LIFE Integrated Projects 2016

Optimising the implementation of the 2nd RBMP in the Malta River Basin District

LIFE 16 IPE MT 008

Action D.2:

Assessment of the Socio-Economic Impact of the LIFE 16 IPE MT 008 Project:

Second Results of the Impact Monitoring Strategy and Overview of LIFE RBMP Complementary Actions

SECOND RESULTS OF THE IMPACT MONITORING STRATEGY AND OVERVIEW OF LIFE RBMP COMPLEMENTARY ACTIONS

ARQ Economic & Business Intelligence

List of Actions

Action	Details
A1	Assessment of the sectoral water demand in Malta and Gozo
A2	Market research on water demand management technologies
A3	Mapping of related EU research projects
A4	Stakeholder assessment and perception survey
A5	Mapping of industrial polluting activities
A6	Development of a monitoring strategy for contaminants of emerging concern
A7	Development of a hydrographic model for Malta's marine waters
A8	Catchment modelling
A9	Groundwater modelling
C1	Household water consumption audits
C2	Eco-label Scheme
C3	Remote sensing for agricultural water demand
C4	Water education campaign
C5	Water App/Game
C6	Demonstration site for the application of new water resources – Gozo
C7	Sustainable Urban Drainage Systems (SuDS)
C8	Development of a managed aquifer recharge scheme in Pwales groundwater body
C9	Valley Management Plan
C10	Industrial discharges – enforcement augmentation and sustainability
C11	Exploitation of deep saline aquifers
C12	Heating and cooling installations
C13	Restoration of one of the coastal wetlands
C14	Anchoring and mooring surveys
C15	Impact of reverse osmosis discharges on the marine environment
C16	Hydrographic model simulations for Malta's marine water to quantify and investigate pressures in the marine environment
C17	Multi-stakeholder platform
C18	Monitoring for emerging pollutants of potential concern
C19	Smart Utilities Pilot Project

1.0 Introduction

This report presents the second set of results pertaining to the socioeconomic impact assessment for the LIFE 16 IPE MT 008 project. The report builds on the various deliverables that have been completed so far in relation to this contract, as well as the previous results which focused on the status of the project as at the first quarter of 2020. The first section delves into the contextual environment of the LIFE RBMP project, providing a snapshot of the key water pressures and mitigating factors that are present on the Maltese Islands, with updated data wherever possible, as identified in Deliverable 2 of this contract. The second section provides an update on the individual project activities and their realised as well as potential socio-economic impacts, including job creation, environmental benefits and knowledge transfer.

2.0 Contextual Indicators

In this section we discuss the key socioeconomic indicators that provide the contextual backdrop to the various actions and activities that form part of the LIFE RBMP project, both in terms of pressures and mitigating factors. A table summarising the linkages between the individual project actions and their potential contribution to these socioeconomic indicators is provided in Annex 1.

2.1 Pressures

2.1.1 Population and Demography

Throughout this socioeconomic impact assessment, our research has highlighted demographic factors as a key determinant of water demand. Population growth is a major contributor to water pressures, not only due to the heightened demand for water for domestic use and a potential rise in municipal waste, but also because it often brings with it increased economic activity, urbanisation and development – all of which are a further drain on water resources and a significant challenge for water conservation policy.

2.1.1.1 Population Size

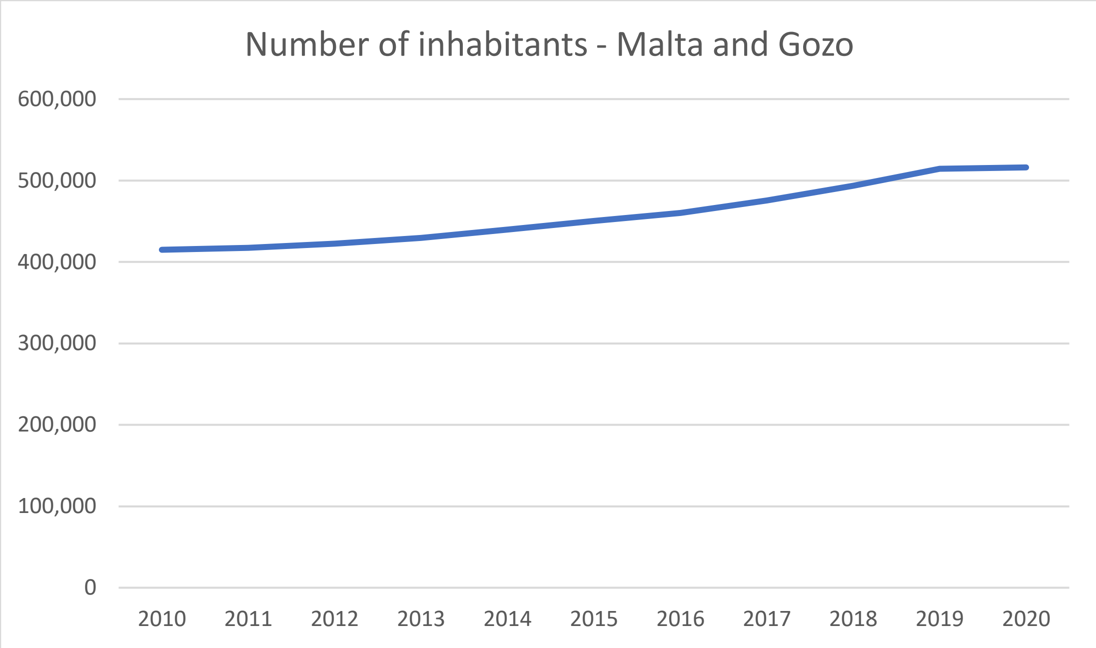

Figure 1: Number of inhabitants – Malta and Gozo (Sources: NSO, 2021)

As seen in Figure 1 above, the population across Malta and Gozo continued to rise in recent years, reaching 516,100 by the end of 2020. Growth levelled off in 2020 due to the onset of COVID-19, which impacted both new arrivals as well as departures of foreign workers. Maintaining this basic population data as part of the monitoring strategy is an essential starting-point for assessing any related impacts on water demand in the coming years.

2.1.1.2 Geographical Distribution of Inhabitants

This indicator provides some insight into regional pressures on water resources. This data is relevant since it identifies regions with a larger population, which may indicate stronger pressures on water resources in those regions. These pressures are mainly the following:

- Higher population density exerts higher water demand in that region or sub-region: this requires adequate infrastructure capacity and has ancillary impacts on water resources and wastewater.
- Population shifts closer to Malta's valleys and wetlands, as well as to coastal areas, impacts the viability of the natural water resources in those areas, with subsequent pressures on the relative ecosystems and habitats; this also applies to population shifts in coastal areas with ensuing impacts on the marine and coastal environment.

Table 1 below captures the total population per region in Malta and Gozo.

Regional Population	2015	2016	2017	2018	2019
Southern Harbour	80,273	80,664	81,582	82,910	85,046
Northern Harbour	138,687	143,773	151,664	160,173	170,220
South Eastern	68,442	69,187	70,490	72,375	74,589
Western	59,683	60,131	60,692	61,689	62,733
Northern	71,405	74,336	78,550	83,024	87,546
Gozo & Comino	31,925	32,206	32,723	33,388	34,430

Table 1: Number of inhabitants by region (Source: Regional Statistics Malta 2021 Edition, NSO)

The above data indicates that the Northern Harbour region is the most highly populated region, followed by the Southern Harbour. In recent years, the highest growth in population has also been experienced within the Northern Harbour region, with population increasing by 22.7% since 2015, a trend which may be partly attributed to the significant expansion of office and commercial space in several of its urban localities. This population increase may therefore reflect migratory movements based on proximity to the workplace. A further factor may be the higher numbers of foreign workers arriving in Malta, with a majority of these opting for accommodation in this region.

The Northern region has also experienced significant growth in recent years, with population increasing by 22.6% since 2015. While the reasons for this increase may be less clear-cut compared to the Northern Harbour localities this shift does require close monitoring, given the region’s long coastline and potential impacts on the coastal and marine environment.

2.1.1.4 Foreign Nationals Resident in Malta for Employment Purposes

Given that the influx of foreign nationals relocating to Malta for employment purposes since 2015 was identified as a significant socioeconomic characteristic in Activity 1, it was determined that the most effective indicator to track this cohort was to quantify this number as a proportion of the total labour force. The resulting data is presented in Figure 2 below. The data covers all foreign nationals authorised for employment in Malta by Jobsplus – this includes those originating from countries within the EU, the EEA and EFTA, as well as Third Country Nationals

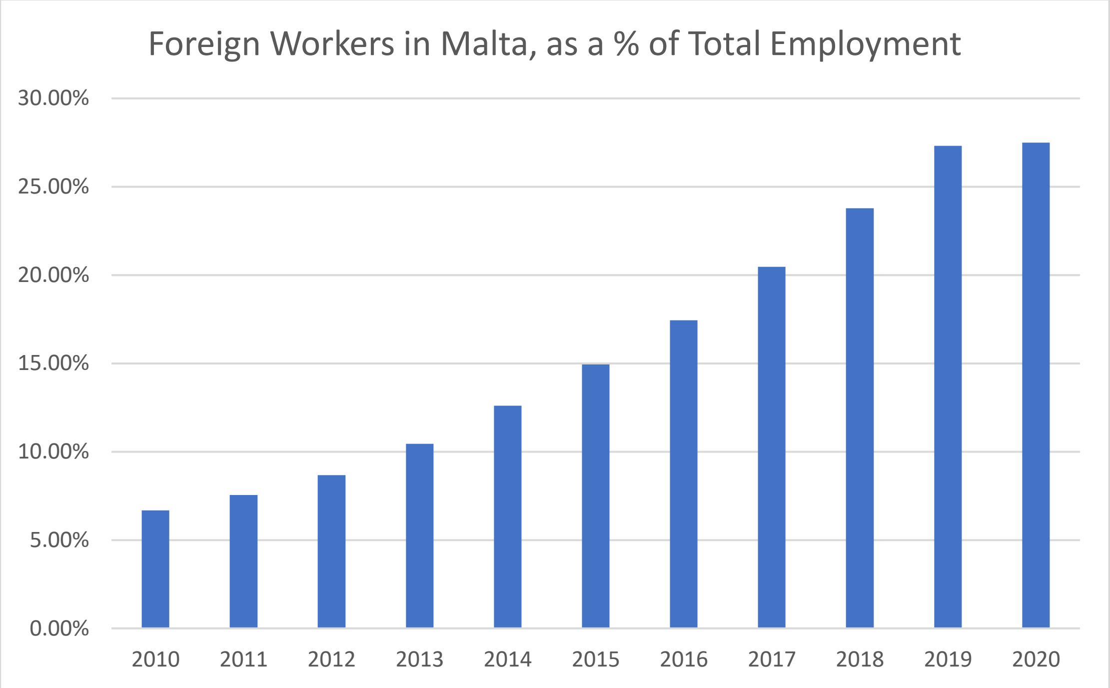

Figure 2: Number of employed foreign nationals as a % of total employment (Source: Jobsplus, NSO)

This data indicates a marked increase in the proportion of employed foreign nationals, rising from 6.7% of total employment in 2010 to 27.5% by 2020. As referenced above, this sharp rise in the number of gainfully employed foreign nationals residing in Malta and Gozo has impacted population growth in the Maltese Islands as well as regional population distribution. Further pressures on water consumption and demand may also be indicated by this trend given that a high proportion of these individuals (relative to the local population) would reside in smaller households, which may point to a higher per capita consumption, and in long-let accommodation where it is less likely that any investment would be made in water-saving appliances.

