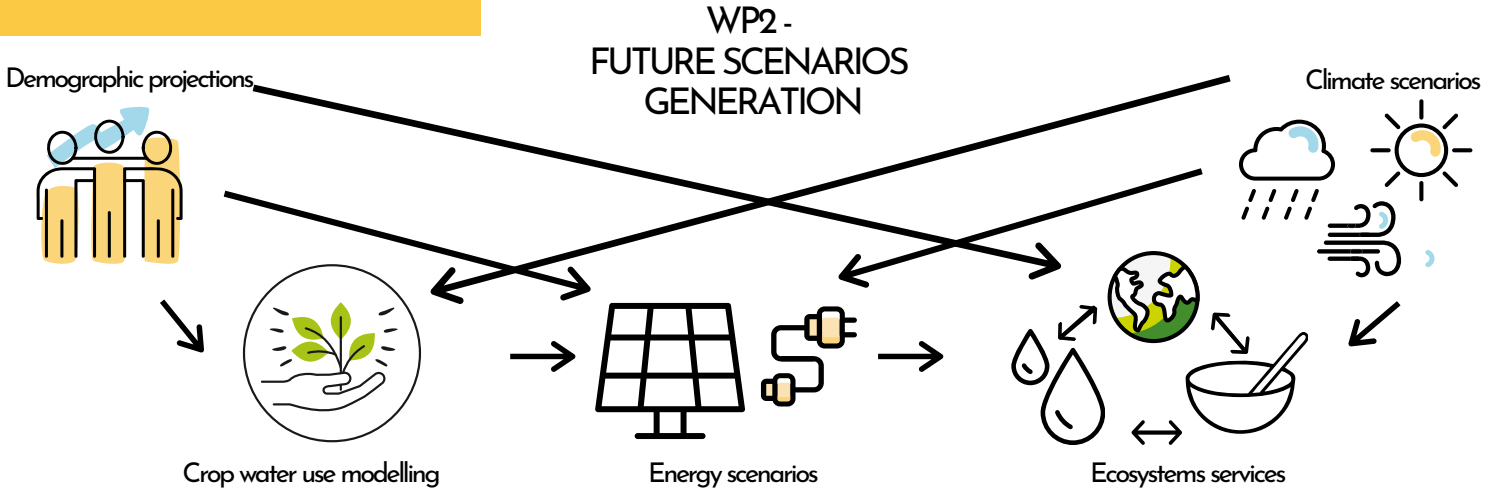
AWESOME
WATER-ECOSYSTEM-FOOD

Demographic scenarios and areas of interest

Probabilistic population projections

Economic drivers projections

In this factsheet we provide **scenarios** for **population and economic drivers** expected to impact the **agricultural sector** for countries in the **Mediterranean** and adjacent regions relevant for the AWESOME models. Population scenarios are based on **probabilistic scenarios** using the Bayesian hierarchical population model by Raftery et al. (2012), appropriately modified to fit within the SSP scenarios **(see Box 1)**, while the economic drivers scenarios are provided in terms of the **global macroeconomic MaGE model** [Fouré et al. 2013].



- *Raftery, et al. (2012). Bayesian probabilistic population projections for all countries. Proceedings of the National Academy of Sciences, 109(35), 13915-13921.*
- *Fouré, et al. (2013). Modelling the world economy at the 2050 horizon. Economics of Transition, 21(4), 617-654.*

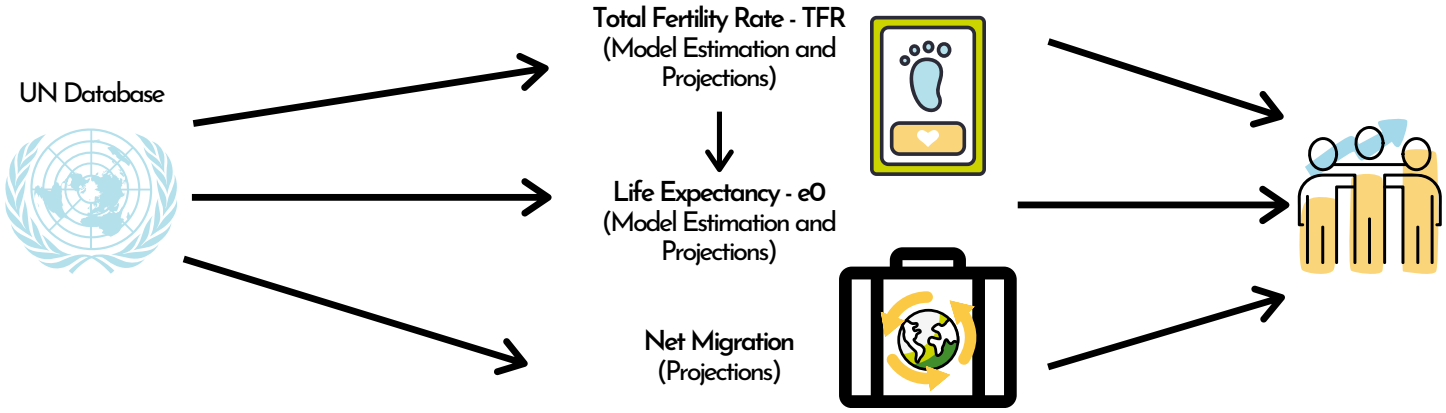
Probabilistic population projections

The underlying model is based on the UN typical population projection model :

