INSTITUTE for DEVELOPMENT and DIPLOMACY

WORKING PAPER

17 June 2022

Improving Azerbaijan's Water Management System

Chingiz Mammadov

Azerbaijan's leadership has recognized that the optimization of the country's water management system is an urgent national interest. Perhaps the most important piece of evidence in this regard is that on 15 April 2020, a special State Commission under the chairmanship of the Deputy Prime Minister was created by presidential decree to deal holistically and systematically with the management of water resources in Azerbaijan (its formal name is the State Commission for the Rational Use of Water Resources). This working paper should therefore be understood as a "from the balcony" contribution to ongoing efforts by Azerbaijan's authorities to improve the country's water management system.

There is much evidence indicating that Azerbaijan is already experiencing a freshwater shortage, and this problem is likely to be exacerbated in the near future. The government is evidently aware of this problem, hence the establishment of the aforementioned State Commission—an encouraging first step in ensuring the political prioritization of the quest to improve water management in the country. A second major step was made in a second presidential decree, dated 27 July 2020, which offered concrete action plans, identified major stakeholders, and listed the most urgent actions that needed to be taken. Additional major steps have also been taken subsequently in relation to water management issues in the liberated territories.

This working paper will therefore not enumerate what is already being done successfully; rather, it will concentrate on bottlenecks and shortcomings, the elimination of which may help to further improve Azerbaijan's water management system.

Chingiz Mammadov is Senior Programme Adviser/Programme Analyst in the United Nations Development Programme (UNDP) office, based in Baku. The views and opinions expressed herein are solely those of the author, who is writing exclusively in a personal capacity in full accordance with the UN's longstanding policy concerning the public activities of UN employees outlined in the Code of Ethics for UN Personnel.
The author would like to thank the authors of the reports cited in this Working Paper, as well as various colleagues who provided feedback on earlier drafts.

Macro Indicators

Let us start from the big picture and look to macro indicators in Azerbaijan in relation to water.

According to the State Statistical Committee, Azerbaijan consumed the following amounts of freshwater over the past several years (in millions of cubic meters).

	2016	2017	2018	2019	2020
Total water taken from natural sources	12,504	12,781	12,847	13,227	12,961
Total water usage	8,824	9,154	9,205	9,472	9,693
out of that:					
drinking / household usage	308	291	306	312	319
for productive purposes	2,108	2,224	2,111	2,070	2,073
for irrigation and agriculture	6,342	6,570	6,722	7,038	7,252
Water lost during distribution	3,680	3,627	3,642	3,755	3,268
Amount of sewage water	5,673	5,453	5,147	4,863	4,759
out of that: cleaned/treated	319	326	272	218	225

As seen from the table, more than one fourth of freshwater in Azerbaijan is wasted. However, there is no statistical data showing to what cause those losses should be attributed. Are these losses due to pipe leakages, water seeping into the ground from earth-made channels, or evaporation? There could be other reasons, as well. For example, water could be used illegally, which is not rare, yet reported and accounted as losses. Thus, there is a need for clearer differentiation. This could become possible with more thorough measurements, calculations, investigation, etc.—in short, all that is usually meant by Measurement, Reporting, and Verification System (MRV). In this regard, adopting SCADA systems (supervisory control and data acquisition), which is used in many countries for the control and acquisition of data, would be very useful: SCADA systems would allow the authorities to see where real-time problems are occurring and fix them.

Let us next look at how effectively water has been used. One of the major indicators of the effectiveness of the usage of water resources is the amount of GDP produced per unit of freshwater withdrawal.

The table below shows the data for this indicator, along with some other useful data.

	2016	2017	2018	2019	2020
Changes in water productivity, USD/m3	3.70	3.89	4.85	4.58	3.67
The level of water taking intensity, shown as a percentage of freshwater taking out of total freshwater resources	52.4	53.5	53.7	55.6	53.9
Percentage of sewage water treated safely	43.6	47.0	49.2	51.8	52.6

As we may see from the table, Azerbaijan's water productivity during the last years fluctuates between $4,00 and $5,00 per cubic meter.