2.1.1.5 Household Size

Shifts in household size and composition have a direct bearing on water demand and efficiency. As indicated in our initial research on socioeconomic characteristics, data on residential water consumption points to a linkage between the number of persons residing in the household and the daily specific water consumption per capita within that household. Recent data on water consumption patterns in Malta (Energy and Water Agency, 2018) indicates that residential average daily specific water consumption for a single-person household is 110 litres per person, with this estimate dropping to 64 litres per person in households with five or more residents. As amplified in the analysis carried out under Activity 1, these consumption patterns are aligned with those observed in other countries, such as Ireland (Morgenroth, 2014), and may reflect the fact that larger households are more likely to invest in water efficient equipment (Millock & Nauges, 2010).

Therefore, any shifts in Malta's household composition trends are relevant to the monitoring framework.

The average size of households in the EU has been shrinking in recent decades, and based on the most recent Eurostat data, this averaged **2.3 persons in 2020.**

This same EU-wide data reveals that in a number of Member States, such as Sweden, Denmark and Lithuania, over half of all households were composed of a single person, decreasing slightly to 40-45 % in Germany, Finland, Estonia, the Netherlands, France, Latvia and Austria. Malta lags significantly behind this percentage, with only 27.8% of households being occupied by single-persons in 2020. However, it is important to note that this situation appears to be shifting and this may in large part be related to the fact that several of the social factors referred to above are increasingly applicable to Malta. In fact, the number of single-person households in Malta has grown from 25.2% in 2015 to 27.8% in 2020, with two-person households also increasing over this period, while the proportion of larger households has generally declined.

Figures 3 and 4 below illustrate this increasing share of 1-2 person households in Malta between 2015 and 2020.

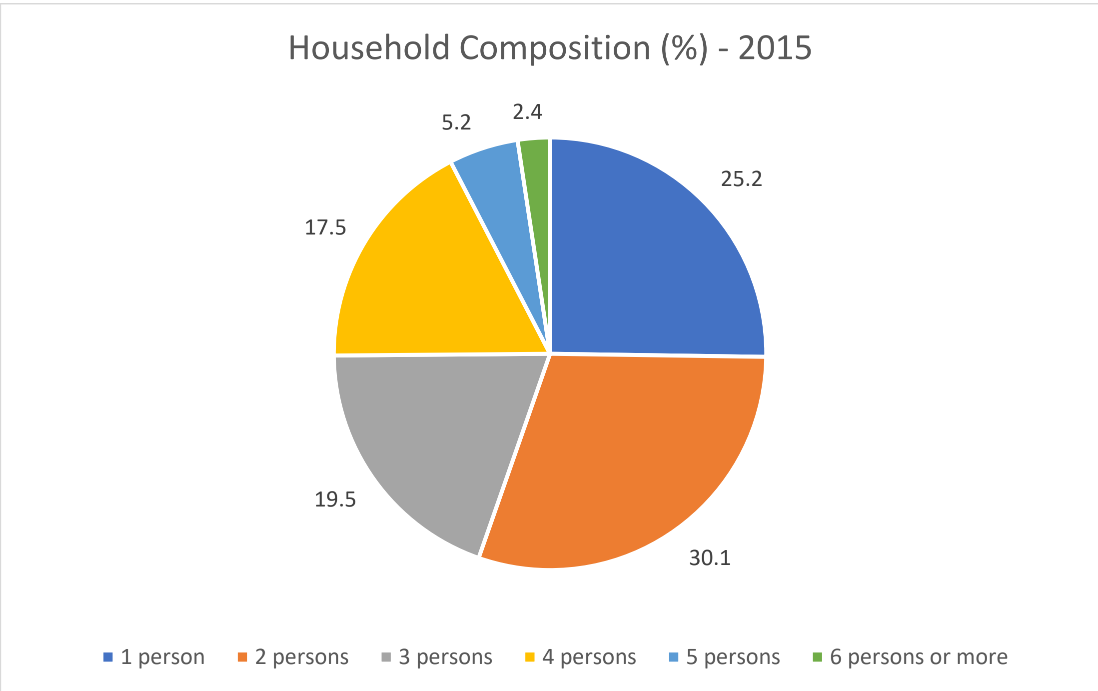

Figure 3: Household size in Malta & Gozo – 2015 (Source: NSO, EU-SILC 2015)

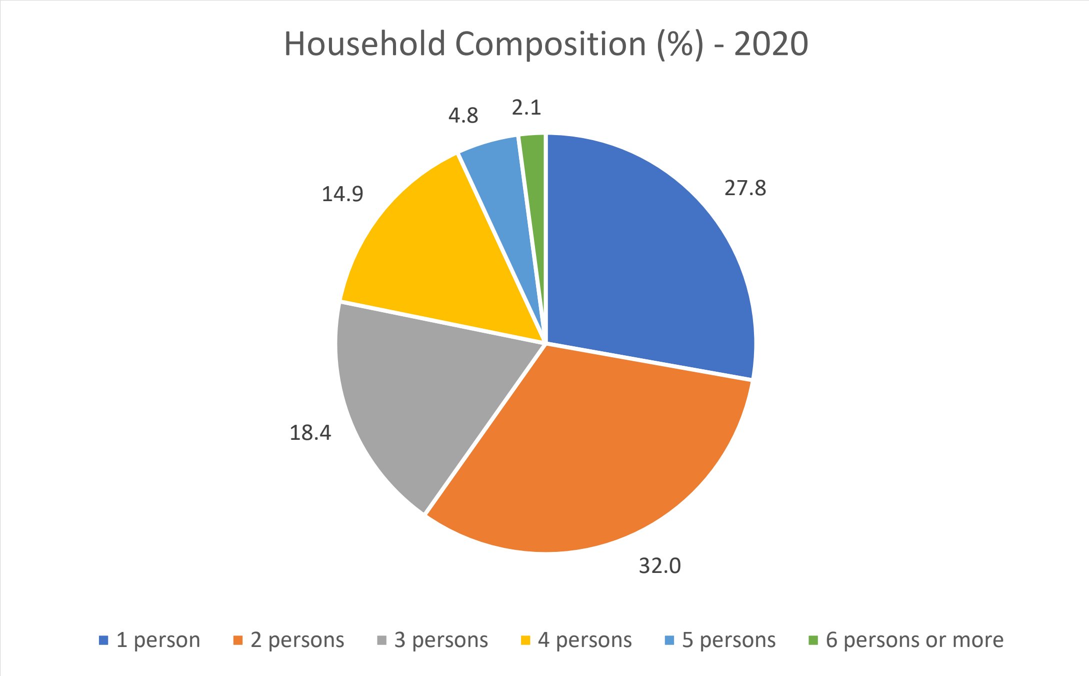

Figure 4: Household size in Malta & Gozo – 2020 (Source: NSO, EU-SILC 2020)

2.1.2 The Economy

The monitoring framework proposed in Activity 2 identifies the following key economic indicators to be reviewed. It is important to note that the COVID-19 pandemic that has afflicted the world for the last two years has had a significant impact on Malta's economic performance within this time period, and therefore these developments must be seen within this context.

2.1.2.1 Real GDP Growth

The monitoring framework includes the tracking of annual changes in real GDP. As seen in Figure 5 below, Malta's economy has grown significantly in recent years, consistently above the EU average, with the exception of 2020 due to the onset of COVID-19. Nonetheless, GDP growth rebounded in 2021 to 9.4%, the third highest growth rate in the EU.

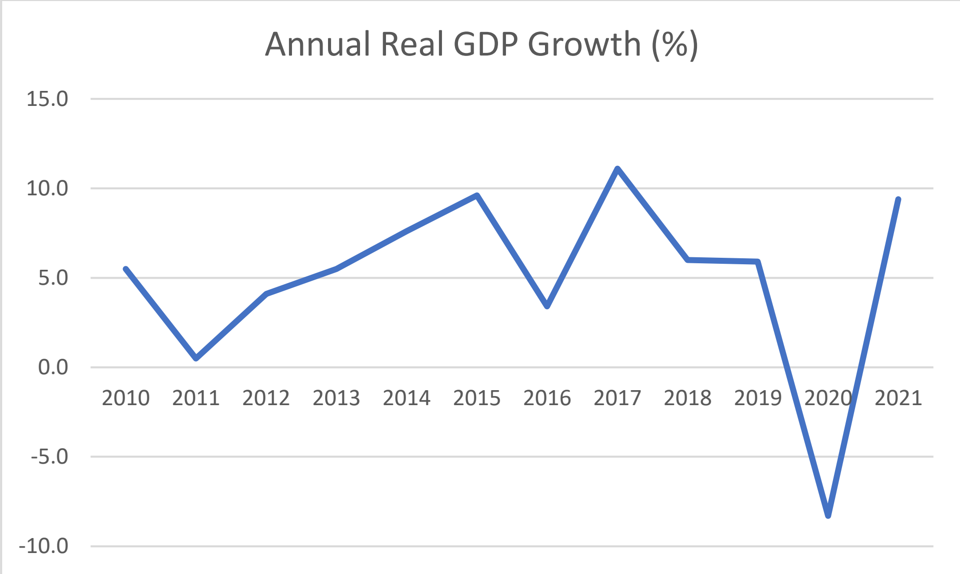

Figure 5: Annual increase in real GDP (Source: NSO)

The indicators below each relate to particular economic sectors that were identified in Activity 1 as being more water-intensive than others.

2.1.2.2 Manufacturing

Although Malta's economy now heavily-relies on service-based sectors like financial services, gaming and tourism, it is important to analyse the role of manufacturing and its performance in recent years. As seen below, the manufacturing sector's economic fortunes have been somewhat mixed, although since 2015 the sector's gross value added has grown by 23.1% following years of relative stagnation, and has proven to be relatively resilient in the face of the COVID-19 pandemic. Nonetheless, it is important to note that the sector's relative importance to Malta's overall economic fortunes has declined, with the sector now contributing 7.8% to Malta's GVA, down from 11.5% in 2010. A number of sectors within the manufacturing industry have been classified by the UN as being heavily water-dependent; thus, monitoring of this sector's performance is warranted.

