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Turkish Dairy Sector Water Conservation Guideline

Civil Society Dialogue - V

Water Sustainability of Turkish Dairy Sector:
Efficiency, Risks and Vulnerabilities

SSSTürkiye

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Presence of Water and Water Risks in Turkey

In the world, water resources are being depleted rapidly and while the water quality is decreasing, the situation is moving towards an alarming point in our country as well. In the second half of the last century, water demand in Turkey has roughly doubled. Recent reports and scientific studies indicate that Turkey could experience severe water shortages in the coming years.

70% of the existing fresh water in our country is used by the agricultural sector. 53% of this is provided from surface waters and 38% from underground resources. Regarding the use of industrial water, it is seen that 34,7% of the water used in production is supplied from fresh water sources.

Our country consists of 25 large basins and the amount of precipitation in our basins has decreased by 25% in the last 30 years. Studies on the effects of climate change show that by 2050, there will be a 37% decrease in water in the Mediterranean Region Basins, 70% in the Konya Basin and 10% in the Fırat-Dicle Basin.

Another important problem for basins is water quality. Pollution constantly lowers the quality of water. Unfortunately, our country is still not sufficient in terms of the treatment of water used in industrial production. This situation affects both the sustainability of water basins and human health negatively. Again, for the same reason, agricultural lands face risk in terms of production.

Researches show that the most important water threat seen in our country is river pollution, followed by lake drying. Excessive and uncontrolled withdrawal of ground waters poses a significant risk for the presence of water.

Increasing drought pressure due to climate change, rising water demand due to population growth, decrease in existing resources and decrease in water quality are among the issues that our country should deal with immediately and with great importance in water management.

A New Approach to Sustainable Use of Water Water Footprint

As water finds more place in the national and international agenda, new approaches are introduced in the management of the issue. The most functionally prominent among these approaches, is the water footprint.

Water footprint, which refers to the amount of clean and fresh water required to produce a product or service, is a multifunctional indicator that shows the volume of water, the type of water used and where it is used for what purpose.

It is evaluated in 3 groups as blue, grey and green depending on the type of water used.

Blue water footprint refers to the total volume of surface and underground fresh water resources needed in the production of a product; grey water footprint refers to the fresh water volume used to eliminate or reduce the pollution load; and green water footprint refers to the volume of rainwater used in the production of a product.

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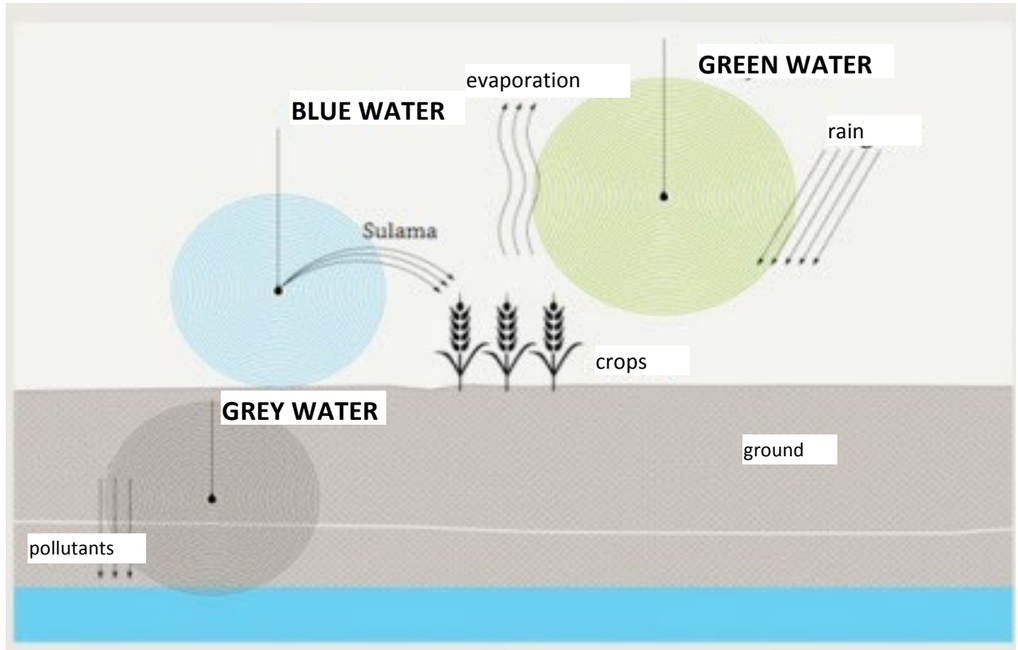

Turkey's Water Footprint

When the water consumption data from our country is analysed, it is seen that the biggest share in consumption is in the agricultural sector and then in the domestic and industrial areas, respectively.

