PEER Project - "Transboundary water management adaptation in the Amudarya basin to climate change uncertainties"

Research report

1. Preparation (planning & design)

1.3 Data collection & analysis

1.3.2. Agricultural product prices and energy tariffs for 2050

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Tashkent, July 2016

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Introduction

The report describes the results achieved during the first stage of the research: the results of collection and analysis of data. Here we give an analysis of data on energy tariffs and agricultural product prices, including possible future trends.

1. Energy tariffs

In Tajikistan, efficiency of hydropower sector may be judged by the country's **tariff policy**, **the cost price** of energy production, and **prices of energy export and import** (cent per kilowatt-hour). To assess the effectiveness of measures for rehabilitation of existing power stations, it is necessary to know **the investment costs** in $ per kilowatt-hour. The tariffs are regulated by the Government and determined in the development strategy.

Cost price

According to the experts from the Institute of Water Problems, Hydropower Engineering and Ecology at the Academy of Sciences of the Republic of Tajikistan Mr. I.Sh. Normatov and Mr. G.N.Petrov, the only reliable way to assess the cost price of energy production is to analyze the results of power system performance during its sustainable operation in Tajikistan. The capacity of energy system in that period has already achieved its today's level; the financial system was sustainable. Based on calculations, the cost price of hydropower production was 0.17 cents per kilowatt-hour in 1985-1990. The current cost price of production is 04.-0.5 cents per kilowatt-hour, given the average energy production of 15 billion kilowatt-hour.

Cost of construction and rehabilitation of new HEPS

Taking into account Tajikistan's experience in HEPS construction, the actual **unit cost of HEPS construction** is not higher than $700 US per kilowatt-hour at present. It indicates to its cost-effectiveness, provided that the energy tariff is not less than 2 cents per kilowatt-hour (I.Sh.Normatov, G.N.Petrov).

In the PEER project, for the increase of energy production, only those HEPS are considered that do not have large reservoirs and regulation facilities: Sangtuda-2 HEPS (useful capacity 0.005 km^3), Shurob HEPS (0.02 km^3) and small HEPS'. The estimated **cost** of the Shurob HEPS is 25 cents per kilowatt-hour and of small HEPS', approximately 22 cents per kilowatt-hour. For comparison: the estimated **cost of guaranteed energy produced by new** thermal power stations (Dushanbe-2 and Shurob-1 and 2) is 8.7-9.9 cents per kilowatt-hour.

Estimated investment costs for HEPS reconstruction are as follows: for the Nurek HEPS (increase of production at about 0.2 billion kilowatt-hour) - $300 US per kilowatt-hour; Golovnaya HEPS of the Vakhsh cascade (increase of production at about 0.02 billion kilowatt-hour) - $500 US per kilowatt-hour.

Energy deficit and tariff policy

The current energy deficit in Tajikistan is caused by two factors: high **demand** for energy in winter and insufficient **energy supply** (at energy consumption points). The first factor is determined by the consumption pattern (aluminum production, house heating with electricity, etc.) and **energy tariffs**. The second factor largely depends on operation efficiency of the Nurek HEPS (presence of idle water spills) and losses in power systems and energy transmission and distribution networks.

The analysis of collection of payment for energy consumption since 1996 showed that until 2001 it has varied within 30-60% in Tajikistan. It indicates to low **paying capacity of population**, i.e.

some years there was no deficit but overproduction of energy (G.N.Petrov, 2009). After 2000, the paying capacity of the consumers increased to 78-98%.

Dynamics of energy tariffs for 1990-2008 is shown in the Chart below. The chart shows that in 2008 tariffs for households were three times less than those in 1980-1990. The total tariff in 2008 is 1.08 times higher than the average tariff for 1980-1990. In 2012, energy tariff increased to 2.25 cents per kilowatt-hour in Tajikistan.

