Ukraine
Water along the food chain

COUNTRY HIGHLIGHTS

FAO INVESTMENT CENTRE

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Ukraine

Water along the food chain

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COUNTRY HIGHLIGHTS
prepared under the FAO/EBRD Cooperation

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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In 2013, the EBRD and FAO launched a multi-country project to improve water efficiency in priority agricultural value chains. On the micro scale, the analyses aim to improve the environmental impact of future EBRD agribusiness investments; and on the macro scale, they are intended to inform policy and investment for a more sustainable agrifood sector in the four countries of interest: Turkey, Jordan, Ukraine and Kyrgyz Republic. In a sector so fundamentally reliant on natural resources and climate, using water and other inputs efficiently is essential.

Two comments are due prior to reading this assessment. Although a revision of the study was done in late 2015, all data were collected and the analysis was done before the 2014 crisis that occurred between Ukraine and the Russian Federation. The crisis has severely impacted the macroeconomic fundamentals of the country, e.g. the drastic depreciation of the UAH, presently (December 2015) standing at one-third of its value at the time of the analysis. Trade matters, including those related to food and the food industry, have been disrupted. Food products of animal origin have suffered the most (e.g. the export index recorded for the period January–September 2015 of milk and milk products, eggs and honey was 59.1 percent that of the same period in 2014). The EU-Ukraine Association Agreement, completed on 27 June 2014, has still to show full benefits to Ukraine. The reduction of the Russian Federation’s importance as an export market had actually already begun in 2011, at a time when no political difficulties existed, while the role of the EU market in Ukraine’s export portfolio has been increasing in importance. The signing and provisional implementation (from 2016 onwards) of the Ukraine-EU Deep and Comprehensive Free Trade Area (DCFTA) will further strengthen trade links with the EU. In addition, the depreciation of the UAH has increased the wage competitiveness of Ukraine and this will further favour the growth of the labour-intensive food industry.

It is thus believed that the burden imposed by the crisis on the trade balance of the country will ultimately be resolved, albeit the timing of the process is unpredictable. Nevertheless, the underpinning principles and the overall findings of this study are still considered valid. Another comment regards the use of official water data following 2007. Unfortunately, the FAO AQUASTAT database has not been systematically updated and adjusted with the national data. Following the review of more recent national data (State Statistical Service of Ukraine [SSSU]), which had appeared to be in conflict with consolidated information in global archives, it was eventually decided to prioritize AQUASTAT registered data for the purposes of this study. National water data has been however used to analyze the food industry.
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The work was carried out by staff of the FAO Investment Centre Division (TCI). The main authors of the study were Andriy Yarmak, Economist and Turi Fileccia, Senior Agronomist, Investment Centre Division, FAO.

Andriy Yarmak worked on the value chain analysis. He conducted two missions in 2013 and 2014. The missions were assisted in Ukraine by the consultant Oleksandr Sikachyna and by the analytical team of the Association of Milk Producers of Ukraine.

Turi Fileccia worked the water-related sections of the report and has authored the conclusions of the assessment, including its overall review and finalization.

Iride Ceccacci, Food Security Economist, EBRD, provided leadership and coordination on behalf of the EBRD.

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<th>Description</th>
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</thead>
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<tr>
<td>AMPU</td>
<td>Association of Milk Producers in Ukraine</td>
</tr>
<tr>
<td>CIS</td>
<td>Commonwealth of Independent States</td>
</tr>
<tr>
<td>DCFTA</td>
<td>Deep and Comprehensive Free Trade Area</td>
</tr>
<tr>
<td>EBRD</td>
<td>European Bank for Reconstruction and Development</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
</tr>
<tr>
<td>FAOSTAT</td>
<td>FAO Statistics Division</td>
</tr>
<tr>
<td>FSU</td>
<td>former Soviet Union</td>
</tr>
<tr>
<td>GDP</td>
<td>gross domestic product</td>
</tr>
<tr>
<td>HTC</td>
<td>Hydrothermal coefficient</td>
</tr>
<tr>
<td>IFI</td>
<td>international finance institutions</td>
</tr>
<tr>
<td>IGW</td>
<td>internal groundwater</td>
</tr>
<tr>
<td>IRSW</td>
<td>internal renewable surface water</td>
</tr>
<tr>
<td>LLC</td>
<td>limited liability company</td>
</tr>
<tr>
<td>OJSC</td>
<td>open joint-stock company</td>
</tr>
<tr>
<td>SCWA</td>
<td>State Committee for Water Administration</td>
</tr>
<tr>
<td>SCWM</td>
<td>State Committee of Water Management</td>
</tr>
<tr>
<td>SMP</td>
<td>skimmed milk powder</td>
</tr>
<tr>
<td>SSSSU</td>
<td>State Statistical Service of Ukraine</td>
</tr>
<tr>
<td>TCI</td>
<td>FAO Investment Centre Division</td>
</tr>
<tr>
<td>TRWR</td>
<td>total renewable water resources</td>
</tr>
<tr>
<td>UAH</td>
<td>Ukrainian hryvnia</td>
</tr>
<tr>
<td>USD</td>
<td>United States dollar</td>
</tr>
<tr>
<td>WUAs</td>
<td>water users associations</td>
</tr>
</tbody>
</table>
EXECUTIVE SUMMARY

In Ukraine, water balance, after all uses, is positive for renewable surface waters. At the current level of withdrawals, water balance is also positive for internal groundwater resources, which are however more limited. In terms of water withdrawal, a substantial change in the share among sector use has certainly occurred since independence. This has almost exclusively to do with a contracted, irrigated agricultural subsector and the realignment of investment priorities towards the industrial sector. Both industrial and municipal withdrawals of water have remained substantially unchanged in quantitative terms.

Municipal water-use per capita has instead increased, while the total population has decreased. The rain-fed agriculture output, given its current specialization towards grains for food/feed and oil purposes, is still sufficiently cost-effective, while substantial rehabilitation and renovation of irrigation investment is to be considered deferred. Adoption of Climate Smart technologies, such as NoTill/Conservation Agriculture, should be prioritized. The prospected highest priority of water withdrawal will still be for municipal use, but a substantial share will also be for the industrial sector, including the expanding food industry. Policy and investment attention will increasingly need to consider the sustainable use of internal groundwater resources. This argument is even more important for the food industry, which is a heavy user of groundwater (60 percent of its relative withdrawals compared with the rest of the industries that use only 40 percent). Among the food industries, a special focus will be placed on the dairy industry, which is the leading user of groundwater within the subsector.

The agricultural sector of Ukraine plays a very important role in the economy of the country. It contributes to the growing amounts of export revenues. At the same time, Ukraine is among the top countries annually ensuring global food security. Ukraine’s exports of grains, oilseeds and vegetable oils have surged since 2000 and the country has become one of the global leaders in the grain and oilseed segment. Crops have contributed the most to the increase in the agricultural gross domestic product (GDP) of Ukraine. However, growing investments in livestock production in recent years are expected to facilitate the production growth of the livestock subsector in the upcoming ten years, as Ukraine has one of the best levels of feed supply in the world.

The organizational structure of the agricultural production system in Ukraine is almost equally organized around two types of producers: household farmers and commercial farmers. As of 2012, commercial farms accounted for 50.7 percent of total agricultural output and households for the remaining 49.3 percent. Since
2000, the share of commercial farms has increased from 38.2 percent to the current level of 50.7 percent. Sustained attention needs to be concentrated on the livestock sector, not only because its growth could have a higher social impact, but also because of its more dynamic and important linkages with the food industry. The food industry in Ukraine has been developing rapidly: total sales of food products of the Ukrainian food industry have reached an equivalent of United States dollar (USD) 24 billion (2010). Moreover, access to the European Union (EU) market is expected to improve this growth.

The value chain selected for in-depth analysis is the dairy chain. Food chains that purely belong to the primary sector (agriculture) have been excluded as they are at present less critical from the water-use standpoint. The selection of this subsector within the food industry was made on several grounds: the economic size of the industry, water withdrawal sources, water-use, perspectives on water efficiency, social impact and European Bank for Reconstruction and Development’s (EBRD’s) ongoing commitments.

Water fees are increasing in Ukraine but such explicit water-related costs have had only a small incidence on the overall costs of production. There are, however, hidden water-related costs that are insufficiently considered and on the rise – e.g. energy costs for pumping water – and that are perhaps growing in importance. By and large, there are increasing reasons to consider water as a key area to improve the competitiveness of the subsector.

Ukraine is a net exporter of milk and milk products despite negative trade balance trends following independence. More recently, positive trends in the production of milk are becoming apparent with increased production and productivity. In 2012, milk production finally showed the first signs of recovery with commercial milk producers actively investing into larger dairy herds and modern technologies. Currently, milk production of households has declined while the share of commercially produced milk used by processors grew from 36 percent in 2007 to 57 percent in 2013. The Ukrainian market of milk and dairy products has reached Ukrainian hryvnia (UAH) 25.9 billion in 2013 growing rapidly (by more than 76 percent) from just around UAH 14.3 billion in 2009. However, the increase of the overall market size in terms of value is mainly due to the price increases of milk and dairy products, while total sales remained relatively unaffected. Ukraine has yet to fully utilize the huge potential of its dairy business based on the availability of: inexpensive feed, vast land resources, educated and inexpensive labor and relative proximity to key markets.

The bulk of the milk produced does not enter the market as it is largely used for home consumption by the milk producing households. Effectively, it is estimated that only some 30–35 percent of the milk produced in Ukraine is processed either into fluid, pasteurized milk or into any other dairy product. Moreover, dairy processing makes large use of cheap, low-quality milk. Higher
quality milk, from the commercial farms, is mainly used by processors to produce fluid, pasteurized milk; although, much of the lower quality and cheaper milk from households is also utilized even in the case of this product.

A few crucial issues affect the dairy sector as it faces once more in only twenty years the challenges of a delicate transition from a household-centered system to one that is becoming more commercially oriented. This is also a time when the comparative advantages and competitiveness of the dairy sector are being threatened by several market and trade issues.

Major investments and organizational changes are urgently required to move towards a modern dairy sector that will also pursue improved water efficiency. From the analysis, a few areas along the value chain have emerged that require urgent attention and can be summarized as follows:

**Production level**
- a need to support the diverse categories of commercial dairy farms in speeding up their modernization process in terms of productivity and sustainable competitiveness;
- investment facilitation to transform the most promising segment of household-level producers into commercial dairy farmers, with a strategy to gradually phase out the production of low-quality milk while improving food safety standards at rural market places;

**Intermediary/processing levels**
- support the upscaling of dairy chain intermediaries, including improved and equitably inclusive organizational changes;
- backing and boosting modernization investments and system efficiency upgrading of processors;

**Water/energy specific (cross cutting)**
- assess the scope to improve the surface versus groundwater utilization ratio within the food industry, following a site-specific discrete approach;
- optimize sustainable water-use and increase water management efficiency, including related energy costs;
- invest in adequate water reuse options, waste water management, water treatment and water pollution reduction; and
- Adopt water pricing policies.
Chapter 1 – Introduction

The Food and Agriculture Organization of the United Nations (FAO), through its Investment Centre Division (TCI), is assisting the European Bank for Reconstruction and Development (EBRD) in its goal to improve the impact of future EBRD agribusiness investments regarding water efficiency. To this end, in 2013, a joint FAO/EBRD project entitled “Water along the food chain” was initiated in four pilot countries – Ukraine, Turkey, Jordan and Kyrgyz Republic.

The specific objectives of this project are four-fold:

(i) conduct selected analyses of water efficiency along the food chain to inform EBRD’s agribusiness investment decisions;
(ii) identify potential agribusiness clients for the bank and areas for further policy dialogue to improve water efficiency;
(iii) improve agricultural water-use policy-making processes at the country level in the four abovementioned pilot countries through the involvement of private sector players; and
(iv) coordinate the bank’s future interventions regarding water efficiency along the food value chain with those of other international financial institutions (IFIs) operating in the transition region.

The main objective of this report is to indicate ways for Ukraine to move towards more water efficient and productive solutions.

The report provides the findings of two missions to Ukraine. The first was meant to scope the “water issue” and identify the food value chain that merits analysis in order to orient EBRD’s future investment in the country, while the second served as an opportunity to interact with main sector players and to collect the primary data for the analysis.1

The report encompasses the scoping activities of the water dimension and food value chain, as well as an indepth analysis from a water perspective of the selected value chain: the dairy industry.

1 Andriy Yarmak, Economist, Investment Centre Division, FAO, is the primary author of this analysis. He fielded two missions in 2013 and 2014. The missions were assisted in Ukraine by the consultant Oleksandr Sikachyna and by the analytical team of the Association of Milk Producers of Ukraine. Turi Fileccia, Senior Agronomist, Investment Centre Division, FAO, has worked the water-related sections and has authored the conclusions of the assessment, including its overall review and finalization.
Chapter 2 – Scoping of the study

The water economy in Ukraine

In terms of water availability, the total renewable surface water resources of Ukraine\(^2\) are accounted at 136.61 km\(^3\)/year,\(^3\) while the internal renewable surface water resources of Ukraine are estimated at 53.1 km\(^3\)/year. Resources are distributed among eight water basins (see Figure 1).