Water footprint resulting from production is 139.6 billion m3/year. 89% of this results from agricultural use, 7% from domestic use and 4% from industrial use. 92% of the 89% agricultural sector water footprint, originates from crop production and 8% from grazing.

Consumption footprint in our country is 140.2 billion m3/year. The biggest share in this water footprint still belongs to the agricultural sector with 89%. The agricultural sector is followed by industrial consumption with 6% and domestic consumption with 5%, respectively.

Taking necessary measures on the basis of resource efficiency, determining a water management plan based on data, determining the usage areas and quantities of water, determining the risks and implementing water management with the active participation of all stakeholders based on the emerging table is essential for the sustainable management of water in our country.

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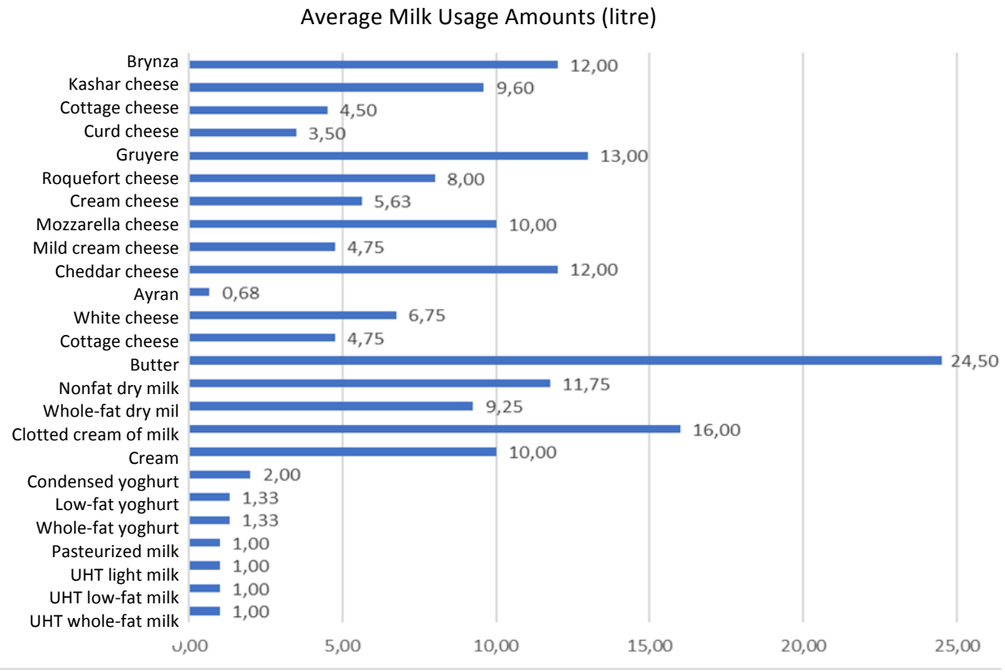
Dairy Sector In Turkey

In addition to being a regular and continuous sourceofincomefortheagriculturalenterprises, the dairy sector has a strategic importance with the added value it offers to the country's economy. The sector also has a share in the development of social development through direct and indirect employment provided in the entire value chain; it is extremely effective in protecting public health and improving rural development.

In the sector, the focus is on the production of cow milk, but sheep and goat milk also has an important importance. These milks are processed into milk and dairy products that contain extremely important nutrients in terms of adequate and balanced nutrition. The average amount of raw milk used in the production of the mentioned milk and milk products is given in the table below. Water footprint of 1 litre of cow's milk production in



Turkey is an average of 806 litres. The water footprint of each product can be calculated from the milk usage amounts given in the table.

The dairy sector is by nature one of the sectors that are most affected by vulnerabilities due to climate change. Many raw materials which are inputs for the industry, especially feed, have the potential to be directly affected by climate change. However, the sector faces

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risks especially about water.

To determine these risks and vulnerabilities and to determine how water sustainability can be achieved, "Turkish Dairy Sector Sustainability of Water; Efficiency, Risks and Vulnerabilities" Project, for which Packaged Milk and Milk Products Manufacturers Association (ASÜD) is a coordinator beneficiary, was launched within the framework of the EU-Turkey Civil Society Dialogue 5th Semester call, which is coordinated by T.R. Ministry of Foreign Affairs EU Directorate. Within the scope of the project, the data obtained through literature review, site visits and stakeholder interviews were presented to stakeholders through prepared reports and workshops.

One of the most important outputs of the project is revealing the size of the sector's dependence on water.

Water Dependency of the Dairy Sector in Turkey

A reliable and quality water supply is essential for dairy farms.

The milk system can be considered as four subsystems.

- Feed crop production
- Feed production-industry
- Milk production
- Milk processing

In each of these sub-systems, physical water is used for purposes such as; feed production, ensuring cattle hygiene, animal-related consumption, milk cooling, equipment cleaning, air conditioning of cows' habitats, production of value added products, fertilizer transport and barn cleaning and milk processing. However, each of these systems also drains the water. The water consumption of each activity is defined as the difference between the water drawn from the source and the water left to the same source and suitable for the conditions.

