How have food resistance strategies for strawberries, potatoes, and qagħaq tal-għasel (honey rings) contributed to Malta's adaptive capacity to combat food vulnerability and what are the untapped avenues to increase food security?

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ABSTRACT

Food insecurity driven by climate change, governance, and environmental limitations shapes the decisions farmers make—from crop selection to land management. On small islands like Malta, agricultural production is constrained by limited arable land, population pressures, economic dependence on tourism, and freshwater scarcity. This study examines local food production through public datasets, government reports, and semi-structured interviews with farmers, pastry chefs, and government officials (n=8), focusing on strawberries, potatoes, and *qagħaq tal-għasel*, a traditional Christmas pastry. Findings reveal a general awareness of climate change and the adoption of water-resilient practices such as drip irrigation and rainwater harvesting. Shortened supply chains, young farmer policies, and access to cooperative markets like the Pitkali are helping sustain farming, despite rising land costs and competing career opportunities. Many farms are located far from farmers' homes, often on rented land with uneven soil and traditional rubble wall boundaries, further contributing to the decline in self-sufficiency. Strawberries are sustainably grown using plasticulture, while potatoes—exported during Northern Europe's winter—remain economically viable. However, *qagħaq tal-għasel* production relies on imported ingredients for consistency, although bakeries increasingly incorporate energy-saving measures. Malta's farmers are not just food producers; they are stewards of biodiversity, soil, and landscapes. Their work is a labor of love requiring public recognition and support. Ensuring food security and cultural preservation demands policies and consumer awareness that value and sustain the contributions of these essential caretakers.

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INTRODUCTION

Why should we care about such a small yet economically productive island like Malta? Gross Domestic Product (GDP) as the only measure of success of a country can mask underlying issues for that state. Food insecurity is increasing with climate change, increasing populations, and a dependence on global food imports demanded by consumers. Malta is no exception. This paper is designed to 1) address the history of Malta and Malta's land use 2) explain how agricultural and land use practices have led to the current agricultural challenges 3) describe the influence of European policy in the twentieth century on Malta 4) focus on three Maltese products: strawberries, potatoes, and qagħaq tal-għasel (honey rings) as representatives of successful and culturally relevant foods and 5) how climate change, value chains, economies of scale, and sustainability practices can affect these food futures.

MALTA'S LAND USE HISTORY

Malta is unique because of its location in the Mediterranean Sea, located between Sicily and Tunisia on the northern edge of the Afro-Eurasian plate. The climate of Malta is Mediterranean while the geological land formation is North African. The island's highest point is 234 meters above sea level (Reuther, 1984). Climate change has affected the expected yearly rainfalls and temperature in Malta creating economic uncertainty for farmers. The seasonal climate is a complex of three pressure systems: Atlantic, Eurasian, and African. The summer months, June to August/September, has light surface winds without rainfall. Autumn months are short, September to November that bring cold winds from northern Europe clashing with the warm tropical air inviting instability, increased rainfall and Gale force winds. The winter months run from late November through February. According to the Met Office Weather Website, May through August receive the least amount of rainfall on average of five to nine (mm) per month. The location of Malta in relation to Sicily and Tunisia affect climate conditions on the island. An increase in sea temperatures, reduced rainfall, and change in cloud cover create stressors on this semi-arid densely populated island (Cassar, 2020; Galdies, n.d.; Main et al., 2021a; Met Office, 2025).

The island of Malta is food insecure because of poor soil quality and limited freshwater. The upper and lower coralline limestone of this geologically young island (formed 5-30 million years ago) is separated by a blue clay and globigerina limestone that serves as a barrier to the two groundwater systems. The Romans used the land for cotton production, a core crop for sea faring imperialism and global exchange of goods (Dimova et al., 2021). The removal of forests in favor of cotton stressed the soil. The geologically young soil had little biological organic matter that made the land susceptible to erosion by wind and water. The Smithsonian Institute catalogs the importance and power cotton provided for colonization of the seas (Farnie & Jeremy, 2004). Malta has had food insecurity challenges since the Knights of St. John (1530) because of the

need to use agricultural land as fortified areas for protection from invaders. The governance system also caused a decline in land fertility and management. The Knights of St. John used Malta as a strategic location for shipping and military defense with some agriculture included. Malta continues to be an important shipping port. Goods from Africa and Europe passed through Malta, so Malta always has access to foods via trade. COVID-19 illustrated the weaknesses in a reliance on imports for food security and tourism as economic supports.

IMPORTANCE OF MALTA IN THE MEDITERRANEAN

Malta is a small island 316km^2 in size with a population of 600,000 - 700,000 people. In the NSO Census Report on Population Malta had 519,562 people (NSO Malta, 2023b). For cultural relevancy for both agriculture and food insecurity the following is a brief history of Malta. The Phoenicians were the first dominant culture that used Malta as a strategic location for controlling the Mediterranean Region. The Romans invaded Malta in 218 BCE and ruled until 476 CE. The forests were cleared for crops such as cotton, wood was used for ship building and a tithe needed to be paid to Rome, as per usual when incorporated willingly or not, into Rome's fold. The Byzantine Empire (476-870 AD) cultivated wheat, olives, grapes and barley. The Arab Caliphates (870-1091 AD) introduced new irrigation techniques so that water intensive crops such as fruits, vegetables, sugar cane, and cereals could be cultivated. This period introduced crop rotation as a method for increasing crop fertility. The Normans (1091-1194 AD) introduced pastoralism for sheep and goats. The Normans increased infrastructure for movement of goods, and military defense around the island. An increase in fortification lead to a reduction of agricultural lands. The Swabian and Angevin Rulers (1194-1309 AD) contended with pirates both within Malta and from afar. During this rule, feudalism increased noble land ownership extracting taxes from the locals causing a decline in agriculture sustainability. The Kingdom of Aragon (1309-1530 AD) saw a continued attack by pirates causing more land to be used for defense and fortification that led to the development of Valletta.

Today Malta is a popular tourist destination accessed by cruise ship, ferry from Sicily, or air that offers a rich and well-maintained history that is under threat loss to urban expansion. The seasonal year-round temperatures (15°C–32°C) offer an economic boon to Malta's GDP. Multiple UNESCO Heritage sites, harbor towns, and restaurants offer tourists a variety of choices and landscape to enjoy. The long history of various land managers from the Phoenicians to the Arabs, French, and British and the Maltese have left small rubble wall patterns over the island that are sandwiched between the urbanized areas that occupy 25% of the island (Grech, 2021). Small Island States are coming under economic developmental pressure that create pressures for water use, food resources, land use change, energy, sewage, and waste management. In Malta, farms are often less than one hectare in size, in a networked rubble wall configuration that may require permission from another farmer to get access for large equipment to prepare the soil. The farmers themselves may not live near their fields. The soil depth and type can vary from field to field. The expense of purchasing land or leasing land for family bar-b-ques, and not farming, further stretch the limited agriculture production as the number of agricultural holdings decreased by 16.2% for utilized agricultural from 2010 to 2020 (NSO Malta, 2023). According to the Census of Agricultural 2020 potatoes are grown on 7.3% of arable land. Strawberries are grown in greenhouses and outdoors. Strawberry greenhouse production is 12.2% and out of doors is 3.7% of arable land. Increasing population on the island has driven up land prices, increased construction, and left limited space for the residents of the island to enjoy their lives. The challenge these tourism dependent islands face is how to balance already scarce resources while managing the islands' economies of scale (Connell, 2018; Hampton & Jeyacheya, 2020).

In the case of Malta, there is a connectedness of urban, island area, and state policy decision making that is an example of a multi-zoned island, densely populated due to net in-migration (Main et al., 2021a). The dynamics of a city-island-state influence and create unique challenges for Malta's agricultural community as well as the retention of endemic culture.

Figure 1: Local boundaries of Malta. Esri ArcGIS online 2024 by Bauer.

POLICY CHANGES AND LAND USE PERSPECTIVES IN EUROPE

The European Landscape Convention highlights the importance of clearly defining "landscapes" including their historical uses, evolving land use patterns, characteristics, and cultural significance. Establishing definitions and frameworks support inclusivity and an acknowledgement that societal perceptions of land use have shifted over time. Traditionally, public policy regarding land has been shaped by top-down governance, determining ownership rights, and delineating boundaries based on natural features or administrative divisions (Bergsvik & Skeates, 2012). Distinctions between public and private land, as well as regulations on land use, often generate debate and tension within communities, reflecting differing values and priorities (Conrad & Cassar, 2010; Nijnik et al., 2009). Historically, land ownership has served as a marker of wealth and power, from feudal systems to colonial imperialism, and now present day. Legal designations of land such as protected, commercial, agricultural, or residential, further shape how land is managed and experienced (M. V. Balzan et al., 2018a; Schulp et al., 2019). As communities evolve, land use policies change, with a growing trend toward participatory decision-making that includes diverse stakeholders, moving away from exclusive, command and control approaches. Landscapes carry layers of geological, cultural, and regional history, and these inherited perspectives continue to influence current land use and policy decisions (Conrad & Cassar, 2012; Schulp et al., 2019).

Within Malta the land use changes in monocropping of cotton, sugar, citrus and olives is evidenced in the environmental history of the island. Citrus and olive trees are common crops while cotton and sugar cane are now imported. Animal husbandry practices of small ungulate grazers like sheep and goat are part of the terrestrial food culture. Strawberries were identified in Malta's literature in the 1300s and potatoes were present in the 1800s (Farrugia, 2008; Magro, 2001). Busuttil (1993) describes a change in Malta's economy from an agricultural power, positioned strategically for seafaring ships' replenishment, to a gradual decline in the mid 1800s as the harbors became sites for economic and political strategy. World War II brought farmers an increased economic opportunity from food scarcity by supplying the British Army with fresh produce. Agricultural quality varied as the demand for produce was high. Malta's farmers had an exclusive client, the British Army, and they did not need to market their wares elsewhere. With

Malta's independence from British rule in 1964, agriculture was protected by the government. Food prices were controlled and imports of non-Maltese produce stabilized farming prices, but the lack of competition instilled a lack of desire for initiating innovative farming techniques (Attard et al., 2024; Busuttil et al., 1993; Walls et al., 2018).

The EU recognized the need to support agriculture in the wake of WWII that led to the 1957 Treaty of Rome the foundational work for the current Common Agriculture Policy (CAP). When Malta joined the EU in 2004, they joined agreeing to abide by EU policies including the CAP. The initial intent of the treaty was to provide food security and supporting policies that included subsidies across Europe. Competitive pricing for agricultural produce with a stabilizing economic plan supported by policy increased the amount of produce available reducing the dependence on imports. The increase in production through mechanization and the introduction of chemical fertilizer rebuilt the agriculture sector into an industrial powerhouse. Fair wages to the farmer and the fear of starvation were the primary motivators for the CAP. Industrialization changed the farming community dynamics in the smaller extended family-owned farms. Those farms that received subsidies were able to innovate and outcompete other farming community members. Balzan (2024) reports that only 55% of farmers in Malta receive CAP subsidies. Labor using the Maltese cow changed to mechanical tilling reducing the number of people who worked the farms daily. Those farms that were unable to produce and provide for their families were more likely to abandon farming in future generations (J. Balzan, 2024; Debela et al., 2020; Hendrickson & James, 2005). The NSO Census of Agriculture 2020 (2023) identifies both full-time and part-time farmers in the census data. Part-time farmers are designated by the term other gainful activity (OGA) that is not related to the agricultural holding. The decisions to grant government monies based on land size holdings and production created a divide among farmers even with the successful production of food and economic stability for crop prices. The distribution of funds based on size of holdings created inequalities within the farming community.