**Figure 1: Structure of internal renewable water resources of Ukraine**

<table>
<thead>
<tr>
<th>Water Basin</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dnipro</td>
<td>41%</td>
</tr>
<tr>
<td>Dnister</td>
<td>18%</td>
</tr>
<tr>
<td>Tysa</td>
<td>13%</td>
</tr>
<tr>
<td>Southern Bug</td>
<td>7%</td>
</tr>
<tr>
<td>Prut</td>
<td>6%</td>
</tr>
<tr>
<td>Coastal</td>
<td>6%</td>
</tr>
<tr>
<td>Siverskyj Donets</td>
<td>5%</td>
</tr>
<tr>
<td>Northern Bug</td>
<td>4%</td>
</tr>
<tr>
<td>Coastal</td>
<td>5%</td>
</tr>
<tr>
<td>Northern Bug</td>
<td>4%</td>
</tr>
<tr>
<td>Dnipro</td>
<td>41%</td>
</tr>
</tbody>
</table>

Source: FAO AQUASTAT.

The internal groundwater resources are estimated at 20 km\(^3\)/year. Artesian wells are found at an average depth of 100–150 m in the north of the country and at 500–600 m in the south. The overlap between surface and groundwater resources has been estimated at 17 km\(^3\)/year.

The dependency ratio on renewable water resources originating outside the country is equal to about 62 percent, which is on the high side. In addition,

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\(^2\) Note that all numbers in this chapter and in many other parts of the report would need revision if the Crimean peninsula is not to be considered a region of Ukraine.

\(^3\) Statistics on water are serviced by the State Committee for Water Administration (SCWA) and managed by the State Statistical Service of Ukraine (SSSU or UkrStat). Data is not systematically updated with the FAO AQUASTAT database, which reports on data communicated by SSSU.
water issues are regulated through old agreements: the Soviet legislation regarding international water matters is still valid.  

Annual total renewable surface water resources in Ukraine are abundant and those of internal origin are considerable. Renewable annual groundwater resources are otherwise more limited.

Internal surface and groundwater renewable resources (53.1 km³/year; 20 km³/year) are to be considered the safest water asset of the country.

Water-use largely occurs in regions with developed industry and agriculture and a relatively dry climate. The leading region in terms of water withdrawal is Donetska oblast (around a 14 percent share). Similarly, the Dnipropetrovska oblast uses around 11 percent of all Ukrainian water. The Autonomous Republic of Crimea and Khersonska oblast are also major water users.

Water-use by all sectors in Ukraine is estimated at 19.24 km³/year. In 1992, total water withdrawal was estimated higher at 26 km³/year. At that time, water withdrawals were attributed as follows: 30 percent for agricultural purposes, 52 percent for industry and the remaining for municipal and other uses. The current total water withdrawal of 19.24 km³/year (as per last available AQUASTAT report) was distributed by sectors as indicated in Table 1.

Table 1: Water-use in Ukraine

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural water</td>
<td>n.a.</td>
<td>30%</td>
<td>1.19</td>
<td>6%</td>
</tr>
<tr>
<td>withdrawal (km³/year)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial water</td>
<td>13.5</td>
<td>52%</td>
<td>13.44</td>
<td>70%</td>
</tr>
<tr>
<td>withdrawal (km³/year)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Municipal water</td>
<td>4.65</td>
<td>18%</td>
<td>4.61</td>
<td>24%</td>
</tr>
<tr>
<td>withdrawal (km³/year)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total withdrawal</td>
<td>26</td>
<td>19.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(km³/year)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: FAO AQUASTAT.

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4 An agreement between Moldova and Ukraine stipulates that the Republic of Moldova may use water stored in the Curciugan reservoir, located on a tributary of the Dnestr. This tributary rises in Ukraine and forms the border with Moldova before it reaches the Dnestr. Ukraine and Poland have begun discussions concerning the protection of the Northern Bug resources against pollution.
A special window is considered for water used by the food industry. In this case, reference is made to the latest available data of the SSSU.

In 2012, the total amount of water used by the food industry was reported at 126 million m³, which was 24 percent less than in 2007. The water used by the food industry in Ukraine appears to have dropped sharply during the global financial crises in 2008 and 2009, when the food production in Ukraine had also declined.

Figure 2: Water used by the food industry in Ukraine by source, 2007–2012

While the total amount of water used declined, proportions between underground and surface water remained nearly the same from 2007 to 2012. The food industry however uses more ground water than surface water, with an opposite proportion to the overall industry: around 60 percent of all water used by the food industry is supplied from underground sources.

One argument that could explain the decline in water-use may be the growing water fees charged to food processing companies: costs of water have been more than doubling every year since 2007.
In 2007, the share of water costs in the total sales of the food industry was close to 0.02 percent: a figure that rose sharply to reach 0.13 percent in 2012. The food industry hence paid about UAH 1.3 for every UAH thousand in sales, as water fees in 2012 went up from UAH 0.22 in 2007.

Such increases in the costs of water fees make the issue of water efficiency in Ukraine important. However, the fees that have increased exponentially still remain proportionally less relevant to overall production costs. What really matters to the producers is the high cost for pumping water. Roughly, the pumping cost of one cubic meter of water is equal to UAH 0.7.

The sugar industry in Ukraine was the largest user of water from 2007 to 2012, accounting for around a quarter of all the water used by the food industry during these six years. The dairy industry was the second largest with a 15 percent share. The brewing and alcohol industries used 12 percent of water each. Thus, these four industries together accounted for 64 percent of all water used in the food industry.
When looked from a water source point of view, the largest volumes of groundwater is used by the dairy industry in Ukraine, which accounts for 26 percent of the food industry’s underground water-use.

As clearly shown in Table 1, a substantial change in the share among sector use has certainly occurred that has almost exclusively to do with a contracted irrigated agricultural subsector and the realignment of investment priorities towards the industrial sector. Both industrial and municipal withdrawals of water have remained substantially unchanged in quantitative terms. The municipal water-use per capita has instead increased, while the total population has decreased over the period by some 10 percent. The latest reporting on irrigated agriculture lands otherwise indicates that less than 27 percent of the lands that are equipped for irrigation are actually irrigated.

The main conclusions, which can be reasoned by observing such changes, are as follows (see also Annex 1 and the remainder of the report):
(i) The rain-fed agriculture output, given its current specialization towards grains for food/feed and oil purposes, is still sufficiently cost-effective and there is little comparative advantage of the yield gains through irrigation for such crops, which also entails increased costs of production due to pumping (roughly calculated in UAH 0.7/m³ at 2013 prices); 5

(ii) The 0.7 million ha of currently irrigated areas is better utilized under higher value cash crops;

(iii) The structural and organizational changes in the livestock sector, which has resulted in a decreased number of specialized, livestock large-farms, has likely imposed a lower demand for fodder crops; whereas before independence, the irrigated cropping pattern was quite different; 6

(iv) The prospected highest priority for water withdrawal will be for municipal use but also for the industrial sector, including the expanding food industry;

(v) Significant irrigation investment both off-farm as well as on-farm (for the rehabilitation and renovation of the conveyance infrastructure and for the irrigation equipment that is obsolete) is certainly required but will likely be deferred. In this subsector, when the economics will justify investment, a first priority would be to rehabilitate the existing irrigation-equipped area (2.6 million ha) and eventually to exploit maximum irrigation potential (5.5 million ha).

It is also important to highlight that while all agriculture water withdrawal is from the existing considerable surface resources, industrial and municipal water sources are aligned with similar shares between surface and groundwater (see Table 2).

<table>
<thead>
<tr>
<th>Use (km³/year)</th>
<th>Source</th>
<th>Availability (km³/year)</th>
<th>Surface water cumulative balance (km³/year)</th>
<th>Groundwater cumulative balance (km³/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>1.19</td>
<td>surface 100% groundwater 0% 53.1 (IRSW)</td>
<td>51.91</td>
<td>0</td>
</tr>
<tr>
<td>Industry</td>
<td>13.44</td>
<td>surface 60% groundwater 40% 20 (IGW)</td>
<td>43.85</td>
<td>14.62</td>
</tr>
<tr>
<td>Municipalities</td>
<td>4.61</td>
<td>surface 65% groundwater 35% 20 (IGW)</td>
<td>40.85</td>
<td>13.01</td>
</tr>
</tbody>
</table>

Source: FAO AQUASTAT and own calculations.

Note: Internal renewable surface water (IRSW); Internal groundwater (IGW).

5 Currently: UAH 2.16/m³ after UAH depreciation.
6 In 1990, actual irrigated land was used for growing fodder crops (52 percent) and grains (33 percent). About 9 percent was used for growing vegetables and the remaining 6 percent for the production of industrial crops.
The balance after all uses is still positive for internal renewable surface waters, which makes future investments in irrigated agriculture – that may eventually be imposed by climate change adaptation needs – a possible venture in Ukraine.

It is however likely, on economic grounds, that cheaper investments compared with irrigated agriculture infrastructure will be prioritized by the public and private sectors. The findings of recent studies would effectively encourage Ukraine to speedily move towards the adoption of Climate Smart Agriculture technologies and particularly of Conservation Agriculture/“No till” techniques, which appear to be very rewarding at all levels: farm, national and global.7

The balance is also positive for internal groundwater resources at the current level of withdrawals, as only 35 percent of the available resources are used altogether by the industrial and municipal sectors every year. However, in the light of an expanding industrial sector and of the higher priority that must be given to quality groundwater for drinking purposes, policy and investment attention will increasingly need to consider the sustainable use of internal groundwater resources and it is likely that in the near future the industrial sector might need to increase the withdrawal share of renewable surface water. This argument is even more important for the food industry, which is a heavy user of groundwater (60 percent of its relative withdrawals compared with the rest of the industries that uses only 40 percent). Among the food industries, a special focus will concern the dairy industry, which is the major user of groundwater within the subsector.

A separate discussion regards water that is returned after use. According to national data, around 55 percent of the water withdrawn was returned into natural objects from 2008 to 2012. This does not include the amounts of water returned to sewage. In reality, the argument concerns the industrial and the municipal sectors more, while the agriculture sector, by definition, is the one which returns less water after its use.

In all cases, a specific analysis (which is out of the scope of this study) needs to be done in order to better understand actual water withdrawal volumes (sector-wise and district-wise), which is also required to determine the investments needed to improve the environmental management of water resources, as well as those wanted for a more modern treatment of waste water.

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Overview of the agricultural sector in Ukraine

The agricultural sector of Ukraine plays a very important role in the economy of the country. Although the GDP share of agricultural production dropped from 16.3 percent in 2001 to 9.2 percent in 2012, it contributes to growing amounts of export revenues. At the same time, Ukraine is one of the top countries annually ensuring global food security.

Following the financial crisis in 2008, the agricultural GDP has been growing more rapidly than the total GDP of Ukraine and thus the share of agriculture in the total GDP has increased from 7.5 percent in 2007 to 9.2 percent in 2012.

Figure 6: Share of Ukraine’s agriculture in national GDP

![Graph showing the share of Ukraine’s agriculture in national GDP from 2001 to 2012.]

Source: SSSU.

The agricultural sector in Ukraine has been developing very rapidly since 2000. Average annual increases in the agricultural GDP since 2000 has been around 4.6 percent: mainly attributed to the growing crop production segment. Ukraine’s exports of grains, oilseeds and vegetable oils have surged since 2000 and the country has become one of the global leaders in the grain and oilseed segment.

It is not surprising that crops have contributed most to the increase in the agricultural GDP of Ukraine. On average, the crop production segment of agriculture has grown by 7 percent per year since 2000 and the livestock segment – by about only 1.7 percent per year. However, growing investments in livestock production in Ukraine from 2008 to 2012 are expected to facilitate production growth in livestock in the upcoming ten years as Ukraine has one of the best levels of feed supply in the world.
High reliance of agricultural GDP on crop production makes it more volatile as climatic conditions affect crop production much more significantly than livestock production. The climate of Ukraine varies significantly from year-to-year, increasing risks to agriculture. It is dry in the south of the country making the production of some crops periodically risky. The variations in agricultural GDP caused mainly by the crop segment are evident.
As noted, crop production in Ukraine has a four-year cycle with one good year, one bad year and two average years.

Irrigation can certainly mitigate crop production volatility, but at a cost. The effect at a country scale, however, would be limited. Even if the entire potential for irrigation were exploited (5.5 million ha), it would only cover 12 percent of the entire arable area. For the time being, should the overall equipped area (roughly 2.6 million ha) be actually utilized, it would concern about 8 percent of the current cultivated area. Investing in Conservation Agriculture/”No till” techniques in farm areas managed by large, commercial farms would prove more effective (in terms of sustainable land productivity), at a much lower investment cost.8

Contribution of crops to gross agricultural output has been growing steadily. In 2012, the share of crops in the total agricultural output was close to 67 percent.

Figure 9: Agricultural GDP by subsectors, 2000–2012

![Bar chart showing agricultural GDP by subsectors from 2000 to 2012.](chart.png)

Source: SSSU and own calculations.

The organizational structure of the agricultural production system in Ukraine is almost equally structured around two types of producers: household farmers9 and

---


9 Rural households farms (”households”) are defined in this report in line with Ukraine’s official statistics definition as several persons or one person, who live together in the same building (or its part), that share common costs of living and food and so on, and who reside in the rural areas. This category also includes those who are registered as private entrepreneurs and those who are not registered.
commercial farmers. As of 2012, commercial farms accounted for 50.7 percent of total agricultural output and households for the remaining 49.3 percent. Since 2000, however, the share of commercial farms has increased from 38.2 percent to the current level of 50.7 percent.

Production of both crops and livestock are highest in central Ukraine where climatic conditions are quite balanced. These regions are also located in close proximity to key consumption areas. Among the leaders in total agricultural GDP are Vinnytska, Poltavska, Cherkaska, Kyivsk, Dnipropetrovska and Kharkivska oblasts.