Fig.1. Energy tariffs in Tajikistan (source: G.N.Petrov, Kh.M.Akhmedov 2010)

The fact that a reasonable increase in tariffs may lead to improved economic situation is proven by **market reforms** being implemented in GBAR in Tajikistan. **Almost** threefold increase in energy tariffs in GBAR as compared to the republican tariffs allowed completing the construction of Pamir-1 HEPS (G.N.Petrov, Kh.M.Akhmedov 2010). Tariffs for winter and summer and for domestic and nondomestic consumption were determined there (see Table below).

Energy tariffs in GBAR in Tajikistan, cent per kilowatt-hour (Source: G.N.Petrov, Kh.M.Akhmedov 2010).

Year	2004	2005	2006	2007
Tariffs in winter				
Nondomestic consumption	1.26	1.78	2.31	2.67
Domestic consumption	0.95	1.18	1.45	1.57
Tariffs in summer				
Nondomestic consumption	0.90	1.27	1.65	1.91
Domestic consumption	0.68	0.84	1.03	1.12

<u>Assessment of tariffs for the future</u>

The simplest method to construct scenarios of rise in tariffs for the future is to construct trends based on various **coefficients of tariff growth**. Here, three options may be proposed: option 1 – annual growth by 5% (coefficient K = 1.05); option 2 – annual growth by 10% (coefficient K = 1.1); option 3 – annual growth by 15% (coefficient K = 1.15). This approach was applied by

G.N.Petrov (2009) **to analyze options of tariff policy** in Tajikistan; based on his assessment, if the growth is 5%, Tajikistan will have the same tariffs as in other Central Asian states, while if the growth is 10%, it will have the same tariffs as developed countries; and only if the growth is 15%, energy development of the country will be at the same level as global energy development as a whole.

Below we show an assessment of growing energy tariffs in Tajikistan for 2012-2030 based on coefficients of tariff growth.

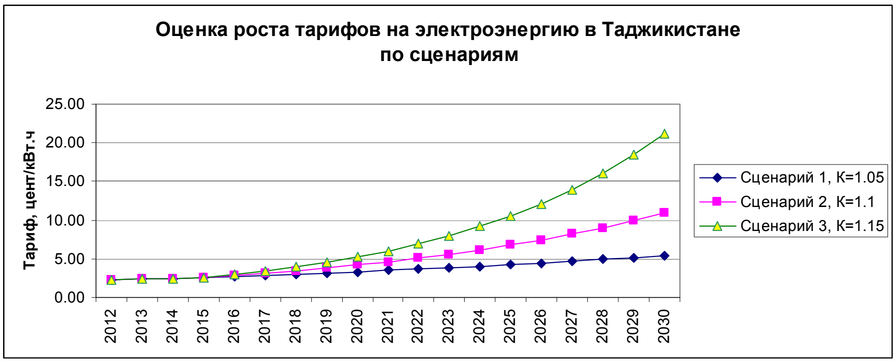

Fig.2. Assessment of growing energy tariffs based on scenarios

There is a linkage between energy tariffs in the domestic sector and energy consumption by population: when tariffs increase, consumption decreases. If the government will increase tariffs for households, then demand for energy may decrease, thus, energy deficit will be reduced. However, this may lead to social problems: one should consider not only the percentage of growth and initial tariff, but also the **readiness to pay** for energy.