The data revealed shows that the most water use in the dairy sector is due to feed raw material production. Turkey average created based on 2005-2013 feed crops water consumption data is presented in the following graph.

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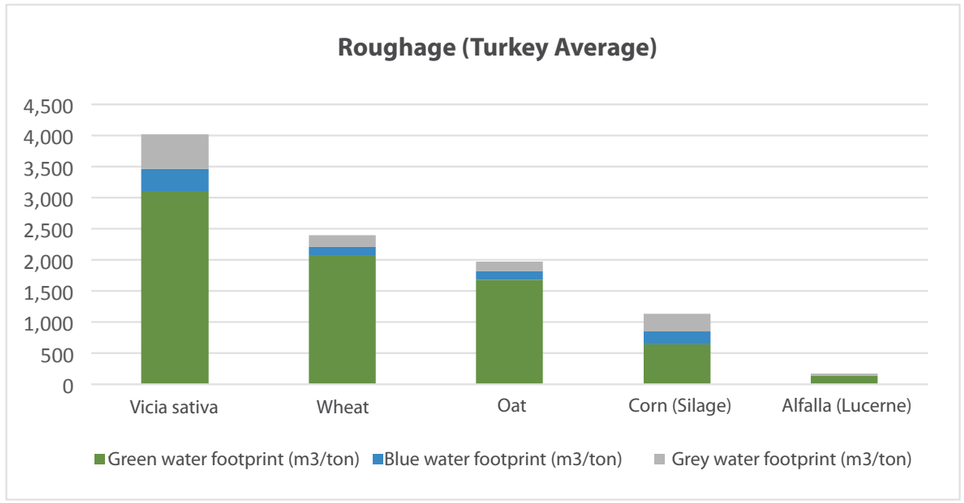

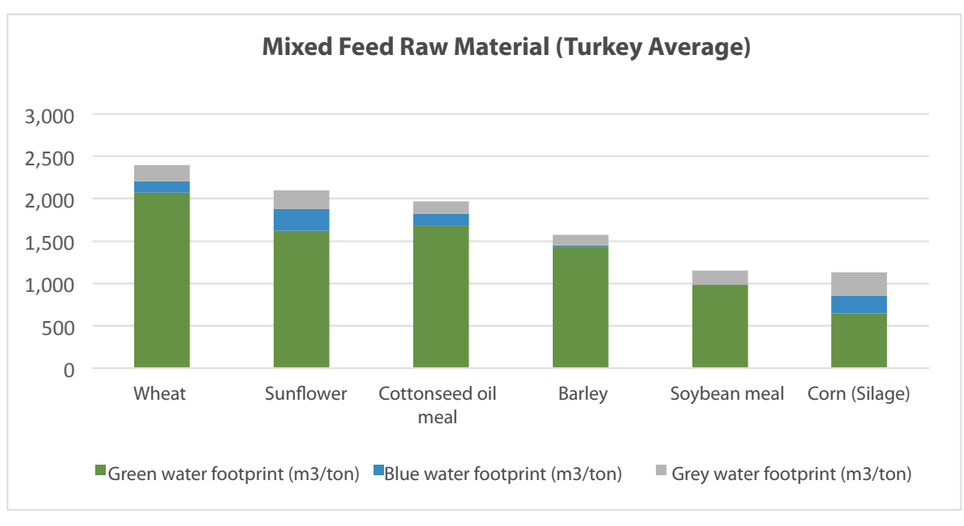

Within the scope of “Turkey’s Dairy Sector Water Sustainability; Productivity, Risks and Vulnerability” Project, 8 provinces in Turkey where raw milk production is concentrated on were identified and water footprint assessment for milk and dairy products is made in these provinces.

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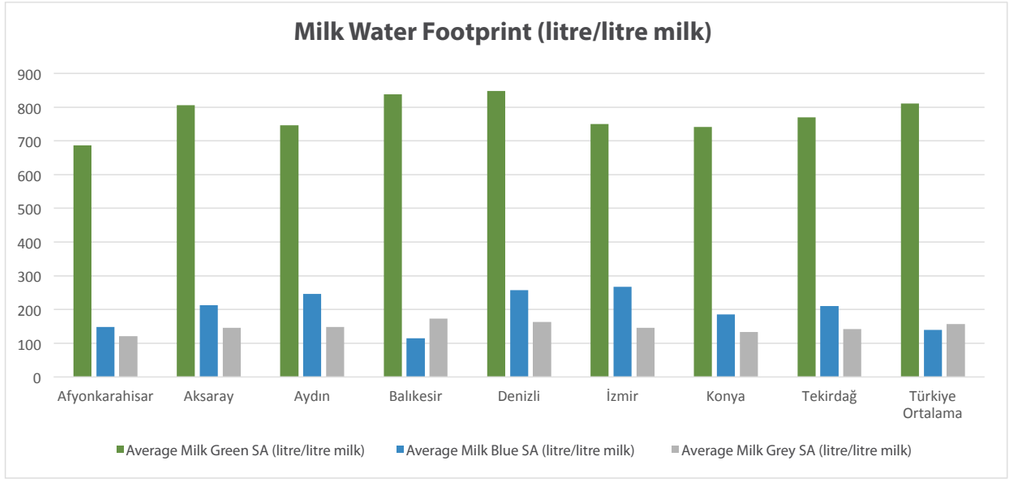