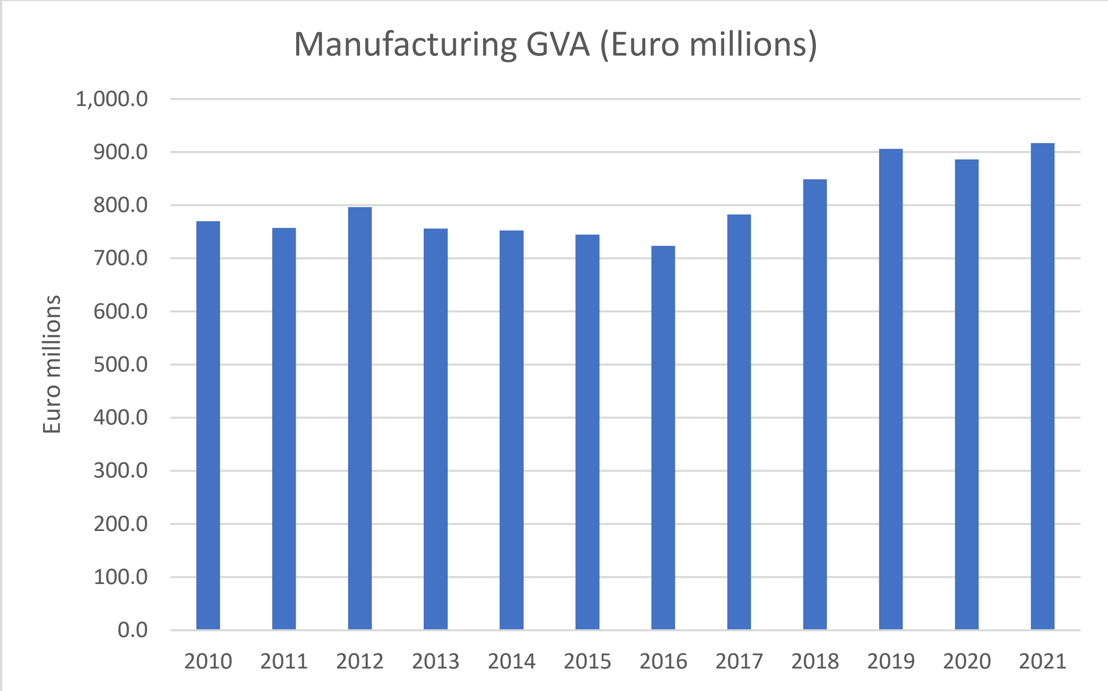

Figure 6: Manufacturing sector GVA (Source: NSO)

We can take a closer look at the different sub-sectors of the Maltese manufacturing sector. As seen from Table 2, the manufacture of furniture, jewellery, musical instruments, toys; repair and installation of machinery and equipment is the largest sub-sector (22.16%), followed by wood, paper printing and reproduction (15.75%) and food, beverages and tobacco (14.44%). Since 2015 a number of subsectors have experienced a decline, notably food, beverages and tobacco and textiles, while others have recorded impressive levels of growth, particularly the manufacture of transport equipment, the pharmaceuticals sector and wood and paper production.

	GVA (Euro millions)	% of Manufacturing GVA
Manufacture of food products; beverages and tobacco products	132.4	14.44%
Manufacture of textiles, wearing apparel, leather and related products	11.2	1.22%
Manufacture of wood, paper, printing and reproduction	144.4	15.75%
Manufacture of chemicals and chemical products	10.6	1.16%
Manufacture of basic pharmaceutical products and pharmaceutical preparations	52.0	5.67%
Manufacture of rubber and plastic products and other non-metallic mineral products	123.7	13.49%

Manufacture of basic metals and fabricated metal products, except machinery and equipment	51.1	5.57%
Manufacture of electrical equipment	23.2	2.53%
Manufacture of motor vehicles, trailers, semi-trailers and of other transport equipment	79.0	8.62%
Manufacture of furniture; jewellery, musical instruments, toys; repair and installation of machinery and equipment	203.1	22.16%

Table 2: Leading manufacturing sub-sectors in terms of contribution to sectoral GVA, 2021 (Source: NSO)

2.1.2.3 Tourism Sector

The tourism sector is a major driver of water demand in the Maltese Islands. This is due to a number of factors. Firstly, the demographic pressures referred to in section 2.1.1 above do not consider the impact of the tourist arrivals throughout the year, a number that in recent years has been rising significantly as the sector expands and diversifies, although this has stalled somewhat due to the travel restrictions imposed as a result of the COVID-19 pandemic.

As seen below, the contribution of accommodation and food services to Malta's economic prosperity has largely hovered around the 5% mark in recent years, before dipping in 2020 due to the pandemic.

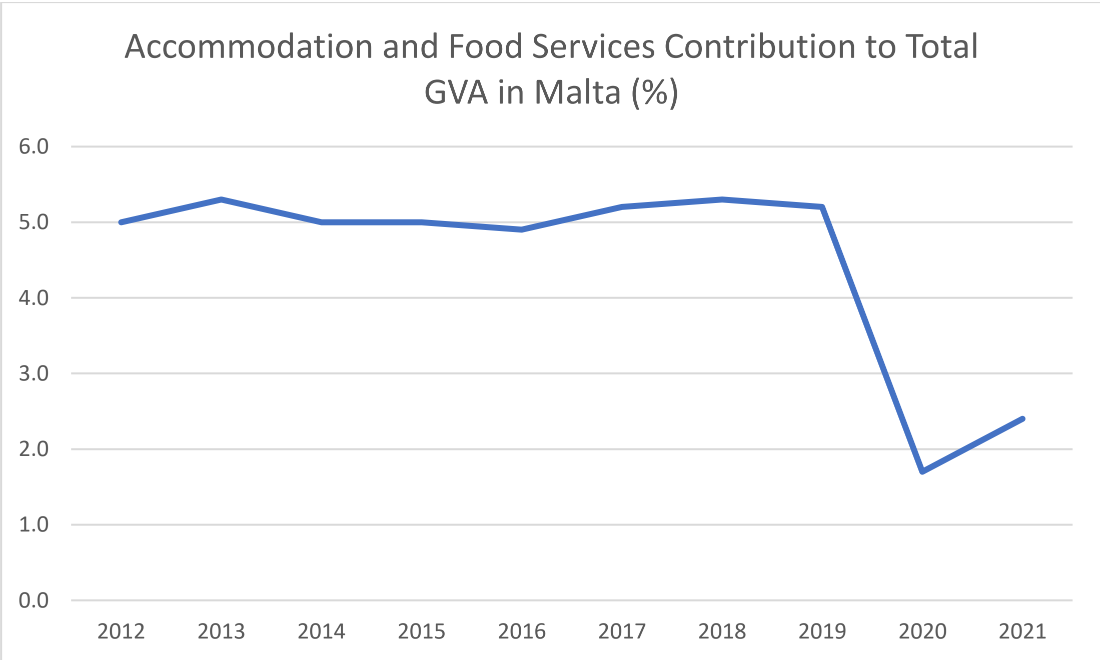

Figure 7: Tourism sector contribution to total GVA (Source: NSO)

A number of key indicators have been identified to monitor this sector.

Annual Tourist Bed Nights

This indicator tracks the number of tourists staying in collective accommodation in terms of bed nights. Tourist accommodation is a critical component of the water demand exerted by the sector and therefore this indicator is useful to track this particular impact. The relevant data is presented in Table 3.

2015	2016	2017	2018	2019	2020	2021
8,915,297	8,971,191	9,580,329	10,081,852	10,068,632	2,361,970	4,115,955

Table 3: Total no of nights spent by inbound tourists in collective accommodation (Source: NSO)

Proportion of tourist nights spent in private accommodation

This indicator seeks to capture the growing sub-sector of the hospitality sector that offers private, as opposed to collective accommodation. This includes the use of short-term rentals as well as Airbnb accommodation. Data is presented in Table 4 below. It is clear that private accommodation has emerged as the leading type of accommodation sought out by tourists visiting the Maltese Islands, with this trend persisting even throughout the COVID-19 pandemic.

	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Private acc. tourist bed nights (million)	5.4	6.1	7.1	8.5	9.3	2.9	4.3
Total tourist bed nights (million)	14.2	15.0	16.5	18.6	19.3	5.2	8.4
Proportion (%)	37.8%	40.6%	42.9%	45.7%	48.2%	55.8%	51.2%

Table 4: Proportion of tourist nights spent in private accommodation (Source: NSO)

2.1.2.4 Construction Sector

The construction industry has undergone major expansion in the last five years and is a key driver for the Maltese economy. This is due largely to the population and economic growth referenced above which generated a greater demand for residential and commercial space. Construction activities tend to have significant environmental impacts, not least on water resources. It is a water-intensive operation, not only in terms of direct onsite requirements but also all along the construction value chain, particularly in the production of goods and services necessary to the sector. In addition, as highlighted in the Activity 1 report, an increase in construction projects, particularly in greenfield sites, contributes to the generation of storm water runoff which further pollutes water bodies. For these reasons, construction activity was factored into the monitoring framework through the indicators described below.

Building Permits

The level of activity within the sector can be tracked through the number of building permits issued by the Planning Authority. Data is presented in Figure 8 below.

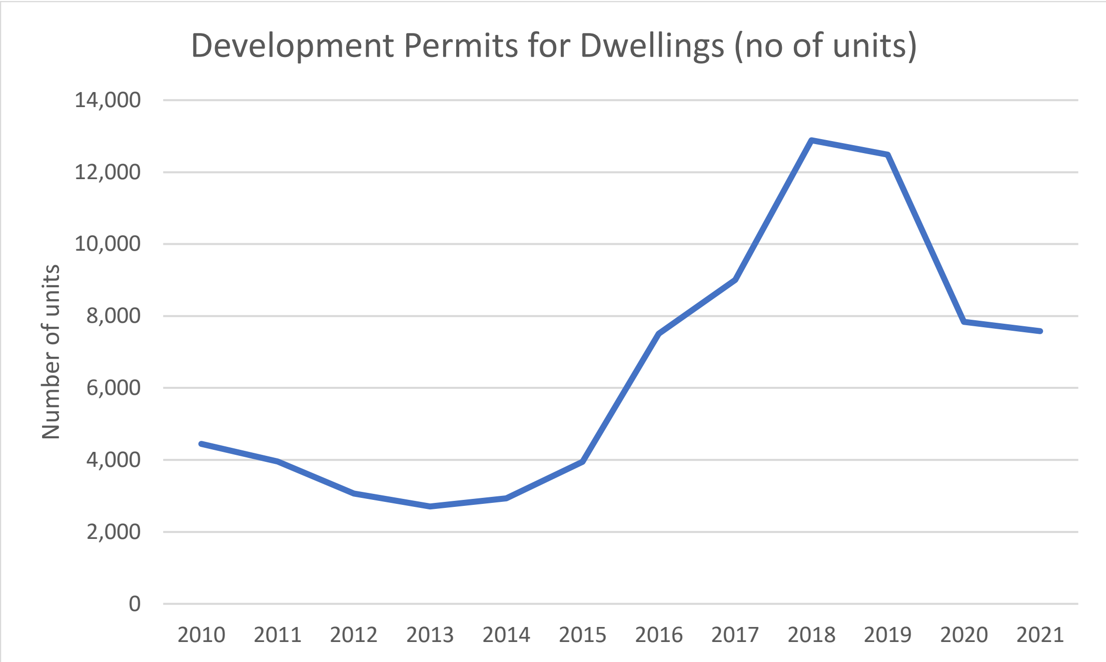

Figure 8: Number of construction permits issued per year (Source: Central Bank of Malta)

As seen above, the number of development permits issued for dwellings in Malta increased substantially between 2013 and 2018, before plummeting in 2020 and 2021 in response to the COVID-19 pandemic.

Proportion of built-up land

Specific, recent land cover data has been hard to source however it remains an important indicator that should be monitored from year to year. For use in the monitoring framework it should be calculated as the area of built-up land relative to the total surface area of the Maltese Islands (316 Km^2).

The latest data available, for 2015, indicates a total built-up area of 103.8 km^2. This means that in that year, 32.8% of Malta and Gozo was built up. Given the sharp increase in construction permits issued since then, it is likely that this percentage has increased. Data issued by the Central Bank of Malta (2019) indicates that the majority of new units built in Malta are apartments – these constitute the highest growth segment of the construction sector since 2013 with an average annual increase of almost 44%. These are followed by maisonettes (27.8%) and terraced houses (17.7%). The high-rise mixed-use developments presently under construction or in the pipeline are also to be considered.