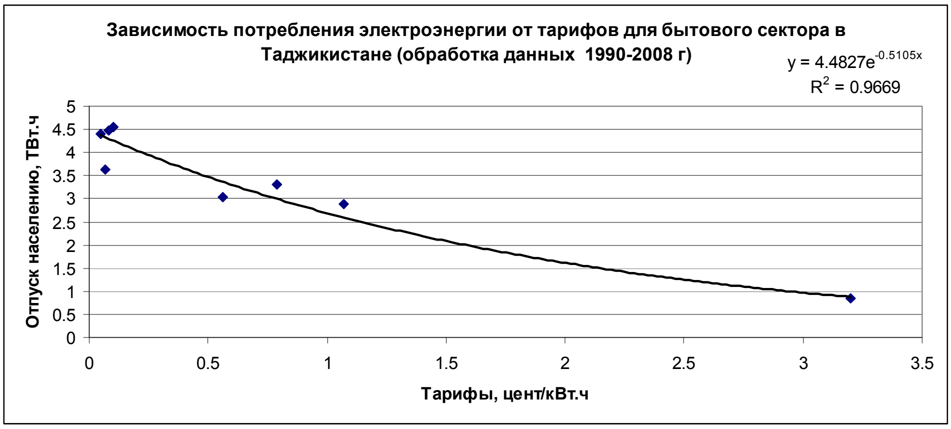

Fig.3. Relationship between energy consumption and energy tariffs in the domestic sector of Tajikistan (processing of data for 1990-2008)

According to the World Bank's studies (Daryl Fields et al., 2013), **by 2025**, the maximum price **household consumers** are ready to pay is **4.6 cents per kilowatt-hour,** whereas other non-household groups of consumers are ready to pay **10.4 cents per kilowatt-hour**. Given the fact that energy consumption in households is about 44% of the total demand for energy, the estimated **weighted average** energy tariff is to be **7 cents per kilowatt-hour** in Tajikistan by 2025. According to the forecast by the World Bank, until 2040, the growth of energy tariffs may amount to 3% annually (Daryl Fields et al. 2013). If we continue these trends until 2055 (the last year for assessing scenarios in the PEER project), we will have the following tariff dynamics.

Assessment of rise in energy tariffs in Tajikistan for the PEER project, cent per kilowatt- hour

Consumer	2025	2035	2045	2055
Domestic sector	4.6	6.2	8.3	11.2
Nondomestic sector	10.4	14.0	18.8	25.2
Average tariff	7.0	9.4	12.6	17.0

Tariffs of imported energy

In the long-term prospect, energy import from Turkmenistan may be considered in the PEER estimations. Energy import from Uzbekistan is not considered because of probable absence of extra capacities to produce winter energy. The cost of energy import from Turkmenistan to Tajikistan is estimated at 6-7 cents per kilowatt-hour. According to the data for 2011, the installed capacity of all power plants is 4,110 MW in Turkmenistan. By 2020, Turkmenistan is planning to increase energy production up to 27.4 billion kilowatt-hour and export capacity – to 6 billion kilowatt-hour (Daryl Fields et.al, 2013).

Export tariffs

In the CASA-1000 project (volume of exports from Tajikistan to Afghanistan is 2.4 billion kilowatt-hour), the export tariff is estimated at 4.4.cents per kilowatt-hour; in the CASA-1000 Stage II, the tariff is 6.2 cents per kilowatt-hour (volume of export at 4 billion kilowatt-hour). This tariff is formed by energy price of 3.5 cents per kilowatt-hour and transit price of 0.9 cents per kilowatt-hour for CASA-1000 and 2.7 cents per kilowatt-hour for CASA-1000, Stage II.

2. Prices of agricultural products

In order to assess the value of gross agricultural product, the so-called **economic prices** are proposed as they are the most suitable measure for assessment of economic value of the main agricultural products. It is supposed that **financial** prices will be stabilized and have the same level as economic prices in the future. The assessment of prices was carried out for the Republic of Uzbekistan.

Cotton prices

Cotton is assessed based on prices of **cotton fiber** calculated as the prices of **raw cotton** using the coefficient of 3.75. Dynamics of export prices of Uzbek cotton in 1995-2005 compared to global prices is given in the Table below. There is close relationship between export prices and global ones.

Dynamics of cotton prices for 1995-2004 (source: Economic review. №3(55), 2004, www.review.uz)

Price, $ / tone	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*
Global price of cotton fiber (A index)	1,900	1,750	1,700	1,500	1,300	1,300	900	1,000	1,700	1,600
Export price of Uzbek cotton fiber (”Birinchi	1,750	1,600	1,600	1,600	1,100	1,150	1,100	1,100	1,800	1,700

Urta")										
Estimated price of raw cotton	465	425	425	425	295	305	295	295	480	465

In Uzbekistan, the low purchasing prices of raw cotton are linked to the state order for cotton. After 2001, one may observe that prices of Uzbek cotton are higher than the global ones. In 1995-2001, the global prices sharply decreased; only since 2003 they have rapidly increased. By 2003, the global cotton production decreased from 21.4 million tones in 2002 to 19.2 million tones; cotton reserves dropped to the level of 1995, and demand for cotton fiber increased – this caused the rise in cotton prices. **The forecast of cotton prices** is, firstly, linked to high demand for cotton fiber (China and other countries). **Maximum expectation** (by 2050) is that the cotton price will increase to $2,300-2,500 US/t.