The inclusion into the EU and access to CAP funding caused a change in rural community dynamics in Malta because those who were unprepared to meet the CAP criteria left the farming sector (Ministry of Agricultural, Fisheries, and Animal Rights, 2024). New seeds were imported, reducing a need for the farming community to be interdependent in seed sharing. An increase in nitrogen pollution, loss of genetic diversity of crops, soil erosion, water loss, increase in microbial and invertebrate infestations, loss of biodiversity, and air pollution resulted as a natural response to the years of investing in a policy of high-yield production initially devised in the Treaty of Rome 1957 (Giuliani & Baron, 2025). The CAP allows for flexibility in fund distribution by country based upon each of the EU agricultural members needs and the criterion set for the EU's agricultural goals. In Malta, subsidies were distributed for utilized agricultural areas (UAA) in the following areas -- investment in physical assets (144), business start-up support for young farmers (33), agri-environment-climate (1,824), organic farming (6), and payments to areas facing natural or specific constraints (6,198) (NSO Malta, 2023a). The agri-environment-climate holding distribution received the most subsidy specific investment support for 1,824 holdings. In Malta 75.6% of holdings are less than 1 hectare (Camerelli, n.d.). The farmers small holdings are often disconnected from one another, and a neighboring farmer's practice can affect another's holding. For example, one farmer has a Cyprus tree whose roots extend into their neighbor's holding. The neighbor's tree affects the crop competition for water (ZG162).

The CAP has taken on new initiatives to reduce pollution while restoring ecosystem services and retaining production of agricultural crops. The challenging life of farming has led to rural depopulation. The lack of young farmers, loss of crop diversity, institutional farming knowledge, and an increased awareness of

farmers as guardians of ecosystem services and landscape ambiance has placed rural development at the center of the CAP. Fair subsidy distribution given to farmers as income addresses the difference in production capacity of large farms compared to smaller farms. Another challenge for implementing CAP is the expansion of the EU (originally the European Economic Community (EEC)) from six countries initially, to fifteen and finally to twenty-seven countries in 2013. The greatest enlargement of the EU was in 2004 when ten countries were admitted with Malta being one of those members (EU Watch, 2025; Giuliani & Baron, 2025).

Zero pollution monitoring is one of the current focuses of the CAP. The Zero pollution program assesses the effects of production and consumption, on health and ecosystems. Forty-five pollution indicators are used to assess trends designed to inform exploration and use of funds for further insight. A Zero pollution monitoring dashboard is comprised of qualitative and quantitative data sets and knowledge (European Commission. Directorate General for Environment. & ECORYS., 2021). Methyl bromide is no longer applied to soil as was a traditional practice in the early 2000s as a general pesticide. The current aim of the CAP is to reduce nutrient overload, fungicides, herbicides, pesticides, and molluscicides pollutants to increase soil health (Malta Environment and Planning Authority, 2014). Soil health is addressed in Malta's National Biodiversity Strategy and Action Plan 2012-2020. Malta has a higher rate of fungicide use, 8.7 kg/ha on average, compared to other pollutants (*Figure 9*) (Food and Agriculture Organization, 2019). Malta's agricultural plan aims to have 70% of farmers trained to do soil analysis with the goal to reduce gross nitrate balance caused by agricultural inputs by 30% on their land parcel using the Nitrates Action Programme (2011) as guidance. Malta's annual nitrate concentration was not in excess of 10mg/L even though a number of agricultural sites measured 50mg/L (Malta Environment and Planning Authority, 2011). The current Nitrate Action Programme 2011 indicates Malta's improvement overall from its 2004 designation as a Nitrate Vulnerable Zone (NVZ).

To apply for the subsidy the farm must be within the EU, produce or perform an agricultural activity, and be considered as an active farmer. Minimum income support requirements are in place (European Commission, 2025b). Direct payments can be made as a safety net for farmer income provided, they are strengthening environmental conditions known as good agriculture and environmental conditions (GAECs). Small and medium sized farms are to receive higher payments compared to larger farms as an implementation of fairness. Specific protein/legume crop support will increase by 25% for the purpose of reducing fertilizer input while increasing soil health.

The CAP gave access to the agricultural community to funds with the intention of increasing sustainable practices and access to technology transitioning traditional farming practices. The EU CAP allows for flexibility in how funds can be allocated by each country. The CAP began with a focus on crop production much needed after WWII (1950s), guaranteeing prices to farmers as indirect subsidies including state quota systems for market management (1960s), direct government intervention for the purchase of surplus crops with farmer subsidies (1980s), and direct farmers subsidies centering on family farms (1990s). A shift to area production including livestock and guaranteed pricing led to higher EU markets compared to the world. The government no longer had access to foreign markets, and the surplus was stored at a cost (2000s). The Fishler reform was enacted when Malta joined the EU. The importance of the EU CAP for Malta is when joining the EU in 2004, the removal of agricultural protectionism for farmers occurred. A Single Farm Payment (SFP) was given directly to the farmer based on historical income, not production. Environmentally friendly practices such as crop diversification and landscape preservation were encouraged. The 2013 reform included a socio-economic strategy for older farmers, natural areas

that are less productive, and rural depopulation by encouraging young farmer supports (Camerelli, n.d.; Census for Agriculture 2020, 2020; Nitrates Action Programme Malta, 2011; de Marco & Dingli, n.d.; Giuliani & Baron, 2025; Ministry of Agricultural, Fisheries, and Animal Rights, 2024; Petra Caruana Dingli, 2012; Sultana, 2024).

MALTA'S CURRENT AGRICULTURE AND CULTURE SITUATION

Malta joined EU in 2004, after having frozen its formal application submitted in 1990 because of the change in political leadership. A resurgence in accession negations began in 2000 and were put to a referendum in 2003 resulting in the Treaty of Accession (European Commission, 2025c). Malta benefitted from CAP expenditure investment through modernization and direct aid to farmers in the amount of 130 million euros from 2005-2013 (European Commission, 2014). Farming is labor intensive and requires precious land and uses 30% of freshwater extractions to produce crops that cannot feed all the inhabitants. Agriculture represents 48% of land use on Malta (Conrad & Cassar, 2012). The farmers are grouped by age into three groups: 26-45, 46-65, and 65+ years old (Galdies et al., 2016). Farmers do not necessarily live on or near their fields (Main et al., 2021a). Trade, migration and historical occupations of this Mediterranean region have affected food culture and food preferences. Traditionally, Maltese relied on kitchen vegetables, a variety of birds, rabbit, and pork. Fruits were popular and imports of olive oil, butter, and cheese arrived from Italy, Sicily, North Africa, and Ireland. Grain grown on the island provided different attributes that created a high-end bread and peasant bread (Attard et al., 2023a). The Roman Catholic Church influenced consumption during holidays where abstinence from sugars and meats are common. Today, agriculture accounts for 2% of Malta's GDP (Borg & European Commission. Directorate General for Research and Innovation., 2018). Kitchen gardens are defined as the cultivation of crops for personal use. In other words, these are subsistence agricultural parcels. The number of kitchen gardens has increased by 463%, with market crops decreasing by 22.87% (Galdies & Meli, 2022). The Evolution of Global Agrifood Trade and Trade Policy and Implications for Nutrition 2017-2019 report that 84% of kilocalories are imported to Malta (Food and Agriculture Organization, 2025).

Malta's inclusion in the EU has implications for farming practices to meet IPCC goals of sustainability. In addition to EU inclusion, farming has changed in response to climate change, availability of land, cost of labor, and a competitive EU agricultural market (Attard et al., 2023a). The mosaic pattern changes in land use due to intensive agricultural practices, population increase, urbanization, and increased tourism are affecting heterogeneity and ecosystem services in Malta (M. V. Balzan et al., 2018b). Agricultural landscapes provide important ecosystem services such as provisions, crop pollination, flood protection and carbon sequestration, that regulate air quality, well-being, and biodiversity. Homogeneity decreases agricultural adaptive capacity response to economic downturns or climate change.

Over the past 30 years, EU farming policy has shifted toward reducing pesticide and nitrate use, while promoting biodiversity and sustainable practices in response to climate change. These changes align with broader policy initiatives and legislative frameworks that encourage the adoption of sustainable and climate-smart agricultural methods, such as diverse crop farming, conservation agriculture, and integrated pest management, all aimed at improving soil health, increasing biodiversity, and reducing negative environmental impacts. The adoption of new technologies including the use of plastics, plastic tunnels, drip irrigation, and increased mechanization for tillage—has supported the expansion of greenhouse practices. These changes have enabled year-round production of crops such as tomatoes, cucumbers, green peppers,

melons, zucchini, lettuce, runner beans, and aubergines (Attard & Meli, 2008). According to the National Malta's Agricultural Policy for 2018-2028 (Camerelli, n.d.), lists seventy-eight hectares of registered greenhouses, with L-Imġarr accounting for the largest share (20.06 ha). Farmers have responded to climate change by planting local olive trees and implementing rainwater harvesting to combat periods of insufficient rainfall. There is a growing awareness among farmers of increased droughts, and intense rainfall, although data indicate that temperatures have risen, but island wind speeds have decreased by 0.8knots (0.4m/sec) over the past three decades (Galdies, 2020). Climate change has led to noticeable effects on crop yields, with evidence of an 11.6% vegetable yield loss in 2011 compared to 2010, attributed to decreased rainfall of 5% to 6% and increased surface temperature of 1.2°C to 2.3°C relative to baseline data from 1986-2005 (Galdies et al., 2016). These negative production changes in crop yields highlight the vulnerability of agriculture to climate variability and underscore the need for continued adaptation and innovation in farming practices and water conservation (Choi et al., 2024a).

The Maltese government has established nitrogen application limits to soil to meet the EU standards for agriculture and protect the groundwater (50mg/L of nitrates). Freshwater is a limited resource on the island, 61% comes from groundwater and rainwater harvesting is 7%, and an increase in tourism has placed greater pressure on this essential resource (Choi et al., 2024b). The government has invested in reverse osmosis technology where 64% of the drinking water on Malta per Choi et al. (2024) is then mixed with groundwater and everyone benefits from this treated water. Urban development has placed pressure on water use, runoff, and water infiltration. Farmers need better environmental soil moisture monitoring to make sound agricultural decisions in real-time (Borg & European Commission. Directorate General for Research and Innovation, 2018). New Water is treated wastewater that removes the bacteria, chemicals through reverse osmosis, and oxidation of pollutants (Water Services Corporation, 2025). This water is referred to as dead water by the agricultural community. The New Water will be mixed with groundwater in a 50/50 mix and then applied to the fields per the farmers I interviewed (XF121, XF122, XF141, XF161, XF201). This water is non-potable and concentrated in the northwest and southeast areas of Malta.

Farmer cooperatives also wield influence, with large retailers holding more sway than smaller, less well-known farmers. Government representative YG162 spoke about the history of the cooperatives that began in 1947 as a response to the hunger and unemployment in post-WWII. The government of Malta at that time gathered the farmers together to create the first cooperative. The government would amass agricultural inputs in bulk and deliver those items to the farmers. The first cooperative was formed by a fruit and vegetable farmers with other cooperatives soon to follow—dairy, wine, fisheries, and Agricoop, an agricultural input supply cooperative--created with the intent of pooling and distributing resources within the agriculture community (Rizzo, 1994). The Pitkali started as a direct farm to consumer pathway for fruit and vegetable distribution. Only local produce is sold here in effort to elevate the access of agricultural product to consumer. The cooperative structure provides a tracking system for quality control, and payment to the farmer. Farmers are paid at the end of month, and a 9% commission is given to the cooperative for operating expenses and infrastructure (YG162). Quality control comes in the form of permits for food handling through the Malta Consumer Agency, training on machinery such as a forklift, and support in government documentation like taxes and insurance. All the cooperatives are united under the Koperattivi Malta designed to represent and promote the co-operative movement in Malta. The governance of the cooperatives requires a transparency of schemes and distribution of funds controlled in a democratic fashion (Mediacoop, Ltd, 2021).

