areas in Kazakhstan would be equal 7.7 million hectares, including 5.3 million hectares of regular and 2.4 million hectares of a lemon irrigation [institute of S. Ya. Zhuk], 5.5 million hectares of a regular irrigation [Sredazgiprovodkhlopok and Kazgiprovodkhoz]. However, 1.3 million hectares of lands are now irrigated, requirements of natural complexes is satisfied not fully [15]. The specified tasks, according to requirements of the Water code of RK, it is presented as National strategy of water supply of the country, fig. 2.

The principles of an assessment of water resources and water use, and also sequence of solution of the problem of water supply of the country are presented in figure 3.

As a whole the methodology of justification of social, ecological and economic efficiency of nature protection and water preserving actions is carried out in two stages. The assessment of level of pollution is carried out and damages to environment are defined. Thus the assessment of a state of environment pollution is established by means of integrated criterion:

$$IPI = (IEW + IPW) + IPA + (0.2\text{-}0.5)\ IPS, \quad (1)$$

Where: IPI – an environmental pollution index

IEW–index of exhaustion of water; norm of irrevocable withdrawal of the superficial drain making 10 - 20% of annual value of a natural drain;

IPW-index of pollution of water;

IPA - index of pollution of the atmosphere;

IPS –index of pollution of the soil. If, even it isn't polluted now, but it was once polluted, the residual principle works, and pollution partially from the soil passes to products of this ecosphere.

**Results**

At the second stage gets out the criterion of social-ecological-economic efficiency.

$$SSEP_i = I_i - D_i - C_i + AEE, \quad (2)$$

where $SSEP_i$ – national income with i-variant of overregulation of a drain (with i-variant of complex use of water resources of a river basin);

$I_i$ – income of economy branches with i-variant of overregulation of a drain (with i-variant of complex use of water resources of river basin taking into account positive accompanied affects);

$D_i$ – damage from exhaustion and pollution of water source at i -variant of overregulation of a drain (at i-variant of complex use of water resources of a river basin taking into account negative cooperative effects);

$C_i$ – costs of building of water management and water preserving objects;

AEE – the additional economic effect arising from increase of value of natural resources.



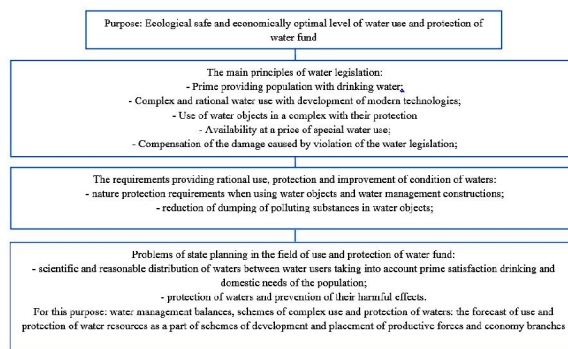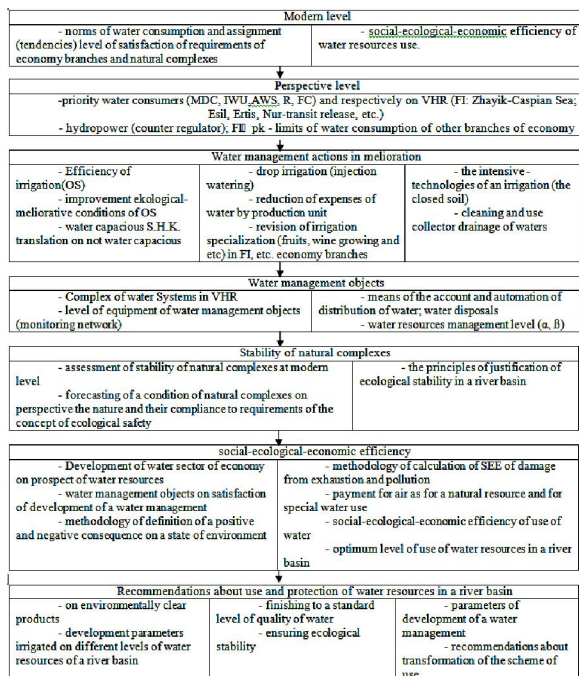**Figure 2. National strategy of water supply of RK**

| Water consumption of branches of natural complex economy | | | | |
|---|---|---|---|---|
| MDC | AVS | WT - | HPI - | -watering of pasture-land |
| IWU | FI | regeneration | irrigation - | -natural complex |