**Figure 10: Crop GDP by subsectors, 2000–2012**

Grain production remains the main contributor to crop output with an average share of 35 percent from 2009 to 2012. Potatoes and vegetables accounted for another 30 percent but unlike grains, the crops were mainly consumed domestically. So called “technical crops,” which include mainly oilseeds and sugar beets, accounted for 26 percent of the total crop output.

10 Here and elsewhere in this report “commercial farms” are farms which are registered as a legal entity in Ukraine in various forms (“farm”, limited liability company (LLC), open joint-stock company (OJSC), etc.) and are involved in commercial production, usually on a large scale.
The output of the livestock sector was dominated by the production of animals for slaughtering. The share of these products has grown from 37 percent back in 2000 to 45 percent in 2012. The share of milk in the meanwhile has dropped from 52 percent to 39 percent and the share of eggs has grown from 7 percent to 12 percent.
By comparing the leading subsectors of livestock and crop production, it can be noted that in 2012 grains have remained a leading subsector of agriculture with 22 percent of total output, followed by potatoes and vegetables with a 21 percent share. Technical crops (oilseeds and sugar beets) represented the third largest subsector with an 18 percent share.

**Figure 13: Structure of agricultural GDP by subsectors in 2000 and 2012**

The largest increase in output since 2000 was registered for technical crops (+141 percent) and grains (+82 percent). Milk was the only subsector of the leading five for which output has declined since 2000.

Investments have highly regarded the crops sector. Renewed attention now needs to be concentrated in the livestock sector, which is one that not only through its growth may have a higher social impact but also has more dynamic and important linkages with the food industry. According to SSSU (2013), 38 percent of households in the rural areas of Ukraine kept cows. This is already a significant decrease since 2007 when 48 percent of households owned at least one cow. The average size of a rural household in Ukraine is 2.19 people.
It can thus be assumed that some 4.4 million people were involved in milk production and received a certain income from this activity. Most of the milk produced by households in Ukraine is not sold to processors. A part of the milk is consumed directly by the producing households and their relatives, while another part of the milk, specifically that produced by the farms located in close proximity to larger towns, is sold at the local green markets as fluid unpasteurized milk or alternatively, is transformed in fresh cottage cheese or sour cream, and more rarely in butter or other types of soft cheeses.

**Overview of the food industry in Ukraine**

The food industry in Ukraine has been developing as rapidly as the agricultural sector. In 2010, the total sales of food products of the Ukrainian food industry reached UAH 192 billion, equivalent to USD 24 billion.

The share of the food industry in the country’s GDP was close to 4.7 percent, in 2007, on par with the 4.6 percent share registered in 2001. Since 2008, the SSSU has no longer monitored this indicator. However, according to the SSSU, the production index of the food industry has dropped by 3.9 percent from 2008 to 2012 as a result of the global financial crises in 2008. During the two years (2008–2009) alone, the production index dropped by 8.1 percent. Since then, it has slowly been recovering but has remained below the levels achieved in 2007.

**Figure 14: Food industry production index, 2000–2012**

![Food industry production index chart](image)

*Source: SSSU and own calculations.*
Noteworthy, the production index of the food industry in Ukraine more than doubled from 2000 to 2007, growing by 113.2 percent. The increase was most rapid from 2000 to 2003 when it grew by 69.7 percent.

Production of food products in Ukraine increased thanks to growing domestic and export demand, as well as an ample supply of affordable raw material. Most Ukrainian food products have enjoyed duty-free market access in Russia and other Commonwealth of Independent States (CIS) countries. Ukraine was also the largest global exporter of sunflower oil to a large number of countries in the world. The country has been lately increasing its grain processing and its exports of wheat flour.

Higher value products, such as cheese, confectionery products, canned vegetables and fruits had been mainly exported to the CIS countries, but, in recent years, food processors started developing new markets outside of the CIS, such as in: China, other Asian countries and the Middle East. The access to the EU market is expected to grow following the DCFTA.

Vegetable oil production was the largest subsector of the food industry in Ukraine, accounting for about 17 percent of all sales in 2010, with total revenue of USD 4.1 billion. As mentioned, a large share of vegetable oil produced is exported out of Ukraine.

Meat and meat product processing was the second largest sector accounting for 13 percent of all sales with only a small share of it being exported as Ukraine still remains a net importer of meat and meat products. The dairy sector was the third largest with a 12 percent share in total revenues. Altogether vegetable oil, meat and dairy subsectors accounted for 42 percent of the food industry’s sales.

The fourth largest subsector was confectionary, which was once highly developed in Ukraine with a high export value and potential. Sugar was the fifth largest with about 5 percent of total revenues, nearly on par with the beer subsector, which followed.
Figure 15: Share of different subsectors of the Ukrainian food industry in total sales, 2010

Source: SSSU and own calculations.

To determine subsectors with the best production dynamics, we analyzed production trends in terms of volumes in recent years. As Figure 16 demonstrates, vegetable oil again is the most important food item in terms of volumes produced. Other leaders include flour, grouts and sugar. Bread, dairy products and meat combined with meat products are other relatively large subsectors.

Figure 16: Production volumes of food industry subsectors, 2003–2012

Source: SSSU and own calculations.
By analyzing the dynamics of production of various subsectors, vegetable oil is again on top of the list as its output tripled in 2012 in comparison to 2003. Other rapidly growing subsectors were juice production (output nearly doubled), beer (+76 percent), meat and meat product production with a 74 percent increase and mineral water production (+58 percent). Only three subsectors lost production volumes: bread, sugar and flour with grouts.

Table 3: Change in production volumes of food industry subsectors in tonnes, 2003–2012

<table>
<thead>
<tr>
<th>Products/years</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>from 2012 to 2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetable oil</td>
<td>7%</td>
<td>3%</td>
<td>50%</td>
<td>7%</td>
<td>-16%</td>
<td>49%</td>
<td>8%</td>
<td>6%</td>
<td>20%</td>
<td>202%</td>
</tr>
<tr>
<td>Flour and grouts</td>
<td>5%</td>
<td>0%</td>
<td>-8%</td>
<td>7%</td>
<td>5%</td>
<td>-8%</td>
<td>-5%</td>
<td>-1%</td>
<td>1%</td>
<td>-5%</td>
</tr>
<tr>
<td>Sugar</td>
<td>-14%</td>
<td>0%</td>
<td>21%</td>
<td>-28%</td>
<td>-16%</td>
<td>-19%</td>
<td>42%</td>
<td>43%</td>
<td>-17%</td>
<td>-14%</td>
</tr>
<tr>
<td>Bread</td>
<td>-1%</td>
<td>-2%</td>
<td>-5%</td>
<td>-6%</td>
<td>-3%</td>
<td>-8%</td>
<td>-1%</td>
<td>-2%</td>
<td>-5%</td>
<td>-28%</td>
</tr>
<tr>
<td>Meat and meat products</td>
<td>4%</td>
<td>9%</td>
<td>15%</td>
<td>21%</td>
<td>2%</td>
<td>-5%</td>
<td>6%</td>
<td>5%</td>
<td>1%</td>
<td>74%</td>
</tr>
<tr>
<td>Fluid milk &amp; fermented milk products</td>
<td>10%</td>
<td>15%</td>
<td>-1%</td>
<td>4%</td>
<td>-4%</td>
<td>-6%</td>
<td>1%</td>
<td>6%</td>
<td>3%</td>
<td>30%</td>
</tr>
<tr>
<td>Confectionary products</td>
<td>9%</td>
<td>5%</td>
<td>0%</td>
<td>7%</td>
<td>3%</td>
<td>-4%</td>
<td>4%</td>
<td>-2%</td>
<td>0%</td>
<td>23%</td>
</tr>
<tr>
<td>Juices</td>
<td>18%</td>
<td>29%</td>
<td>14%</td>
<td>46%</td>
<td>-9%</td>
<td>-23%</td>
<td>5%</td>
<td>-5%</td>
<td>7%</td>
<td>91%</td>
</tr>
<tr>
<td>Margarin and other fats</td>
<td>13%</td>
<td>7%</td>
<td>3%</td>
<td>2%</td>
<td>0%</td>
<td>12%</td>
<td>3%</td>
<td>-1%</td>
<td>-9%</td>
<td>31%</td>
</tr>
<tr>
<td>Cheeses</td>
<td>28%</td>
<td>21%</td>
<td>-13%</td>
<td>9%</td>
<td>-3%</td>
<td>-6%</td>
<td>-8%</td>
<td>-11%</td>
<td>-3%</td>
<td>7%</td>
</tr>
<tr>
<td>Pasta</td>
<td>-3%</td>
<td>24%</td>
<td>5%</td>
<td>0%</td>
<td>-5%</td>
<td>-10%</td>
<td>0%</td>
<td>10%</td>
<td>-2%</td>
<td>15%</td>
</tr>
<tr>
<td>Butter and spreads</td>
<td>23%</td>
<td>19%</td>
<td>-13%</td>
<td>5%</td>
<td>-9%</td>
<td>-11%</td>
<td>-2%</td>
<td>-6%</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>Alcohol and alcoholic beverages</td>
<td>25%</td>
<td>23%</td>
<td>7%</td>
<td>2%</td>
<td>-5%</td>
<td>-8%</td>
<td>-5%</td>
<td>-13%</td>
<td>-4%</td>
<td>15%</td>
</tr>
<tr>
<td>Beer</td>
<td>14%</td>
<td>23%</td>
<td>13%</td>
<td>18%</td>
<td>1%</td>
<td>-6%</td>
<td>3%</td>
<td>-1%</td>
<td>-2%</td>
<td>76%</td>
</tr>
<tr>
<td>Mineral waters</td>
<td>-1%</td>
<td>35%</td>
<td>14%</td>
<td>23%</td>
<td>-3%</td>
<td>-16%</td>
<td>10%</td>
<td>-8%</td>
<td>3%</td>
<td>58%</td>
</tr>
<tr>
<td>Soft drinks</td>
<td>12%</td>
<td>21%</td>
<td>4%</td>
<td>11%</td>
<td>-12%</td>
<td>-15%</td>
<td>1%</td>
<td>-2%</td>
<td>0%</td>
<td>16%</td>
</tr>
</tbody>
</table>

Source: SSSU and own calculations.
Rationale for the value chain selection

The approach followed to select the food value chain that merits priority investment is grounded on our understanding of the water economy in the country and based on the review of Ukraine’s food producing and processing sectors. A value chain that is limited to the primary sector has been excluded because both currently and in the near future, agriculture is not a major water-use competitor in Ukraine. Alternatively, the food industry is continuously growing in economic importance, while also putting more pressure on the most limited water resource of the country: groundwater.

The reasoning conducted so far in this analysis provides sufficient elements and a rationale for an informed choice. In order to proceed on lesser subjective grounds, the selection process of the value chain that deserves more attention (from a water perspective investment point of view) and that requires further investigation under this study (to identify investment areas that would improve its overall competitiveness) is conducted through a scoring system that takes into account the following factors:

- the economic size of the food industry’s subsectors (sales per year in USD million or local currency equivalent);
- underground water-use by the subsector in million m³;
- surface water-use by the subsector in million m³;
- total water-use per unit of output (m³ of water per each thousand in sales revenues).

The potential for improvement of water-use efficiency, as well as existing lending operations by EBRD in the subsector are both further considerations that strengthen the validity of the selection choice.
Table 4: Value chain scoring according to various criteria

<table>
<thead>
<tr>
<th>Industry</th>
<th>Industry size (sales)</th>
<th>Underground water-use</th>
<th>Surface water-use</th>
<th>Sales per m³ of water</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy products &amp; ice cream</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>Sugar production</td>
<td>5</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Distilled alcoholic beverages</td>
<td>7</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>Beer</td>
<td>6</td>
<td>2</td>
<td>6</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>Fruit &amp; vegetable processing</td>
<td>9</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>21</td>
</tr>
<tr>
<td>Meat &amp; meat products</td>
<td>2</td>
<td>6</td>
<td>5</td>
<td>9</td>
<td>22</td>
</tr>
<tr>
<td>Vegetable oils &amp; animal fats</td>
<td>1</td>
<td>8</td>
<td>7</td>
<td>10</td>
<td>26</td>
</tr>
<tr>
<td>Mineral water and soft drinks</td>
<td>11</td>
<td>3</td>
<td>10</td>
<td>5</td>
<td>29</td>
</tr>
<tr>
<td>Confectionary</td>
<td>4</td>
<td>10</td>
<td>8</td>
<td>8</td>
<td>30</td>
</tr>
<tr>
<td>Bread production</td>
<td>8</td>
<td>9</td>
<td>9</td>
<td>7</td>
<td>33</td>
</tr>
<tr>
<td>Grain &amp; cereal processing</td>
<td>10</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>43</td>
</tr>
</tbody>
</table>

Source: Authors’ own elaboration.

Note: (score: 1 highest – 11 lowest).

The dairy industry along with the sugar industry appear to top the list of value chains that would require further investigation. Both industries are among the most important in terms of total sales, water-use and water-use per sales. In addition, EBRD is already working very closely with large companies and leaders in both industries, which is also encouraging a wider impact of incremental investments.

In terms of water footprints, the sugar produced in Ukraine has an indicator almost double that of milk: 1 900 m³/tonne as opposed to 1 000 m³/tonne. The water footprint is used as an indicator of water consumption in the full production chain of a food product. The water footprint consists of three components. The green water footprint is the amount of precipitation that is stored in the soil and consumed by crops during the growing season by evapotranspiration. The blue water footprint is the amount of fresh water that is extracted from ground and surface water that is used for irrigation, as well as the amount of water used in processing a food product. The grey water footprint is the amount of water needed to dilute pollutants to an acceptable level and conform exiting water quality standards. See also later on in this study in Chapter 3.
higher water footprint impact of the sugar industry is evident and the water-effectiveness of the dairy industry is also manifest.