2.1.3 Agriculture

Along with domestic use, the agricultural sector has the highest demand of water, particularly in terms of abstracted groundwater. Activities across the sector have a direct impact on the quality and the quantity of this particular water resource, not only in terms of extraction for irrigation and other uses but also through practices that risk its direct or indirect contamination. These include the use of fertilisers and the inappropriate disposal of agricultural runoff (including livestock waste). As discussed in previous reports the main mitigating action undertaken by the authorities to address this issue is the introduction of New Water as an alternative to groundwater.

Research carried out in Activity 1 determined that this sector is exhibiting slower rates of production and may be described as one in a state of gradual decline. This is evident largely in terms of the decreasing numbers of full-time farmers as well as of farms and livestock. Crop production has also exhibited a decline, decreasing year on year from €54.4 million in 2015 to €46.5 million in 2021 (NSO, 2021). However, given the sector's significant impact on water resources it must be monitored closely to assess any noteworthy shifts in this trend. This will be done through the indicators listed below.

2.1.3.1 Agriculture Gross Value Added

As seen above with reference to the manufacturing and tourism sectors, this indicator tracks the relative 'health' of the sector in terms of activity and productivity. Table 5 below therefore records the GVA for the agricultural sector, while Figure 9 captures this data as a percentage of total GVA. As seen below, both in aggregate and percentage terms the contribution of agriculture to Malta's economic fortunes has been on the decline in recent years.

Year	Agriculture GVA € million
2015	92.3
2016	109.4

2017	85.7
2018	97.7
2019	66.7
2020	56.8
2021	56.5

Table 5: Agricultural Sector Gross Value Added (Source: NSO)

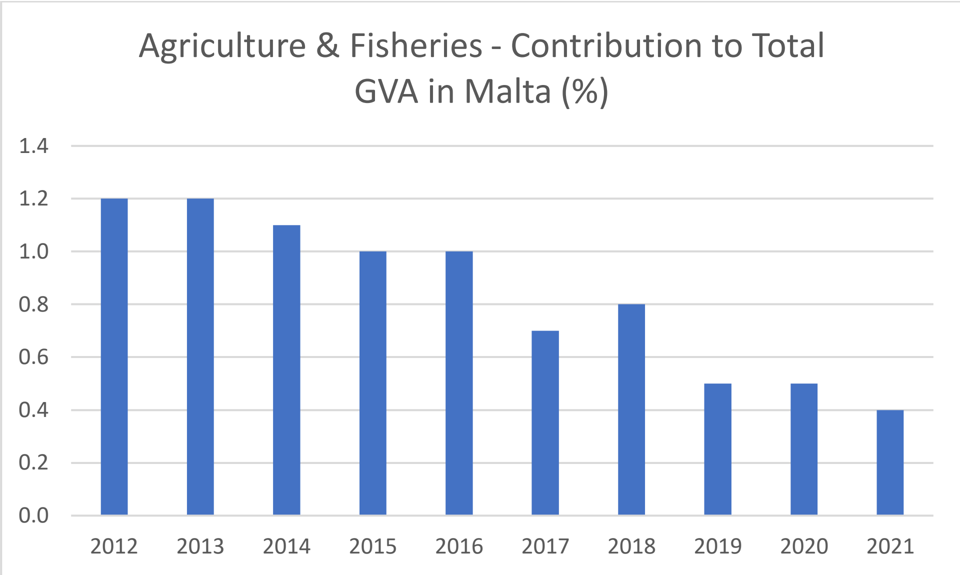

Figure 9: Agricultural sector contribution to total GVA (Source: NSO)

2.1.3.2 Annual Groundwater Abstraction

This indicator monitors the volume of metered groundwater abstracted from registered boreholes. It will be particularly indicative over the next few years in measuring the effectiveness of the introduction of New Water within the sector as an alternative to groundwater. The data is presented in Table 6 – this shows a year-on-year increase in the volume of water abstracted, despite the fact that agricultural GVA actually decreased over this time period. Therefore, it is important to understand why groundwater abstraction has continued to increase despite a slowdown in economic activity, and thus the extent to which such resources are being deployed efficiently.

2017	2018	2019
2.1	2.6	3.0

Table 6: Volume of groundwater extracted from registered boreholes (million m^{3}) in Malta and Gozo (Source: EWA)

2.1.3.3 Annual imports of nitrogen fertiliser

The use of fertilisers in agriculture can impact the marine environment, mainly through diffuse pollution from run-off. This primarily concerns nitrogen fertilisers and occurs when the sub-hydrological catchments across the Maltese Islands and their individual valley systems transport nutrients from inland agricultural areas to coastal marine waters. The monitoring framework factors in this impact by tracking the annual importation of nitrogen fertilisers.

To provide some preliminary insight, importation data was sourced from the United Nations' trade database. This data is presented in Table 7 below.

Year	Total Value of Imports (€)
2017	654,217
2018	563,638
2019	517,048
2020	492,914

Table 7: Total annual imports of fertilisers (Source: UN Comtrade Database, 2021)

2.1.4 Water Consumption Indicators

This set of indicators serves to track the main water consumption patterns, mainly for agricultural and domestic use.

2.1.4.1 Public groundwater production by the Water Services Corporation per capita

For the purposes of this indicator, data was obtained from Water Services Corporation reports comprising groundwater production from all boreholes and pumping stations in Malta and Gozo. This data is presented in Table 8 below – this indicates a marginal increase in 2020 compared to the base year of 2017, with an increasing proportion of public water supply being derived from reverse osmosis plants.

Year	Groundwater Production by WSC (million m^3)	Total Population	Volume of Groundwater Produced per Capita (m^3)
2015	13.4	450,415	29.6

2016	13.5	460,297	29.3
2017	14.2	475,701	29.9
2018	14.2	493,559	28.9
2019	14.3	514,564	27.8
2020	14.5	516,100	28.1

Table 8: Volume of public groundwater production by the WSC per capita (Source: water data from WSC REWS Returns; population data from NSO)

2.1.5 Coastal Waters

Besides the agriculture-based impacts referred to above, one of the major pressures on coastal waters are sea-based activities close to the shoreline. These include contamination by hazardous substances, such as discharges from maritime traffic, and oil spills.

These impacts are therefore factored into the monitoring framework with a focus on sea-based activities in the three main harbour areas.

2.1.5.1 Number of small-scale oil spills

There is little to no data in the public domain on recent incidents however a review of available information indicates that to date there have been no large-scale spills in the main harbour areas. The 2018 State of the Environment report issued by the Environmental Resources Authority (ERA) reveals that a few minor spills occurred between 2007 and 2014 "*involving less than 10 tonnes of oil products.*" A more recent press report, dated January 2019, also mentions that there have been no major incidents in more recent years and any spillages are described as "*relatively small accidental oil spills*".[1]

2.1.5.2 Maritime Traffic

The objective of this indicator is to track the level of maritime activity in Maltese ports, namely the Grand Harbour, Marsaxlokk Harbour and Marsamxett Harbour. This is achieved by monitoring the annual number of vessels calling at the ports and the data is presented in Table 9 below.

Year	Number of vessels
2015	24,310

[1] The Times of Malta. 9 January 2019. *Pollution Prevention and Response*

2016	26,451
2017	26,617
2018	27,308
2019	30,202
2020	31,676

Table 9: Number of vessels calling at Maltese ports (Source: Eurostat)

2.1.6 Water Exploitation Index

The water exploitation index (WEI), or withdrawal ratio, in a country calculates the percentage of water use against renewable freshwater resources. It is defined by the European Environment Agency as "*the mean annual total abstraction of fresh water divided by the long-term average freshwater resources. It describes how the total water abstraction puts pressure on water resources*." This has therefore been included as a key indicator since it measures water stress in terms of relating the level of abstraction to available water resources. As a globally accepted index, this data will contribute to the monitoring framework as a general indicator of water pressures, flagging instances where demand is exceeding supply. It should be noted that the data presented in Table 10, which is sourced from Eurostat, does not factor in subsurface natural losses of groundwater, which when considered would increase the actual WEI+ value. Nonetheless, it is clear from the Table below that the WEI has remained fairly constant in recent years, dipping to its lowest level in 2019 since 2015, which may be indicative of improved use of water resources, both from a demand side (e.g. more widespread use of water-efficient appliances) and/or a supply side in terms of management of groundwater.

Year	**Malta - Water Exploitation Index by year (Percentage)**
2015	49.7%
2016	49.8%
2017	51.2%
2018	50.5%
2019	48.3%

Table 10: Water Exploitation Index for Malta by year (Source: Eurostat)

2.2 Mitigation Indicators

In this section of the report, which deals with mitigation indicators, reference is made to project actions under the LIFE 16 Integrated Project (referred to as the LIFE RBMP) which have been identified as being relevant to the indicator under discussion. These linkages are dealt with in more detail in Section 3.0 below.

2.2.1 New Water Production

As indicated in Activities 1 and 2, the Government has recently invested in facilities across several wastewater treatment plants in order to generate New Water for agricultural use. Production is now up and running in several plants, with capacity expected to increase over the coming years. In the meantime, the LIFE RBMP project will contribute towards the management and diffusion of new water within the agricultural sector through actions C.3, which will assess agricultural water demand, and C.6, which will envision the setting up of a demonstration site for New Water in Gozo, in order to improve acceptance and usage among farmers. Table 11 below presents the data on the volume of New Water produced, including as a percentage of total water production. As shown below, new water production has increased substantially over a relatively short period of time, reflecting significant investment in such facilities, with further investments in the pipeline, including an improved distribution infrastructure. This will assist in further managing Malta's groundwater resources while promoting circular economy practices within the agricultural sector.

Year	New Water Production (million m^3)	Total Water Production (million m^3)	Proportion (Percentage)
2017	0.14	33.1	0.41%
2018	0.63	33.6	1.89%
2019	0.94	34.1	2.76%
2020	1.5	34.7	4.32%

Table 11: Volume of New Water production (Source: WSC REWS Returns)

2.2.3 Water Resource Productivity

As seen from the data in Table 12 below, water resource productivity in Malta has risen over the last five years, with a slight dip in 2020 reflecting the general economic slowdown brought about by the COVID-19 pandemic. The LIFE RBMP project is expected to contribute to further gains in water productivity, namely through actions A.1 and C.1, which will seek to assess and characterise water demand in Malta in lieu of possible future improvements, as well as action C.2 via the launch of water labels on various consumer appliances and products, and C.5 through the launch of the water app which will allow users to track their usage and realise important savings.

If we focus specifically on groundwater resource productivity within the agricultural sector, in 2019 each metre cubed of metered groundwater abstracted generated €22.24 of Gross Value Added (GVA) to the Maltese economy, down significantly from the €47.56 per cubic metre generated by the same sector in 2018. This reflects both a 46% increase in the sector's metered groundwater abstraction, coupled with a 31.7% drop in GVA, further underscoring the need to improve water resource usage within the agricultural sector, as well as the pressing need for more circular solutions like New Water, whose production is currently being ramped up significantly in Malta.