The data of the State Statistical Committee is close to the World Bank's country-by-country estimates of water productivity. For example, in 2014 Azerbaijan's water productivity stood at $4,90 per cubic meter, which put it only slightly ahead of Armenia ($3,80).

In this part of the world, only states like Turkmenistan ($1,30), Uzbekistan ($1,00), the Kyrgyz Republic ($0,70), and Tajikistan ($0,60) ranked lower in water productivity per cubic meter.

In the same year, the water productivity of both Iran and Iraq was estimated by the World Bank at $5,00 per cubic meter, very close to Azerbaijan; that of the United States was $43,00, Kuwait $146, Israel $269, the UK $361, and Ireland $428.

There are myriad reasons to explain the differences in figures, including climate, the character of the economy, and differences in approaches and estimations, but also the accuracy of statistics and the year for which the latest data is available. For example, why does Kuwait have a significantly higher indicator than the U.S.? Is it because its economy is stronger and more balanced? No, the reason is that Kuwait has very limited water resources and part of its freshwater is brought in by tankers or is desalinized by using expensive technologies, while its very big GDP is formed mainly by hydrocarbon exports. Rather, in this particular case it points to imbalances in Kuwait's economy.

Still, the overall and inescapable point is that water is used in Azerbaijan inefficiently. This is especially alarming if we look to the water-taking intensity, shown as a percentage of freshwater taking out of total freshwater resources. As we see from the table, it exceeds 50 percent.

Let us now look for the possible reasons of inefficient usage of water.

Sectoral Situation Analysis: Households

There are three major areas of water usage: households, industry, and agriculture. Each will be examined in turn.

The norms and practices of per capita water usage in households vary across countries. The World Health Organization (WHO) identifies three levels of access to water: *basic, intermediate*, and *optimal*.

Basic access is the availability of a source of water that is, at most, 1,000 meters or 20 minutes away and that affords the possibility of reliably obtaining at least 20 liters per day per family member. Such access allows for consumption, hand washing, and rudimentary hygiene; but it does not guarantee laundry or bathing. These limitations have a notable impact on health.

Intermediate access is where people have access to 50 liters of water per day at a distance of less than 100 meters or 5 minutes away. It covers laundry and bathing as well as *basic access* uses. In this case, the impact on health is low.

Optimal access allows for the consumption of 100 liters of water per person per day on average, which is supplied continuously through multiple taps and meets all consumption and hygiene needs.

According to the State Hydrometeorological Service, 11,5 billion cubic meters of water were consumed in Azerbaijan per year on average during the past several years. (It should be noted that these numbers are slightly different than those provided by the State Statistical Committee, but not by very much, if we consider the complexities of precise measurements and calculations in relation to water).

However, the same source (i.e., the State Hydrometeorological Service) reports that the average water consumption per person per day equals to 310.6 liters. This is more than three times higher than the *optimal access* figure envisaged by the WHO, which (as indicated above) is 100 liters per day. The Azerbaijani figure appears to be questionable, given its status as a water-stressed country.

Let us look for the same figure in other countries, by way of comparison. Among EU member states, for example, Spain has more or less similar climactic features to those of Azerbaijan. According to the Spanish National Statistics Institute, in 2012 the average household water consumption was 137 liters per person per day.

Or look at India, a water- and rain-abundant country. There, the standard norm for domestic water usage, as prescribed by the country's Central Public Health and Environmental Engineering Organization, is 135 liters per capita per day. The same source indicates that the actual average consumption by households is higher: 183 liters per day per capita.

Therefore, the Azerbaijani figure of 310.6 liters per capita per day seems not real. One explanation could be that the total usage of freshwater was divided by the number of households, i.e., real per capita per day consumption is confused with some other figure.

Other reasons could be attributed to losses and the "irregular" usage of water. For example, the State Hydrometeorological Service's report rightly enumerates the usage of water for cleaning yards and areas in front of houses, the frequent washing of cars and carpets, and the watering of gardens and orchards. Thus, policies to reduce the wasting of freshwater should be prioritized further.