If social impact is taken into consideration, the employment by the dairy value chain is certainly largest: some 4.4 million people are involved at the primary production level. The number of employees of commercial milk producing companies is estimated at about 35–40 thousand people. By including those involved in processing, supplies, services and trade segments, it can be assumed that overall some 4.5 million people are economically concerned by the dairy industry, which is almost 10 percent of the Ukrainian population and 32 percent of the rural population (2013). Although it is expected that the percentage of households who keep cows will decline substantially in the coming years, the dairy sector will continue to be a significant employer and contributor to the welfare of the rural population in Ukraine.

Finally, FAO and EBRD have helped establish a very successful public-private dialogue in the dairy sector, which will be conducive to sound and inclusive investments in this subsector.
Chapter 3 – Dairy sector value chain analysis

Sector trends in Ukraine and worldwide

Ukraine is a net exporter of milk and milk products, although its trade balance has shown negative trends following independence. The production of milk declined constantly from 1991 until 2011, when Ukraine lost most of its traditional, Former Soviet Union (FSU) markets. In 2012, milk production finally showed the first signs of recovery with commercial milk producers actively investing in larger dairy herds and modern technologies.

Nevertheless, although Ukraine covers its domestic demand for milk and dairy products and exports relatively small volumes, it is not utilizing its huge potential in the dairy business, given the availability of inexpensive feed, vast land resources, educated and inexpensive labor and relative proximity to key markets.

Figure 17: Ukraine’s share in global milk production and milk production trends

In 2012, Ukraine produced around 1.8 percent of the global milk output and its share in global milk production has dropped since 2000 due to negative production trends. During this period, global milk production grew by about 2 percent per year on average while Ukraine’s production decreased by 0.75 percent per annum. Notably, Ukraine did not take advantage of the global trend of rising demand for milk and dairy products and its importance in the global dairy market continued to decrease.

Source: FAOSTAT.
Table 5: Milk production volumes in leading countries and Ukraine

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia (million tonnes)</td>
<td>9.1</td>
<td>9.1</td>
<td>9.3</td>
<td>9.5</td>
<td>9.0</td>
<td>-1.1</td>
</tr>
<tr>
<td>EU-28* (million tonnes)</td>
<td>135.0</td>
<td>134.2</td>
<td>136.3</td>
<td>140.6</td>
<td>141.7</td>
<td>+5.0</td>
</tr>
<tr>
<td>New Zealand (million tonnes)</td>
<td>16.9</td>
<td>17.1</td>
<td>18.9</td>
<td>20.5</td>
<td>20.1</td>
<td>+18.9</td>
</tr>
<tr>
<td>USA (million tonnes)</td>
<td>85.9</td>
<td>87.5</td>
<td>89.0</td>
<td>90.9</td>
<td>91.3</td>
<td>+6.3</td>
</tr>
<tr>
<td>Ukraine (million tonnes)</td>
<td>11.6</td>
<td>11.2</td>
<td>11.1</td>
<td>11.4</td>
<td>11.5</td>
<td>-0.9</td>
</tr>
</tbody>
</table>

*Only the milk supplied for processing is accounted for.

Source: clal.it and European Commission.

Positive trends in milk production are however becoming apparent with increased production and productivity at the commercial farm level. While household milk production declined, the share of commercially produced milk used by processors has grown from 36 percent in 2007 to 57 percent in 2013.

Figure 18: Production of milk by type of producers in Ukraine, 2007–2013

Source: Automated supply and demand balance for milk and dairy products in Ukraine of FAO/EBRD based on Derzhstat data.
According to the Association of Milk Producers in Ukraine (AMPU), the Ukrainian market of milk and dairy products reached UAH 25.9 billion in 2013, growing rapidly (by more than 76 percent) from just around UAH 14.3 billion in 2009. The share of imports also increased but has remained relatively low around 7.5 percent of the total.

**Figure 19: Ukrainian market size for milk and dairy products, 2009–2013**

Source: AMPU based on Derzhstat and World Bank data.

Ukraine is a net exporter of milk and dairy products; in fact, the total value of the products sold by dairy processors was higher than the domestic market size. The output of Ukrainian dairy processors actually increased by 65 percent in 2013 compared with 2009 and was valued UAH 28.3 billion (USD 3.5 billion).

**Figure 20: Annual revenue of Ukrainian dairy processors, 2009–2013**

Source: AMPU based on Derzhstat and World Bank data.
Considering market size and the share of imports of various categories of dairy products in terms of volume instead of value, the trend is different for each product. Almost all markets grew in size slightly but the share of imports has significantly increased for cheese and butter.

**Figure 21: Estimated market size and share of imports in Ukraine for milk & cream, dried milk, butter and cheese, 2009–2013**

The increase of the overall market size in terms of value is due to the price increases of milk and dairy products, while total sales remained relatively unchanged. Processing companies actually decreased the amounts of milk processing by 4 percent in 2013 in comparison with 2009 and by 25 percent in comparison to volumes achieved in 2007. This may indirectly give consideration to the numerous claims shown in Ukrainian media on instances of milk being replaced by non-milk components (predominantly vegetable fats) in the production of dairy products.

Source: AMPU based on Derzhistat and World Bank data.
While in 2009 most of the processed milk was used for cheese production, in 2013 processors stepped up the production of whole milk and fermented milk products and used most of the raw milk for this purpose. There was a 10 percent increase in 2013 (with respect to 2009), even though the volumes achieved dropped by 20 percent compared with those in 2007. The greatest decline occurred, however, in the volumes of milk used for cheese, which dropped by almost one-third in four years.
Ukraine’s production of milk has great potential, considering animal productivity remains relatively low compared with that of the leading milk producing countries with ample scope for improvement. In fact, it has been growing quite fast in recent years, while global productivity remains quite stable. The average global productivity of milk cows grew only by 3.6 percent from 2000 to reach 2320 kg/year/cow in 2012. Otherwise, average productivity in Ukraine during the same period grew by an impressive 88 percent.
In 2012, Ukraine ranked only 45th in the global ranking of milk productivity per cow. It is though expected to grow relatively fast over the next few years as the productivity of cows in Ukraine is increasing rather rapidly. Leading producers in Ukraine are already exceeding 10 000 kg/year of average productivity.
Table 6: Global ranking of countries in terms of milk productivity per cow

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</thead>
<tbody>
<tr>
<td>1 Martinique (kg/year)</td>
<td>751.8</td>
<td>763.0</td>
<td>770.1</td>
<td>809.2</td>
<td>11 065.6</td>
<td>17 834.4</td>
<td>17 500.0</td>
</tr>
<tr>
<td>2 Israel (kg/year)</td>
<td>8 607.9</td>
<td>8 739.5</td>
<td>9 481.6</td>
<td>9 822.3</td>
<td>10 767.2</td>
<td>11 393.1</td>
<td>11 579.7</td>
</tr>
<tr>
<td>3 Saudi Arabia (kg/year)</td>
<td>6 427.3</td>
<td>7 462.7</td>
<td>8 423.7</td>
<td>9 531.3</td>
<td>10 437.5</td>
<td>10 625.0</td>
<td>10 802.5</td>
</tr>
<tr>
<td>4 South Korea (kg/year)</td>
<td>6 007.3</td>
<td>6 284.4</td>
<td>8 832.7</td>
<td>9 813.8</td>
<td>10 161.8</td>
<td>10 048.4</td>
<td>9 895.8</td>
</tr>
<tr>
<td>5 USA (kg/year)</td>
<td>6 705.2</td>
<td>7 441.3</td>
<td>8 254.4</td>
<td>8 876.7</td>
<td>9 587.3</td>
<td>9 677.7</td>
<td>9 841.3</td>
</tr>
<tr>
<td>6 Canada (kg/year)</td>
<td>5 808.4</td>
<td>6 366.6</td>
<td>7 396.2</td>
<td>7 495.7</td>
<td>8 531.4</td>
<td>8 699.3</td>
<td>8 816.8</td>
</tr>
<tr>
<td>7 Sweden (kg/year)</td>
<td>6 086.1</td>
<td>6 853.4</td>
<td>7 829.4</td>
<td>8 157.4</td>
<td>8 337.0</td>
<td>8 340.7</td>
<td>8 716.9</td>
</tr>
<tr>
<td>8 Denmark (kg/year)</td>
<td>6 247.6</td>
<td>6 656.5</td>
<td>7 421.1</td>
<td>8 123.8</td>
<td>8 640.2</td>
<td>8 636.4</td>
<td>8 529.3</td>
</tr>
<tr>
<td>9 Finland (kg/year)</td>
<td>5 764.0</td>
<td>6 189.4</td>
<td>6 729.2</td>
<td>7 633.4</td>
<td>8 074.4</td>
<td>8 057.8</td>
<td>8 097.8</td>
</tr>
<tr>
<td>10 Portugal (kg/year)</td>
<td>4 027.3</td>
<td>4 419.3</td>
<td>5 631.9</td>
<td>6 144.3</td>
<td>7 809.4</td>
<td>7 874.3</td>
<td>7 846.2</td>
</tr>
<tr>
<td>11 Japan (kg/year)</td>
<td>5 870.5</td>
<td>6 245.9</td>
<td>6 792.2</td>
<td>7 236.0</td>
<td>7 502.9</td>
<td>7 477.3</td>
<td>7 795.2</td>
</tr>
<tr>
<td>12 United Kingdom (kg/year)</td>
<td>5 313.7</td>
<td>5 702.8</td>
<td>6 154.6</td>
<td>7 244.8</td>
<td>7 605.9</td>
<td>7 630.3</td>
<td>7 683.5</td>
</tr>
<tr>
<td>13 Czech Republic (kg/year)</td>
<td>4 071.7</td>
<td>4 244.9</td>
<td>5 411.8</td>
<td>6 521.2</td>
<td>7 090.2</td>
<td>7 320.2</td>
<td>7 633.3</td>
</tr>
<tr>
<td>14 Netherlands (kg/year)</td>
<td>6 050.1</td>
<td>6 612.9</td>
<td>7 281.3</td>
<td>7 299.5</td>
<td>7 467.8</td>
<td>7 545.8</td>
<td>7 576.5</td>
</tr>
<tr>
<td>15 Estonia (kg/year)</td>
<td>4 118.7</td>
<td>3 351.8</td>
<td>4 549.1</td>
<td>5 750.8</td>
<td>6 983.9</td>
<td>7 175.0</td>
<td>7 491.9</td>
</tr>
<tr>
<td>16 Spain (kg/year)</td>
<td>3 668.3</td>
<td>4 801.5</td>
<td>5 352.0</td>
<td>6 294.7</td>
<td>7 674.9</td>
<td>8 174.0</td>
<td>7 471.0</td>
</tr>
<tr>
<td>17 Germany (kg/year)</td>
<td>4 926.7</td>
<td>5 424.1</td>
<td>6 121.7</td>
<td>6 761.6</td>
<td>7 082.4</td>
<td>7 236.9</td>
<td>7 280.0</td>
</tr>
<tr>
<td>18 Luxemburg (kg/year)</td>
<td>6 103.4</td>
<td>6 855.9</td>
<td>7 154.8</td>
<td>7 224.5</td>
<td>7 265.6</td>
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</table>
According to FAOSTAT data, Ukraine ranked 17th in terms of global exports of milk and dairy products. However, assuming difficulties with exports due to trade issues with Russia and the ban on sales of Ukrainian dairy products to Russia introduced in mid-2014, Ukraine may lose positions.

**Figure 25: Exports of milk from Ukraine and share of Ukraine in global dairy export, 2005–2011**

![Graph depicting exports and share of Ukraine in global dairy exports from 2005 to 2011.]

Source: FAOSTAT.
In 2011, Ukraine exported significant quantities of cheese and relatively large volumes of condensed milk. Ukraine, in fact, was among the top ten exporters of condensed milk in the world and ranked 16th for cheese exports.

Table 7: Ukraine’s place in the global ranking of countries in terms of exports of selected dairy products, 2011

<table>
<thead>
<tr>
<th>Product</th>
<th>Exports, thousand tonnes</th>
<th>Share in global exports, %</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butter</td>
<td>2.1</td>
<td>0.15</td>
<td>31</td>
</tr>
<tr>
<td>Fermented milk products</td>
<td>3.2</td>
<td>0.25</td>
<td>32</td>
</tr>
<tr>
<td>Cheese</td>
<td>80.3</td>
<td>1.54</td>
<td>16</td>
</tr>
<tr>
<td>Lactose</td>
<td>0.7</td>
<td>0.92</td>
<td>21</td>
</tr>
<tr>
<td>Dried skimmed milk</td>
<td>0.3</td>
<td>0.02</td>
<td>59</td>
</tr>
<tr>
<td>Dried whole milk</td>
<td>2.1</td>
<td>0.1</td>
<td>39</td>
</tr>
<tr>
<td>Condensed milk</td>
<td>12.5</td>
<td>3.21</td>
<td>10</td>
</tr>
</tbody>
</table>

Source: FAOSTAT.

Importance of the dairy sector in the Ukrainian economy

According to official statistics, milk production in 2013 accounted for 11.5 percent of Ukraine’s total agricultural GDP. The value of the milk produced was estimated at around UAH 30 billion. However, the bulk of the milk produced never entered the market as it was used for home consumption by the milk-producing households themselves. Effectively, it is estimated that only some 30–35 percent of the milk produced in Ukraine is then processed either in fluid, pasteurized milk or other dairy products.
The share of milk in the agricultural GDP of Ukraine evidently dropped from 19.4 percent in 2005 to 11.5 percent in 2013, as a result of the decline in milk production combined with the increased production of grains, oilseeds and other field crops. Nevertheless, milk remains an important component of Ukraine’s agribusiness with good perspectives for the commercial growers and processors, while also providing additional incomes to the rural communities.