| Modern level | |
|---|---|
| - norms of water consumption and assignment (tendencies) level of satisfaction of requirements of economy branches and natural complexes | - social-ecological-economic efficiency of water resources use. |

| Perspective level | |
|---|---|
| -priority water consumers (MDC, IWU, AWS, R, FC) and respectively on VHR (FI: Zhayik-Caspian Sea; Esil, Ertis, Nur-transit release, etc.) | |
| - hydropower (counter regulator); FII  pk - limits of water consumption of other branches of economy | |

| Water management actions in melioration | | |
|---|---|---|
| - Efficiency of irrigation(OS) - improvement ekological-meliorative conditions of OS - water capacious S.H.K. translation on not water capacious | - drop irrigation (injection watering) - reduction of expenses of water by production unit - revision of irrigation specialization (fruits, wine growing and etc) in FI, etc. economy branches | - the intensive - technologies of an irrigation (the closed soil) - cleaning and use collector drainage of waters |

| Water management objects | |
|---|---|
| - Complex of water Systems in VHR - level of equipment of water management objects (monitoring network) | - means of the account and automation of distribution of water; water disposals - water resources management level (α, β) |

| Stability of natural complexes | |
|---|---|
| - assessment of stability of natural complexes at modern level - forecasting of a condition of natural complexes on perspective the nature and their compliance to requirements of the concept of ecological safety | - the principles of justification of ecological stability in a river basin |

| social-ecological-economic efficiency | |
|---|---|
| - Development of water sector of economy on prospect of water resources - water management objects on satisfaction of development of a water management - methodology of definition of a positive and negative consequence on a state of environment | - methodology of calculation of SEE of damage from exhaustion and pollution - payment for air as for a natural resource and for special water use - social-ecological-economic efficiency of use of water - optimum level of use of water resources in a river basin |

| Recommendations about use and protection of water resources in a river basin | | |
|---|---|---|
| - on environmentally clear products - development parameters irrigated on different levels of water resources of a river basin | - finishing to a standard level of quality of water - ensuring ecological stability | - parameters of development of a water management - recommendations about transformation of the scheme of use |

**Figure 3. Logical sequence of problem solutions of water resources management in the Republic of Kazakhstan**

Technical and economic calculations for justification of social-ecological-economic efficiency of the water preserving and water saving actions are made. Basis of justification of social-ecological-economic efficiency of use of natural resources and including at the same time considering interests of preservation of ecological safety in environment will be the new advanced criterion, dependence (2).

Principal basic of infinite management of rational use:

- for non-renewable resources condition observance is: economical use and not to allow their pollution. Most important is a search of its substitutes.

- for not exhausted resources condition observance is: when using not to allow their pollution.

At modern level, to the listed problems are added also a global warming of climate or a climate cold snap.

However researches on clarification of scale of potential impacts of climate change on a condition of water resources at regional, national or local level weren't conducted almost. According to IPCC forecasts rather little change of air temperature, on only some degrees, will lead to increase of river drains and water security for 10-40% in some regions while in others they will decrease for 10-30%.

For example, the most important directions of the state economic policy of Russia in connection with climate change is the assessment of consequences of climate changes demanding the

acceptance of adaptation measures. Development of these sectors is defined by the strategy accepted now till 2020, and for some of branches – till 2030 [16, 17].

In the long term it is necessary to develop "The national program of measures for mitigation of the consequences of climate change of 2020 and further on 2050-2100 years". Problems of adaptation to climate change will be considered in our next researches.

**Conclusion:**

1.      Climate of the Republic of Kazakhstan sharply continental as its territory is removed from oceans and the seas. In the territory of Kazakhstan the difference in dates of emergence of snow cover makes about 2-3 months.

2.      Sovereign and independent development of the state is provided when the economy of Kazakhstan is successfully integrated into world economy and respectively will take a worthy place in world economic system. Proceeding from requirements "The concept of transition of the Republic of Kazakhstan to a sustainable development for 2007-2024" that in 2013-2018 the Republic of Kazakhstan to be among fifty most competitive countries of the world in order to reach by the efficiency of use of resources (EUR) the indicator, not lower than 43%, it is necessary to increase efficiency of use of resources, to increase life time of the population and to provide increase of an index of ecological stability.