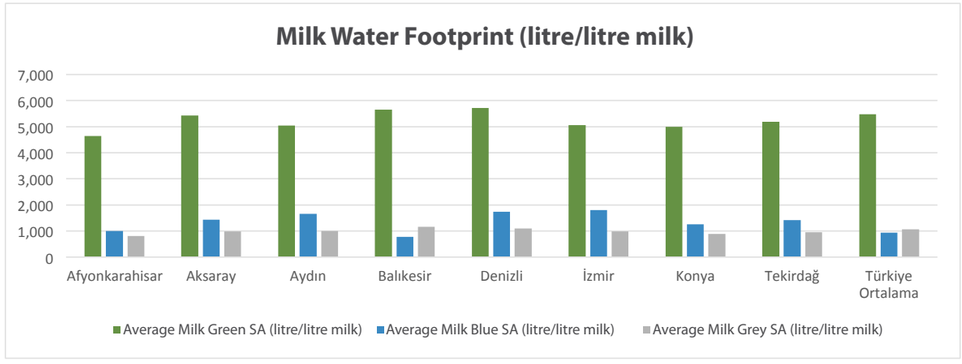

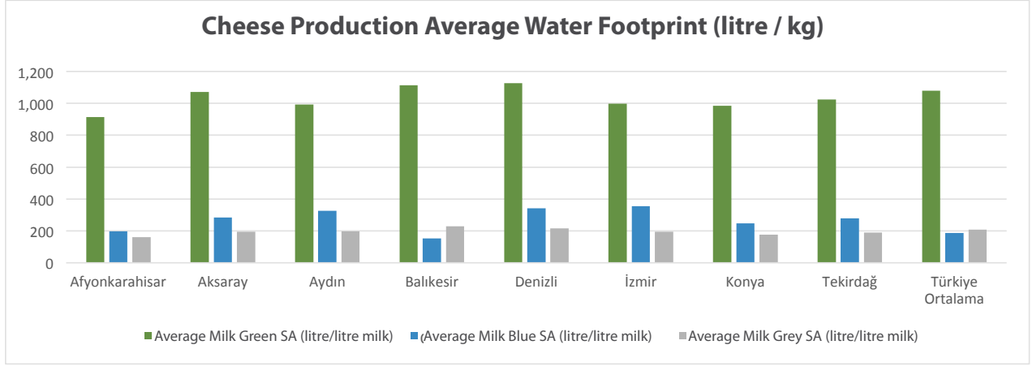

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Vulnerabilities of Turkey's Dairy Sector

While the use of large amounts of water in production processes along the value chain of milk and dairy products makes the sector dependent on water resources, it makes the sector vulnerable in the face of water-related events. On the other hand, increasing water scarcity and drought in our country also increases this vulnerability. All this can have negative consequences for the milk and dairy products sector, such as production disruption and shortage of raw materials.

For the evaluation of this possibility and risks, a report was prepared on the sector's vulnerability within the scope of the project; water demand of the dairy industry in Turkey was mapped and how vulnerabilities related to water may affect the supply of milk production and key components it is attached were evaluated. The report reveals what are the potential vulnerabilities of water sustainability and economic stability of the dairy sector in Turkey, and which production stages might be affected more by water problems in the short and long term future.

The report sets out five strategic recommendations, in order to reduce the vulnerability of the dairy industry of Turkey against water problems.

1. Farmers' capacity should be enhanced in terms of water use, management and climate change.

2. In feed crops cultivation; investments should be made in irrigation efficiency, drought resistance, water reuse and recycling.

3. In the future investments should be made in areas rich in water, especially in the North and East Anatolian regions, and the production system should be changed.

4. Easier access to information on the impacts of climate change and associated financial risks should be provided for key sensitive production stages.

5. The use of water-based, artificial intelligence-based technologies and especially air-based information tools among farmers should be encouraged for weather forecasting.

Good Practices for Sustainability of Water in the Dairy Sector

Today, many countries around the world are developing programs to reduce the environmental footprint of the dairy sector and water is one of the main topics of these programs.