Milk production is most important for the western and northern regions of Ukraine where it plays a significant role in their agricultural GDP. In Zakarpatska oblast, the share of milk in the agricultural GDP was as high as 24.2 percent in 2013 and in Ivano-Frankivska it was 21.3 percent of total GDP.
Dairy, besides grains and oilseeds, is among the three agribusiness sectors in Ukraine with a stable positive trade balance, providing export revenues close to USD 0.5 billion in 2013. The share of dairy in the country’s total exports in 2013 was 0.8 percent and its share in the total agricultural exports was close to 3 percent. This was however a significant decrease in comparison with 2008 when the share of dairy in all agricultural exports was 8 percent.
Water-use assumptions

In this study, we mainly refer to the actual water consumed at the various stages of the dairy value chain. Estimated measurements have regarded the actual water that is withdrawn from natural water sources (e.g. rivers, lakes, etc.), underground sources or through centralized communal supply systems, inclusive of the water used to irrigate some of the feed crops when producing milk and milk products. However, we have not accounted for green water used by rain-fed feed crops and we have not considered the water animals drink while on pastures.

We discuss also the virtual-water content of a product. It refers to the volume of water consumed or polluted for producing the product, measured over its entire production chain.

If a country exports/imports such a food/feed product, it exports/imports water in virtual form. The ‘virtual-water content of a product’ is the same as ‘the water footprint of a product’: the former refers to the water volume embodied in the product alone, while the latter term refers also to which sort of water is being used and to when and where that water is being used. The water footprint of a product is thus a multi-dimensional indicator, whereas virtual-water content refers to a volume alone. In water footprint terms, it is estimated that 1 litre of milk requires around 1 000 litres of water.

Our analysis shows that for each litre of milk, commercial producers withdraw 35.5 litres of water while household producers withdraw only 18.0 litres. The rest comes from rain-fed feed crops and drinking water from natural sources while cows are on pastures. Therefore, while 1 kg of cheese requires around 10,000 litres of virtual water to be produced, it requires from 230 to 360 litres of actually withdrawn measurable water.

For all milk products other than milk itself, it has been assumed in this study to consider only the incremental quantity of water required to produce each specific milk product. This means that the conversion factor of milk-to-milk product is implicit and not accounted for in water terms.

**Water in milk production systems**

AMPU data collected from commercial farms throughout Ukraine suggests that the use of water/kg milk at farms with extensive technologies is 2.0–2.8 times that of intensive farms, although water consumption per cow at intensive farms is higher. Extensive farms in Ukraine usually yield 10 kg or less of milk/cow/day, while intensive farms milk 20 or more kg of milk/cow/day.

**Figure 29: Direct water-use of milk produced by dairy farms with different levels of daily productivity per cow**

Source: SSSU and Authors’ own elaboration.

Note: This number only reflects the water used on the farm level and doesn’t include water used for the production of inputs such as feeds.

Households produce more milk than they consume and sell excess milk to processors or in green markets as milk, sour cream, cottage cheese or sometimes even butter. In most cases, they only have one cow and seldom more than two. Efficiency of milk production at these farms is low and they consume relatively large amounts of water per kg of milk produced.
With regard to commercial farmers, several types can be distinguished:

- specialized dairy family farms
- specialized corporate dairy farms
- agriholdings with modern dairy operations
- agriholdings with ‘old’ dairy operations (and farms with old dairy operations that specialize in the production of grains and oilseeds)

There are very few family farms specialized in dairy production in Ukraine. They usually hold 10–100 cows with relatively high milk yields; the production of milk at such farms is usually much more efficient than at the households, however, these farms deal with competition coming from larger commercial farms. They also lack the capital needed to grow to a more commercial size.

Specialized corporate dairy farms are the most efficient farms in Ukraine, according to AMPU. Although in most cases they also grow significant amounts of grain and oilseeds for the market, milk production remains their core business. These farms have from 300 to 1 500 cows on average and their milk yields range between 6 500 and 10 000 kg/cow/year. Water-use efficiency at these farms is also the highest.

Agriholdings with modern dairy operations usually get relatively high productivity per cow but at high production costs: on average, 25–30 percent higher than at specialized dairy farms.

The fourth type of commercial dairy farm is the least efficient. These farms have usually inherited dairy herds and barns from an old kolkhoz system and, in most cases, haven’t improved them much. The only reason they keep cows is to provide employment for the local rural community, which leases the land to the farm. Land-owners are usually reluctant to lease land to companies who don’t keep livestock. Milk yields at such farms are usually low, at around 3 000–4 000 kg/year/cow, and they normally keep between 100 and 300 cows. Water efficiency at these farms is also the lowest among the commercial farms and even lower than at the household level.

The size of the farm is another factor that determines the prevailing milk production technologies. While most of the milk is still produced worldwide by small and medium farms, a trend, however, exists towards larger farm sizes. In the USA, one of the global leaders in the dairy sector, the number of dairy farms has dropped by one-third over the last ten years while the share of large farms that have 2 000 or more cows has grown from 10.5 percent in 2000 to 34.7 percent in 2013.
Commercial dairy farms with 1,000 cows or more account for less than 2 percent of the total number of farms, but in 2013 nearly 26 percent of the milk produced in the country came from these large commercial farms. In fact, their share in total milk production has more than doubled since 2009, going from 12.8 percent to the current 26 percent. Meanwhile, the share of smaller, commercial farms (producing less than 1,000 tonnes of milk/year) has dropped from 33.4 percent to 21.9 percent. As a result, the efficiency of water-use has also improved: larger farms had better productivity per animal and respectively lower water-use per each litre of milk produced. This has been the trend over the last four years.
Another important differentiation of milk production is the system of cow keeping. Worldwide, farms have predominantly moved away from station-barn or ‘fixed’ keeping to free-stall keeping and Ukraine is also joining the trend. However, most commercial farms use the station-barn keeping system and reach relatively high productivity levels per cow with such a system.

In the station-barn system, watering conveyance is organized to service individually each cow: a system that in the end considerably wastes water. In addition, pipes need to be heated in the winter to prevent water from freezing, which negatively impacts water and energy efficiency. Free-stall farms are usually 10–15 percent more water efficient.

Independently from production technology, cows need to have free access to drinking water. Environmental air temperature is also an important factor. In regions with very high temperatures, some farms install barn cooling systems based on fans and dispersed water.

**Table 8: Daily water requirements per cow depending on air temperature and productivity**

<table>
<thead>
<tr>
<th>Milk yield per day, kg</th>
<th>0–10 °C</th>
<th>11–20 °C</th>
<th>21–25 °C</th>
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<tbody>
<tr>
<td>10</td>
<td>78</td>
<td>86</td>
<td>105</td>
</tr>
<tr>
<td>20</td>
<td>88</td>
<td>98</td>
<td>119</td>
</tr>
<tr>
<td>30</td>
<td>99</td>
<td>110</td>
<td>133</td>
</tr>
<tr>
<td>40</td>
<td>100</td>
<td>121</td>
<td>147</td>
</tr>
</tbody>
</table>


Ukrainian commercial farms usually produce their own silage and their own concentrated mixed feeds, as well as most of the elements of these concentrated feeds. Farmers grow corn for silage and for grain; they also grow wheat, barley and other grain crops, which are used in the feeding rations. Farmers who grow sunflower, rapeseeds and soybeans usually sell the output to crushing plants and then buyback oil meals, which are an important protein source.

According to this analysis, only 2.6 percent of all feed components fed to cows in 2013 came from irrigated land. The estimated total amount of water used was close to 254 million m³ or around 22 litres water/kg milk produced in Ukraine.13

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13 Should Ukrainian farmers irrigate all their feed/fodder crops, the irrigation water-use would amount to some 8.5 billion m³.
**Water in dairy processing technologies**

Total water expenditures of dairy processing plants in Ukraine in 2013 were estimated at UAH 7.2 million (less than USD 1 million), which is equal to around 0.5 percent of the total plant costs of production.

In dairy processing, water is mainly used for heating, cooling, washing and cleanup. While water fees in Ukraine are not very high yet and their share in the total costs of production is low, water costs are rising and some dairy plants have already started looking for ways to improve their water efficiency.

In the US, the most efficient plants use 1 litre of water per kg of processed milk, while, on average, the water used is less than 2 litres per kg. Ukrainian dairy processing consume on average 3.96 litres of water per kg of milk processed, leaving significant room for improvement.

Most of the water wasted at dairy processing facilities happens during the clean-up processes. Rinsing is often overdone to compensate for inefficient circuits. Improper management translates into overusing water and also chemicals.

It is interesting to note that most dairy plants, including the more efficient, typically have obsolete equipment (including those for water reuse). They merely practice good diligence in their cleaning and water flush procedures.

In Ukraine, the water used for the production of milk and milk products varies highly, depending on the source of information.
The sharpest difference regards the water needed to produce butter, which may be explained by the following points:

- Some plants partially use imported butter fat in their products.
- Some dairy processing companies use vegetable fats to reduce the amount of milk that is normally required to produce a kg of butter.
- Part of the milk is bought from households but not reported in the statistics.

**Water along the value addition**

The dairy value chain study is based on enquiries conducted with different types of farms in Ukraine. Information has been collected also from several, large and medium dairy-processing companies, as well as from intermediaries and cooperatives collecting milk from households for further processing. We interviewed three mid-size and one large, national retail chain to determine the costs associated with milk sales and their respective water-use and related costs. Price monitoring of Ukrainian supermarkets was done for all key products investigated: pasteurized milk, butter and hard cheese, in order to determine the
margins of all players in the value chain. For the purpose of the study, we have selected the most common types and brands of these products.\textsuperscript{14}

**Pasteurized Milk**

Price monitoring in the retail chains of Ukraine suggests that most of the pasteurized milk is produced from lower quality and less expensive raw materials collected from households. Most of the value, 61 percent in this case, is added by processors, who usually also take care of distributing the product. Milk producers add around 22 percent of the value, milk collection (coops or commercial intermediaries) around 11 percent and retail around 6 percent.

**Figure 34: Distribution of value added among participants of the pasteurized milk value chain**

\[\text{Retail} \quad 6\% \quad \text{Processing \\& distribution} \quad 61\% \quad \text{Milk collection} \quad 11\% \quad \text{Milk production} \quad 22\% \quad \text{Retail} \quad 6\%\]

*Source: AMPU based on interviews with participants of the value chain, retail and wholesale price monitoring.*

The share of water costs in pasteurized milk produced from raw materials collected from households is 1.4 percent. Furthermore, if the milk is collected from commercial farms, the share of water in the costs is much lower – 0.6 percent only.

\textsuperscript{14} Our value chain study showed some critical results. For example, we found that inexpensive pasteurized milk and plastic bag milk, as well as the most common brands of butter can only be produced from less expensive milk supplied by households. In addition, hard cheese of the low price category can be produced only if some part of the milk fat is substituted by vegetable fats.
This is in part due to the higher costs of raw materials when producing pasteurized milk from milk coming from commercial farms, where the share of water costs are also lower. Moreover, while households typically pay fees for water supplied via centralized water supply systems, most of the commercial farms are exempted from water fees.

However, the total volume of water used per kg of product is higher in the value chain based on the raw materials coming from the commercial farms. Currently, households, in most cases, let their cows graze for 6–8 months out of the year and thereby benefit from free animal drinking water. Households also use very small amounts of concentrated feed, lowering the computation of irrigation water for feed/fodder.
Analyses of margins show that pasteurized milk produced from raw material procured from households provides a 16 percent return on overall costs, or 14 percent on price.

Most of the pasteurized milk sold in the retail chains is sold in the low price category and can’t be produced from high quality milk, as otherwise, costs of production and distribution would be higher than the actual retail price. If we assume that all participants of the value chain retain their margins, production of pasteurized milk from higher quality raw material would be more profitable, providing a 31 percent return on costs only when distributed among three instead of four value chain participants. In this case, there would be no milk procurement intermediary involved.
Figure 37: Net margins in the value chain of fluid milk

Source: AMPU based on interviews with participants of the value chain, retail and wholesale price monitoring.

Note: In the case of direct sales by households, milk is unpasteurized, unpackaged and sold directly by cow owner to end consumer in re-usable glass jars.

Figure 37 includes information on the distribution of net margins along the value chain depending on the raw materials used. In the case of commercial milk producers, the value chain is rather theoretical as pasteurized milk is usually produced from lower quality raw material. When household milk is used as a raw material, the highest net margin is earned by the milk collection intermediary, who adds value by bringing significant volumes of milk to processors. Retailers make a little more than the producers and processors make the least among the value chain participants.

We have also included the calculation of the direct sales of fresh unpasteurized and unpackaged milk sold by cow owners to end consumers in re-usable glass jars. In this case, the price charged for fresh milk is as high as or even higher than the price for pasteurized and packaged milk in the supermarket and the producer keeps the entire margin, minus the costs of production and delivery. This means that the cow owner makes 15–20 times as much by selling milk through this marketing channel compared with selling it to dairy processors.
Butter

Similarly to pasteurized milk, our price monitoring in the retail chains of Ukraine suggests that the most common brands of butter are produced from the lower quality and less expensive raw materials collected from households. Theoretically, however, the most efficient butter producer could potentially offer competitively priced butter at the stores. The costs of butter production also depend on the revenue producers would fetch from the dried skimmed milk.