$$P_{c,t} = P_{c,t-1} + B_{c,t} - D_{c,t} + M_{c,t}$$

where $P_{c,t}$ denotes the population of country c at time t (corresponding either to a single year or a 5-year period), $B_{c,t}$ stands for the number of births (which depends on the total fertility rate), $D_{c,t}$ denotes the number of deaths (which depends on the life expectancy) and $M_{c,t}$ measures the net international migration.

Areas of interest

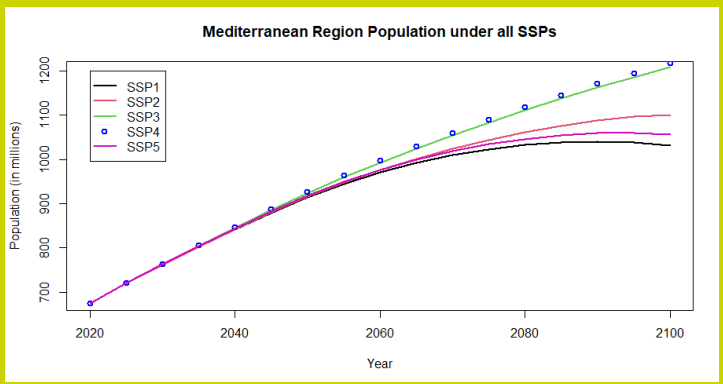


Box 1: Shared Economic Pathways (SSPs) and Graphic Projections

An important step in our approach is the definition of the various **Sustainable Socio-economic Pathways scenarios (SSPs)** in the probabilistic setting. This approach divides the possible states of the world in **five scenarios (rapid development, medium development, stalled development, inequality and conventional development)** according to the levels of specific demographic characteristics and specifically **fertility, life expectancy (or mortality) and migration**. Countries are assigned either to the Low fertility (LowFert), High fertility (HiFert) or Rich OECD group. In our context, the Mediterranean regions comprehend both Rich OECD and HiFert countries.

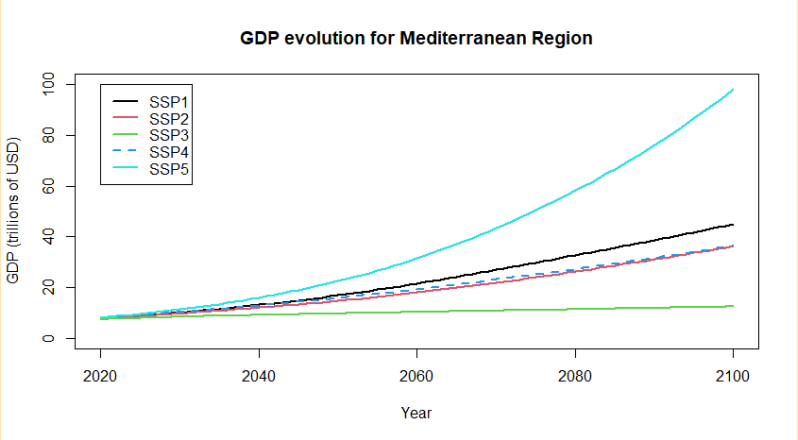
	Country Groupings	Fertility	Life Expectancy	Migration
SSP1 Rapid Development	HiFert	◆	●	▲
	LowFert	◆	●	▲
	Rich OECD	▲	●	▲
SSP2 Medium Dev.t (baseline)	HiFert	▲	▲	▲
	LowFert	▲	▲	▲
	Rich OECD	▲	▲	▲
SSP3 Stalled Dev.t	HiFert	●	◆	◆
	LowFert	●	◆	◆
	Rich OECD	◆	◆	◆
SSP4 Inequality Dev.t	HiFert	●	◆	▲
	LowFert	◆	▲	▲
	Rich OECD	◆	▲	▲
SSP5 Conventional Dev.t	HiFert	◆	●	●
	LowFert	◆	●	●
	Rich OECD	●	●	●