England

England, one of the largest milk producers in the world, carries out monitoring, reporting and communication studies all together, for the development of the dairy sector. The UK Dairy Roadmap and "Environmental Comparison" are examples in this area.

Dairy Roadmap is an cross-sectorial initiative that brings together milk supply chain stakeholders such as farmers, milk producers and industry representatives in the UK. Dairy Roadmap is also working to reduce the impact of dairy farms on the environment. The goals in this area includes the reduction of greenhouse gas emissions, energy efficiency, water use and waste management.

According to the latest report on the UK dairy sector by the Initiative, which reports environmental developments in the milk supply chain, the industry has achieved 23.4% improvement in water efficiency since 2008. The improvement in waste water is 17.5%. Between 2010 and 2012, water efficiency increased from 58% to 78%. In ensuring this; rainwater harvesting, reuse of water from plate cooling systems and diversification of water supply have been effective.

Belgium

It was decided to put forward a sustainability program that will cover the entire value chain in the dairy sector in Belgium. Raising awareness, monitoring and communication are determined as the 3 main pillars of this plan. The program has been called "Monitoring Sustainability Across the Dairy Chain".

Within the scope of the program, visiting more than 7,000 dairy farms and listing the sustainability activities in these farms require extensive work in terms of both time and labour. However, works have started at the end of a 2-year preparation and consultation process.

Denmark

Operating in Denmark for agricultural research and innovation, SEGES also carries out studies to reduce the environmental impact of the dairy industry and steers the sector with projects. SEGES tried to control the environmental impacts of the sector by increasing the pasture lands in Denmark. This also enabled dairy farmers to access higher quality feed raw materials, thereby increasing milk yield.

Ireland

SDAS (Sustainable Dairy Assurance Scheme) was prepared with the combination of milk producers, industrialists and legislators in Ireland. This plan has 4 main objectives. A platform called "Dairy Sustainability Ireland" has been established in order to meet the expectations of the plan and studies are carried out through this platform.

As a result of the researches carried out in particular for the Irish dairy products sector, it was detected that the water consumption of the dairy products industry in 2013 was 13 billion litres; 40% of this amount was obtained from ground waters, 58% from surface waters and 2% from the network. Studies and researches conducted across the country revealed that the water used in the industry decreased by 26% between 2005 and 2013.

New Zealand

Sustainable Dairy, which leading institutions and organizations operating in the country

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voluntarily gathered and signed: Water Accord, (Sustainability Dairy: (Water Accord) aims to improve the environmental performance in farms.

Water Accord includes coastal planting plans, waste water management, comprehensive standards for new dairy farms and measures to increase the efficiency of water and nutrient use in farms. The accord was initiated by establishing the milk industry's commitment to improve water quality in New Zealand. Within the framework of the accord, regular reports are made and achievements are periodically detailed.

Water / Waste Water Management Assessment for the Dairy Sector in Turkey and Water Efficiency Improvement Opportunities

Within the scope of the "Water Sustainability of Turkey's Dairy Sector: Efficiency, Risks and Vulnerabilities" project; another report prepared is the Water / Waste Water Management Assessment and Water Efficiency Improvement Opportunities Report.

The following studies were carried out during the creation of the report, respectively.

- Information request from companies before the field visit
- Field visits
- Determination of firm water risks (water quality and supply risk)
- Assessment of performance indicators

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- Preparation of a water efficiency survey report containing suggestions on a business basis

Report includes suggestions that will set an example for businesses and enable them to be more resistant to environmental and supply risks.

Within the scope of reporting; key performance indicators (KPIs) were determined for the areas where the water resource, quality and water usage / waste water formation points of the facilities are the most intensive resource consumption and need to be monitored more closely in terms of environmental management. Moreover, risks concerning water quality and water quantity have been assessed.

Businesses Covered by Reporting

In the report study, prepared in order to ensure the realization of opportunities that will provide natural resource and monetary savings on a business basis, by evaluating the existing and potential water risks in businesses located at different stages of the milk value chain, water efficiency studies were conducted in 4 businesses. These businesses are two dairy farms that produce feed; a medium-sized facility that produces dairy products (cheese) and a large-scale facility that produces dairy products such as milk, yoghurt, and cheese.

DAIRY FARMS
Water and Waste Water Management

Farms which were visited within the scope of the study were using water for;

- For irrigation purposes in the stage of growing feed crops
- As washing water for hygiene / cleaning of milking parlour, milk tanks and farm
- In order to meet the water needs of animals
- In scrapers to remove animal waste from the farm and they were observed to be supplying from ground waters and surface waters (from dams/lakes etc.).

Most of the facilities do not have a water metre and the water consumption is calculated based on how many times the raw water tank of the facility is filled and drained during the day. For this reason, it is not possible to distinguish how much water is consumed in which parts of the farms (washing, feces stripping, irrigation, etc.).