Year	Water Resource Productivity (Euro per metric tonne of water)
2015	297.77
2016	283.67
2017	309.17
2018	322.51
2019	339.49
2020	309.22

Table 12: Water resource productivity (Source: WSC)

2.2.4 Bathing Water Quality

Bathing water quality in Malta is among the best in the EU, with all sites achieving at least 'Good' quality as defined by the European Commission's Bathing Water Directive[2]. The

[2] As per the Bathing Water Directive, bathing waters are to be classified as 'good':

economic benefits of bathing water are numerous, including revenue from tourism, recreational and leisure activities, public health, ecosystem services, existence and non-use values. In total, 87 bathing sites are monitored under the Bathing Water Directive, with 84 deemed to be of ‘excellent’ quality, two classified as being ‘good’ quality, and only one site classified as ‘sufficient’, based on the most recent assessment for 2021.

Year	Excellent Bathing Water Quality Sites	Good Bathing Water Quality Sites	Sufficient Bathing Water Quality Sites	Poor Bathing Water Quality Sites	Total Number of Bathing Water Sites
2015	86	1	-	-	87
2016	86	1	-	-	87
2017	86	1	-	-	87
2018	86	1	-	-	87
2019	85	2	-	-	87
2020	84	3	-	-	87
2021	84	2	1	-	87

Table 13: Bathing sites – water quality classifications (Source: NSO)

2.2.5 Water Losses

In recent years, absolute levels of real water losses have been reduced as a result of several important infrastructural investments to improve the efficiency of water provision. This is further reflected in the Infrastructure Leakage Index (ILI), an international metric used to measure water leakages from the public water supply, which has declined considerably over time. ILI is the ratio of Current Annual Real Losses (CARL) to Unavoidable Annual Real Losses (UARL), with a score of 1 indicating that all current water losses are unavoidable, while

1. If, in the set of bathing water quality data for the last assessment period, the percentile values for microbiological enumerations are equal to or better than the ‘good quality’ values set out in Annex I, column C; and
2. If the bathing water is subject to short-term pollution, on condition that:
    - adequate management measures are being taken, including surveillance, early warning systems and monitoring, with a view to preventing bathers' exposure, by means of a warning or, where necessary, a bathing prohibition;
    - adequate management measures are being taken to prevent, reduce or eliminate the causes of pollution; and
    - the number of samples disregarded in accordance with Article 3(6) because of short-term pollution during the last assessment period represented no more than 15 % of the total number of samples provided for in the monitoring calendars established for that period, or no more than one sample per bathing season, whichever is the greater.

anything above 1 denoting that at least some of the losses are indeed avoidable. Although further improvements are expected due to the WSC's commitment to further infrastructural investments, this project may also assist in this regard through actions A.1 and C.1, since the data gathered would enable WSC to identify potential leakages from the system in specific localities and geographical locations via extraordinary spikes in water consumption. Table 14 below quantifies water losses, while Table 15 traces the ILI score each year during the period under review. As seen below, water losses have declined, while the ILI index has fallen to its lowest level since 2015, a testament to the investment undertaken to upgrade Malta's water infrastructure.

Year	Real Water Losses
2019	445
2020	389

Table 14: Real water losses by year, in m^3 per hr (Source: WSC)

Year	ILI Index Score
2015	1.91
2016	2.06
2017	2.18
2018	2.09
2019	2.14
2020	1.87

Table 15: Infrastructure Leakage Index (ILI) score by year (Source: WSC)

2.2.5.1 Customers notified of internal water leakage

This indicator provides some measure of responsiveness to water leakages, and therefore efficiency in reducing water losses. In 2020, this system was upgraded to provide quicker and more detailed information to customers via SMS or email, with information on hourly rates of water leakage in cases where abnormal consumption is detected by the new system. In total during 2020 some 20,000 SMS notifications were sent out to customers, with further functionalities available via the WSC website.

2.2.6 Energy consumption

Energy consumption as a result of water generation must be carefully monitored, particularly as Malta's share of desalinated water continues to increase. As seen below, energy consumption has largely remained unchanged in recent years, both in terms of the overall water supply as well as desalinated water. Although none of the project actions are directly aimed at reducing energy consumption from water production and distribution, it is still necessary to keep track of such data to ensure that further improvements are recorded in this regard, in line with the Energy Efficiency Directive.

2.2.6.1 Energy consumption of Water Supply – Production and Distribution

Year	kWh per metre cubed
2015	3.19
2016	3.28
2017	3.23
2018	3.17
2019	3.11

Table 16: Energy consumption of water supply (Source: WSC REWS Returns)

2.2.7 Reverse Osmosis Plants

The provision of public water generated via reverse osmosis plants has increased significantly over recent years as seen below in Table 17, and now constitutes the primary source of public water as supplied by Water Services Corporation (WSC). This is also part of a wider drive towards generating around 70% of total public water from such sources, in an effort to further manage and conserve Malta's groundwater resources.

One of the key issues related to the use of reverse osmosis is the fact that these plants typically consume significant amounts of energy in order to operate, which may result in higher emissions of greenhouse gases which contribute towards climate change. In recent years, substantial investment has been undertaken in order to upgrade and improve the energy efficiency of Malta's reverse osmosis plants. For example, in 2019 WSC reported that energy costs related to reverse osmosis operations declined by 7.7% relative to the previous year, with further improvements envisaged as investment continues across different plants, including the recently-inaugurated plant at Hondoq, Gozo in November 2021.

Year	RO Production (million m^3)	Total Water Production (million m^3)	% RO Water
2015	17.8	31.2	57.2%
2016	18.6	32.1	57.9%
2017	18.9	33.1	57.0%
2018	19.3	34.0	57.6%
2019	20.4	35.2	58.0%
2020	20.2	34.7	58.2%

Table 17: Desalinated water production as a percentage of total water production (Source: WSC REWs Returns)

2.2.8 Monitoring & Enforcement

The LIFE RBMP Project is expected to make a significant contribution in terms of improving the monitoring of industrial wastewater discharges, and thus reducing the presence of harmful substances and chemicals in Maltese waters. Preparatory actions A.5 and A.6 have enabled the development of monitoring strategies on the basis of data and information on industrial effluents and pollutants of emerging concern, while concrete actions C.10 and C.18 will implement each respective strategy in order to gauge the status quo and monitor improvements and trends over time. This will enable key stakeholders like Water Services Corporation and ERA to effectively monitor, enforce existing standards and consider further regulation as necessary. Such efforts are in line with recent increases in the number of inspections undertaken by WSC, as shown below, as well as the increase in both the number of samples tested and compliance with the Drinking Water Directive.

2.2.8.1 Number of annual inspections by Water Services Corporation

Year	Security and enforcement	Discharge permit unit
2015	424	4466
2016	684	4760
2017	1106	3897
2018	1292	5193
2019		4483

Table 18: Number of annual Water Service Corporation inspections (source: WSC)

2.2.8.2 Percentage of potable water samples compliant with Drinking Water Directive parameters

Year	Compliant Microbiological	Compliant Mandatory	Compliant Indicator
2015	100%	97%	85%
2016	100%	97%	90%
2017	100%	100%	92%
2018	100%	100%	91%
2019	100%	100%	92%

Table19: Percentage of potable water samples compliant with Drinking Water Directive (Source: WSC)

2.2.9 Water Dependent Jobs

Employment is a key economic consideration for any country, given its direct impacts on welfare and income. The growth in water-dependent jobs in Malta largely mirrors the economic growth experienced locally over the last seven years, particularly in sectors like tourism and construction. These jobs rely heavily on water resources, both as an input within the production process as well as a potential sink for the disposal of waste. Thus, growth in several of these water dependent jobs acts as an additional pressure on the availability and quality of Malta's scarce water resources, necessitating a more comprehensive water management plan in order to preserve and safeguard these resources. Tables 20 and 21 below quantify the number of water dependent jobs in Malta, using the classification recommended by the United Nations in this exercise.[3] This classifies jobs as follows:

- 'Water-dependent jobs': these cover jobs in economic sectors that are heavily or moderately water-dependent. Sectors that are **heavily water dependent** can be defined as "*those requiring a significant quantity of water as a major and necessary input to their activities and/or production processes. Therefore, failure to secure an adequate and reliable supply of water to support these sectors results in the loss or disappearance of jobs*." Examples of such sectors are agriculture, forestry, mining and resource extraction, water supply and sanitation, most types of power generation as well as a number of jobs in manufacturing and transformation industries such as food, pharmaceuticals and textiles. Other heavily water-dependent jobs include jobs in health care, tourism and ecosystem management.
- Sectors that are **moderately water dependent** can be defined as those that do not require access to significant quantities of water resources to realise most of their activities but for which water is nonetheless a necessary component in part or parts of their value chain. Examples are construction, recreation, transportation and manufacturing/transformation industries such as wood, paper, rubber, plastic and metals.

The LIFE IP project contributes significantly in this regard across several preparatory and concrete actions, with the aim being to regenerate and enhance various water resources across the islands, without impinging on the economy's ability to create new job opportunities in these water-dependent sectors. In fact, the project also directly and indirectly contributes to further economic development and job creation through the promotion of water and energy efficiency, new technologies for water conservation, rehabilitation of sites with important ecosystem and recreational value, as well as new jobs at the Water Services Corporation, the Environment and Resources Authority and the Energy and Water Agency.

[3] United Nations. (2016). *The United Nations World Water Development Report 2016: Water and Jobs*

2.2.9.1 Heavily water dependent jobs (thousands)

Employment by NACE Code	2015	2016	2017	2018	2019	2020
Agriculture, fisheries, forestry & mining	2.6	2.2	1.9	2.0	2.3	2.6
Water Services	2.1	2.3	2.1	1.8	2.8	3.0
Electricity, gas, steam and air conditioning supply	1.5	0.9	0.92	0.96		
Healthcare	17.3	18.9	19.9	22.7	24.0	24.9
Accommodation and food service activities	14.1	16.4	16.0	16.5	18.8	17.5
Manufacturing – food, pharma, textiles	7.2	6.9	6.6	6.3	7.3	7.3

Table 20: Heavily water dependent jobs in Malta by NACE sector (Source: NSO)

2.2.9.2 Moderately water dependent jobs (thousands)

Employment by NACE Code	2015	2016	2017	2018	2019	2020
Construction	12.6	13.9	15.1	15.1	17.1	15.3
Recreation	6.0	7.3	8.6	11.4	13.3	13.4
Transportation	9.4	11.1	12.5	12.9	12.9	13.7
Manufacturing – wood, paper, rubber, plastics, metal	1.2	1.4	2.4	2.3	3.3	3.2

Table 31: Moderately water dependent jobs (Source: NSO). Note that transportation incorporates land, water and air transportation.

3.0 Impact Analysis of Project Actions

3.1 Background

This section presents a detailed analysis of the key socioeconomic impacts of the individual actions pertaining to this project as at the first quarter of 2022. This analysis is a follow-up on the results presented in the previous iteration of this report, which consisted of an initial socioeconomic analysis of project outcomes up to Q1 2020. As before, this report will draw on both quantitative results (planned and achieved) for these project actions, as well as more qualitative assessments derived from published literature and in-depth discussions with individual action leaders or coordinators.

The overall objective is to understand the specific socioeconomic benefits resulting from the LIFE RBMP project, together with their economic value to Malta, which would serve as a basis for a longer-term evaluation of the project's impact, conditional on the periodic updating and review of socioeconomic benefits resulting from the project as further actions are implemented and completed.