Since Malta joined the EU, vegetable farmers have had protective subsidies removed. The semi-arid conditions, small arable land holdings, and lack of fertile soil in Malta create challenging conditions for competing with other EU countries. While sustainable practices, such as drip irrigation, reduced fertilizer inputs, and the use of green manure, are being implemented, Maltese farmers continue to face water scarcity and struggle to meet the island's population's food needs. WasteServ, responsible for managing Malta's domestic waste collects organic waste on Monday, Wednesday, and Friday according to their Waste Separation Guide (WasteServ, 2023). White bags are available to households for organic wastes such as cooked and raw food, bones, bread, pasta, coffee, tea, and peels. Bags are left on the sidewalk for garbage truck pickup. According to WasteServ (2023) 40% of organic waste ends up in the mixed waste bag and is not able to be composted. The organic processing plant converts organic waste into biogas and agricultural compost to enhance Malta's circular economy. Based on the Regional Councils' data a total of 27,077.68 tonnes (2023) and 29,522.02 tonnes (2024) of organic waste was delivered to the treatment facility. Food waste that is composted from the Pitkali is returned to the farmers as peat or compost (YG162).

The Maltese government is interested in promoting sustainable and regenerative agriculture to meet the EU's National Agricultural Policy goals, which sometimes conflict with farmers' requests. Small scale farmers are impacted by the net zero emission pledges that are designed for large, agri-corporation farming systems. NGOs such as The Friends of the Earth support eco-friendly policies that may disadvantage some farmers, and these NGOs may collaborate with the government to enact these changes. Retailers, exporters, and consumers demand quality products that enhance the efficiency of the food chain (Ministry of Agricultural, Fisheries, and Animal Rights, 2024).

Food imports are a necessity for food security in Malta, complementing local food production. The diet of Maltese has changed over the past two decades because of changing access to imports and food policy. A once locally sourced food protectionist policy transitioned into an open market system that increased access and initiated a processed, high-fat diet. Mizzi (1994) reported that Malta imported 80% of its calories—100% sugars and cereals, 90% oils and fats, 87% fish, and 70% meats—for residents and tourists. High consumption of breads, cereals, dairy, sugar, red meats and a low consumption of fresh fruits and vegetables (Caruana, 2022; Malta Department of Health, 2014) is due to tourism food demands and changes in imported foods (Mizzi, 1994). The Food and Nutrition Policy and Action Plan for Malta 2015-2020 (2014) includes the change in Malta's food available items: year-round food access to once seasonal food items along with an increased availability of fat, salt, and sugar items with fewer healthier choices. An increase in supermarkets and a decrease in local grocers affects food choice and food availability. Caruana (2022) identifies one large supermarket on the outskirts of each Maltese locality and two to three medium-to-large grocery stores within. Frehner et al. (2022) examined the relationship between low-opportunity-cost biomass (LOCB) with a circular economy. This analysis found Malta had a large LOCB compared to other countries resulting in a large nutritional gap because trade is not equal between countries (Frehner et al., 2022). An assumption is made that all countries can trade equally. Malta, an island with a small-scale export economy is unable to trade equally with continental countries such as Italy, or Spain. As demand for healthier food choices increased, whether through social media or government policy, the war in Ukraine, along with the pandemic, illustrated the dependence of Malta's foreign supply chain (Ministry of Agricultural, Fisheries, and Animal Rights, 2024). Food Resiliency Plan includes the Ministry of Agriculture, Fisheries and Animal Rights (MAFA) was tasked with organizing the Malta Food Agency (MFA) after the global interruptions of trade flow and food prices. Food security was assigned to MAFA in 2020, and the MFA was established in 2021. The Food Safety Commission was

transferred to MAFA in 2022 along with a Food Systems and Food Standards directorate in 2023 to provide support and implement food security measures for Malta.

Included in the Food Resiliency Plan is a recognition that farmers, first and foremost need to provide a decent income for their families. Feeding their community and providing healthy, culturally relevant products increases Malta's culinary heritage, and maintain a beautiful landscape. Investing in farmers through research and technology while returning to cultural varieties is essential to create food independence and food choices.

The Organic plan for Malta stems from the EU Organic Action Plan that identifies a locality (biodistrict) as food produced with a reduction in chemicals that is shared with the public and tourism operators. These biodistricts will emphasize a sustainable supply chain, quality produce, culturally relevant produce, and agri-tourism that is appealing to today's generation. Increasing the number of organic farmers in the Maltese farming community along with organic education support, and an organic certification is in the works for the near future (Ministry of Agricultural, Fisheries, and Animal Rights, 2024).

The loan rates for farmers tend to be unfavorable and therefore are not utilized in the agricultural sector (*National-Agriculture-Policy-for-the-Maltese-Islands-2018-2028*, n.d.). While farmers may be eligible for subsidy funding, there is personal capital that must also be invested. The subsidies do not cover all farming expenditures. Farmers eligible for national subsidies are those who sell their produce through the Pitkali cooperative market, have a registered vineyard, those applying for VCS tomatoes for year 2022, or those who have a digitized crop plan for food production with the Agriculture Directorate. These farmers are eligible to receive a direct grant of €650 per hectare that is intended to cover the rising costs of fertilizer. Several different payment schemes are found in the Guidelines Direct Payments 2023-2027 v6.9 –small farmers, young farmers, integrated pest management, bio-mulch, non-productive arable land, propagation of drought resistant varietals, pest resistant varietal development—land areas that are eligible are 0.3 ha of total holdings, not less than 0.1 ha for the parcel (Agriculture and Rural Payments Agency, 2023). Farmers can apply for multiple categories of payments. What cannot be covered through the Malta CAP scheme may require the farmer to seek funding from banks, or farmers may be required to put their capital upfront before receiving CAP funds. Malta Bank (2025) lending rate is 3.435% and Swedbank (2025) offers a Direct Payment Loan for €4,500-€100,000 and an individual annual interest rate with an 18-month term. The uncertainty and risk involved in agriculture due to climate change in particular make securing loans from banks unfavorable in many farmers eyes. Farmers have almost doubled the use of mechanized land cultivators that rely on fossil fuels, doubled the reliance on irrigation, and increased greenhouse cultivation from 41.74 ha to 51.17 ha from 2000-2010. A positive correlation exists between total rainfall and crop weight (Galdies & Meli, 2022). The changes in climate patterns create an uncertainty for the farmer that they will be able to produce enough crop to meet the loan payments.

RESILIENCE

The three pillars of food resiliency for Malta directed by the Ministry for Agriculture, Fisheries and Animal Rights (MAFA) include local production viability, food supply consistency, and pride in cultural foods and food production (2024). The island's small size along with small farms understand that food importation is necessary but not to the extent of pre-COVID-19 imports. Regional conflicts and civil wars are another factor in the strategizing food security sustainability decisions in the supply chain for both access and

health. Maltese farmers are unable to compete with farmers in the EU that have much larger economies of scale. The CAP allows for support for farmers in several areas. Direct payments are being implemented under the CAP to crop producing farmers and the maintenance of landscape. Coupled income support for a competitive standard price of crops on the market, and payment for soil management along with biodiversity enhancements are designated for farming practices. Training for farmers, especially new farmers is available where the farmers can attend classes free of charge and the CAP funds pay the organizations offering those courses. The Malta College of Arts, Science & Technology (MCAST) offers a variety of courses in applied agriculture. This vocational training allows for transfer of knowledge and integration of new techniques. These courses are free to the farmer and they are covered under the CAP.

Malta has over 70 agricultural organizations that are recognized cooperatives. The benefit of being a part of a cooperative is that participation can lead to bargaining power and sharing of limited resources (Camerelli, n.d.). However, this comes at the expense of individual farmers' control over their client base. The Maltese government, in collaboration with Friends of the Earth an NGO, is working to enact the Malta Strategy for Resilient Food Systems Program (2025-2034). The focus is on local production and sustainability, which will enable Malta to achieve EU agricultural goals and retain its EU agricultural brand. Retailers and consumers demand a level of quality and consistency in agricultural products, encouraging farmers to meet these expectations and receive top dollar (Ministry of Agricultural, Fisheries, and Animal Rights, 2024).

CULTURE

Accession into the EU has changed the demographics of Malta, and the food consumption practices. EU citizens are free to come and go, taking their food preferences with them as they travel. Joining the EU has removed agricultural protections that Maltese agriculture enjoyed in the past (National Statistics Office-Malta, 2020). The creation of central markets, like the Pitkali, Ta'Qali, Birgu, and Marsaxlokk markets, are central locations for local access to farmer produce and tourists alike shortening the supply chain. The FCCS cooperative brought 2,000 farmers together to begin the Ta'Qali market that could compete with eighteen private fruit and vegetable brokers (Palmér et al., 2004).

An increase in tourism development has given people from other countries an opportunity to start restaurants using local produce in different dishes. Tourists are demanding local authenticity that has given rise to the authentic Malta cuisine restaurants. Emigration brings in people with different cultural backgrounds to fill job openings (NSO Malta, 2022). The immigrants arrive from Eastern Europe, South Asia, Middle East, and central African countries filling jobs that the tourist and gaming industry provide. Tourism brings in money but also creates pressures on local food demand that can shape farmer planting decisions (Hampton & Jeyacheya, 2020).

According to the Census of Agriculture 2020 (2022) 98.7% of agricultural holdings were run by individuals known as sole-holders. Sole-holders who were also farm managers are 93.7% of holdings while the other 5.7% of holdings were managed by a family member. Only .6% of holdings were managed by a non-family member. Farmers sell their products to organized farmer's markets, other wholesalers, street hawkers or retail shops including supermarkets, hotels and restaurants, direct to consumers, industry for processing, or livestock farms. Utilized agricultural land area has decreased by 6.2% compared to the 2010 Agricultural Census. Unutilized agricultural area has increased by 43% since 2010.

The number of hectares of permanent crop cultivation are declining, with the current holdings producing 41.4% (1,835 ha) of their produce for sole consumption as categorized by the increase of kitchen gardens. Other kitchen crop farmers utilized 58.6% (8,895 ha) of arable land selling the remaining, or all their produce through the various markets (NSO Malta, 2022). Thirty-nine percent of managers have 10-30 years as the responsible agriculture decision maker, with 80% having practical farming experience. Seventeen percent have basic agricultural training and 1.4% have full agricultural training.

Only 23.7% of farmers are under the age of 45, and 45.8% of farmers have a succession plan of continued agricultural land use after their retirement. Those managers under 44 years, 3.3% have full agricultural training. Farming is a male dominated industry with 11.1% women managers. Forty-nine percent of agricultural land tenure is rented from the Government of Malta. Other agricultural land was owner occupied (27.9%) or rented from private landowners (22.5%) (National Statistics Office-Malta, 2020).

Areas of conflict exist in land use, irrigation access, agriculture, and development (Pace et al., 2023). There are also regulatory and compliance issues, particularly concerning the differing requirements for traditional, organic, and hydroponic farmers. Conflicts also arise with regulatory compliance for pesticide use that can translate into hiring laborers instead of using chemicals, which leads to increased costs for farmers (Menghi et al., 2014). There is tension between the difficult life of a farmer versus the decision to sell land for a more comfortable future, or lose land for development (Debela et al., 2020). According to Eurostat Agricultural Land Rental Prices (2025) the cost to rent one hectare of land is €91. Market access for long-term farmers can differ from that of newer farmers. Times of Malta reported that the average price for a hectare of arable land was €283,000 in 2023 (Galdes, 2025). Water availability in addition to land access creates pressures for all of Malta's inhabitants irrespective of profession.