Water Efficiency Opportunities for Farms

Studies on farms have shown that the recommendations listed below will yield results in terms of water efficiency.

- **Use high pressure low volume flush systems**

Studies have shown that the water consumption required for the same process as high pressure washing systems has decreased by 80-90%.

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• Use efficient washing equipment in milking units

Efficient washing equipment reduces water consumption and energy consumption for water heating.

If the C-200 system is used instead of traditional cleaning methods, it is possible to save 25% to 32% of the water spent on cleaning.

• Use pipe cleaning elements (Pig)

'Pig' elements are parts that clean and drain pipe systems. In order to clean the pipe systems, pig is sent from the mixing tank towards the hopper. Thus, the raw material / product remaining on the pipe walls is taken. With this method, the amount of water consumed for cleaning and waste water is reduced.

• Use automatic water spray systems

Periodic water discharge during milking makes cleaning processes faster and easier, reducing the amount of water spent on this process.

• Make the floors sloping

This will make cleaning processes easier.

• Use enzyme-based cleaners to clean milking equipment

This method does not require any prewash and saves about a third of water and energy.

· Determine the correct flow rate in cooling processes, pre-cool the water supply and use ice baths

It is also possible to save water by recycling cooling water and using it in different areas.

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• Raise your employees' awareness about managerial measures

Examples of managerial methods are to keep water valves closed, not to run equipment when not necessary, to prevent water, energy and other resource losses through optimization of chemical doses. Train and raise awareness of your employees on these issues.

•Get your periodic maintenance and repairs aimed at water reduction, prevent leaks

Detecting and eliminating leaks in water lines not only saves water, but also prevents leaking water from forming sludge etc., creating an additional waste water and creating waste water costs.

• Recover rainwater

In a study by the Pacific Institute covering the state of California, the results show that rainwater in commercial/industrial facilities in California is widely used for; irrigation (35%), kitchens (6%), industrial cooling (15%), toilets (12%), processes (17%), for laundry purposes (2%) and other (9%) purposes.

• Use central moving irrigation systems

Central moving irrigation systems can reach a radius of 50 metres to 1,100 metres and irrigate up to 3,800 decares. The central moving irrigation systems, which move circularly on a reinforced concrete platform, allow irrigation to

be done automatically without human touch. It is also possible to fertilize and spray along with irrigation through the system that can be used on sloping lands. The systems provide homogeneous water distribution, saving labour, water and time.

• Use drip irrigation systems

Drip irrigation provides an efficient irrigation solution by reducing water and nutrient use while increasing yield in corn production. Using different methods such as sprinkler irrigation and drip irrigation in field irrigation significantly reduces water consumption compared to traditional irrigation methods.

MEDIUM-SCALE DAIRY PROCESSING FACILITY

In the report, a business that mainly operates in the field of cheese production and operating in an area of 7,500 m2 is evaluated as an example for medium-sized milk processing facilities.

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Water and Waste Water Management

In the facility included in the report, mains water and ground water are used for production purposes. There is no water metre at the entrance of the facility other than the network water metre monitored by the relevant Water and Sewerage Administration. The company does not have a water map or water flow chart showing the use of water in different production lines.

The facility has a treatment plant in common with other dairy farmers and process waters are treated in this treatment plant. The commonly used 960 m3/day treatment plant was established for the purpose of treating waste water from dairy product facilities.

Water Efficiency Opportunities for Medium-sized Dairy Processing Facilities

• Build water/waste water monitoring infrastructure and determine reporting method

Collect data on water consumption by placing additional water metres at specific points and periodically monitor the quantity and quality of water/waste water. Report the data so that all employees adopt the subject.

• Use Cleaning in Place (CIP) systems and improve systems regularly

Identify water reduction measures and improvement opportunities that can be implemented in CIP systems.

• Recover water that was evaporated in the production process

In the production process, evaporation occurs with boiling. The recovery of evaporated water contributes to water efficiency.

- Increase reverse osmosis system efficiency

Although the efficiency of reverse osmosis systems is expected to be around 80% under normal conditions, the efficiency of optimized systems can reach up to around 85%. Periodically check the efficiency values to run the system with high efficiency rates such as 80-85%.

• Recover and reuse process-based waste waters

Determine the recovery possibilities by using the “Water Pinch Analysis”, which enables to determine the process water supplied by industrial facilities from different sources or produced with different water treatment plants; and the amount and characteristics of waste water originating from processes using these waters.

• Use high pressure low volume flush systems

Studies have shown that the water consumption required for the same process as high pressure washing systems has decreased

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by 80-90%. Turning the water off by the trigger (shut-off) at the end of the hose will reduce the water consumed during the operator’s cleaning passages when the water turns on and off.