Sectoral Situation Analysis: Industry

As noted in the table above, during the past several years, about 21 to 24 percent of total water usage was used for "productive" purposes.

But it is not at all clear what is meant by the term "productive"—what, in other words, constitutes "productive usage"? The term definitely excludes agriculture, as there are separate figures for agricultural usage. At the same time, the term "productive usage" ("istehsal ehtiyacları üçün" in Azerbaijani) does not allow for differentiation between extracting industries, light industry, food processing, the chemical industry, etc. So, the recommendation here could be to track "productive usage" more precisely and, thus, to provide more differentiated figures.

Let us next cast a glance at world practices. Globally, approximately 19 percent of total water withdrawals are used for industrial purposes. So, in this sense, Azerbaijan lies close to the average world figures. However, the numbers differ significantly between high- and low-income countries. According to the United States Geological Survey (USGS), high-income countries use 59 percent of their water for industrial use, while low-income countries use only 8 percent.

According to the UN classification, which is based on GDP per capita, Azerbaijan is not a low-income country. In fact, it is already a top middle-income country (again, according to this classification). However, by the structure of water usage Azerbaijan is closer to low-income agricultural countries.

One final comment before we move to an examination of how water usage for agriculture is related to the treatment of sewage water. If we look back to the second table above, the percentage of sewage water treated *safely* exceeded 50 percent during the last years, equaling in 2020 to 52.6 percent. At a first glance, this is an excellent figure. However, if we look to the data in the first table above, we can see that only 4.7 percent of sewage water (i.e., 225 million cubic meters out of 4,76 billion cubic meters of total sewage water) was treated overall. Thus, it is not half of the total sewage water (i.e., 4,76 billion cubic meters), but only a half of treated sewage water (i.e., one half of 225 million

cubic meters, or around 117 million cubic meters) is treated *safely*. This is a very low figure. Hence, treated sewage water represents another untapped potential source for greening cities and other such initiatives.

Sectoral Situation Analysis: Agriculture

According to the Fourth National Communication (FNC) for Azerbaijan to the United Nations Framework Convention on Climate Change (UNFCCC), which was presented in June 2021, the total land fund of the country stands at more than 8.641 million hectares. Of this, only 4.78 million hectares (or 55 percent) is designated as fit for agricultural production. The amount of per capita agricultural land equals to 0.47 hectares. Out of this figure of 4.78 million hectares, however, only about 2.06 million hectares are classified as arable land. A further consideration is the fact that—except for the foothills the south-eastern part of the country—only 1.45 million hectares require irrigation (0.61 million hectares are rain-fed).

Now, the height of water coverage in millimeters is usually used to evaluate the irrigation situation in a country. In the case of Azerbaijan's agriculture sector, the total water usage for agriculture in the past few years fluctuated at around 7 million cubic meters per year, with the last reporting year 2020 equaling to 7,25 million cubic meters (all this is according to the State Statistical Committee). Further, if we divide this amount by the number of days required for watering crops (the calculation assumes 110 days, which is a conservative one, since some crops can require up to 120-130 days) and then by the area of irrigated land, namely 1.45 million hectares, then we arrive at a height of nearly 4.5 millimeters of water available for irrigation in Azerbaijan.

The question is whether this is sufficient. The answer requires us to look further into the relevant data.

Globally, the water needs of irrigated lands vary significantly not only between countries, but also within them—and even between and within rayons in the same country. This depends on factors such as geography, soil and crop types, rainfall, altitude, mean daily temperature, number of sunny days, and so on. In fact, the variance can sometimes be quite significant, depending on the relative weight of some of the aforementioned variables in the overall equation. Therefore, unlike household consumption, it is very difficult to make an average estimation of agriculture-based water consumption. Still, we do need to identify at least the range of water resources required for irrigation, which does require that we make use of average/aggregate figures.

In this regard, the UN's Food and Agriculture Organization (FAO) 1986 manual on irrigation water management, entitled "Irrigation Water Needs," can be a useful bench-

mark. This report developed a measurement method whereby grass is considered to be the referential crop, and its water needs in a given geography are estimated on the basis of climate, mean daily temperature, soil type, and so on.