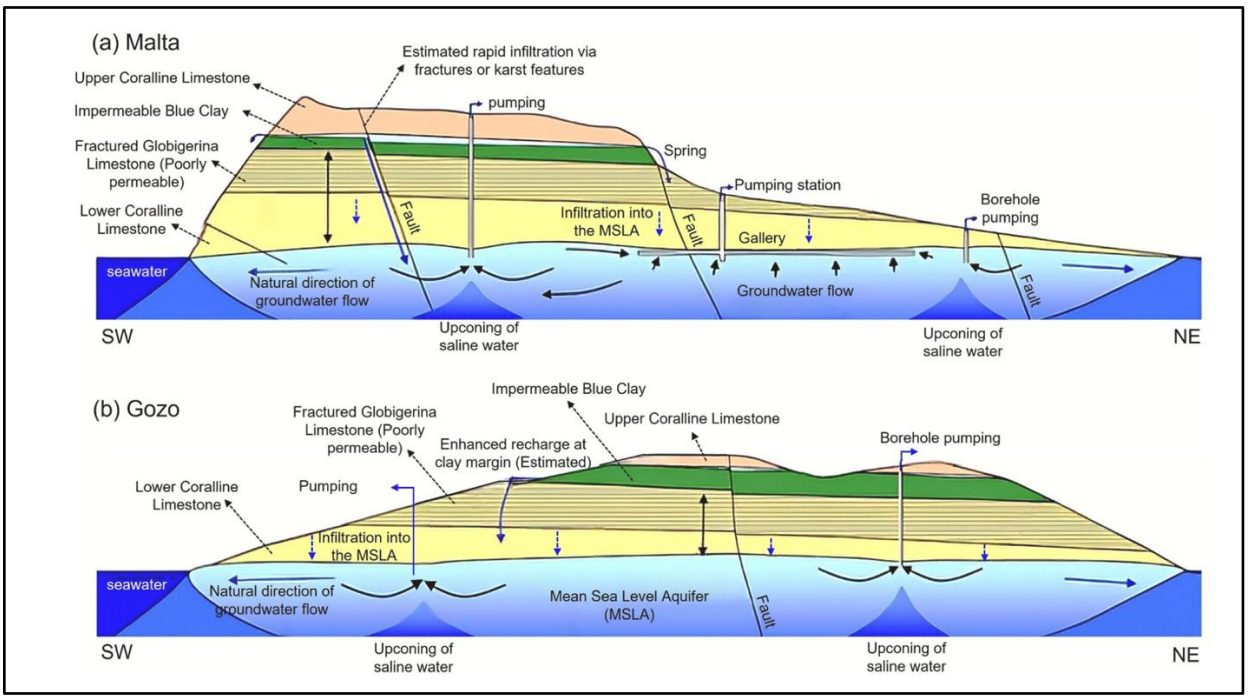


Figure 2: Groundwater resources for Malta. (Choi et al., 2024a)

The water withdrawal intensity for Malta is 78.28% and is calculated as the level of water stress. The freshwater includes all major sectors and includes renewable sector data with farmers accounting for one third of water use (Delia, 2005). The environmental water requirements are calculated for industry, agriculture forestry, fisheries, electricity, and services. The degree of competition between country's sectors. Travel and Tourism socioeconomic impact is a 4.0. General public awareness and concern for agricultural water footprint efficiency is demanded (Gavilán et al., 2021).

Food availability and culture of qagħaq tal-għasel is based on the history of past occupants of Malta that provides the ingredients for this traditional dessert. The original inhabitants of Malt during the Bronze Age grew wheat and barley. The Phoenicians introduced honey, eggs, and agricultural production of cereals, olive oil, figs, dates and nuts. Animal husbandry of sheep and goats was started with the Phoenicians. The Romans introduced salt and regulated grain production. Under the Arab period milk products were made and citrus trees, almonds and other nuts such as pistachios were planted. Almonds and sugar cane were incorporated into agriculture. Wild herbs that could be found easily were anise, coriander, fennel, and lavender (Morana, 2020). The extraction of groundwater and new irrigation techniques changed farming practices. Malta's feudal period left farmers vulnerable to slave capture; therefore, the fields languished, and the practice of grain importation began for the Maltese. Barley was the commoner's food while the rich ate wheat. Cinnamon from India was available through imports along with cloves and nutmeg (Vincenti, 2023). Prior to this period, Malta was able to meet the grain needs of the local population. Sicily was close enough to supply Malta with grain. Cotton, intensively cultivated during the Arab period, created the cash required to purchase the grain. Morana (2020) notes that The Knights of St. John exported oranges, lemons, orange-blossom water, and honey from Malta. Chocolate was imported from the Americas in the 17th Century. Under British rule the Maltese adopted British culinary dishes from those serving as housekeepers and cooks in those homes. Sugar became cheaper in the early 1900s (L-Furnar, 2025) . Qagħaq tal-għasel is a dessert that was traditionally made during the Christmas holidays because of the cost and rarity of ingredients. Black treacle was traditionally made from melted down honey combs, but now burnt sugar from sugar cane, beet sugar or molasses is used (Dougall, 2013). Honey may or may not be used in today's making of qagħaq tal-għasel.

Potatoes are exported to the Netherlands because Malta's growing season covers the Netherlands winter season when potatoes are not produced. Malta's potatoes are renowned for their quality. The value chain for potatoes has become a piece of culture and pride for Maltese. A couple who I spoke with shared with me in a casual conversation their surprise that other Europeans from Italy, and the Netherlands knew their potatoes were grown and exported from Malta. They expressed pride in their small country when sharing this story with me. Strawberries are grown and sold on the island. The yield is not large enough to support exports outside of Malta. The map of Malta in Figure 1 includes the major regions (Bauer, 2024).

SUSTAINABILITY

The complex history of Malta, a small island located in the Mediterranean, with an increasing population, and a historical lack of capacity for food security, created wicked problems. The addition of tourism dependence for income creates added pressures on the island both in terms of space and food production. Tourism trends change because of climate issues such as devastating storms, or health issues as seen during the pandemic; diversification of resources is critical for small island sustainability. Small scale agriculture is incapable of competing with large scale farming, the government owns much of the land, and

there appears to be a lack of trust between farmers and the government because of past land access issues. This distrust creates the crux of the problem for farmers and government in the realm of sustainable food security. In Malta, stakeholders in the vegetable agriculture subsidy sector include farmers, but within this group, there are various sub-groups: eligible farmers have different subsidy payouts based on size of the agricultural holding, land use for kitchen gardens, permanent crops, and arable land (potatoes occupy 570 ha of total arable land), change to organic farming, young farmer start-up, and physical asset investment (NSO Malta, 2023a) water conservation investment strategies (Paladini, 2022). Farmers are grouped by full-time and part-time farmers. Livestock farmers are separated into cattle, pigs, chickens (layers and broilers), sheep, rabbits, bees, and goat farmers. Agricultural groups are permanent crops, kitchen gardens, fruit and vegetable farmers, hydroponics, cereals and legumes, amenity horticulture, tomatoes for processing, potatoes, olive orchards, and agricultural services (Attard et al., 2023b; Camerelli, n.d.).

Malta's application of the CAP is focusing on stabilizing full-time farmers' income with the intention of ensuring continued management of landscapes and reducing the income gap between agricultures and other economic sectors. The increase in quality will be through investment and marketing that will enhance competitiveness. The government will upgrade rural roads and improved waste management. Beekeepers will receive investments in pest combatting invaders and disease. Construction of greenhouses and diversification into new or niche sectors such as organic farming can be funded in this CAP. Water storage, recycling and water treatment projects will be invested in. Conserving biodiversity and increasing indigenous species are included in the CAP and adaptation to changing climatic conditions (Camerelli, n.d.; Paladini, 2022).

For strawberry and potato farmers, the CAP applies to those farmers that are certified by training or experience. They can apply for various CAP funding under the following projects that can be found under the National Agricultural Policy for the Maltese Islands 2018-2028 (2022):

- Direct payments in the Basic Payment Scheme (BPS) based on farm size and being a registered full-time farmer on arable land. The minimal holding of arable farmland is 0.3 ha.
- Sectoral support under the small farmer scheme.
- Rural development for farm modernization—irrigation upgrades, digitization, and eco-friendly equipment.
- Environmental and climate objectives under rural development
- Eco-schemes under direct payments for crop diversification, soil cover, low impact-spraying, nitrogen fixing plantings, and integrated pest management.
- LEADER program is for farmers or rural businesses that are diversifying, innovating, enhancing skills, or creating a food brand or cooperative.
- Young farmer direct payment scheme is for farmers under 40 to receive funds in the first 5 years setting up a farm.

Subsidies for fresh fruit and vegetables are exempt from income tax according to the Agricultural Subsidies (Income Tax Exemption) Rules. These farming groups include vegetable farmers, farmers over and under 40 years of age, organic farmers, farmers who rent land, farmers who own land, full-time farmers, and part-time farmers. Additionally, there are farmers practicing greenhouse agriculture, including micro-agriculture. Some farmers are members of cooperatives, while others deal directly with the public. The government recognition of the valuable services farmers provide is evident in the CAP focus from production, to quality, to socio-economic equity, and recognizing farmers as stewards of biodiversity and ecosystem services that

benefit everyone (Bindi & Olesen, 2011). Other stakeholders include consumers from both Malta and the EU, retailers, transporters, market consumers, and supermarket consumers (Fratila et al., 2021). Scientists and researchers in the agricultural industry are indirect stakeholders in the vegetable agriculture subsidy sector (Paladini, n.d.). The government entities that administer permits affect the stakeholders (Camerelli, n.d.).

Malta is sitting on two freshwater aquifers, and upper limestone and a lower limestone aquifer (Figure 2). The changes in agriculture, land use, and increase in population have reduced the recharge rates for this freshwater system. The current water usage is unsustainable without technical solutions. The number of equipped irrigated holdings has doubled since 2000 from 22.2% to 44.4% of cropland with 38% of the overall water withdrawals (Food and Agriculture Organization, 2024).

CAP expenditures have been decreasing since 1980, and yet the demand for agricultural support has increased (Figure 3). The EU has expanded to 27 countries since its inception which stands to reason the increasing demand.

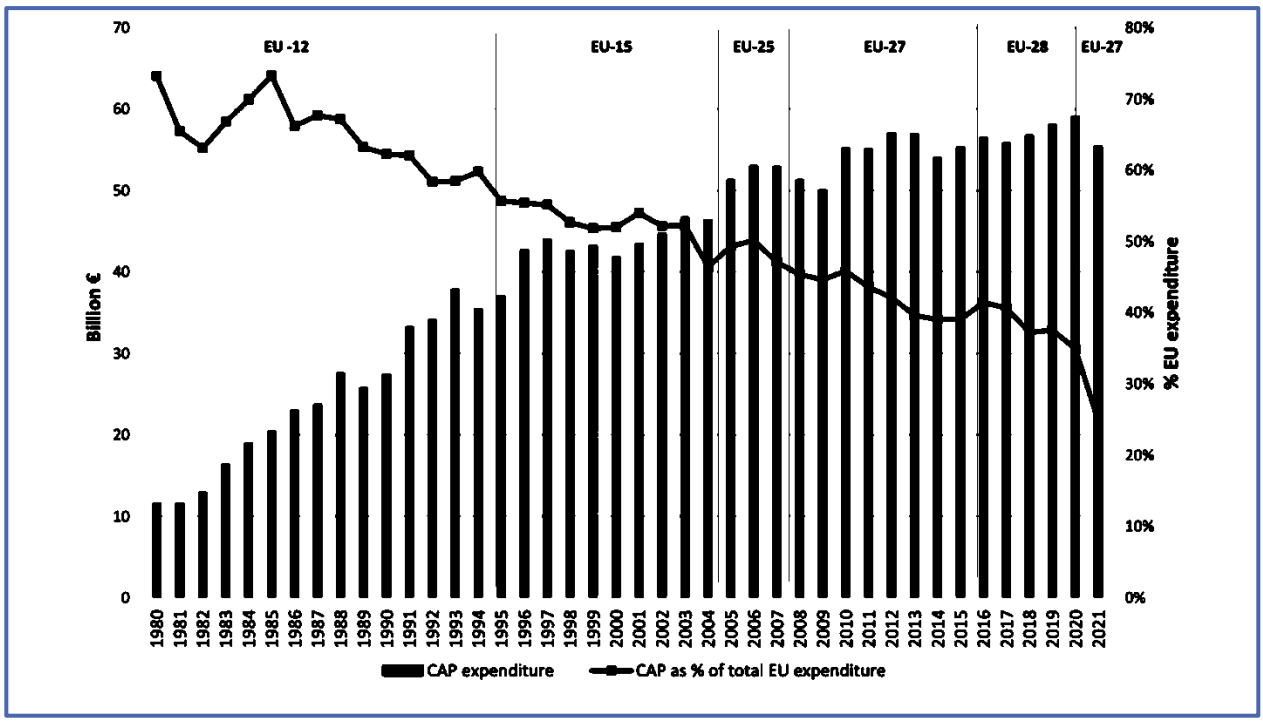


Figure 3: CAP expenditure in the total EU expenditures (current prices). Keep in mind that Malta joined the EU in 2004 (Giuliani & Baron, 2025).