3.      According to EPM PK in 2012 in comparison with 2005 emissions of harmful substances in the atmospheric sphere as a whole decreased by 22,8%, and gaseous and liquid substances for 26.3%.

4.      The gross national product in the Republic of Kazakhstan in US dollars per capita in 1995 made 1 052.1, with its steady growth, and in 2010 made 9 070.0 in US dollars. Life expectancy of the population of Kazakhstan in 1991 was equal 67.6 years, the smallest value of 63.5 years was observed in 1995, then there was slow growth and in 2012 reached 68.4 years.

5.      Similar indicators for rather safe in the ecological relation the Kyrgyz Republic show that though the index of human development decreased from 0.908 – in 1990 to 0.676 – in 1995, gradually raising to 0.719 – in 2000 (at decrease in a gross national product from 1160 - in 1991 to 300 – in 1999 and now about $800), lifetime of the population of Kyrgyzstan during those periods remained, practically, at the same level, within 68.5 years. It testifies that lifetime and incidence of the population

depend on a state of environment, than on the income of population. It reached 68.4 years more.

6. In the solution of tasks in the field of rational use of natural resources, priority is given to the approaches in which problems are solved cooperatively, that is, problems of economy don't come off an environmental problem. Thus have to proceed from a condition that society gives preference to environmental protection questions.

7. Basis of justification social-ecological-economic efficiency of use of natural resources and including at the same time considering interests of preservation of ecological safety in environment will be the new advanced criterion, dependence.

8. The purpose of introduction of adaptation actions in national strategy and programs in connection with climate change in the Chu-Talassky cross-border basin is the decrease in risks and the safety, connected with climate change, by increase of adaptation potential in the considered cross-border basin.

9. Thus, development of special events for adaptation to climate change is actual. In the long term it is necessary to develop "The national program of measures for mitigation of the consequences of climate change of 2020 and further on 2050-2100 years".

**Corresponding Author:**
Dr.Kapar Shekarban
Kazakh National Agrarian University
Abay str., 8, Alma-Ata, 050000, Republic of Kazakhstan

**References**
1. Information on RGP "Kazgidromet" activity of 2005 for its inclusion in "The national report on a state of environment for 2005", 2006. Alma-Ata.
2. RGP "Kazgidromet" information "The short review of weather for 2005", 2006. Alma-Ata.
3. Hardy, J.T., 2003. Climate Change: Causes, Effects, and Solutions. John Wiley & Sons.
4. The CONSTITUTION of the REPUBLIC OF KAZAKHSTAN of 30.08.1995, with changes and additions as of 21.05.2007.
5. The list of standard and normative and technical acts in the sphere of architecture, town planning and the construction, operating in the territory of the Republic of Kazakhstan of 01.12.2007. MSP 3.04 – 101 – 205. Astana, pp: 168.
6. The concept of transition of the Republic of Kazakhstan to a sustainable development for 2007-2024, Astana, 2007, pp: 69.
7. The law of the Republic of Kazakhstan of 11.03.2002 #302-II About protection of atmospheric air, with changes and additions as of 29.12.2006.
8. The declaration of Rio-de-Zhaneyro on environment and development, 1992. Conferences of the Organization of the United nation on environment and development, Rio de Janeiro on June 3-14, pp: 9.
9. Krommer, R., 2002. European directive on a water management. Hydro technical construction, 12: 44-46.
10. Ecological code of the Republic of Kazakhstan, 2005. Astana, pp: 151.
11. Water code of the Republic of Kazakhstan, 2004. Alma-Ata, pp: 72.
12. Kurayev, S.N., 2006. Adaptation to Climate change. RRETs, GOF, pp: 16.
13. Mysiak, J., H.J. Henrikson, C. Sullivan, J. Bromley and C. Pahl-Wostl, 2009. The Adaptive Water Resource Management Handbook. Routledge, pp: 216.
14. Feldman, D., 1995. Water resources management: In Search of an Environmental Ethic. JHU Press, pp: 264.
15. Sharad, K. and V.P. Jain, 2003. Singh Water resources systems planning and management. Elsevier, pp: 882.
16. Walter, L.F., 2011. Climate change and the sustainable use of water resources. Springer, pp: 835.
17. Baba A., G. Tayfur, O. Gündüz, K.W.F. Howard, M.J. Friedel and A. Chambel, 2011. Climate change and its effects on water resources: issues of national and global security. Springer, pp: 318.

7/4/2014