The table below, taken from the aforementioned FAO manual, shows the water needs of grass as a standard crop, depending on the type of soil and mean daily temperature.

Climatic Zone	Mean Daily Temperature		
	low (less than 15°C)	medium (15-25°C)	high (more than 25°C)
desert/arid	4-6	7-8	9-10
semi-arid	4-5	6-7	8-9
sub-humid	3-4	5-6	7-8
humid	1-2	3-4	5-6

In the case of Azerbaijan, most of the country's agricultural lands are classified as semi-arid, with some arid zones and some sub-humid areas, and with mean daily temperatures ranging from 15°C to 30°C. Semi-deserts occupy about 15 percent of the territory of the country. Therefore, according to the FAO's standard grass crop approach, the water needs of soils in Azerbaijan range from 4-5 to 8-9 millimeters. For example, the standard grass crop grown in a semi-arid climate with a mean daily temperature of 20°C needs approximately 6.5 millimeters of water per day. The same grass crop grown in a sub-humid climate with a mean daily temperature of 30°C needs about 7.5 millimeters of water per day.

The next step—according to the FAO manual's methodology—requires the other crops to be compared with the standard grass crop. Olives and grapes will need about 30 percent less than the standard grass crop, while cucumbers and radishes need about 10 percent less; carrots, melons, onions, pepper, tea, and spinach each fall into the standard grass cop category—i.e., they each require about as much water as a standard grass crop. On the other hand, cotton, tomatoes, eggplants, sunflowers, wheat, and so on need about 10 percent more water in comparison with the standard grass crop, whereas nuts and fruit trees need about 20 percent more.

As noted above, most irrigated lands in Azerbaijan are classified as either semi-arid or sub-humid. Therefore, the 4.0-5.0 millimeters per day figure, as we had calculated above, already puts agricultural production in Azerbaijan under stress, especially in high daily mean temperature areas. This might constitute one of the reasons why agricultural lands in Azerbaijan are of low productivity.

However, for building a policy, more accurate calculations and estimations are necessary to be able to draw reliable conclusions. We can therefore examine some of the main reasons for the inefficient usage of water and accrued losses. Here we can mention three.

First, most water channels—especially those located in the fields—are rudimentary, hand-dug open-air ditches. Thus, part of the water simply goes into the ground. In this regard, it is worth mentioning that the government is already planning to cover with concrete 20,000 kilometers of water channels. It may make sense to think about moving to more advanced technology of using big pipes for water distribution.

The *second*, related, reason is evaporation, given Azerbaijan's prevailing hot and sunny climate. However, there is no data on the amount of evaporated water. More precise measurements of losses due to evaporation may advise whether to use concrete channels or pipes, from which evaporation is practically non existent.

If the two previous reasons could be considered "natural," then the *third* reason is purely "manmade," namely: the currently prevailing system of land ownership in Azerbaijan. It traces its origin back to the dismantling of collective and state farms (kolkhoz and sovkhoz) in the period immediately following the reestablishment of Azerbaijan's independence, in accordance with recommendations made at the time by the International Monetary Fund and The World Bank. Arable lands were divided and allocated among 1.5 million newly minted private landowners.

This represents a great challenge for effective watering. In Azerbaijan, small land plots with a patchwork of different crops growing on them require different amount of water at different times. This results in insufficient watering for some crops and over-watering for others, not to mention the effects of salinization, and so on. Only large farms in which one crop occupies an extended area can take advantage of optimal or at least efficient use of water resources and, in turn, make possible the high productivity of agricultural land. It is thus not surprising that, according to the State Statistical Committee, in 2021, the agricultural sector of the economy, which employs almost one third of the workforce, produces only about 6.9 percent of Azerbaijan's GDP.