Prices of agricultural products

From the mid-1970s to the beginning of 1990s, because of irrigation expansion, the prices of foodstuff significantly decreased; according to FAO, from 1990 to 2001, the index of global prices of foodstuff varied from 115 to 85 (in 1990=100). The change in prices of agricultural products (foodstuff and forage crops) in the future will depend on a number of factors: growing demand for foodstuff and forage crops (if one assumes that demand for foodstuff per person remains unchanged, then demand will be governed by population growth); and, increasing water deficit.

In context of water deficit, demand for foodstuff may be met only through water saving and improved land and water productivity (crop yield). In this case the decline in prices observed in the 1970-1980s may be stopped. Prices will vary and depend largely on weather conditions (droughts and floods), as well on the use of new technologies, agrarian and trade policies in the leading countries.

Therefore, it is advised to accept the following hypothesis of agricultural product price changes in the future (2015-2055): economic prices will vary within the price range of 1995-2015; the only exception is the prices of cotton fiber.

Such approach allows comparing agricultural products in 2015-2055 **in unified prices of the base period** by reasonably assessing production effectiveness by scenarios, excluding inflation effect on prices and devaluation (decrease in exchange rate compared to other countries). Inflation, i.e. reduction of purchasing capacity expressed in rise in prices of all goods and services is caused by a range of factors related not only to production, but also to money circulation, financing, nonmanufacturing costs of the state, etc.

Fluctuation of agricultural products prices: economic, financial and expert prices, $/t

Crop	*1995-2014 (based on assessment of CAWa-II project, WP2, SIC ICWC report 2014)*		*From DB of the Aral Sea management model*		*Proposal for the PEER project for 2016-2055*	
	Economic	*Financial*	*ASBmm*	*BEAM*	*MIN*	*MAX*
Raw cotton	295 - 480	230 - 340	500	700	300	650
Wheat	130 - 320	120 – 140	300	300	130	320
Rice	300 - 450	200 - 280	490	500	300	450

Crop	*1995-2014 (based on assessment of CAWa-II project, WP2, SIC ICWC report 2014)*		*From DB of the Aral Sea management model*		*Proposal for the PEER project for 2016-2055*	
	Economic	*Financial*	*ASBmm*	*BEAM*	*MIN*	*MAX*
Maize	200 - 230	150 - 200	200	-	200	230
Vegetables	200 - 350	80 - 190	250	100	200	350
Potato	150 - 250	130 - 160	150	-	150	250
Fruit	300 - 500	60 - 150	500	450	300	500
Grapes	400 - 600	90 - 210	500	-	400	600
Cucurbits	250 - 400	20 - 100	200	-	250	400
Forage	100 - 200	30 - 60	100	100	100	200
Sugar beet	100 - 150	80 - 100	120	-	100	150

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List of abbreviations

ASBmm – The Aral Sea Basin Management Model (UNESCO-IHE & SIC ICWC)

BAB – Big Amudarya Basin includes the basins of the Amudarya River and its tributaries – Vakhsh, Pyandj, Kafirnigan, Surkhandarya and Kunduz, as well as the basins of rivers that currently do not flow into the Amudarya River – Kashkadarya, Zaravshan, Murghab and Tedjen

BEAM – Aral Sea Basin Economic Allocation Model, USAID.

BWO Amudarya – Basin Water Organization Amudarya – an executive body of ICWC and has four territorial divisions: VDD, SDD, NDD and Upradik.