3.2 Typology of Specific Project Actions

As stated in the original proposal document, the LIFE RBMP Project was designed to have a significant impact on Malta's socioeconomic fabric, quite apart from its clear environmental benefits. More specifically, the project was envisaged to contribute to the following broad socioeconomic benefits:

- Job creation, with specific reference to green jobs and regional employment.
- Economic development, with particular reference to the short- and long-term sectoral income impacts and impacts on SMEs and cottage industries.
- Poverty, as this would be impacted by effects on employment, incomes, efficiency of resource management and consequent effects on costs to consumers, and climate resilience of especially vulnerable communities among other effects;
- Overall social welfare, as potentially impacted through use (including water consumption, recreational amenities, rehabilitation of sites and landscapes), and non-use effects (including option and bequest effects).

Accordingly, this section sets out to map the individual impacts resulting from each preparatory and concrete action, with a view to quantifying their economic value. To this end, individual actions have been grouped together in line with key commonalities shared in terms of their specific scope and/or targeted stakeholders, in order to assist in the derivation and aggregation of economic values. The groupings selected for the purposes of this analysis are provided in Table 22 below.

Grouping	Individual Actions
Value of groundwater	A.9, C.3, C.6, C.8, C.11, C.12
Household water demand	C.1, C.2, C.4, C.5, C.19
Industrial pollutants and sectoral impacts	A.5, A.6, C.10, C.18
Marine environment	A.7, C.14, C.15, C.16
Ecosystem value of catchments	A.8, C.7, C.9, C.13
Cross-cutting actions	A.1, A.2, A.3, A.4, C.17

Table 22: Classification of Individual Project Actions

Each of the six broad groupings will be discussed in turn, drawing on both the actual and expected results for each action included therein, together with any interlinkages across the different groups. A more detailed table listing each specific action, classification as well as their associated socioeconomic indicators is provided in Annex I of this report.

3.3 Value of Groundwater

As indicated by the European Environment Agency (EEA, 2018), Malta's groundwater resources are under significant pressure due to abstraction for public supply, industry and agricultural use. Therefore, it is no surprise that five of the individual actions included as part of this project are directly targeted at groundwater resources.

Action A.9 is related to groundwater modelling, with the aim being to develop three-dimensional, quantitative groundwater models for Malta's mean sea level aquifer, Gozo's mean sea level aquifer, the Pwales aquifer as well as two additional aquifers that had previously not been envisaged within the original project proposal, namely the Mizieb mean sea level aquifer and the Ghajnsielem perched aquifer. For this action, the Numerically-enhanced Conceptual Modelling (NeCOM) framework was applied in order to develop scenarios for groundwater management within these aquifers, assisting in pointing out existing data gaps while also helping to characterise the qualitative and quantitative pressures on groundwater bodies. This directly feeds into the Energy and Water Agency's (EWA) ongoing upgrades to Malta's hydrological monitoring infrastructure, levering the findings and insights provided by the NeCOM model. As part of the action, specialised training was provided to EWA personnel in order to improve their knowledge on the development, calibration and use of these numerical models. In addition, the activities related to this action have resulted in the publication of three scientific papers in international, peer-reviewed journals, with one paper recently selected as one of the Editor's Choice articles for 2021 by the Hydrogeology Journal. Therefore, this activity has resulted in the following benefits:

- Capacity building through the provision of specialised technical training to three (3) EWA staff members, boosting the quality of green jobs and employability;
- The dissemination of scientific knowledge in high-quality international journals;
- Support for other actions related to the management of groundwater resources in Malta.

Action C.3 is targeted at developing an online remote sensing tool for monitoring agricultural water demand. This shall be based on extensive agricultural and crop data collected from over 1,500 individual parcels of land by EWA scientists to ensure that the process is as painstaking and accurate as possible, combined with commercially-available spatial data. At the same time, this data will feed into another project, named WARM-EO (Water Resource Management platform using Earth Observation), which aims to develop a cost-effective high-resolution evapotranspiration model to estimate the irrigation water use at land parcel level, with the data gathered by EWA assisting in calibrating and validating the model. This model will form the algorithmic backbone of the online platform, which shall have embedded downloading, processing and analytical capabilities. A core component of the activity has been (and will continue to be) active, steady outreach and engagement with farmers, both as part of the data collection process but also in order to understand field practices for crop cultivation and agricultural practices, in order to further link such practices to the remotely-sensed data on water demand. This activity is expected to yield a number of socio-economic benefits. Firstly, it will assist in understanding agricultural water demand in a more granular, accurate and holistic manner, both via the data gathered as well as engagement with farmers, with the online tool facilitating the transmission and acquisition of this information. This can feed into the work done by government and other stakeholders in the development of rural policy, water resource management, land use and food security. Therefore, once again the benefits of this action are expected to persist beyond the end of the LIFE RBMP project. In addition, the activity has also served as an invaluable research and training activity for the scientists and staff members at EWA allocated towards this activity.

Action C.6 seeks to develop a demonstration centre in Gozo to show the effective use of New Water and how it can substitute groundwater for irrigation purposes, with the aim of raising awareness and acceptance of New Water among farmers. Gozo retains a strong agricultural tradition, accounting for almost 20% of all agricultural holdings in the Maltese Islands and over 24% of total arable land (NSO, 2022). Therefore, it is imperative that farmers in Gozo are acquainted with the use of New Water and how this can be used in a safe and effective manner for the purposes of crop irrigation, and a reliable alternative to groundwater derived from boreholes, in order to ensure a more sustainable and circular agricultural sector. This is particularly pertinent since in February 2022 the Water Services Corporation extended the New Water network to Gozo as part of a EUR 6 million project, which also includes the installation of 60 New Water dispensers on the island. The site for the demonstration centre has already been identified, with a development permit submitted to the relevant authorities in 2021. The Demonstration Centre will include advanced testing systems in order to assess the impact of New Water use on various crop typologies, relative to the use of groundwater. Similarly, these results should assist in convincing the general public that agricultural products cultivated using New Water are also safe for consumption. The socio-economic benefits of this activity are largely related to the use of New Water as a safe, circular alternative to groundwater. These could be quantified based on the increase in the quantity of New Water used by farmers in Gozo once the Demonstration Centre is up and running, with the monetised value of these benefits incorporating both the foregone private costs of borehole abstraction, estimated at around €0.25/m^3, based on estimates provided in the 2nd Water Catchment Management Plan for Malta (WCMP, 2018), as well as the foregone external costs of groundwater use like natural resource depletion costs, increased saline intrusion, etc.

Action C.8 will involve the implementation of a Managed Aquifer Recharge Scheme (MAR) in the Pwales groundwater body. This activity will assist in significantly improving the quantitative and qualitative status of this groundwater body, which is characterised by high levels of pollutants like chlorides and nitrates due to intense agricultural activities in its vicinity. Currently, the baseline work is currently underway in order to assess the status of groundwater resources throughout the Pwales valley, culminating in a planned geophysical survey. These results will feed into the installation of the MAR infrastructure. The expected socio-economic benefits of this activity will revolve around any potential improvements to the Pwales groundwater body both in terms of qualitative and quantitative status, which would be measurable as part of the envisaged final phase of this activity. The actual economic value varies considerably, depending on the type of MAR used and the economic appraisal method employed, as seen from the range of economic values estimated in the literature (Maliva, 2014). In addition, this activity may serve as a test case for the implementation of MARs at other larger groundwater bodies across the Maltese Islands.

Action C.11 will develop a pilot abstraction, treatment and discharge system in order to exploit deep saline groundwater, as part of the Mean Sea Level aquifer system. The aim is to potentially develop a new source of water supply, thus alleviating existing pressures on natural water resources, with an abstraction rate of 1,500 m^3 per day, yielding 600m^3 of water per day serving as an additional source of water for Malta. A test site has already been set up, with drilling and core geological analysis commencing in October 2021 in order to understand the geological characteristics of the site as well as determine where abstraction of deep saline groundwater should take place, and thus the establishment of the pilot plant. Various tenders have been published related to the infrastructural works necessary for the pilot site, as well as the procurement of the necessary equipment, with the pilot plant scheduled for commissioning in April 2023. The project is currently being handled by three staff members within the Water Services Corporation (WSC), who have been provided with the necessary training in order to contribute towards this action. The insights and results derived from this action may also assist in the establishment of plants at other sites in order to further exploit deep saline groundwater, thereby yielding further potential water resources in the future. Should the project prove successful, then the socio-economic benefits would be clearly quantifiable in terms of the additional water resources unlocked as a result of this action. These benefits would include:

1. The market value of these additional water resources. Assuming that the water will be non-potable and would be used for agricultural purposes, the average abstraction cost of groundwater is estimated at around €0.25/m^3, based on estimates provided in the 2nd Water Catchment Management Plan for Malta (WCMP, 2018). Therefore, at a daily flow rate of 600m^3 per day, the financial benefits of this project would be equal to €150 per day, or €54,750 per year;

2. The externality cost savings related to the use of these alternative water resources as opposed to groundwater (e.g. reduced availability for other uses, increased salinity of groundwater, etc.), although this would have to be offset against the externality costs emanating from this new source of water;
3. Any direct or indirect employment creation resulting from the commissioning of this new plant.

Action C.12 is an innovative, exploratory initiative aimed at assessing the potential for the use of a subsurface heating and cooling solution within a coastal aquifer system. Such technologies have been successfully implemented in larger aquifer systems; however, their applicability in smaller-scale systems is largely unknown. On the one hand, although the technology can assist in achieving Malta's energy efficiency and alternative energy targets, the discharge of heat to the subsurface may be considered as a pollutant under the Groundwater Directive, apart from other potential ancillary negative effects like the ingress of saline waters in groundwater. Therefore, this action is intended to assess both the feasibility and impact of such closed loop heating and cooling technologies in Malta through the creation of one heating and cooling pilot system within a coastal aquifer system, with results expected by the end of 2025. Thus, at this stage it may be too early to assess the action's net socioeconomic benefits, since this would depend both on the success or otherwise of the heating and cooling (and thus the improvements in energy efficiency and reduced greenhouse gas emissions), coupled with the potential downside from possible groundwater pollution.

3.4 Household Water Demand

The LIFE RBMP Project includes a number of initiatives targeted specifically at households, in order to improve water resource consumption patterns among private citizens. These actions will ultimately aim to provide significant financial benefits, in terms of lower water bills, as well as improved social welfare through reduced environmental pressures caused by excessive water usage and exploitation.

Action C.1 involves the execution of a number of household water visits, in order to raise awareness regarding water consumption patterns and provide guidance in order to reduce consumption and minimise wastage. These visits pre-date the commencement of the LIFE

RBMP project, averaging 500 visits per year, although since 2020 they have been conducted within the remit of this project. The one-hour visits involve an analysis of a household's three most-recent water and electricity bills in order to assess consumption patterns and evaluate any reasons why water consumption is high, including water leakages, appliances, billing issues, etc. Despite some disruption caused by the COVID-19 pandemic, these visits have persisted, with 370 visits conducted in 2021 alone, with 100 visits conducted over the phone, although the aim is to resume the regular 500 house visits in 2022, with a new promotional campaign launched on various media in order to generate interest. Gift bags are also distributed to each household as part of the visits, which include a soil moisture reader and a booklet containing energy and water saving tips. In February 2022 the site visits were also expanded to include micro enterprises in order to tackle water consumption among these businesses, which collectively account for 91.7% of Malta's total enterprises (NSO, 2021). It is also envisaged that these visits (both to households and micro enterprises) will persist beyond the end of the project.

Given the nature of the visits, it is difficult to quantify the water savings that are directly attributable to this action, particularly since there is no continued observation of households beyond the visit, in terms of implementation of advice or recommendations or review of new water and electricity bills. Nonetheless, this action has also led to the employment of one additional officer within the Energy and Water Agency (EWA) to assist with the house visits, as well as the engagement of another officer to handle promotion and administration, while training has been provided to four officers in conducting these visits, with additional training provided at the end of 2021 in relation to the micro enterprise visits.