A final note: notwithstanding valid criticisms of various policies adopted by Belarus, those concerning the preservation of profitable collective and state farms has enabled that country to establish a strong and, in many ways, efficient agricultural sector, such that the export of agricultural products provides a significant revenue stream for the state budget of that country. The lessons learned from this model could have positive implications for the liberated areas of Karabakh. Similarly, in Turkey, the improvement and modernization of water systems in agriculture goes hand-in-hand with the land consolidation. More on this below.

Availability of Water Resources

According to the aforementioned FNC Report, Azerbaijan's freshwater resources are limited compared to other countries in the South Caucasus, accounting for only 15 percent of the region's water resources (whereas Azerbaijan, with its population of more

than 10 million, constitutes about 60 percent of the region's total). Azerbaijan's dependance for its average yearly water inflows from abroad is at about 70 percent.

Sources of the country's surface water resources include rivers, lakes, reservoirs, and glaciers. Glaciers play very minor role in Azerbaijan and, therefore, we will not consider them here.

Surface water resources are represented mainly by rivers, with between 67 and 70 percent of river water resources originating outside of the country. Azerbaijan's fluvial network consists of more than 8,350 rivers; however, only two of them, the Kura and the Araz, are more than 500 kilometers in length: most rivers measure less than 10 kilometers in length.

The river system of Azerbaijan comprises the Kura River and its tributaries, as well as the rivers flowing directly into the Caspian Sea. The Kura River is the country's main water source—the fluvial artery of Azerbaijan. This river flows through the territory of Turkey, Georgia, and Azerbaijan. Its total catchment area is 188,000 square kilometers; of these, 58,000 square kilometers (31 percent) run through Azerbaijan. The Araz River, for its part, originates in Turkey before straddling the borders between Turkey and Armenia, Azerbaijan's Nakhchivan exclave and Iran, Armenia and Iran, and mainland Azerbaijan and Iran, before, finally, moving through Azerbaijan where it joins the Kura River before entering the Caspian Sea.

There are 21 main transboundary rivers in Azerbaijan. In addition to the Kura and the Araz, three other transboundary rivers (i.e., the Ganikh, Gabirri, and Samur rivers) play important roles supplying Azerbaijan with water. Usage share agreements are regulated through bilateral agreements with the neighboring countries.

In Azerbaijan, there are about 450 lakes with a total area of 395 square kilometers, but only five of these have an area greater than 10 square kilometers, and only six of them contain a volume larger than 20 million cubic meters.

In total, there are 140 natural and artificial water reservoirs in Azerbaijan. Their total area is 982.84 square kilometers, and their total volume is 21 billion cubic meters. Of these, 60 have a volume above 1 million cubic meters. Water reservoirs are built both within and beyond natural riverbeds, and their reserves are used to produce both electricity and for irrigation.

Another category of water resources is groundwater. In the wake of the reestablishment of Azerbaijan's independence, the usage of this resource has increased, notwithstanding its limited supply, uneven geographic distribution, and high mineral content. This presented less of a problem in the past, when groundwater was mainly used by rural households as a supply of drinking water. However, over the past few decades, ground-

water has increasingly been used for irrigation through the drilling of artesian wells. This has resulted in an even higher rate of salinization of already salinized lands in parts of Azerbaijan.

Finally, to complete the picture, it is worth mentioning that Azerbaijan is blessed with positive population growth, which, according to statistical projections, will continue for another 20 to 25 years. This is part of a historical trend: Azerbaijan's population has grown more than three times since the 1960s, which is attributable not only to higher birthrates and lower infant mortality rates, but also to an influx of refugees from Armenia and elsewhere. Thus, even without the deleterious effects of climate change, the country would need to better manage its natural resources. Amongst all these, water is both the most important and the most directly affected.

The first major question to address is whether Azerbaijan has enough water resources. The answer will impact greatly on the main direction of Azerbaijan's water policy in the decades to come.

If the answer to this question is positive, then the main focus should be on water management. If the answer is negative, then Azerbaijan will need to make a concerted effort to secure larger water flows from the outside. As mentioned above, about 52 percent of totally available freshwater is already being used. Thus, the question becomes whether the remaining 48 percent is sufficient to avoid a water crisis in Azerbaijan, especially when its strategic plans to engender economic growth are taken into account.