• Use pipe cleaning elements (Pig)

‘Pig’ elements are plastic parts that clean and drain pipe systems. In order to clean the pipe systems, pig is sent from the mixing tank towards the hopper. Thus, the raw material / product remaining on the pipe walls is taken. There are also advantages such as increase in yield, short cleaning times, decreasing cleaning costs, only product hosting without adding cleaning agent / water etc., transfer of small product quantities / residues to reproduction, and providing product / material change on the lines without being exposed to cross-contamination.

• Harvest rainwater

You can foresee the water usage savings that you can achieve through rainwater recovery by using the annual average rainfall amount of your province and the information about your roof area, so you can diversify your water resources.

• Raise your employees’ awareness and train them about managerial measures

Managerial measures do not incur any investment costs and can be implemented immediately after the possibilities are determined. First of all, determine these measures for your facility and inform your employees regularly about these measures.

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• Establish your water reduction targeted periodic maintenance and repair procedure

There are losses and leakages in almost every company that performs water intensive production. To prevent these losses and leakages, create your periodic maintenance and repair procedure with water reduction target and assign your staff.

LARGE-SCALE DAIRY PROCESSING FACILITY

The business, which is evaluated as part of the report, is an example of large-scale dairy processing facilities that produce both for the domestic market and for export. The main product groups are; ayran, strained yoghurt, white cheese, milk powder, UHT milk, fruit yoghurt, butter, yoghurt and kashar cheese.

Water and Waste Water Management

There are 2 ground water resources in the facility and the total water consumption of the facility is monitored by keeping a daily record with the water metre. It was also learned that studies were carried out to install water metres at the water consumption points at the facility.

The facility has a waste water treatment plant with physical, chemical and biological treatment units, respectively. It has been designed for the purification of domestic and industrial waste water and has a capacity of 2000 m3/day.

Water Efficiency Opportunities for Large-Scale Dairy Processing Facilities

• Build your water/waste water monitoring infrastructure and determine your reporting method

Collect data on water consumption by placing additional water metres at specific points, periodically monitor the quantity and quality of water/waste water and assign your staff.

• Use and improve Cleaning in Place (CIP) systems

Use the “Cleaning in Place - CIP” systems to clean your machinery and equipment, milk tanks and lines. Check the systems regularly and make improvements.

Carry out analysis of CIP final rinse water based on water recovery criteria and implement according to results

• Install water softening system for water recovery in cooling systems

In order for the cooling water recovery systems to work properly, installing water softening systems are an important factor. When installing ion-exchange resin systems, backwashing with systems where instant hardness measurement is made over automation will be a efficiency-enhancing move and is recommended.

• Increase reverse osmosis system efficiency

Although the efficiency of reverse osmosis systems is expected to be around 80% under normal conditions, the efficiency of optimized systems can reach up to around 85%.

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Periodically check the efficiency values to run the system with high efficiency rates such as 80-85%.

• Use electro deionisation systems instead of mixed-bed ion-exchange resins

In electro deionisation systems, there is no need for regeneration and chemicals such as acid and caustic required for regeneration as in the classical method. Since the conductivity value of the water discharged by the anode and cathode is relatively low, Reverse Osmos is mixed with the feed water to provide extra benefit.

• Recover and reuse process-based waste waters (Water Pinch Analysis)

With the water pinch analysis, you can reveal your potential for on-site water recovery. With this analysis, you can determine the process waters that you supply from different sources or produce with different water treatment plants; and also the amount and characteristics of the waste water originating from the processes using these waters.

• Use pipe cleaning elements (Pig)

‘Pig’ elements are plastic parts that clean and drain pipe systems. In order to clean the pipe systems, pig is sent from the mixing tank towards the hopper. Thus, the raw material / product remaining on the pipe walls is taken. Pigging systems used in the dairy industry can be examined in more detail in order to make a more accurate assessment.

• Harvest (recover) rainwater

You can foresee the water usage savings that you can achieve through rainwater recovery by using the annual average rainfall amount of

your province and the information about your roof area.

• Raise your employees’ awareness and train them about managerial measures

Identify your managerial measures that may be a priority for your facility, train your employees about these measures and regularly inform your entire organization about these measures.

• Establish your water reduction targeted periodic maintenance and repair procedure

Work on your losses and leaks to identify these areas, and in parallel, create a periodic maintenance and repair procedure with a water reduction target. Review your procedure periodically and inform your staff by making improvements where necessary.

• Perform unit-based efficiency analyses at subsidiaries

If available, perform your analysis on water efficiency by reviewing the processes in your

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auxiliary facilities. Invest in improvement areas if you spot them.

Result and Recommendations

Both studies on water efficiency in the dairy sector and other studies carried out within the scope of the project showed that more steps should be taken regarding accurate and accessible data in order to make a detailed assessment of the sector. Developing a healthy strategy and plan for water management will only be possible with the provision of this data. Therefore, it is extremely important that all stakeholders of the sector come together around this common goal and develop cooperation.