Action C.2 will seek to introduce a new Eco-Label for water efficiency, to be used with appliances and devices in order to guide consumers when making their purchase and hence ensure further water savings. The proposed eco-label will build on similar schemes that are currently in place within the EU and globally, but tailored specifically to the needs and realities of the Maltese market. This will be done via a series of at least fifty stakeholder and supplier consultation meetings, who shall be involved both at the scheme design stage and at the final stages for feedback. The socio-economic benefits of such a scheme are expected to centre around the potential water savings that would be accruable to consumers due to their purchase of more water-efficient appliances and products as a result of the information provided by the eco-labels, which would persist long after the end of the LIFE RBMP project.

These may be measured periodically through surveys among consumers, as well as feedback from suppliers and retailers regarding sales of water efficient products.

Action C.4 involves the development of a comprehensive educational campaign among school children, in order to raise awareness regarding the importance of water conservation among the younger generation. Through this action, various educational programmes have been carried out at the Ghajn National Water Conservation Awareness Centre in Rabat, Malta, aimed at both students and educators in order to mainstream the inclusion of water conservation issues as part of their curricula, together with the distribution of various educational materials. During the COVID-19 pandemic, the activities pivoted towards online delivery, with the production of a number of virtual lessons and resources aimed at primary school students. In addition, annual events have been organised for the general public in order to raise awareness regarding water conservation and the work done at the Ghajn Centre, coupled with annual calls for school projects centred on water conservation, and which shall continue in the future. For example, this year's edition of the school projects activity yielded participants from eight schools, with 10,000 Euro allocated towards the enactment of these initiatives. Therefore, the qualitative socio-economic contribution of this action is aimed at mainstreaming matters related to water conservation, and more importantly to engender awareness and knowledge regarding this issue among young children, which would lead to reduced water usage and improved utilisation of water resources in the future.

Action C.5 involves the development of a Water App and Water Game, building on recent developments in gamification and behavioural science in order to nudge users towards more efficient water use. The Water App is at present almost ready for launch, and will allow users to input their daily water consumption figures directly into the app interface across different uses (e.g. dish washing, cooking, etc.), with various tips provided on how consumption can be reduced across different uses. The app would also provide a notification if the user's water consumption is above the average consumption of others within their locality, together with a list of further tips to reduce water consumption, and share their progress, thereby leveraging insights from behavioural science related to social norms and peer group comparisons in order to nudge improvements. Data regarding user activity and consumption will be collected in a database in order to enable the project's administrators to quantify water savings across different water uses. Thus, once this app is launched, it should be relatively straightforward to quantify any socioeconomic benefits emanating from app usage, mainly in relation to water savings, both financial (using the latest tariff data for domestic consumption) as well as external benefits related to reduced groundwater resource usage and reverse osmosis use. In terms of the Water Game, which is currently being developed and finalised, this will be aimed at children aged 11-13, and will present a fun, interactive setting where players can perform various tasks and progress through levels while learning about water resources in Malta and the importance of proper conservation and management. This game thus ties in nicely with action C.4 in terms of its focus on generating water conservation awareness and knowledge among children.

Action C.19 is an innovative intervention whereby a random sample of households will be selected in order to analyse how the use of various AI-driven smart technologies can enable them to save energy and water. This activity has required considerable planning and research, including the development of new technologies, since this involves the use of smart meters and gadgets which would be able to provide data on energy and water usage for each appliance or device used within the chosen households, and feed this information to the households via app notifications. Nonetheless, the sophisticated nature of the system will allow for the early detection of any failures, thus enabling households to take preventative action and identify any issues immediately, which would thus contribute towards a more efficient use of water and energy resources. This will also assist in measuring the tangible socio-economic benefits of this action, which shall mainly be related to improved water and energy usage among the sample of households. As part of this action, one individual has been employed as the project manager, while the knowledge of the three people involved in the action has been significantly enhanced as part of the preparatory activities and planning.

3.5 Industrial pollutants and sectoral impacts

Apart from analysing water demand and conservation within the agricultural sector and households, the LIFE RBMP project also looks at water use and pollution from industrial sectors. While the generation and disposal of industrial effluents are governed by a number of environmental regulations and permits, this project is aimed at supporting the regulator's monitoring and enforcement efforts, while inter alia assisting in the reduction of water use and pollution from key industrial sectors in Malta.

Action A.5 involved the commissioning of desk research aimed at collating information on polluting activities emanating from nine industrial sectors, namely pharmaceutical manufacturing, electronics, injection moulding, wineries/breweries, engineering works, healthcare, printing, laundries and service stations/mechanics/panel beaters. The indicators for polluting activities vary according to the sector in question, although the key ones targeted include pH levels, suspended solids, COD/BOD, toxicity, chloride and petroleum hydrocarbons. The action assisted in identifying pollution hotspots, particularly in industrial zones related to sectors like pharmaceuticals. As part of this action, a risk assessment matrix was developed in order to assist in classifying pollution risks from different industries, based on variables like the presence of a quality management system, the volume of water discharged, and the presence of wastewater treatment systems and fail safes, among other variables. This research, consisting of a number of reports, will thus provide the analytical framework in order to measure and monitor industrial pollutants in Action C.10.

Action A.6 sought to identify various contaminants of emerging concern (CECs), which may have a significant impact on the water environment. CECs may be present in different types of surface waters, including coastal and inland surface waters, rainwater runoff, groundwater, and new water (i.e. reclaimed water from urban waste water treatment). This action has identified the potential sources for CECs which focused on pharmaceuticals (human use and veterinary); agricultural chemicals (pesticides and fertilisers); household chemicals and personal care products; chemicals used in industry; and metals. This was done via detailed consultations with various relevant stakeholders in order to identify potential CECs through a use characterisation exercise. The levels of potential CECs in four water categories (ambient concentrations) will be determined through Action C.18 as part of the implementation of the monitoring programme identified in this action.

Following on directly from A.5 above is **Action C.10**, which as mentioned earlier will utilise the framework developed in order to monitor and gauge industrial pollutants across sectors. The first stage involves the implementation of a wastewater monitoring programme in order to gauge the extent of business effluents across different zones and determine key ‘hotspots’ where wastewater quality is low. The second stage involves collaborations and knowledge sharing between staff members at Water Services Corporation’s (WSC) Discharge Permit Unit (DPU) and other EU utility companies in order to acquire new skills and knowledge while increasing awareness of best practices with regards to monitoring of wastewater discharges. The activity also envisages significant capacity building within the DPU through the hiring of new staff members as well as the purchase of new equipment which will enable the unit to perform its duties in a more efficient and effective manner, particularly with regards to the enforcement of the Sewer Discharge Control Regulations. The socio-economic benefits of the activity are clear. Firstly, the activity will directly assist the DPU in targeting problem areas of high effluent discharges from industrial sources, thus assisting in reducing negative environmental impacts on a variety of ecosystem endpoints, including marine waters. Secondly, the capacity building within the DPU will result in the creation of new jobs, with four (4) new staff members already recruited as at January 2022, while the international collaboration will boost the skills and employability of participants.

Finally, **Action C.18** follows through directly from A.6, in that it involves the implementation of the monitoring strategy developed in that action. The scope of this action has widened somewhat, in that it will focus on both pollution from chemicals of emerging concern (CECs) as well as pollution from diffuse sources for priority substances and priority hazardous substances in major water catchment areas. The action will first seek to assess the presence or otherwise of these CECs across in surface waters, rainwater runoff, groundwater and new water (i.e. reclaimed water from urban waste water treatment), as part of a two-year screening process. This will be followed by a monitoring of select contaminants in order to understand their origins and thus manage contamination sources in a more targeted and informed manner, including diffuse sources of pollution. The identification of potential emerging pollutants of concern and concentrations of said pollutants, may lead to further regulation with respect to toxicity and potential health effects. The socioeconomic benefits of this action will mainly relate to the ability of regulatory bodies to utilise the data gathered in order to reduce the presence of CECs and diffuse source pollution from the four water bodies mentioned above and to further regulate diffuse sources of pollution. Management of contamination of waters, since this will increase both the availability of water resources in Malta, but also provide several potential ecosystem benefits.

3.6 Marine Environment

The marine environment is crucial to Malta's socioeconomic wellbeing, given the multitude of services that it offers, from supporting commercial activities like shipping and fisheries to the provision of recreational services related to tourism and scuba diving, quite apart from the ecosystem services provided. Therefore, it should come as no surprise that the marine environment features very heavily in the LIFE RBMP project, with no less than four actions directly related to it.

Action A.7 constituted the preparatory action towards the development of a hydrographic model for Maltese marine waters. Through this action, ERA, in collaboration with the University of Malta's Physical Oceanography Research Group, within the Department of

Geosciences identified the requirements for the observation and modelling systems to be developed under concrete action C16. The model will be assisting in tackling a significant gap in available data, by enabling the assessment of changes to the hydrological regime, together with the characterisation of pressures resulting from the land-sea interface as well as identification of pressures/impacts of transboundary origin. The results from this action feed directly into Actions C.15 and C.16.

Action C.14 is aimed at assessing and quantifying the impacts of anchoring and mooring activities on sensitive seabed habitats. This will facilitate the management of such impacts as well as policy-making in this regard, with an eye on both the resultant impacts on seabed habitats as well as the socio-economic implications of any interventions. At present the contractor engaged as part of this action is carrying out the necessary preparatory works in order to assess the distribution of anchoring and mooring activities in order to select suitable areas for the assessment of impacts, and thus the development of relevant management options that are practical, feasible and effective, subject to testing. In terms of the socio-economic benefits expected from this project, since each management option will be subjected to a socio-economic assessment it is expected that the selected option/s would yield a net benefit to society in terms of the protection provided to the important seabed habitats, and the various ecosystem services provided. In addition, this activity has also resulted in the employment of one additional person within the Environment and Resources Authority (ERA).

Action C.15 will seek to understand the extent of brine discharges emanating from mainland Malta's reverse osmosis plants. This action will allow regulators and policymakers to understand the extent to which reverse osmosis activities result in the generation and disposal of brine into the sea, which in turn impacts its salinity, temperature and alkalinity, and thus the marine environment. At present, the contract for carrying out this activity has been awarded, and the collection of samples at different depths from each site is expected to take place over a two-year period in order to control for seasonal and hydrodynamic variations, particularly in terms of waves and sea temperatures. Thus, the benefit of this action lies in providing regulators with a more complete picture of the environmental impacts resulting from reverse osmosis plants via brine releases, which may in turn inform future management plans and actions in this regard.

Finally, **Action C.16** set up and run basic elements of modelling and observation systems in order to understand the baseline hydromorphological conditions in Malta's coastal and offshore waters. This will enable assessment of impacts resulting from hydrographical changes, since such conditions may impact the ecological status of these waters. This activity is being carried out in tandem with the University of Malta's Physical Oceanography Research Group within the Department of Geosciences, with two researchers currently engaged as part of this project. The results are expected to improve characterisation of the hydrographic conditions of Malta's nearshore and offshore waters, help in the assessment of hydrological dispersion of pollutants and sediment and understand the potential transboundary sources of contaminants. Results will inform policymaking as well as feed into decision tools like environmental impact assessments (EIAs), with long-term benefits in terms of ensuring that related developments (e.g. along the coast) are sustainable.