Current State of Water Management

By its nature and due to the complexities affecting usage, water management is a very difficult public policy issue. Thus, in Azerbaijan several ministries and state agencies are involved in this process, in one way or another.

- The *Ministry of Ecology and Natural Resources* carries out hydrological and meteorological monitoring, monitors the ecological condition of water resources, and prepares cadastral records of surface and ground waters.

- The *Azerbaijan Amelioration and Water Economy Open Joint Stock Company* supplies arable lands with irrigation water, manages the operation of state-owned amelioration and irrigation systems, and maintains the state inventory of water use. At the local level in rural areas, it also sells water to water user associations, which are formed by farmers.

- The *Ministry of Economic Development* is in charge of setting economic policy within the country. By relevant presidential decrees, the former Ministry of Taxes,

the State Committee for Property Issues, and the State Service for Antimonopoly Policy and Consumer Market Control were integrated into the structure of the Ministry of Economy.

- The *Azersu Open Joint Stock Company* supplies the population with freshwater.
- The *Azerenergy Open Joint Stock Company* produces hydropower by using water reservoirs and manages reservoirs.
- The *State Agency for Water Resources under the Ministry of Emergency Situations* is tasked with improving the management of water resources.
- At the local level in rural parts of the country, both *executive authorities* and *municipalities* are also involved in water supply and regulations.

As in any system of governance, contradicting interests are sometimes made manifest between water users, regulators, and policymakers. For example, agricultural users need water most in summertime, whereas *Azerenergy* may require higher levels of water in the various reservoirs under their jurisdiction at different times. We could also say that some of the aforementioned entities have an interest in demonstrating higher water usage whereas others are interested in demonstrating the opposite.

Recent Regulatory Developments

Being aware of the complexity and the necessity of prompt actions in the face of looming crisis, the state has undertaken various important steps in this regard. Two can be mentioned here.

On 15 April 2020, a presidential decree established a State Commission to oversee measures to ensure the efficient usage of water resources. Chaired by the First Deputy Prime Minister, this new body includes representatives from all the ministries and state agencies mentioned in the previous sections. Called the State Commission for the Rational Use of Water Resources, its formal tasks include:

- Analyzing the current situation with the usage of water resources and the management of water enterprises.
- Increasing the efficiency of the usage of water resources, ensure improvements in the inventarization and management of water resources, and operative communication.
- Ensuring the involvement of the relevant state agencies, scientific enterprises, and specialists, including international experts, in works involving water rationalization.

- On 27 July 2020, another presidential decree mandated "additional measures on ensuring effective usage of water resources." It reiterated the supervisory role of the State Commission and outlined major directions of work for addressing the challenges, including:

- To provide accurate statistics for the actual usage of water during the past three years, the expected needs for the current year, and a prognosis for each coming year.

- To quickly (within two months) establish rules and norms for the paid usage of water and inform all water users about those rules and norms.

- To develop an Action Plan and regularly report to the President about its implementation.

- To hold regular consultations with scientific organizations, experts, representatives of civil society, international specialists, and international financial institutions to ensure the effective and economical usage of irrigation and potable water, the usage of water from the production of energy, and industrial usage.

Worth mentioning is the fact that both presidential decrees were signed during the COVID-19 pandemic but before the onset of the Second Karabakh War. Thus, this decree can be interpreted as demonstrating the state's prioritized concern with upgrading Azerbaijan's water management system. It should also be noted that a December 2020 amendment to the second presidential decree ensured that its scope covered the usage of rainwater within the context of the country's water management system, but also the effective and efficient usage of water in the liberated territories.

Recommendations

As mentioned above, the State Commission for the Rational Use of Water Resources acts on the basis of an Action Plan elaborated in presidential decrees (and subsequent documents, including a "Report on the Performance of the Action Plan for 2020-2022 to Ensure the Effective Utilization of Water Resources"), which reflects both the existing situation and contains recommendations for the future. These include building reservoirs in economic zones, collecting water from precipitation, processing sewage waters and waters collected in metro stations and other underground networks, and so on.