During COVID-19 the government and residents demanded more locally produced foods. Many discovered local products that had been overlooked in favor of imported goods. Imported goods were also more expensive than local goods (YG162). A concern for consistent quality by consumers requires traceability that the Pitkali provides along with government testing every 6 weeks. The farmer registers for a government recognized number, they receive a bar code at the office that includes the farmer's region information and name. This tracking process gives the farmers and the government transparency about the harvest and payment.

PAST FOCUS IN THE LITERATURE

Climate change effect on food security and global supply chains.

There is a growing body of evidence illustrating the effect of climate change on agricultural production, import, quality, and income uncertainty (Bindi & Olesen, 2011). The weakening of the food supply chain requires broader understanding of adaptation and resilience beyond the relationship of physical factors: water fluctuation, temperature extremes and crop choice in production values only (Tchonkouang et al., 2024). Along with change in temperature and rainfall patterns, concerns over freshwater availability for agriculture is another concern for Mediterranean farmers who are competing with residents for potable water (Antonelli et al., 2022).

Technology has helped with the Product Environmental Footprint (PEF) (Soode-Schimonsky et al., 2017) and life cycle assessment of strawberry production (Nitzsche et al., 2016; Parajuli et al., 2022). Plasticulture (Galafton et al., 2023) and drip irrigation systems (Yang et al., 2025) have increased the sustainable practices of strawberry crop production.

Potatoes are the most commonly grown non-grain crop that contributes to food security (Economou et al., 2023). Europe's Farm to Fork program is filling gaps in research between organic and conventional farming sustainability practices (Timpanaro et al., 2021). Climate change causes farmers to adjust their planting practices based on irrigation and water management, drought tolerant variety choices, and sustainable practices (Litskas et al., 2023).

Disruption of global supply chain because of governance issues.

Alternative Food Networks (AFN) includes farmer's markets, food consumer cooperatives, and non-traditional food distribution pathways. The organization of these alternative food centers is dependent upon consumer access to food sources beyond the conventional providers such as supermarkets (Hunter et al., 2022). Qatar suffered in the 2007-2008 financial crisis as they rely on imports because of the poor sandy-lime soils and lack of rainfall from May to November (Miniaoui et al., 2018). Small islands are more dependent on trading with other nations and imports to their food systems. The Seychelles Ministry acknowledged food stocks of only four weeks when the COVID-19 pandemic affected the food supply chain. Food security was threatened when the ports were going to close and the lack of imports from Europe and North Africa. In addition to the pandemic effects on food security, the war in Ukraine was causing food import prices to increase. The government initiated the Maltese Food Agency (MFA) with the intent to help farmers become competitive (YG202). Farmers in other countries have machinery that increases food security. One government representative (YG162) points out that continental states have larger areas to farm so the risk of failure is reduced because of economy scale.

Europe's call for ecosystem services rendered by farmers and their value.

Before joining the EU in 2004, Malta had protected the farmers by limiting imports from other countries, both the EU and Northern Africa. Land was affordable for farmers. Land is owned by the government, the Catholic Church, and private individuals. Farmers who rent land from the government are called land managers and they often have a 99-year lease that can be transferred to family members.

The importance of food, farming, and local supply chains on retaining cultural practices. There is a growing dependence of small islands on imported foods that is changing food choices often leading to inferior food consumption. The change from traditional diets to imported foods increases health issues not previously experienced by the island community but also an economic vulnerability (Hardy, 2021).

How tourism effects island food security.

Tourism and travel can be rated on a scale of 1-7 on the Travel and Tourism Competitive Index (TTCI), with 7 being the highest score. Malta's GDP is 30% from tourism, an important component of the economy according to the VisitMalta website (2024). The World Economic Forum (WEC) gives Malta high marks for government prioritization of tourism, marketing, and spending. In fact, globally Malta is ranked first in the world (Calderwood & Soshkin, 2019a). Infrastructure, health and security, environmental stability, and natural resource and culture such as UNESCO sites play a factor in Malta being identified as a popular travel destination. Calderwood & Shoshkin (2019) listed cultural and natural resources in Malta with a low score (2.2). This low score is due to a lack of biodiversity, natural landscape development, or cultural attractions in comparison to other tourism choices. The island of Malta is rich in historical attractions and UNESCO heritage sites.

Sultana (2024) identifies 56% of Malta as arable land using GIS: 53% is arable land, 3% is degraded agricultural land, and 1% permanent crops. Ninety-four percent of the island lives in urban areas (Main et al., 2021b). The urbanized areas are used for tourism in the form of hotels, restaurants, roads, and historical buildings. The crowding of residents in these urbanized developed areas is one of the challenges Malta faces.

Malta has a score of 86 out of 100 for property rights that represent the ability to acquire private property (Global Economy, 2025). Malta has a high score that represents a right to private property but does not translate into ownership with 55.89 GVA attributed to irrigated agriculture (Aquastat, 2025). The GVA percentage translates to the amount of irrigated crops compared to all arable land available (Gillet & Biancalani, 2022). According to the EU farmers and agrofood business (SMEs) survey in 2022 the unmet financial needs of primary producing farmer has doubled from 2017 to 2022 (EU Agriculture and Rural Development, 2023). No water is being guaranteed for farmers according to the 2023 World Bank data. Twenty million cubic meters per year of desalinated water is produced as New Water with 100% of the population reliant on this water for drinking and 12.4% of products exported from Malta dependent on this water.

Malta currently has 115 m^3 of water per capita per year available. In 1972, 157.6 m^3 per capita per year of water was calculated indicating a significant reduction in water resource availability (World Bank, 2025a). The combination of population increases, a growing tourist sector, and agriculture requirements has placed demands on Malta's groundwater resources. The water stress has influenced Malta's water use efficiency in the agricultural sector. In 2000, farmers were paying \$2.06 per m^3 of water and in 2022 \$3.96 m^3. The Agriculture Census of 2020 (2022) states the use of 3,891 hectares of total agriculture managed water usage from boreholes and reservoirs: 985 hectares for open and greenhouse irrigation. Forty-seven percent of the water is derived from boreholes and forty percent from reservoirs (National Statistics Office-Malta, 2020). Fruit cost is 1.1 PPP dollars per person per day while vegetables are .83 PPP (*Cost of Fruits*, 2025). The least daily cost of meeting fruit and vegetable intake for a healthy diet indicates vegetables are better economically compared to fruit. The Residential Property Price Index (RPPI) puts housing price to income is 165.22 in 2024 (NSO Malta, 2025b). The percent change in housing from year

to year in Malta is increasing. Last year's RRPI was 5.2% percent less according to the NSO Malta housing database (2025).

Note: in the World Bank Group documents, Malta was considered part of the Middle East and North Africa Region economically.

WHY AND WHAT PROBLEMS ARE ADDRESSED IN MY WORK

- The problems addressed in my work are the sustainable and unstainable practices in strawberry and potato farming.
- The adaptations farmers and pastry chefs have made for sustainability
- Identifying the importance of these crops and qagħaq tal-għasel to the culture of Malta.
- The value chain of producing these products to identify weaknesses
- The importance of governance
- Elevate the recognition of labor intensity positions such as farming and food production.
- Climate change as a factor for consideration and how adjustments have been made.
- The necessity of retaining institutional knowledge of food production in Malta.
- The value of farming, food production relating to ecosystem services, biodiversity, and ambiance.
- Ecology issues related to strawberries, potatoes, and qaghag tal-ghasel.
- Soil specific needs and how these soils are related to the CAP.

WHY IS THIS WORK NEEDED?

Small islands are on the forefront of climate change effects. These communities are restricted by economies of scale and limited resources. The dependence on imported goods is essential for understanding vulnerable links in local food security systems. In addition to daily food requirement is the cultural food relevance that these unique communities are at risk of losing. Loss of food items can equate to loss of culture. Food production maintains ecosystem services and biodiversity that are critical to small island systems. My work brings together three food items that are important to Malta: strawberries, potatoes, and qagħaq tal-għasel.

METHODOLOGY

Semi-structured interviews were conducted with farmers, government officials, and a pastry chef on site.

Data collection and processing was conducted as a literature search through public sources including World Bank, Eurostat, Food and Agriculture Association, Organization for Economic Co-operation and Development, National Statistical Office of Malta, Asian Development Bank. In addition to data sets, policy briefs and reports from the European Union and Malta are included. Climate data was retrieved from Meteoblue weather archive.

RESULTS

CLIMATE

Climate change is affecting agricultural yields and strategies for farmers. Soil erosion, groundwater withdrawal, varietal selection, and policy are being implemented to maintain food production levels. Unexpected rainfall patterns and amounts are affecting crop yield, organic matter decomposition rates that affect soil productivity. An increase in temperatures increases the likelihood of pestilence where cold temperatures kept microbes and invertebrates in check. Diversification of crops increases biodiversity that can reduce infestations. Pesticides are used in lesser quantities than in the past as part of the EU CAP that is focusing on lower input systems such as organic farming systems as resilience strategy. Malta has a wealth of biodiverse insects even with the pressures of land use and agricultural land management, new species are being identified (Cassar et al., 2023). Earth.org (2025) identifies a growing trend of insect decline in Europe and globally. Europe has a 75% decrease in flying insects affecting ecosystem services, food security, and overall biodiversity. The causes of the decline is anthropogenic: pesticide applications, habitat destruction, pollution, climate change, and invasive species (Saravia, 2025). Many crops are dependent on pollinators for flowering and fruiting like tomatoes. The presence of pollinators increases crop yields compared to crops that were only wind pollinated (Bugin et al., 2022).