3.7 Ecosystem Value of Catchments

When discussing the importance of safeguarding and conserving Malta's water resources, it also imperative to look beyond the simple economic value of water in terms of its marketable price, but also the plethora of recreational and ecosystem values derived from water in Malta. Such considerations have already been touched upon throughout this document (e.g. with regards to the marine environment), and in this section an assessment of additional types of water resources will be analysed, with particular focus on Malta's valleys and catchment areas.

Action A.8 was a comprehensive preparatory initiative that aims to develop a long-term vision for the protection, conservation and rehabilitation of Malta's valleys. To this end, the action sought to quantify the ecosystem services provided by the catchments, including crop and livestock production, flood protection and pollination, as well as the development of a series of master plans and technical guidelines to guide policymakers and regulators. This action also involved the publication of an edited book on valley resources and their importance for Malta. This action has resulted in the employment of three new full-time staff, thus contributing to employment creation and economic development. The activity has also led to the creation of a dedicated web portal that provides all key outcomes emanating from the action, including a downloadable version of the book. A key outcome of this activity is the provision of the economic value of pollinated crops across Malta's valley catchments, which will enable researchers, policymakers and regulators to obtain a more complete understanding of the true value of ecosystem services provided by valleys.

Action C.7 envisages the application of state-of-the-art, cost-effective techniques for sustainable urban drainage systems (SuDS) in Malta, particularly in terms of promoting storm water management. A strategic framework is currently being devised in order to guide the process and identify opportunities for implementing SuDs in Malta, followed by the launch of three demonstration sites which shall be assessed on the basis of their environmental benefits, costs, operability and efficacy, with technical guidelines and best practices extracted thereafter. If successful, this action will yield a number of important benefits, namely improved upstream water management to reduce the risk of flooding in key catchments, and a reduction in downstream generation of rainwater runoff. At this stage, given that conclusion of the action is expected by December 2025, a more considered assessment of its socioeconomic benefits is somewhat premature. Nonetheless, for catchment flooding prevention an analysis of benefits would consider the reduction in flooding risk, the amenities that would be impacted from flooding of the catchment area and finally the economic benefits of each amenity. In turn, the downstream benefits would be assessed on the basis of the reduction in rainwater runoff, in terms of the quantities of pollutants that have been abated (e.g. nitrates, COD/BOD, suspended solids) and their respective externality costs. In addition, the action has already led to the employment of one additional person, with the potential for two additional positions.

Action C.9 follows directly from A.8, since it envisages the development of a valley management plan. The pilot plans shall be implemented across two sites, namely Wied tal-Isperanza in Malta and Wied tal-Grixti in Gozo. The plans include the conservation and enhancement of existing ecosystem services provided within these valleys via several restoration initiatives, with five-year management plans developed for each site which can serve as examples for other valleys in the Maltese Islands. A key aspect of this activity is that, in tandem with action A.8, this will result in the production of an ecosystem services valuation and categorisation tool, which can be used to prioritise interventions and conservation measures in valleys and watercourses across the country, while also serving as a useful tool for stakeholders to raise awareness regarding the true value of these resources. Therefore, the socio-economic benefits of this activity will mainly relate to improved conservation and management of valley catchments in the Maltese Islands and the improved provision of related ecosystem services, both in those valleys directly involved in this activity as well as others across the country, particularly in terms of ecological integrity and water-harvesting potential. The high degree of stakeholder engagement and citizen involvement, particularly in the formulation of the Master Plans, will also assist in raising awareness regarding the importance of valleys and engender greater conservationist attitudes among the Maltese population.

Finally, **Action C.13** will involve the restoration of one of Malta's coastal wetlands, namely il-Ballut ta' Marsaxlokk, in terms of the hydro morphological elements (including water quality and coastal erosion) related to his wetland, which support various habitats, species. The restoration measures that will be identified under this action will be based on detailed studies and assessments in order to ensure greater relevance, and the findings from this activity will assist in the restoration and protection of all of the five protected coastal wetlands in Malta. Coastal wetlands yield significant economic benefits, both in terms of its support for native flora and habitats, together with significant amenity values. Thus, by identifying these various benefits, it would be possible to assign economic values to each benefit in turn, based on the improvements achieved as a result of this action. In addition, as part of this action one person has already been employed.

3.8 Cross-Cutting Actions

The final set of actions have been grouped under this heading since they are extremely broad in scope, impacting various sectors and water resources. In many ways, these activities lay out the analytical and data groundwork to enable the other, more specific or targeted actions to take shape and flourish. Nonetheless, these actions will all yield various socioeconomic benefits for years to come, beyond the confines of the project's timeline.

Action A.1 developed a set of econometric models in order to analyse water demand in Malta across all sectors (domestic, agriculture and industrial/commercial). Each sector was analysed historically and a demand forecast developed and projected for the next 50 years, with demand expressed as a function of several important socioeconomic and environmental determinants. Thus, the value of this action lies in providing crucial strategic information to regulators, policymakers and other stakeholders when it comes to the effective management of Malta's water resources, not just now but in the future, and plan ahead based on various different scenarios that can be simulated via these models.

Action A.2 involved market research on water demand management technologies. More specifically, the action focused on the proliferation and usage of water efficient and water recycling technologies within the key water using sectors in Malta, namely the domestic, agricultural, commercial and touristic sectors. Through carefully targeted consultations with industry and sectoral representatives, the aim of this activity was to identify those water efficient technologies that are widely-used within each sector, whilst also identifying those that are under-utilised but nonetheless have good potential in terms of reaping future water savings and efficiency gains. This action contributes towards promoting social welfare by assisting in identifying potential new water saving technologies that can be widely utilised among key sectors in Malta, while also promoting economic development since such technologies would result in real cost savings for end-users.

Action A.3 sought to develop an inventory of related EU-funded projects and initiatives, in order to acquire valuable knowledge regarding implementation and outcomes, derive best practices and establish contacts with coordinators and project partners from overseas for further knowledge-sharing. The types of EU-funded initiatives included in this inventory exercise span several areas, including water demand management, coastal water management and water reuse applications in agriculture, among others. Thus, although specific benefits related to this activity are not directly quantifiable, its impact percolates practically each and every single action in the LIFE RBMP project, by providing a well of knowledge, guidance and potential contacts which can assist in their implementation and eventual success. Therefore, this activity contributes towards several socioeconomic benefits, including potential social welfare improvements, economic development and job creation, via its impact on the other actions.

Action A.4 involved the identification of key stakeholders and water users within the Malta River Basin District, including representatives from sectors like agriculture, tourism, commercial and maritime. Detailed focus groups were held for each group in order to gauge stakeholder perceptions, attitudes and beliefs. In turn, surveys were also administered across agricultural operators, households and businesses in order to understand stakeholder perception on developments within the water sector in Malta. Once again, the value of this activity lies in the provision of information that is crucial to guiding and feeding into various other actions under this project, including concrete actions C.1 to C.8 and C.17. In addition, understanding the perceptions and concerns of stakeholders is imperative in order to foster acceptance of any project initiatives, since this enhances the possibility of a successful outcome. Thus, this action also contributes towards various socioeconomic benefits like the promotion of social welfare and economic development across key sectors in Malta.

Finally, **Action C.17** envisages the development of a multi-stakeholder platform or 'water table', including stakeholders from the private and public sector, water user associations and environmental NGOs. The stakeholders meet regularly to assess the implementation of the LIFE RBMP and 2nd RBMP, as well as the development of the 3rd RBMP. Once again, similar to the stakeholder engagement in A.4, the purpose of this action is to foster openness and transparency among all stakeholders involved within the water sector, thus fomenting acceptance of the project and any activities undertaken therein. This platform will also help to promote collaboration across sectors and stakeholders, thus ensuring that the successes and benefits derived from the project are distributed and can live on beyond the lifetime of the project.

Annex 1 – LIFE RBMP Project Actions and Socio-Economic Indicators

Action	Details	Indicators	Notes
A1	Assessment of the sectoral water demand in Malta and Gozo	Public groundwater consumption; Water resource productivity	Action should assist in policymaking that encourages more efficient water use
A2	Market research on water demand management technologies		
A3	Mapping of related EU research projects		
A4	Stakeholder assessment and perception survey		
A5	Mapping of industrial polluting activities		See C10
A6	Development of a monitoring strategy for contaminants of emerging concern		See C18
A7	Development of a hydrographic model for Malta's marine waters		See C16
A8	Catchment modelling		See C9
A9	Groundwater modelling		See C3
C1	Household water consumption audits	Public groundwater consumption; Water resource productivity; Real GDP Growth	Action should encourage households and SMEs in improving the efficiency of water resource use

C2	Eco-label Scheme	Public groundwater consumption; Water resource productivity; Real GDP Growth	Action will encourage people to purchase more water-efficient products and appliances
C3	Remote sensing for agricultural water demand	Agriculture GVA; Groundwater abstraction; Water Exploitation Index	Action will help to manage Malta's groumdwater resources more efficiently
C4	Water education campaign	Public groundwater consumption; Water resource productivity	Action will help the next generation to utilise water resources in a more efficient and effective manner
C5	Water App/Game	Public groundwater consumption; Water resource productivity	Action will assist users to improve their water resource usage and raise awareness regarding conservation
C6	Demonstration site for the application of new water resources – Gozo	Agriculture GVA; Groundwater abstraction; Water Exploitation Index	Action will encourage the safe and efficient use of New Water among farmers
C7	Sustainable Urban Drainage Systems (SuDS)	Water Exploitation Index; Water resource productivity	Action may assist in minimising pollution while improving retention of water resources
C8	Development of a managed aquifer recharge scheme in Pwales groundwater body	Groundwater; Water Exploitation Index	Action should improve the qualitative and quantitative status of Pwales groundwater body, and potentially other aquifers

C9	Valley Management Plan	Tourism; Water Exploitation Index; Ecosystem services	Action will safeguard and protect two valleys in Malta, and their associated ecosystem services, and serve as a blueprint for the preservation of other valleys
C10	Industrial discharges – enforcement augmentation and sustainability	Monitoring by DPU	Action will help with capacity building and enforcement within the WSC's DPU
C11	Exploitation of deep saline aquifers	Groundwater abstraction; Water Exploitation Index; Water resource productivity	Action may increase the availability of water resources in the Maltese Islands
C12	Heating and cooling installations	Real GDP Growth	Action may assist in generating new renewable forms of energy in Malta
C13	Restoration of one of the coastal wetlands	Ecosystem services; Tourism	Action will assist in restoring a coastal wetland which has significant ecosystem and amenity value
C14	Anchoring and mooring surveys	Marine waters	Action should assist in improving the state of the seabed habitats, effected by the pressures of anchoring and mooring activity
C15	Impact of reverse osmosis discharges on the marine environment	Marine waters	Action should assist in improving marine water quality by assessing potentially-harmful brine discharges

C16	Hydrographic model simulations for Malta’s marine water to quantify and investigate pressures in the marine environment	Marine waters	Action should assist in improving marine water quality by identifying and assessing pressures
C17	Multi-stakeholder platform		
C18	Monitoring for emerging pollutants of potential concern	Marine waters; Water Exploitation Index	Action will assist in reducing effluent pressures on Malta's water resources
C19	Smart Utilities Pilot Project	Real GDP Growth; Public groundwater consumption; water resource productivity	Action will assist households in reducing their use of both water and energy

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