It is noteworthy that the State Commission has at its disposal more resources—including human resources—than any think-tank or institute. Several state agencies, as well as hundreds, if not thousands, of specialists, have been systematically implementing the Action Plan for 2020-2022, but also collecting data, analyzing the situation, preparing recommendations, thinking about future actions.

The recommendations that follow below can be considered as a fitting conclusion to this "from the balcony" contribution to ongoing efforts to improve Azerbaijan's water management system.

1. Statistics remain one of the biggest challenges in the country. It is not possible to build and implement a policy without accurate-as-possible numbers. Currently, the numbers differ sometimes not only between agencies, but even within a single report. This suggests that either different agencies use different sources of information or different methods of calculation. Evidently, this situation needs to be remediated. The country should adopt a robust MRV (Measurement, Reporting, and Verification) system. The Ministry of Ecology and Natural Resources recently has significantly increased the number of measurement stations and purchased important equipment. This work is to be praised and should be strengthened.

2. Relatedly, statistical reports should adopt a unified approach. It should be clear across all sectors what is meant by terms such as "productive usage of water," "per capita freshwater consumption," and "circular water usage." For example, it should be clear what is meant under "wastes" and "losses." Sometimes, such terms are used interchangeably. Does this refer to water that uselessly went into the ground from hand-dug ditches, or evaporated water, or water wasted by households? Or should water that was first used by thermal electric stations to cool turbines and engines and then used for irrigation be counted as industrial usage or agricultural usage. Otherwise, there is a clear danger of missing some data on the one hand, and double (and even triple) counting on the other.

3. Measurements should be applied accurately to water amounts that comes into the country from abroad and those that are formed within the country. The necessary equipment should be purchased, specialist trained, and a system of appropriate recording and data reporting instituted. On the basis of such measurements, negotiations should be initiated with neighboring countries (i.e., Turkey, Russia, Iran, Georgia, and, as soon as possible, Armenia, regarding water taken from transboundary rivers (e.g., the Kura, Araz, and Samur rivers) that are major sources of freshwater for Azerbaijan

4. Water policy in Azerbaijan is an area of governance that requires an optimal combination of a centralized and decentralized approach. The former because it is necessary to have a central state body in charge of "big picture" water policy; the latter because water is used "on the ground" by households, farmers, and enterprises, and that water demand and usage greatly varies between regions (both regarding its consumption and availability). Therefore, strong both horizontal and vertical coordination among stakeholders is necessary—and not simply at the level of statistical methodology.

5. "Under the counter" selling and usage of water, the embezzlement of water resources, and "illegal schemes" of water usage should be brought to an end. According to observations, they still constitute a significant share of overall water consumption.

6. There is a need to shift from an excessive and wasteful usage of water to more economical methods, including drip irrigation, especially in horticulture.

7. A more cautious policy is required with respect to the usage of artesian water. A reckless policy of allowing or tolerating the drilling of artesian wells has resulted in both the salinization of lands and the lowering of groundwater levels. The drilling of artesian wells should be strictly controlled and properly regulated.

8. It should be accepted that the land privatization campaign conducted in accordance with the recommendations of international financial institutions in 1990s was not optimal. In Azerbaijan, relatively large farms are much more likely to use water economically. Thus, water policy can work effectively only in combination with an effective agricultural policy. Since the occupation of Karabakh took place before the land privatization policy was instituted in the rest of Azerbaijan, the state remains the effectual owner of the entire liberated territory. Thus, liberated Karabakh can serve as a pilot ground for instituting an up-to-date water management system, which ought to include the design and execution of a holistic agricultural, industrial, and social policy.

9. To accomplish all these steps, a new generation of specialists is required. They need to be well-educated and trained in different aspects of water management, including planning, engineering, and statistical methods. Therefore, a list of required professions should be prepared and included into the program of state-sponsored education abroad. The Ministry of Education recently started a new phase of sending students abroad. Water specialists should be among them. Preparation of specialists in local universities having appropriate capacity and faculty should be pursued as well.