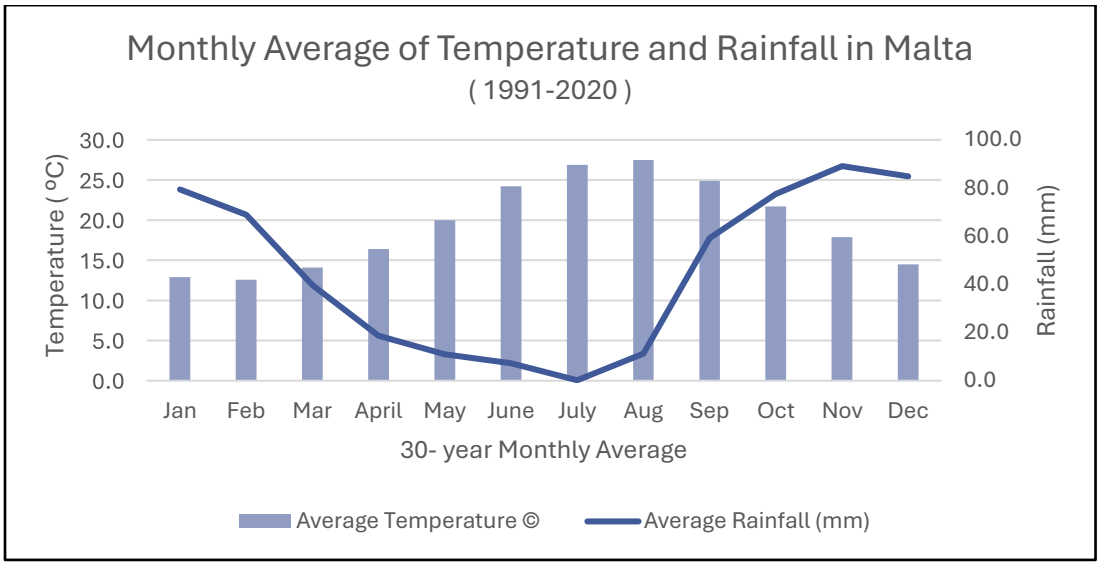


Figure 4: Thirty-year average of temperature (□C) and rainfall (mm) in Malta from 1991-2020.April-August have little to no rainfall while the temperatures range from16-26(□C). https://nso.gov.mt/wp-content/uploads/Climate-publication-2022.pdf

The semi-arid positioning of Malta in the Mediterranean Sea shows a traditional pattern of a rainy season and a dry season typical of north Africa (Figure 4). The months of September through March illustrate rainfalls of 60 mm increasing to 90 mm in November and then dropping to 45 mm in March as shown in Figure 4. Farmers and qaghaq tal-ghasel producers are aware that climate change is an issue and is a common topic for discussion (XF141, XF142, XF141, XF161, XF201, ZP131). Rains patterns are changing and over the last two years with three seasons of reduced winter rain and March 2024 had a high of 31°C which is unusual (XF161). This farmer also noted that in May 2025, people are still in winter jackets and wearing winter clothes. As a child they remember lots of rain and the removal of trees for building.

Temperatures are on average the lowest in December, January and February (13°C-15°C), increasing to 27.5°C on average in the months of July and August (Figure 4). The concurrence of high temperatures and lack of rainfall in May through August limits the food production choices by Maltese farmers primarily because of water availability (XF122).

Farmers collect rainwater during the rainy season to use later in the summer months for their crops. Farmers must also make decisions for planting land that is not irrigated in the dry season (XF121). The cost of pumping water is expensive, and the groundwater has become overused creating a 40-year recharge rate according to farmer XF121 and additionally has become salinized. Farmers are putting water back into the ground with construction and drains. The choice to grow crops that have a long shelf life, or can be pickled, canned, or turned into a preserve are also climate dependent choices farmers make. The ground is always covered protecting it from the elements, keeping the soil in place.

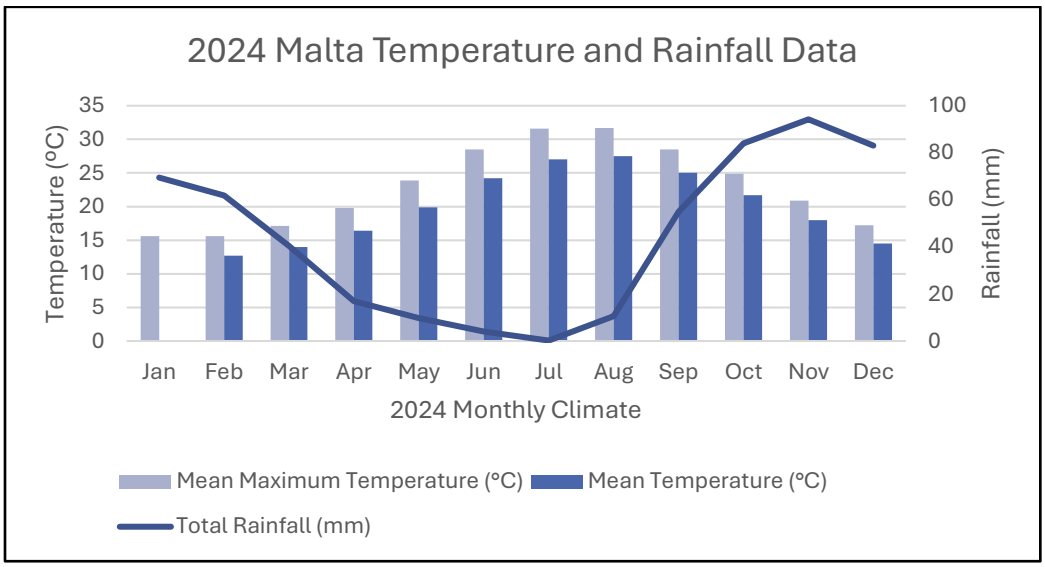


Figure 5: Monthly 2024 temperature and rainfall for Malta (Maltese Island Weather, 2024).

Figure 5 shows the current rainfall and temperature for the year 2024 that can be compared to the thirty-year data shown in Figure 4.

POPULATION

Labor is required to maintain Malta's economic investment in tourism. Food production is also labor intensive. Remaining food secure requires a commitment to producing crops that will sustain the current population. The CAP recognizes the value of crop diversification, biodiverse landscapes, organic agriculture, and conservation in the face of climate change and population increases (Bugin et al., 2022).

Employment of the population is elevated in the service industry. On Malta services include hospitality, tourism, finance, healthcare, and education. Industry includes construction, pharmaceutical production, and gaming. Agriculture includes annual and perennial crops, fruit trees, livestock and fisheries. Figure 7

shows the trend of economic employment from 2005-2024. The service industry shows a positive trend in employment while the agriculture and industry sectors remain constant.

The harsh climate, risks to decimation of crops by pests, concerns about earning a living, competition between farmers themselves, the access to land, and the amount of labor involved were mentioned as deterrents to take up farming by all who were interviewed (XF121, XF122, XF141, XF161, XF201).

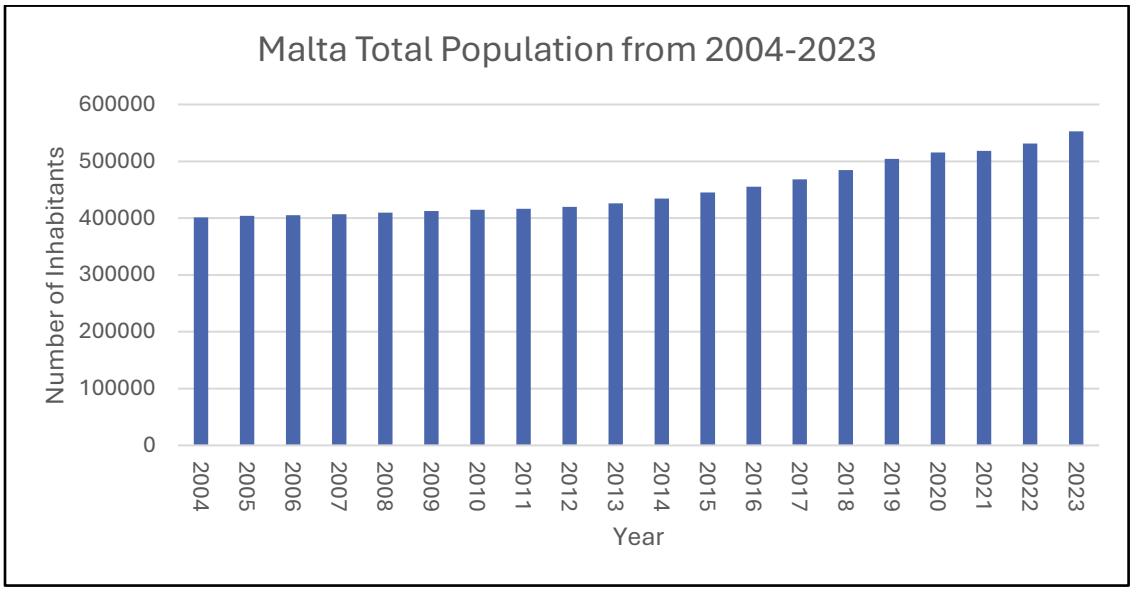


Figure 6: The population of Malta has increased over the last nineteen years per the World Bank (2025).

In 2004 the total residential population increased from 400,000 individuals to 552,747 (2023) as shown in Figure 6. This graph includes national and foreign people. Figure 7 shows a consistent Maltese population with an increasing foreign resident population from under 100,000 in 2018 to 140,000 in 2022.

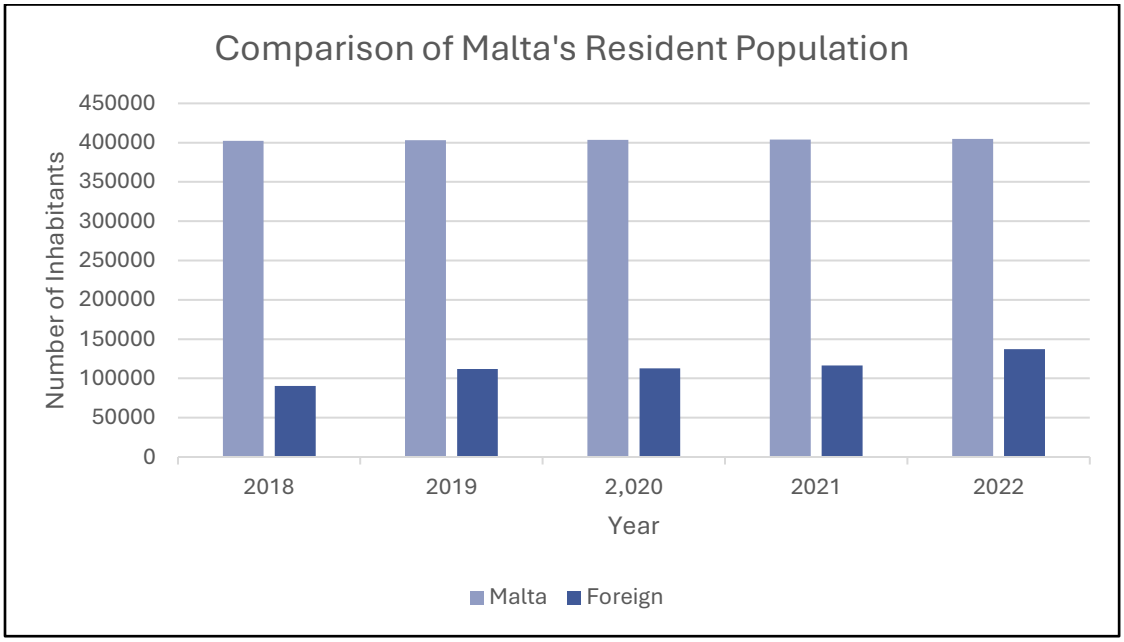


Figure 7: Malta's overall population composition from 2018-2022 (NSO Malta, 2025) .

A steady increase in the population is from the migration of non-Maltese individuals except for 2020 (Figure 9). COVID-19 affected global populations because of travel and residency restrictions as

governments had various procedures and protocols during this period. The increase in non-Maltese residents significantly climbs after 2019.