In order for the dairy sector to make accurate and fruitful evaluations regarding its environmental impacts and water consumption, it must provide and/or produce data in the titles presented below.

- GPS coordinates of facilities / farms
- Feed raw material production data
  - o In which region it is produced
  - o Where the products are supplied from
- Total amount of water used
  - o Total water drawn from the environment
  - o Total water released into the receiving environment
- To which source the water released into the environment is discharged
- Waste water analyses
- Receiving environment water analysis data
- Type and amount of water used (ground water, stream, mains water, etc.)
- Amount of water according to its intended use (irrigation, cleaning, storage etc.)
- Changes in water resources (change in drainage system, water flow rate, ground water depth, evaporation amount
- Main water source information (basin information, source of ground water, river names coming to the region, etc.)
- Additional counters for determining the amount of water used in different processes
- Periodic data that may be related to the presence and quality of water

In addition, the water vulnerabilities of the dairy sector discussed in this guide should be carefully prioritized and addressed. Stakeholders at different stages of production along the value chain of the industry are recommended to take strategic measures to reduce these vulnerabilities and to sustain resources.

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Recommendations to Reduce Water Vulnerability of Turkey's Dairy Sector

Production Value Chain	Recommendations
Feed raw material	• restoration of degraded pastures, planting trees and legumes, planting drought-resistant grass • water use efficiency with drip irrigation • alternative irrigation management options in drought conditions • mixed planting and green manure • farm-level mulching application • awareness raising of water problems for farmers • capacity building of farmers in smart agriculture • weather based insurances • dissemination of weather-based information tools and applications
Feed production	• use of less water intensive, drought-resistant feed crops • Imports of feed crops such as soy beans • prevention of feed losses during production
Animal husbandry	• installation of shadows, sprinklers or blow cooling systems • use of feed crops that consume little water
Dairy processing	• water tanks for seasonal water variability • increasing water efficiency with technological progress • increase in water measurement systems • water recovery and reuse
Dairy sector	• awareness campaigns on sustainable water practices • Further studies on the effects of climate change on crop production • minimizing feed loss and waste • minimizing dairy waste during consumption and production

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“Five strategic proposals to reduce the vulnerability of Turkey’s dairy sector against water problems”

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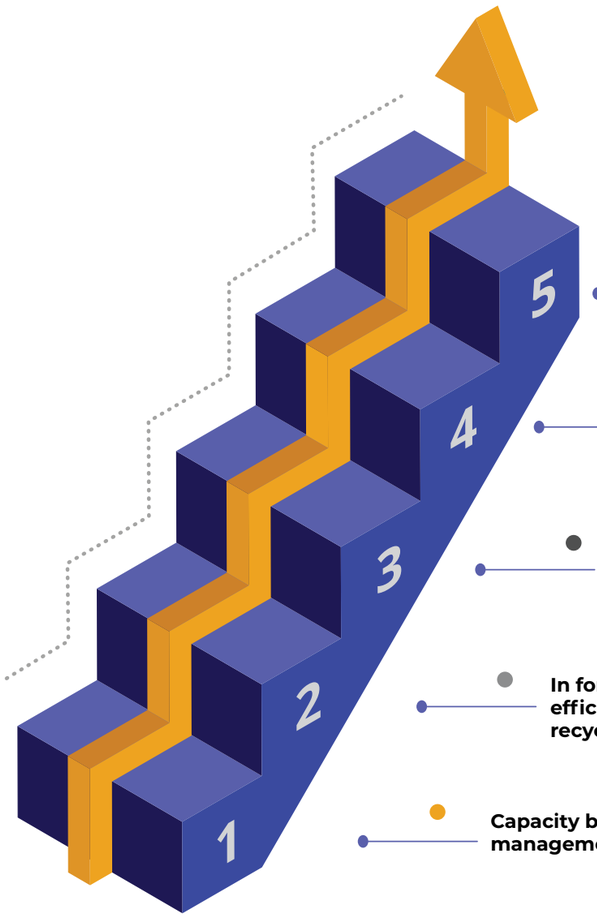

5. Encourage the use of water-oriented, artificial intelligence-based technologies for weather forecast, and especially the use of air-based information tools among farmers
4. Providing easier access to information on the effects of climate change and associated financial risks for key sensitive production stages
3. Investing in water-rich regions and changing the production system in the future, especially in the North and East Anatolian regions
2. In forage crops cultivation; investing in irrigation efficiency, drought resistance, water reuse and recycling
1. Capacity building of farmers on water use, management and climate change

Water Sustainability of Turkey’s Dairy Sector: The Efficiency, Risks and Vulnerabilities Project, is supported under the Fifth Term of the Civil Society Dialogue Program coordinated by the T.R. Ministry of Foreign Affairs EU Directorate and the Contracting Authority is the Central and Financial Unit.

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