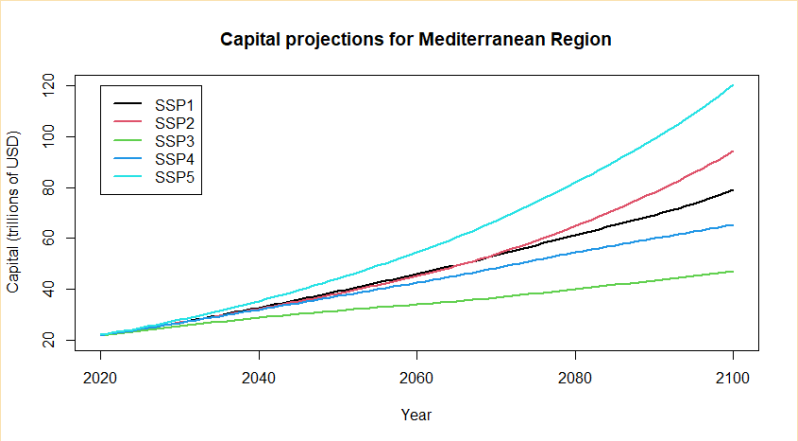
Legend: Low, Medium, High

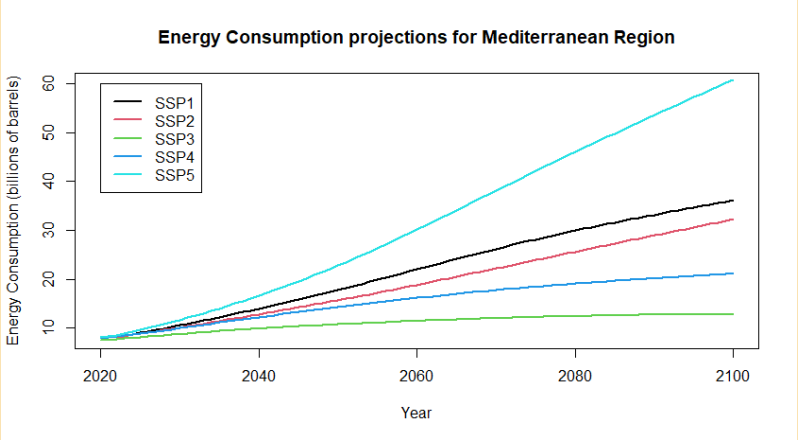


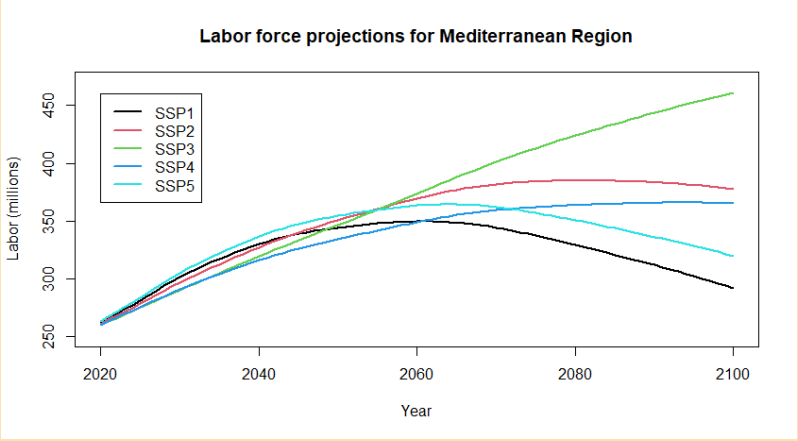
The graph shows that the **Med region** is expected to register an **increase of its population** under all five different SSP scenarios. However, despite the expected demographic growth, we should also consider the heterogeneity of the area of interest, which includes both Rich OECD countries (i.e. those belonging to the EU, characterized by low expected fertility rates) as well as High Fertility countries (i.e. Albania, Turkey, and North-Central Africa, with high expected fertility rates).

Box 2: Some snapshots









Economic drivers projections

Economics drivers scenarios are obtained using a **global dynamic economic model (MaGE)**. The model was developed by Fouré et al. (2013). MaGe assumes that the world consists of economies of individual countries with each country c characterized at time *t* by a three-factor CES production function with the capital and labour contributions modelled by the **Cobb-Douglas form:**

$$Y_{c,t} = \left\{ (A_{c,t} K_{c,t}^{\alpha} L_{c,t}^{1-\alpha})^{\frac{\sigma-1}{\sigma}} + (B_{c,t} E_{c,t})^{\frac{\sigma-1}{\sigma}} \right\}^{\frac{\sigma}{\sigma-1}},$$

where

- Yc;t is the GDP of country c at time t,
- Kc;t is capital of country c at time t,
- Lc;t is labour of country c at time t,
- Ec;t is energy consumption of country c at time t

In this function, t corresponds either to 1-year periods or 5-years periods while α and σ are values in the range (0,1). The elasticities are assumed to be the same for all countries α = 0:31, σ = 0:136 and constant in time, while the parameters Ac;t (Total Factor Productivity or TFP) and Bc;t (Energy Productivity) are assumed to be country specific and temporally varying. The model depends on population primarily through **labour force** and secondarily through the **life cycle savings modelling** which is introduced in the modelling of investment.