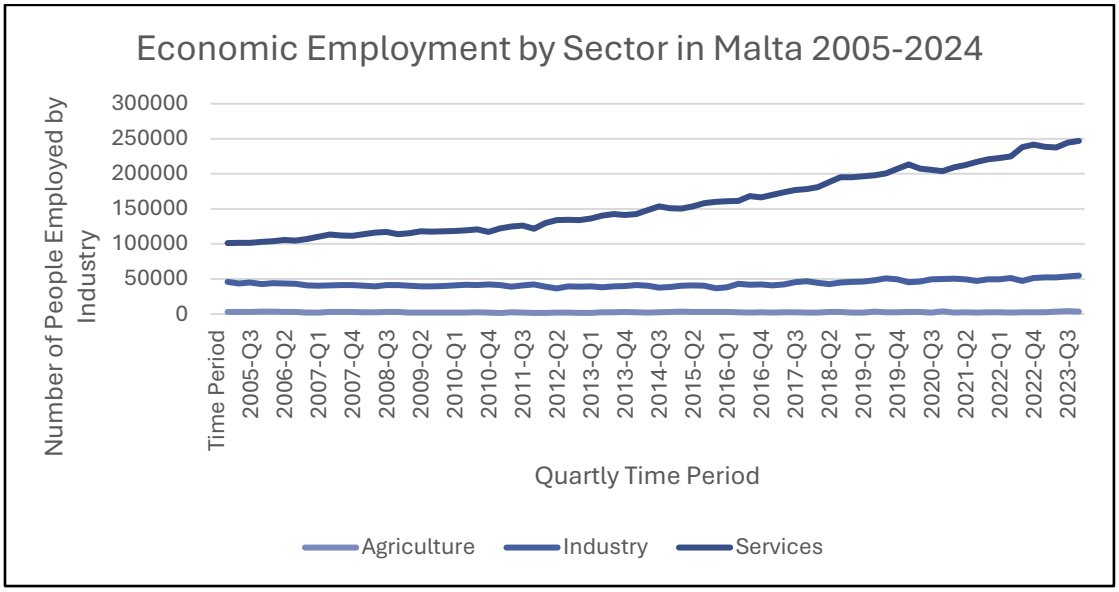


Figure 8: Malta's employment by industry according to the National Statistical Office (NSO) over a 20-year period. The Service Industry has rapidly increased beginning 2012. The Agricultural and Industrial sectors have remained constant.

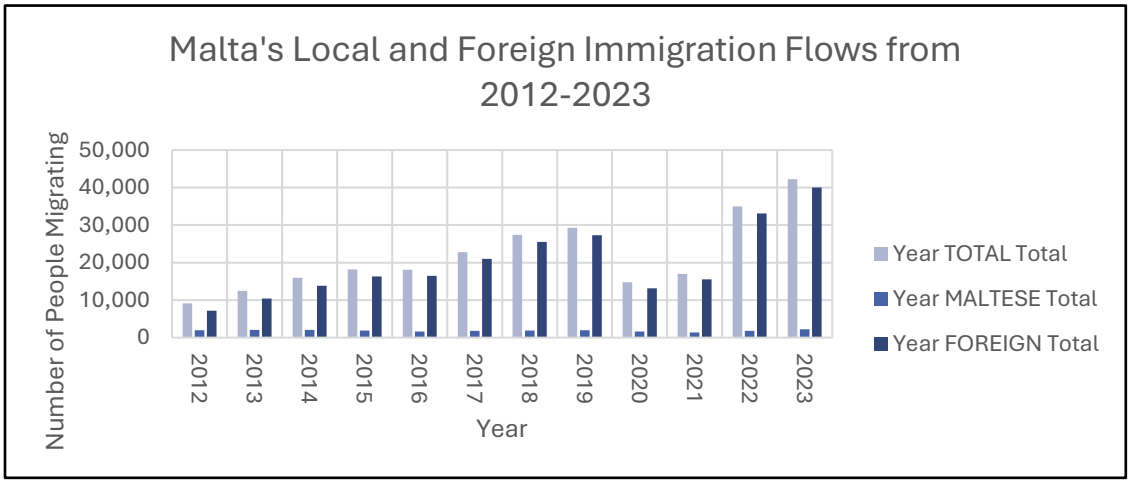


Figure 9: Migration flows on Malta (NSO Malta, 2023b).

Farming is a lifestyle choice that you must love and be committed was reiterated by all the farmers I spoke with. Farmer XF121 stated that it's a 24/7 job, no break from morning to night. It's a lot of work. Getting access to tools, chickens, or seed can be difficult according to farmer XF122. They have become self-reliant by composting kitchen scraps, cardboard and paper using worms, grafting almond root to stone fruit varieties. They started a nursery of herbs, fruit trees, and crop seedlings. Farmer XF 141 said that farmers have a passion for their job, but it is difficult to get land. Farmer XF122 was able to get access to their grandparent's land that had previously been leased out to other farmers. The land is split between aunts, uncles, and cousins. This farmer said that for young people who have a dream to make a piece of

land productive the cost is 100,000 euros. Farmer XF161 sees the need to produce more farmers by investing in them. A lot of jobs in gaming, IT, and tourism sector offer a different lifestyle choice from farming. Another issue is the land that farmers work is government land or private land of people who have owned that land for over 100 years. Their estimation was for every 3 hectares of land worked, 2.9 ha is government owned, and .1 ha is the farmers' land. Even with incentives, the overall farming lifestyle is unappealing to today's population. A government representative, YG202 confirmed that most of the government owned land is accessible by heredity. They stated that private land is being used for BBQs and family picnics pushing farmers out. Some people are going so far as to evict farmers, and the government has intervened to protect farmers in 2024. Figure 8 shows the 250% increase in service industry over the manufacturing and agricultural industry that are maintaining their population with agricultural jobs at the lowest of the industries.

POTATO AND STRAWBERRY PRODUCTION

POTATO

Farmers on Malta grow other crops beyond the ones focused on in this paper. Crop rotation is practiced keeping the soil high in nutrients and reducing the number of inputs required for a high yield. Potatoes are produced year-round with two separate growing seasons (XF141). The history of the potato in Malta began with the British occupation. In 1774, the British expanded production to year-round to Holland using Malta as one of the producers that began the relationship of Maltese potato exports that continues to this day (Farrugio, 2008). The Maltese potato had a reputation for its high quality, yield, and accessibility. The Alpha varietal is grown in the months of March, April, and May. The Alpha potato has a yellow flesh and is popular in Europe where it is exported primarily to Holland, Belgium and Germany per government official YG162. The southern portion of Malta receives more sunlight and is planted earlier than the northern areas of the island and the seed originates in the Netherlands and Belgium (XF161). The seed is imported in October for the southern planting in November, the land is prepared, the seed is cut and harvested in February/March (XF141). The soil of the southern end of the island is high in iron and germinates faster than in the north where there is a higher clay content. The clay holds the moisture and because there is less sun in the northern portion of the island, planting takes place later in the year (XF161). Freshwater access limits potato planting year-round on small these small plots. Farmer XF121 describes the change in soil texture from light to baked in response to the sun's intensity in the summer months. Potatoes require soils that are at least 30cm in depth. The potatoes planted later in the year are white fleshed, preferred by the Maltese are sold locally at the Pitkali Cooperative, and directly by farmers at local markets such as Ta'Qali, Marsaxlokk, or Birgu. These potatoes have red eyes and are planted in February in the north that are harvested in June and July for local consumption (XF161). Figure 10 shows the potato production by region. The north and western portion of the island produces the most potatoes. Potatoes are grown over most of the island except for Valletta.

A Strength, Weakness, Opportunities, and Threats (SWOT) analysis was completed for food labeling to direct Malta's National Agricultural Policy 2018-2028 (n.d.). Traceability for potatoes ensures that no fraud or knock-off product can be substituted thereby maintaining the reputation of quality that consumers come to expect from Maltese potatoes. The economy of scale for potatoes along with a long

shelf life can lead to local marketing and branding opportunities. While a demand exists outside of Malta for potatoes, the reduction of farmers and lack of investment create a ununified sector. Imports can flood the market claiming to be Maltese potatoes, driving the price down and introducing a lesser quality item into the local marketplace. A certified label for export is one of the recommendations that can be achieved through traceability system in place at the Pitkali that would assist in maintaining potato quality.

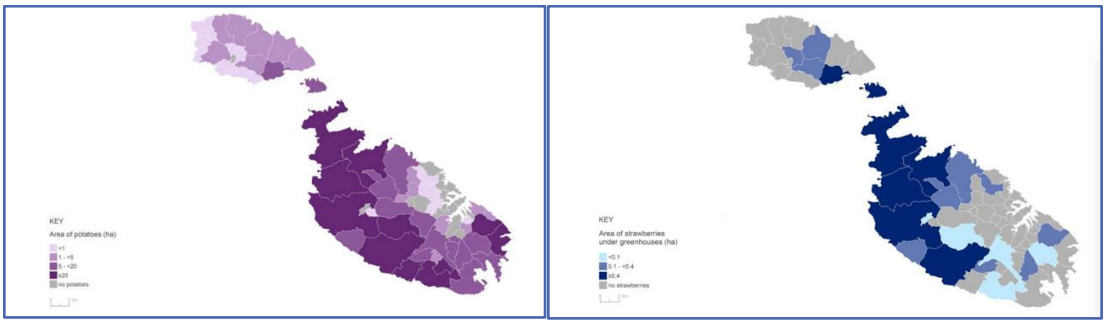


Figure 10: Potato production by local (NSO Malta, 2023a). Area of strawberries under greenhouses by local boundaries from the Agricultural Census of 2020 (NSO Malta, 2023a).

Soil preparation includes the elimination of viruses and fungi along with manure at a ratio of 5 tonnes of manure per tumolo (Farrugio, 2008). The FAO defines a tumolo as a measure of land equaling 1124 m^2. Synthetic inputs of compound fertilizer are placed at a rate of 50kg per tumolo. The compound fertilizer includes N, P, K, Fe and Mg for nutrients and pest reduction. Potatoes are cut and placed in a controlled area of 65% to 75% humidity. This holding area should be well ventilated and placed in a bag. After three days the wound is dry, and the seeds are tagged and planted. The soil and seed preparation reduce the chance of infection by aphids that bring viruses and nematodes that are common during the spring plantings. Nematodes can appear in moist conditions; they bring fungal infections.

Potatoes are produced year-round with a decrease in production in November (Figure 11). The ability to produce potatoes year-round allows for export to countries like Belgium and the Netherlands.

Figures 11 shows potato and strawberry production from the Malta National Statistics Office (2023). Potatoes and strawberries are farmed in the northwestern region and along the western coast of Malta. Potato farms are found farther south compared to the strawberry farms.

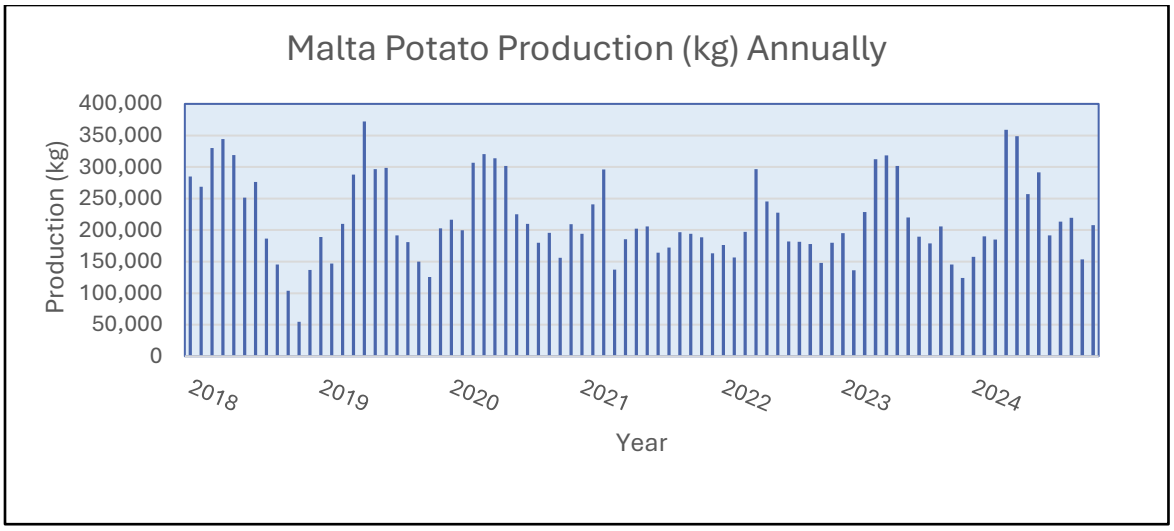


Figure 11: NSO Malta (2025) data for monthly annual potato production.