CDF – collector-drainage flow

DB – Database

DM – Decision maker

EC – Executive Committee

GAMS – General Algebraic Modeling System

GBAR - Gorno-Badakhshan Autonomous Region in Tajikistan.

ICWC – Interstate Commission for Water Coordination in Central Asia

IFAS – International Fund for saving the Aral Sea

IRA – Islamic Republic of Afghanistan

IS – Information system

IWPHE&E – Institute of Water Problems, Hydropower Engineering and Ecology at the Academy of Sciences, Republic of Tajikistan

IWRM – Integrated water resources management

KR – Kyrgyz Republic

NABISA – Nizhneamudarya Basin Irrigation System Administration at MAWR, Republic of Uzbekistan

NDD – Nizhnedarya (downstream) Division of BWO Amudarya operates Takhiatash hydroscheme, head water intakes in Khan-yab and Djumabaysaka canals, controls all water intakes in the lower river reaches from the Kipchak gauging station to the Aral Sea (headquarters in Takhiatash, Republic of Karakalpakstan)

NIGMI – Research Institute of the Hydrometeorological Services Center at the Cabinet of Ministers of the Republic of Uzbekistan

MAWR – Ministry of Agriculture and Water Resources

MWRS – Multipurpose water-resources scheme, in the PEER project, it is the controlled part of the basin, a body of various economic sectors sharing water resources; it is studied in the PEER Project within the boundaries of the countries and of PZs.

PZ – Planning zone, which includes all elements of water infrastructure, such as: water supply, hydropower, and, especially, irrigation and drainage networks; it is located within the boundaries of administrative province of the basin countries or in its part (for instance, for the Republic of Karakalpakstan, its Southern and Northern parts); 22 planning zones are selected in Small Amudarya basin.

RK – Republic of Karakalpakstan

RT – Republic of Tajikistan

RU – Republic of Uzbekistan

SAB – Small Amudarya Basin contains the basins of the Amudarya River and its tributaries – Vakhsh, Pyandj, Kafirnigan, Surkhandarya and Kunduz

SANIIRI – Central Asian Irrigation Research Institute was reorganized into the Research Institute of Irrigation and Water-related Problems

SAOhydroproject – Central Asian Branch of the Hydroproject Institute (Design and Survey and Research Institute); reorganized into "Hydroroject" LLC

SDD – Srednearya division of BWO Amudarya controls water intakes in the middle reach of the Amudarya River between Kelif and Darganata gauging stations (headquarters in Turkmenabad, Turkmenistan).

SIC – Scientific Information Center

Sredazgiprovodkhlopok Institute – Central Asian Design and Research Institute at the Ministry of Land Reclamation and Water Resources, renamed into "UZ GIP" Institute

TALKO – Tajik Aluminum Company

TMHS – Tuyamuyun hydroscheme comprised of HEPS, four reservoirs (in-stream, Kaparas, Sultansandjar and Koshbulak) and hydraulic structures (dam, dyke, water intakes, etc.).

TMHS OA –Tuyamuyun Hydroscheme Operation Authority

Upradik - Amudarya Inter-republican Canal Division controls water intakes in the lower reaches from the Tuyamuyun hydroscheme to Kipchak gauging station; the Division is also responsible for three large inter-republican irrigation systems: Tashsaka, Klychniyazbay and Kipchak-Bozsu (headquarters in Urgench, Uzbekistan).

UzHydroMet – Center of Hydrometeorological Service at the Cabinet of Ministers of the Republic of Uzbekistan.

VDD – Verkhnedarya (upsteam) division of BWO Amudarya controls water intakes from the Vaksh, Pyandj and Kafirnigan rivers and in the reach of the Amudarya River up to Kelif gauging station (headquarters in Kurgan-Tyubeh, Tajikistan)

Water district – upper, middle and lower reaches of Amudarya in the PEER project

WB – World Bank

WMS – Water management system; in the PEER project, it is the system that includes the controlled part, i.e. an object of management (**MWRS**) and the control part; the PEER project task is to draw recommendations for improvements in the control part of WMS in the Amudarya basin.