Most of the value (37 percent) – should the butter be made out of household milk – is added by retailers. Milk collection adds another 18 percent of the value and processing only 11 percent. Producers, on the other hand, add significant value in this value chain – around 34 percent.

Figure 38: Distribution of value added among participants of the butter value chain

Source: AMPU based on interviews with participants of the value chain, retail and wholesale price monitoring.

Costs of water are more significant in the butter value chain than in that of fluid pasteurized milk. Overall, the costs of water in the total costs of butter production and distribution is close to 1.9 percent if the butter is produced from household milk, and 0.8 percent if it is made out of milk produced on commercial farms.
The total amount of water required to produce 1 kg of butter from household milk was estimated at 240 litres and was 92 percent more when commercially produced milk was used, of which only 4.9 percent was used at the processing level in the case of household milk and 2.5 percent in the case of commercially produced milk.
Margins in the butter value chain depend greatly on the type of raw material. Household milk provides higher margins for retailers. However, if commercially produced milk is used, farmers and processors would make more profit and retailers less, assuming butter is sold at the same price as it is sold today. However, this is not the case and thus, retail margins on more expensive types of butter are higher today than on cheaper brands, consequently leading to much lower volumes of sales, as Ukraine remains a very price-sensitive market.

Figure 41: Net margins in the value chain of butter

![Net margins in the value chain of butter](image)

Source: AMPU based on interviews with participants of the value chain, retail and wholesale price monitoring.

**Cheese**

For the purpose of the study, we chose the most common hard cheese for Ukraine, called *Rossiysky*. Cheese of this type can be found at the same retail store with a price differentiation reaching 80–90 percent. Dairy market experts suggest that the reason behind this is because cheap cheese is adulterated by replacing milk fat with vegetable oil fat. Our study confirms this assumption.

Therefore, we considered retail prices of cheese in the medium price segment only, which is supposedly made out of milk. However, even cheese in this price segment is made solely from the cheapest household-produced milk, or else the margins of processors and/or retailers would be negative.

If processors used higher quality milk supplied from industrial farms, retail cheese prices would have to be at least UAH 110/kg vs. UAH 88-89/kg, at the time of the study.

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15 This type of cheese is actually semi-hard with 50 percent fat content and is similar to German Tilsiter cheese. It is also the most popular type of cheese sold by Ukrainian cheese makers to Russia.
Value added in the cheese value chain is distributed differently from the case of butter. Processors add the most value and account for 39 percent. Retailers add another 25 percent and milk aggregators 11 percent. This is only true for the value chain where cheese is made out of milk procured from households, which furthermore, represents the majority of cheese of this type. The share of producers in value addition in this case would be equal to that of retailers at around 25 percent.

Figure 42: Distribution of value added among participants of the cheese value chain

Source: AMPU based on interviews with participants of the value chain, retail and wholesale price monitoring.

Costs of water are more significant in the cheese value chain than in the fluid pasteurized milk value chain but less important than in the butter value chain. Overall, the costs of water in the total costs of cheese production and distribution is close to 1.5 percent, if cheese is produced from household milk and 0.55 percent if it is made out of milk produced on commercial farms.

Figure 43: Value and share of water in the costs of cheese production

Source: AMPU based on interviews with participants of the value chain, retail and wholesale price monitoring.
The total amount of water required to produce 1 kg of cheese from household milk was estimated at 231 litres. If commercially produced milk were used for cheese production, 1 kg of cheese would require 359 litres of water or 56 percent more than in the case of household milk, of which only 6.1 percent is used at the processing level for household milk and 3.9 percent for commercially produced milk.

Thus, the use of water per kg of milk used for cheese making was on average 11 percent lower than in the production of pasteurized milk but 25 percent higher than in the butter production process.

**Figure 44: Volume of water used to produce a kg of cheese by types of raw material supplier and the share of different elements of the value chain in the total water volumes**

Source: AMPU based on interviews with participants of the value chain, retail and wholesale price monitoring.

In the cheese value chain, retailers make the highest net margins. We note, however, that when the same cheese is (or rather was) exported to Russia, the margins of processors were much higher than when sold domestically, and were even higher than the margins of local retailers. This is one of the reasons why most cheese makers have not been interested in developing a domestic market, trying to sell as much as they can to Russia. This may actually change now with the disruption of the Russian market.
Out study shows that all participants of the value chain would have made higher net margins if cheese were made out of higher quality milk procured from industrial farms, due to more efficient logistics and the absence of a milk collection firm claiming part of the value. However, the price of cheese would then be too high and given that Ukrainian consumers are very price sensitive, sales volumes would reduce significantly.

**Figure 45: Net margins in the value chain of cheese**

![Net margins in the value chain of cheese](chart)

Source: AMPU based on interviews with participants of the value chain, retail and wholesale price monitoring.

**Skimmed Milk Powder**

Ukraine used to produce and export large amounts of Skimmed Milk Powder (SMP) in the 1990s when there was a huge oversupply of raw milk. Low prices of raw milk allowed processors to produce SMP (and butter) competitively as a sub-product, and export it worldwide. However, the situation has changed during the last ten years as the milk supply has substantially decreased.

Analyses of the SMP value chain are more complicated, as usually SMP is not sold via retail. It is either exported and stored by dairy processors and used to substitute fluid milk in the winter or sold to other processors.

During the last five years, global SMP prices have ranged between USD 2 250 and USD 5 100/tonne. At the time of the study, the retail price of SMP in Ukraine was close to UAH 60/kg, which is equivalent to USD 4 500/tonne. Recently, prices of SMP on the global market plummeted to about USD 2 700–2 800 /tonne, showing a declining trend. Ukrainian processors were evidently unable to export SMP at this time as their production costs were close to USD 3 000/tonne, even when buying cheap and low quality milk from household farmers. When milk is bought from commercial producers, the production
costs of SMP would be around USD 4,500/tonne, further worsening their competitiveness on the global market.

Once again, at the time of this analysis, Ukrainian processors were gaining 67 percent of their revenue from SMP and 33 percent from butter as a by-product. Since almost all milk for SMP was sold to processors, the value chain was rather short, and included only milk producers and dairy processors. When milk came from households, which was virtually always the case, the value chain would also include a milk-consolidating intermediary.

Should one consider SMP as exportable, significant value portions would be added by exporters. However, this was not the case at the time of the study and therefore, we have not included exporters in the calculation.

**Figure 46: Distribution of value added among participants of the SMP value chain**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value Added</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processing and distribution</td>
<td>56%</td>
</tr>
<tr>
<td>Collection</td>
<td>14%</td>
</tr>
<tr>
<td>Producer</td>
<td>30%</td>
</tr>
</tbody>
</table>

*Source: AMPU based on interviews with participants of the value chain, retail and wholesale price monitoring.*

Costs of water are less important in the SMP value chain than in the cheese and butter chains but more important than in the fluid pasteurized milk value chain. Overall, the costs of water in the total costs of SMP production and distribution is close to 1.6 percent if SMP is produced from household milk and 0.59 percent if it is made out of milk produced on commercial farms.
The total amount of water required to produce 1 kg of SMP from household milk is estimated at 156 litres. If commercially produced milk is used for cheese production, 1 kg of SMP would require 240 litres of water or 53 percent more than in the case of household milk, of which 11.9 percent would be used at the processing level for household milk and 6.4 percent for commercially produced milk.

Thus, the amount of water per kg of milk used for SMP production is the highest of all the dairy products analyzed, even slightly higher (0.3 percent) than that used to produce pasteurized milk.
Figure 48: Volume of water used to produce a kg of SMP by types of raw material supplier and the share of different elements of the value chain in the total water volumes

Source: AMPU based on interviews with participants of the value chain, retail and wholesale price monitoring.

In the case of SMP where no retailer is involved, processors make most of the margin. They make 57 percent of the margin in the value chain with household milk or a 50 percent margin with commercial milk.

Figure 49: Net margins in the value chain of SMP

Source: AMPU based on interviews with participants of the value chain, retail and wholesale price monitoring.
**Water economic efficiency of dairy products**

Water represents a less significant part of the costs for all participants of the dairy value chain. This is due to relatively low prices – although rapidly growing – of water in Ukraine. Moreover, agricultural producers are exempted from paying water fees when they use underground water or water from lakes and rivers, even though they incur costs related to pumping and water-use permits and licenses through a system that is not always transparent. Producers who use centrally supplied water must pay for it, as do the household producers that are connected to the communal water pipelines.

The water cost for retailers and milk aggregators is less than 0.01 percent, thus negligible. Otherwise, for the processors, the cost of water is more significant, varying from 0.3 percent to 1.3 percent.

**Figure 50: Share of water costs in the total costs of production for selected dairy products, 2014**

![Chart showing share of water costs in total costs for selected dairy products]

*Source: AMPU based on interviews with participants of the value chain, retail and wholesale price monitoring.*

As Figure 50 shows, the highest rate of water costs in the total costs of production are found in the production of pasteurized milk procured from household farms and is estimated at around 1.3 percent of the total costs. While the actual total costs of water are the same independently from the source of water, the share of water costs in the value chain based on household produced milk is always higher due to the lower total costs of raw milk.
Table 9: Amount of water used per UAH 1 of profit and UAH 1 of value added for various dairy products, 2014

<table>
<thead>
<tr>
<th>Litres of water per UAH 1 of profit</th>
<th>Pasteurized milk</th>
<th>Butter</th>
<th>SMP</th>
<th>Cheese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail</td>
<td>0.12</td>
<td>0.00</td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>Processor</td>
<td>35.17</td>
<td>1.70</td>
<td>0.45</td>
<td>4.07</td>
</tr>
<tr>
<td>Farmer</td>
<td>58.30</td>
<td>87.45</td>
<td>58.30</td>
<td>58.30</td>
</tr>
<tr>
<td>Total</td>
<td>93.59</td>
<td>89.15</td>
<td>58.75</td>
<td>62.37</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water per UAH 1 of value added</th>
<th>Pasteurized milk</th>
<th>Butter</th>
<th>SMP</th>
<th>Cheese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail</td>
<td>0.09</td>
<td>0.003</td>
<td></td>
<td>0.003</td>
</tr>
<tr>
<td>Processor</td>
<td>0.63</td>
<td>1.35</td>
<td>0.59</td>
<td>0.40</td>
</tr>
<tr>
<td>Farmer</td>
<td>7.95</td>
<td>8.33</td>
<td>7.95</td>
<td>7.95</td>
</tr>
<tr>
<td>Total</td>
<td>8.67</td>
<td>9.69</td>
<td>8.54</td>
<td>8.36</td>
</tr>
</tbody>
</table>

Source: AMPU based on interviews with participants of the value chain, retail and wholesale price monitoring.

In the water to UAH profit ratio, the most efficient value chain appears to be the cheese chain, requiring the least amount of water. In other words, it gives the highest amount of returns per litre of water used in the value chain. Nevertheless, more value would be added per litre of milk used, if higher quality raw material were procured from commercial farms.

Water efficiency improvement options

According to our assessment, the Ukrainian producers, consolidators, processors, distributors and retailers involved in the dairy chain used around 400 million m³ of water in 2013, including the irrigation water used for the feed crops and excluding green water and water used for animal drinking while on the pastures.

Furthermore, 59 percent or 254 million m³ of this water was supposedly used for crop irrigation, although less than 3 percent of feed crops were irrigated. Another 29 percent of water or 126 million m³ was used for cow drinking and only 11 percent during dairy processing. All other segments of the value chain – distribution, consolidation and the retail of milk and dairy products – used the remaining 1 percent of water.
Lately, with the increased production of milk, water withdrawal for the production of dairy products has also increased. However, increased milk productivity has somehow partially compensated this increase.

An additional element of the analysis looked into the trade balance of dairy products by linking it with the amount of water required to produce these products. In 2013, Ukraine exported around 25 million m³ of water, with dairy products down from 38 million m³ in 2007. However, it also imported water and thus, as the exports of water with dairy products exceeded imports by about 5.7 million m³, there was a significant decrease over 2007, when the balance was estimated at 30.6 million m³.
Today the bulk of the milk produced in Ukraine is produced at the household level and does not go through commercial processing. The analysis shows that water efficiency is higher at farms with higher milk productivity, i.e. at the commercial farms.

By assuming commercial farms (that milk 9 000 kg of milk per head per year) produced all of the milk, the overall water efficiency at the system level would also be significantly increased and valued.

Reducing water consumption at the processing level is possible. The best performing companies currently use one-quarter of the Ukrainian average water indicator per kg of milk. Therefore, 14 million m$^3$ of water could be saved.
Ukraine’s water economy is not adequately considered, if not disregarded completely. The matter appears to be an issue for the future and not for today. Currently, the total renewable surface water resources are somewhat abundant. The sector that is the most dependent on their withdrawal is the Agriculture sector, which in irrigation terms is still underdeveloped. It will take time and investment until agricultural water saving issues gain priority attention. Other production technologies such as Conservation Agriculture/No till, might be more rewarding and less expensive in the short-to-medium term.

On the contrary, groundwater is a more limited renewable resource. While for the entire industrial sector, the surface-groundwater withdrawal ratio is about 60:40, for the food industry segment of the country, this ratio is exactly inverted at 40:60.

The food industry in general and the dairy industry in particular, are acknowledged sectors of economic and social importance as has been confirmed by this analysis.

The dairy industry is the prime groundwater user within Ukraine’s food industry. It withdraws about 26 percent of all the food industry’s water-use, which alone would already be a sufficient reason to intervene to improve the water-use efficiency of this subsector. Simultaneously, water fees are increasing, but such explicitly water-related costs have yet a small influence on the overall costs of production. However, there are hidden, water-related costs – i.e. for pumping water, accounted as energy-related costs – which are insufficiently considered. These are also growing and are perhaps becoming even more important. Should the costs be specifically and carefully analyzed, they would likely provide a much grimmer picture of the real situation. By and large there are increasing reasons to consider water as a key area for priority attention in order to improve the competitiveness of the subsector.

However, there are also a number of crucial issues that are affecting the dairy sector while it is facing the challenges of a delicate transition – once again only twenty years – from a household-centered system to one that is becoming more commercially oriented. This is also a time when the comparative advantages and the competiveness of the dairy sector are threatened by several market and trade issues.

As shown by this assessment, a major issue for Ukraine is that a large portion of the milk that enters the dairy products’ value chain is of a low quality. The
challenge is one of a country that aims at diversified marketplaces and at increasing trade slots for its dairy products, including fluid pasteurized milk, in a business framework that is rapidly changing and over-demanding of high quality and high standard food products.

Major investments and organizational changes are urgently required to move towards a modern dairy sector that will also pursue improved water efficiency. From the analysis, few areas along the value chain that require urgent attention have emerged and can be summarized with the following needs:

Production level

• support the diverse categories of commercial dairy farms in speeding up their modernization process in terms of productivity and sustainable competitiveness;
• provide investment facilitation to increase productivity and product quality at the household level, involving as many as possible in a commercial upgrading process, with a strategy to gradually phase out the production of cheap, low-quality milk, while improving food safety standards at rural market places;

Intermediary/processing levels

• support upscaling, including improved and equitably inclusive organizational changes, of the dairy chain intermediaries;
• back and boost the processors’ modernization investments and system efficiency upgrading;

Water/energy specific (cross-cutting)

• assess the scope, following a site-specific discrete approach, to improve the surface versus groundwater utilization ratio within the food (and dairy) industry;
• optimize sustainable water-use and increase water management efficiency, including related energy costs;
• invest in adequate water reuse options, waste water management, water treatment and water pollution reduction and
• adopt water pricing policies.
Annex 1 – Relevant features of Ukraine

**Agricultural land**

The territory of Ukraine is 60.4 million ha. The cultivable area is estimated at 44.8 million ha or 74 percent of the total area of the country. As of 2012, the total actual agricultural area reached 41.5 million ha, of which 32.5 million ha was arable land, 2.4 million ha hayfields and 5.5 million ha pastures. About 74 percent (30.8 million ha) of this land is private, the remaining is state-owned or communal. About 8 percent (2.6 million ha) of the agricultural area has been developed for irrigation. Close to 80 percent of this area is served by pressurized sprinkler irrigation. Most of the irrigated area is concentrated in the southern part of the country.

Ukraine went through a rapid, agricultural land structure transformation in the 1990s, when the land area of collective farms was distributed between the collective farm workers and the rural people. Depending on the available land, each worker received a certificate for a “land share” of 4–8 ha in an unspecified location. Some 6.92 million citizens of Ukraine received these certificates. By 2013, 96.7 percent of them converted the land share certificates into legally valid land deeds and thus became owners of land plots with specified locations. There is a moratorium on buy-and-sell transactions on agricultural land in Ukraine until 2016. Agricultural producers operate predominantly on leased agricultural land, i.e. 84.5 percent (17.4 million ha) of the cultivated agricultural land. The current owners of “land shares” are mainly retired citizens whose children have typically moved away to work in urban areas. Land is now typically leased for 4–10 years, with a maximum period of 49 years. The majority of land rental rates ranged from USD 25/ha to USD 75/ha in 2012, however a high proportion of rental payments is made in-kind. The government set the minimum rental value at 3 percent the normative value of land, which is now about USD 2 600/ha, on average. This represents the floor price for rental agreements.

**Agro-ecologies**

Ukraine is situated southwest of the Eastern-European plain. Ukraine is bordered on the west and southwest by Poland, Slovakia, Hungary, Moldova and Romania, on the North by Belarus, on the East by Russia, and on the south, it is surrounded by the Sea of Azov and the Black Sea. The area of Ukraine is 603.7 km² and has a population of 45.5 million as of 1 August 2013, according to SSSU data.

The potential for agricultural production is rather evenly spread throughout the country, with two distinguishable areas: the western region characterized
by a moderate climate and the southern region with fertile, black soils where irrigation plays an important role. The Chernobyl nuclear accident contaminated about 4.1 million ha. A strict radiological control has been applied over a larger zone, covering an additional 1 288 settlements. Due to the prevailing winds, most of the radioactivity fell on Belarus.

The geomorphology and the soils in Ukraine are very varied due to the vast territory and climate. Three large natural zones and two mountain regions can be distinguished: a mixed forest zone in the north (19 percent of the total land) a forest-steppe zone to the south (35 percent), a steppe zone in the south and southeast (40 percent) and the Carpathians and Crimean mountains occupy respectively the west and the very southern part of the country. Forest (Polissya), Forest-steppe and the Steppe zone represent the three major agro-ecological zones of Ukraine.

The country has a well-integrated network of over 22 000 rivers; the Dnieper is the major river, having a basin that covers 40 percent of Ukraine, crossing the country from north to south and flowing into the Black sea.

Map A1: Ukraine ecoregions

Overall, Ukraine shows a temperate-continental climate, except the southern Crimean belt that has subtropical climate features. Climate characteristics, however, vary considerably according to the zone: specifically, 13 natural and climatic zones can be distinguished, four of which are related to the three major agro-ecological areas (see Table A1).

### Table A1: Hydrothermal values of the major agro-ecological zones

<table>
<thead>
<tr>
<th>Natural climatic zone</th>
<th>April–July Prec. mm</th>
<th>HTC$^{16}$</th>
<th>August–September Prec. mm</th>
<th>HTC</th>
<th>October–March Prec. mm</th>
<th>January Temp. °C</th>
<th>Year Prec. mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest zone</td>
<td>200–270</td>
<td>1.08–1.50</td>
<td>100–140</td>
<td>1.03–1.50</td>
<td>150–180</td>
<td>-7.9/-4.5</td>
<td>500–630</td>
</tr>
<tr>
<td>Forest-steppe zone</td>
<td>190–340</td>
<td>1.00–1.90</td>
<td>75–160</td>
<td>0.75–1.70</td>
<td>130–220</td>
<td>-7.9/-3.8</td>
<td>450–760</td>
</tr>
<tr>
<td>Northern and southern Steppe zone</td>
<td>145–210</td>
<td>0.67–1.00</td>
<td>60–90</td>
<td>0.42–0.81</td>
<td>120–210</td>
<td>-7.9/-0.7</td>
<td>370–520</td>
</tr>
<tr>
<td>Dry Steppe</td>
<td>100–145</td>
<td>0.47–0.70</td>
<td>50–60</td>
<td>0.40–0.50</td>
<td>120–140</td>
<td>-4.4/-2.0</td>
<td>310–390</td>
</tr>
</tbody>
</table>


As shown in Table A1, the amount of precipitation decreases progressively from the Forest zone to the Steppe zone, shifting from 500–600 mm to less than 400 mm of average annual precipitations respectively (see Table A1). Thus, the Steppe shows the most continental and dry macroclimate of the territory with the least relative air humidity, which leads to frequent incidences of drought and dry winds. Due to the consequent unfavourable natural soil moisture, irrigation is diffused in a wide portion of the steppe agro-zone (mostly in the southern Steppe) (see Table A2).

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$^{16}$ The Hydrothermal Coefficient (HTC) index is determined by dividing the sum precipitation for the period with the average day air temperature above 10 °C and the sum of temperatures in the very same period (\(\sum p / 0.1 \sum T\)). HTC values below 0.7 are considered to characterize droughts, while values from 0.7 to 1 characterize moderately dry summers.
Map A2: Sum of effective air temperatures above 10 ° C (1986–2012), progressively higher from Forest zone to Steppe zone in relation to the different macroclimates

**Table A2: Amount of irrigated area in the Forest-steppe and Steppe considering climate characteristics**

<table>
<thead>
<tr>
<th>Agro-zone</th>
<th>Irrigated area (thousand ha)</th>
<th>Soil type</th>
<th>Duration of warm period</th>
<th>Evapotranspiration</th>
<th>Water deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest-Steppe</td>
<td>460</td>
<td>Heavy clay Chernozem</td>
<td>150–160</td>
<td>450–650</td>
<td>150–200</td>
</tr>
<tr>
<td>Northern Steppe</td>
<td>800</td>
<td>Typical Chernozem</td>
<td>165–170</td>
<td>550–650</td>
<td>250–300</td>
</tr>
<tr>
<td>Southern Steppe</td>
<td>1 200</td>
<td>Southern Chernozem</td>
<td>185–200</td>
<td>600–700</td>
<td>300–450</td>
</tr>
</tbody>
</table>


Focusing on the three major agro-ecological zones, the Forest occupies 13.5 percent of the total agricultural land, while the Forest-steppe and Steppe 40.6 percent and 45.8 percent respectively; territorial differences in climatic conditions have an influence on the zonal specialization of agriculture.
The Forest (Polissya) is the least cultivated part of the country, characterized by the presence of many hayfields and pastures; conditions are favourable for many cereals, pulse crops, potatoes, flax and forage crops. Additionally, beef-dairy cattle raising is traditionally developed. Potatoes are used for food and pig fattening, especially on private holdings.

The Forest-Steppe shows a higher amount of cropped land than the Forest. Winter wheat, sunflower, sugar beet, corn, barley and peas are the main cultivated crops; in the northern and northwestern part, perennial grasses are more diffused due to a higher level of soil moisture.

The Steppe’s crop scenario presents mostly winter wheat and sunflower, followed by maize; in the southern Steppe, the driest zone, viticulture has also been developed. Accordingly Forest-steppe and Steppe are the key production zones for winter wheat (mainly the milling quality type), maize and sunflowers as industrial crops.

Map A3: Amount of sown area per region for different type of crops, 2011

Source: Own elaboration based on SSSU 2011 data.
Rivers

The country can be divided into the following seven major river basins, all of them discharging into the Black Sea except the Northern Bug, which flows towards the Baltic Sea:

(i) The Dnepr basin, covers about 65 percent of the country. The Dnepr River rises in the Russian Federation and then flows into Belarus before entering Ukraine. Its main affluents in Ukraine are the following: on the left bank, the Desna River, which rises in the Russian Federation; and on its right bank, the Pripyat River, which comes from Belarus and the Ingulets river.

(ii) The Dnestr basin, covers 12 percent of the country, which flows into Moldova before re-entering Ukraine some 50 km before its mouth in the Black Sea.

(iii) The Danube basin, covers 7 percent of the country. The final 120 km of the Danube River, before it reaches the Black Sea, form the border between Ukraine and Romania. The Danube is the river with the largest number of riparian countries in the world. Some affluents of the Danube rise in Ukraine in the Carpathian mountains and flow into neighbouring countries, joining the mainstream of the Danube before its mouth in the Black Sea. In particular, the Cisa River flows out of Ukraine into Hungary, while the Prut River flows into Romania and Moldova. Ukraine contributes 7.5 percent to the total flow of the Danube.

(iv) The coastal basin, covers 7 percent of the country. It groups all of the small rivers, which flow directly into the Sea of Azov and the Black Sea, including all of the Crimean rivers.

(v) The Northern Donietsk basin, covers 4 percent of the country. It rises in the Russian Federation and flows through Ukraine for about 450 km in its eastern part before re-entering the Russian Federation.

(vi) The Southern Bug basin, covers 3 percent of the country. It is an internal river basin, generating about 3.4 km³/year.

(vii) The Northern Bug basin, covers 2 percent of the country. The Northern Bug River rises in Ukraine and flows north, forming the border with Poland and then the border between Poland and Belarus. Like the Northern Bug, the San River rises in Ukraine before entering Poland where it joins the Northern Bug.

Lakes and dams

Ukraine has about 3 000 natural lakes, with a total area of 2 000 km². The largest freshwater lakes have an approximate area of 50 km² and are located in the central and southern parts of the country. In addition, there are about 12 000 km² of swamp area in the north.

About 22 000 dams have been constructed in Ukraine for flow regulation, hydropower, irrigation and fishery purposes. The largest ones, with a total
capacity of 18.5 km³ and a total surface water area of 6 888 km², are located on the Dnepr: the Krementshutskie (2 252 km²), the Kachowskie (2 155 km²), the Kiivskie (922 km²), the Dnieprodierzhinskie (567 km²), the Zaporoskie (410 km²) and the Kaniowskie (582 km²). They are used for hydropower production for supplying electricity to the main cities and industrial centres, for flood protection and for storing irrigation water. The gross theoretical hydropower potential is estimated at 45 000 GWh/year, about 40 percent of which would be economically feasible. The hydropower installed capacity is estimated at 4.5 GW, generating 9 percent of the total electricity production.

In 1992, the total water withdrawal was estimated at 26 km³, of which 30 percent for agricultural purposes and 52 percent for industry. A further 0.9 km³/year were reported to be withdrawn for other purposes.

**Irrigation development in Ukraine**

Irrigation in Ukraine has a long tradition, particularly in Crimea, where it dates back to the early centuries of the modern era. Major irrigation development also took place in the Middle Ages during the Tatar Empire (thirteenth and fourteenth centuries) and again in the nineteenth century, when it expanded from Crimea to the steppes in the south of the country. Large irrigation schemes were built in the 1930s in eastern Soviet Ukraine, as part of the ‘electrification of the socialist state’ project. In 1967, the area equipped for irrigation was estimated at 667 000 ha.

The irrigation potential has been estimated at 5.5 million ha. The most suitable areas for irrigation development, from a technical and economic point of view, are: the coastal plain along the Black Sea coast between Odessa and the Danube Delta; the area between Odessa and the Southern Bug valley; central Crimea and the coastal areas along the Sea of Azov.

In 1994, irrigation covered about 2.6 million ha. The reservoirs built on the main rivers, and particularly on the Dnepr River, provide water to the irrigated areas downstream through canals up to 500 km long. These canals also provide water to cities and industrial complexes in Crimea and in the far southwest of the country. The main irrigation canals in Ukraine are the following: the north Crimean (400 km), the Kachowski (130 km), the Frunzenski (120 km), the Krasnoznamenski (102 km) and the north Rohaczinski (110 km), which are all in the same area.

However, by 2003 (and still accounted for in 2007) the actual irrigated area dropped to only 0.73 million ha. Nevertheless, statistics report (to date) more than 2 million ha equipped as functional for irrigation. This means that close to 1.5 million ha of land, where an irrigation system is installed, uses no water for irrigation.
The ownership or management status of the irrigated agricultural area in Ukraine according to official statistics and broken down by commercial and non-commercial users is provided in Figure A1.

**Figure A1: Area of irrigated agricultural land in Ukraine, 1990–2012**

Source: SSSU and Authors’ own elaboration.

It is interesting to note that commercial farms have continued to decrease irrigated areas, while non-commercial household farms manage more irrigated land. On the other hand, households, which usually have from 0.1 ha to 1.0 ha of land, use irrigated land more actively. According to official statistics, households accounted for about 30 percent of the total irrigated area in Ukraine in 2012, which grew from about 12 percent in 2000. They also accounted for a large share of sales of the fruits and vegetables produced in Ukraine.

Official statistics have not noted much of a change in the area of irrigated land. In the past five years, the irrigated area declined by 0.5 percent, with the sharpest decrease noted in pastures and grasslands. On average, throughout the years, 97 percent of irrigated land has been made of arable cropland. As of 2012, about 5.2 percent of the agricultural land of Ukraine has been irrigated.
Table A3: Area of irrigated agricultural land by category

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Arable (thousand ha)</td>
<td>2113.40</td>
<td>2112.80</td>
<td>2112.90</td>
<td>2112.40</td>
<td>2110.90</td>
<td>2107.20</td>
<td>-0.3%</td>
</tr>
<tr>
<td>Orchards (thousand ha)</td>
<td>51.20</td>
<td>50.20</td>
<td>50.20</td>
<td>50.20</td>
<td>49.90</td>
<td>49.20</td>
<td>-3.9%</td>
</tr>
<tr>
<td>Pastures and grasslands (thousand ha)</td>
<td>9.90</td>
<td>9.30</td>
<td>9.30</td>
<td>9.20</td>
<td>9.20</td>
<td>9.10</td>
<td>-8.1%</td>
</tr>
<tr>
<td>Others (thousand ha)</td>
<td>6.10</td>
<td>6.60</td>
<td>6.00</td>
<td>6.10</td>
<td>6.30</td>
<td>4.40</td>
<td>-27.9%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2180.60</td>
<td>2178.90</td>
<td>2178.40</td>
<td>2177.90</td>
<td>2176.30</td>
<td>2169.90</td>
<td>-0.5%</td>
</tr>
</tbody>
</table>

Source: SSSU and Authors’ own elaboration.

Statistics indicate that 20 percent of all irrigated land is located in Kherson and 18 percent in Crimea. These two regions, with Zaporizhzhia and Odessa, account for 58 percent of all irrigated land in Ukraine. Other leading regions in terms of area of irrigated land are also located in the south of Ukraine where the deficit of moisture is most significant. On the other hand, there is basically no irrigation in the northwestern and northern parts of Ukraine.

Figure A2: Structure of irrigated agricultural land in Ukraine by regions

Source: SSSU and own elaboration.

Kherson had the highest percentage of agricultural land under irrigation compared with all other Ukrainian regions. In 2012, 24.4 percent of all lands in this region was irrigated. The Republic of Crimea was the second largest with 13.1 percent of agricultural land under irrigation.
From 2003 and onwards, the private sector of Ukraine has been heavily involved in upgrading irrigation systems. Fruit and vegetable producers have invested actively into drip irrigation systems.17

Secondly, large farms in the southern regions of Ukraine discovered the benefits of irrigation and invested in new irrigation equipment. This has specifically affected the production of maize in Ukraine, a significant share of which is now produced on irrigated lands. Other field crops, which are sometimes irrigated, include soybeans and sunflower seeds.

When we look at official data on the response of various crops to irrigation in 2012, we see that a major response is noted in production of fruits, vegetables and melons. Ukrainian farmers growing fruits and berries on irrigated land received 3.5 times more yield from each ha of land than those that produced the same crops on non-irrigated lands. Vegetable growers obtained 2.5 times higher yields and melon growers 67 percent higher yields. Low or negative response to irrigation was noted for wheat, potatoes, sunflower and sugar beets.

**Table A4: Comparison of yields in Ukraine on irrigated and non-irrigated lands, 2012**

<table>
<thead>
<tr>
<th>Products</th>
<th>Non-irrigated</th>
<th>Irrigated</th>
<th>Difference, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruits &amp; berries (tonnes/ha)</td>
<td>3.94</td>
<td>13.92</td>
<td>253%</td>
</tr>
<tr>
<td>Vegetables (tonnes/ha)</td>
<td>15.8</td>
<td>40.03</td>
<td>153%</td>
</tr>
<tr>
<td>Melons &amp; watermelons (tonnes/ha)</td>
<td>5.98</td>
<td>9.98</td>
<td>67%</td>
</tr>
<tr>
<td>Soybeans (tonnes/ha)</td>
<td>1.63</td>
<td>2.61</td>
<td>60%</td>
</tr>
<tr>
<td>Grapes (tonnes/ha)</td>
<td>5.12</td>
<td>6.47</td>
<td>26%</td>
</tr>
<tr>
<td>Barley (tonnes/ha)</td>
<td>2.16</td>
<td>2.55</td>
<td>18%</td>
</tr>
<tr>
<td>Maize (tonnes/ha)</td>
<td>5.15</td>
<td>5.52</td>
<td>7%</td>
</tr>
<tr>
<td>Sugarbeets (tonnes/ha)</td>
<td>42.06</td>
<td>43.32</td>
<td>3%</td>
</tr>
<tr>
<td>Sunflower (tonnes/ha)</td>
<td>1.74</td>
<td>1.73</td>
<td>-1%</td>
</tr>
<tr>
<td>Potatoes (tonnes/ha)</td>
<td>19.49</td>
<td>17.91</td>
<td>-8%</td>
</tr>
<tr>
<td>Wheat (tonnes/ha)</td>
<td>2.88</td>
<td>2.56</td>
<td>-11%</td>
</tr>
</tbody>
</table>

*Source: SSSU.*

17 According to estimates of Fruit-Inform analysts, there are about 80,000 ha of fruits and vegetables under drip irrigation in Ukraine as of 2012.
Official statistics include information from both commercial farms and household farms, which significantly dilutes the picture of actual average yields. The interviews we performed on companies involved in production showed that the response to irrigation on commercial farms was much better and all crops responded positively.

In the case of fruit, farmers were able to triple their yields on irrigation assuming they also used other elements of modern technologies. In the case of vegetables, farmers could receive up to five times as much produce from each hectare of irrigated land than from the same area without irrigation.

Statistics show negative response to irrigation in the case of potatoes because most of the irrigated potatoes grown in Ukraine are early varieties. Early varieties always have lower yields and are difficult to grow without irrigation as they are produced exclusively in the southern regions of Ukraine. In reality, irrigated, late varieties of potatoes could yield 60–80 percent better than non-irrigated ones.

Farmers also noted much better maize response with irrigation, which in the case of official statistics was only 7 percent. In reality, the farmers interviewed said that the highest yield without irrigation was usually close to 70 tonnes/ha, while with irrigation it could reach 130 tonnes and even more.

This is partly confirmed by official statistics reporting the change in the irrigated area under various crops (see Figure A3) in 2005 compared with 2007.

**Figure A3: Change of irrigated areas under selected crops in 2012 compared with 2007**

![Figure A3: Change of irrigated areas under selected crops in 2012 compared with 2007](image)

*Source: SSSU.*
The area under irrigated maize rose by 73 percent, which suggests that the response of this crop to irrigation was rather good. Among other crops with higher irrigated areas were potatoes, soybeans, sunflowers and vegetables. Areas under irrigated wheat, barley and fodder crops have in the meanwhile declined, suggesting worsening irrigation economics for these crops compared with other competing crops.

**Water management on irrigated land**

According to the Ukrainian law “On Land Reclamation” (2000), engineering infrastructures of irrigation systems (networks with hydro-technical constructions and pumping stations, dams protection, observation networks and roads) can be owned by the State, rural or city communities as well as by juridical persons or inhabitants. The State Committee on Water Management controls and regulates the work of enterprises, institutions and organizations, which are included in the operation and maintenance of engineering infrastructures of irrigation and drainage systems.

Today, the main and secondary irrigation infrastructures are owned by the State alone. The on-farm irrigation infrastructures have now been transferred to collective or communal ownership (villages, towns) or are owned by citizens, taking into account the restrictions set by the current legislation of Ukraine.

The Water Code of Ukraine, adopted in 1995, regulates that water management and special water-use, including for irrigation purposes, be carried out on the basis of permission given by the State authorities of environmental control. Permission is given after consumers apply by specifying their water needs, which must be confirmed by state authorities of water management in the case of surface water-use or by state bodies of geology in the case of groundwater-use.

The limit for water intake is fixed in permissions on special water-use, as is the limit of water-use and water discharge containing polluting substances. In the case of water shortage, state authorities could reduce these limits. Special water-use has to be paid.

Water management transformation is still a big challenge today. Solving this problem is a very difficult task as socio-political and economical transformations are taking place faster than water management transformation. The institutions involved in irrigation management have not changed a lot to be more market orientated (except reducing staff and decreasing irrigation management activities). The institutional set-up is the same as it was in the Soviet time. The operations of the main canal and inter-farm irrigation systems are carried out by state organizations, namely by District Irrigation Management Departments, which are operational divisions of the Regional Water Management Departments. District departments have a corresponding repair and engineering
base and are financed, mainly, from the state budget and are at the expense of off-budget returns from self-sustained activities and chargeable services rendering.

The water supply for irrigation is centralized. Main canals and irrigation system management render water delivery services to industrial and municipal enterprises, as well as for irrigated lands. They are responsible for the maintenance, reconstruction and modernization of only main and inter-farm engineering infrastructure owned by the state.

Water consumers are represented by various agricultural enterprises. Today, a standard agreement is in force in the branch that regulates the relationships between irrigation systems management and water-consumers, determines agreed prices for services on delivery and withdrawal of water and sanctions for: water excess expenditure, untimely payment for services, exceeding water-provisions and water withdrawal rates.

The current policy of the government and water authorities at all levels can be described as “[maintaining] and [preserving] the traditional way of irrigated agriculture”, with the main objective of preserving the integrity of the large-scale infrastructure of farms, fields and irrigation systems. The State Committee of Water Management of Ukraine (SCWM) coordinates communication through bureaucratic directives and authorizations and has centralized top-down bureaucratic control over decision-making.

In 2005, farmers paid a relatively small part of the cost for irrigation services: (16 percent on the district level and 5 percent on the national level) and the government is heavily subsidizing the water sector. However, the situation has been rapidly changing in recent years due to budget difficulties. Currently, most of the users have to pay almost full fee for the use of water. According to official statistics, fees for water-use have increased ten-fold and more in 2012, when compared with 2007.

Thus, it is not surprising that official statistics have noted a decrease in the amount of irrigated area, while farmers report increasing the irrigation area. While working on this report we have talked to several farms that pay nothing for the use of surface and/or ground water and don’t report these areas to statistics.

The government of Ukraine has recently declared plans to reclaim around 1 million ha of land in the south of Ukraine into an irrigated area. However, these ambitious plans would be difficult to finance assuming current budget problems.
The following interventions have to be made to implement irrigation management transfer and reduce costs to the government. These interventions can be found in:

- the creation of Water Users Associations (WUAs), to whom the ownership of on-farm irrigation and drainage systems should be transferred, so that those who benefit from it will also maintain and operate it and bear the costs;
- restructuring the District Irrigation Management Departments to reduce public sector costs and reorganize them around “Integrated Water Resource Management” structures;
- a proper adaptation of the irrigation system so as to make it functional for the new users; and
- a scaling down of subsidies.

In order to implement the proposed changes, a clear policy has to be formulated, followed by an enabling legislation.

**Drainage development**

The first drainage works were introduced at the end of the eighteenth century in northwest Ukraine and then in part of Poland. At that time, major canals were built, mainly for communication and transport purposes, and the swamps were drained for cultivation. Drainage development has continued in the nineteenth and twentieth centuries.

Recent studies have identified some 5.4 million ha that require drainage. In 1994, the drained area was estimated at 3.3 million ha, of which 63 percent was equipped with subsurface drains, mainly pipes. About 1.8 million ha of irrigated land are equipped with drainage facilities to prevent salinization. In these areas, the underground water level is kept between 1.5 and 3.0 m below the soil surface.

About 80–95 percent of the drained area is cropped every year. In 1990, the main crops on drained areas were permanent meadows (38 percent), cereals (27 percent) and fodder crops (26 percent).

Drainage is mainly concentrated in the north and west of the country. In 1984, the drained area in Ukraine amounted to almost 3 million ha, of which 53 percent was in the four most northwestern districts. A further 20 000–30 000 ha have been equipped for drainage since 1984, mainly with subsurface drainage.
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