STRAWBERRY

Strawberry plantlets are imported from Spain and Italy. They are driven over land and cross by ferry to Malta over a five-day period (XF141). Farmers are notified of the strawberry plantlet arrival and planted within one day. Farmers place orders at the cooperative in advance.

Magro (2001) identifies 1386 as the first instance of strawberry cultivation in Malta. An increase in pollination increases fruit yield that develops from the flower receptacle that is 20% cell division and 80% cell growth. In Malta, strawberries prefer a south facing slope for sunlight on land that is less than a 5% slope. Temperatures greater than 33°C decrease flower production. Strawberries are farmed from September to June (XF141).

An increase in plasticulture that was introduced globally in the 1950s became popular in Malta in the early 2000s for strawberry production. Freeman & Gnayem (2008) describe ground tunnels at one meter in height and greenhouses as three meters in height using plastics with drip irrigation. Solarization of soil is effective in reducing soil pests especially since the EU CAP has called for a reduction in pesticides use 50% by 2030 (Giuliani & Baron, 2025).

September/October is the first planting of strawberries for first harvest in November/December (XF161). Land preparation prior to planting involves incorporating compost or manure, then fumigate the soil for microbes, make ridges of the soil and then mulch the ridges. Plasticulture can be used as a mulch covering the soil with a biodegradable film, used as row covers, or as tunnel covers of different tunnel heights (Galafton et al., 2023). Any combination of plastics can be used in the planting of strawberries. The plastics protect the fruits from the heavy rains in the rainy season and keep the soil in place reducing erosion. Weeding is reduced so there is less competition for nutrients between strawberries and unwanted plants. Soil moisture is maintained using the plastics and soil solarization can be used to replace pesticide use. The cloches (plastic tunnels) are stretched over frames that can be opened for sunlight and pollinator access (Figure 12). These cloches are opened and closed by hand.

Figure 12: Plasticulture practices in strawberry fields (Jarvis, T. 2025).

Staggered planting and cultivation ushers in the April and May harvests when Festa Frawli is celebrated. Festa Frawli is held on a Sunday in L-Imġarr where strawberry pastries, jams, drinks, and products are sold. There are also other booths and live music at the piazza of the Parish Church of the Assumption of the Blessed Virgin Mary into Heaven (Festafrawli.com). Along the fence drawings from school children about strawberry production and harvest are hung. The strawberry as a crop is being taught in the Maltese educational program from K-12.

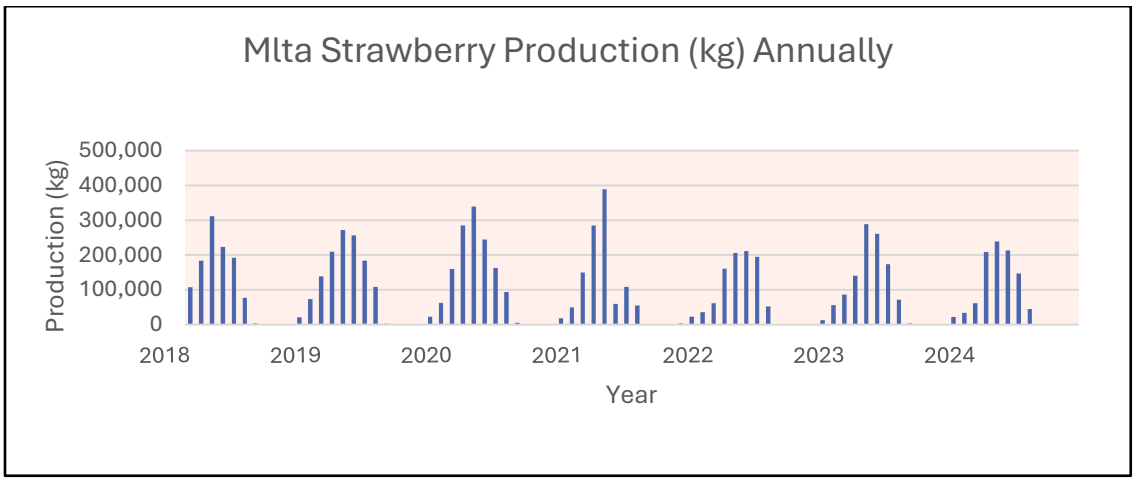


Figure 13: NSO data (2025) for monthly annual Malta strawberry production. The months of August and September do not have any production.

August and September do not have strawberry harvests. Peak months of harvest are January-May (Figure 13). The gap in production is due to environmental conditions hostile to strawberry production success. High temperatures and lack of water access limit the number of months for annual strawberry production.

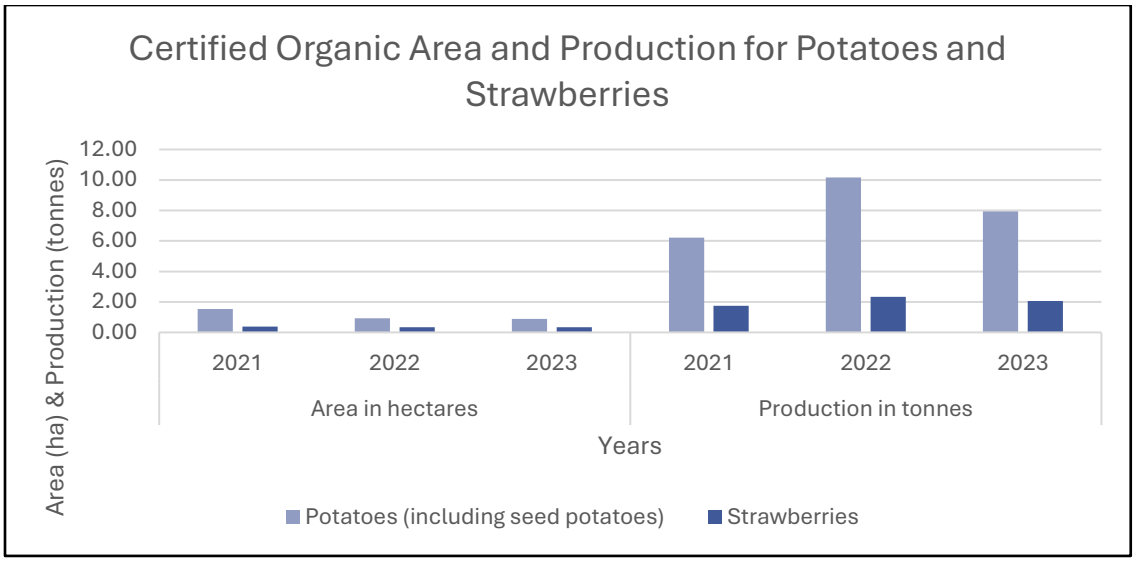


Figure 14: Organic production and area of potatoes and strawberries in Malta from 2021-2023. The commitment to organic produce is part of Malta's Strategy for Resilient Food Systems Program (2024).

A commitment by the Maltese government to investing and supporting organic farming practices is present but has decreased from 2021 to 2023 from 1.75 hectares for potatoes to 1.0 hectares. Strawberry organic area has remained constant (Figure 14). The area currently practicing certified organic farming has increased production in the hectares allotted (Figure 15).

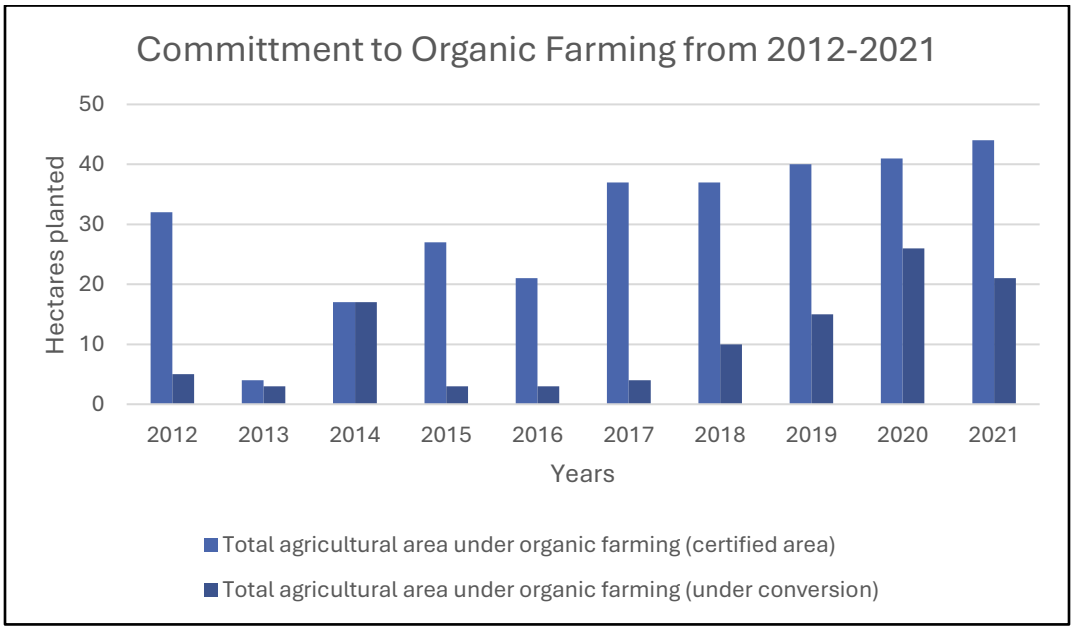


Figure 15: Organic farming commitment in Malta identified as certified by the government. The interest in organic production is increasing (Eurostat, 2025).

WATER USE

The source of freshwater is extracted from rain charged aquifers. The two main aquifers are the perched upper aquifer located in the Upper Coralline Limestone kept in place by the blue clay barrier beneath. The mean sea level aquifer is found beneath the blue clay in the Lower Coralline Limestone that contains freshwater and seawater. The difference in density allows the freshwater to stratify on top of the seawater (Figure 1).

A Water Catchment Management Plan (WCMP) was put in place in 2011 and updated in 2015. The WCMP integrates surface and ground water management. The Maltese Islands are designated as one Water Catchment district that has distinct widien, river valley systems, that are seasonal water pathways. Groundwater is being removed at an unstainable rate even with reverse osmosis plants. Groundwater recharge is being outpaced by groundwater extraction.

The 2018-2028 CAP has identified water sustainable practices as providing water supply, improving rainwater harvesting in water bowsers or reservoir systems, groundwater abstraction, New Water, nitrate management, intensive farming, soil conservation and ecosystem services as key resources for developing and maintaining water supply to farmers.

Sustainable water use through drip irrigation is commonly practiced by farmers. New Water, if available is treated sewage effluent that can be used for crop irrigation. The New Water distribution network is limited to the northern (Mellieha) and southern (Xgahajra) regions in Malta and is described by farmers as dead water (XF121, XF122, XF161, WastServ, 2025). The New Water is mixed with aquifer or rainwater as a 50/50 mix because of the chemical treatment where all life is removed from the water (XF141). Groundwater is metered and computerized watering systems are in place on many farms.

Public and private boreholes indicate that 86% of agricultural water use was derived from groundwater according to the Sustainable Energy and Water Conservation Unit (2015). The average amount of water required for irrigation was estimated at 5,651 m^3 per hectare under an area of 3,900 hectares in total. The supplemental water was from rainwater (9%) and New Water (5%). Most boreholes were dug over the past thirty years whether it be for agricultural use, domestic or commercial usage. A registration of boreholes began in 1997 with metering of registered agricultural boreholes in 2011. There are currently no restrictions on groundwater abstraction, but the cost for water abstraction can be the difference for some farmers as expressed by farmers XF121 and XF122. Extraction peaks in May, July and August with minimal use in October through March. The view of groundwater as a commons and those farmers who drilled early had a competitive advantage over those who did not.

SOIL SPECIFIC NEEDS AND THE CAP -INCLUDE AGRICULTURAL LAND HOLDINGS CAP

Malta's soils have been classified as arenosols, calcisols, cambisols, leptosols, luvisols, regosols, and vertisols (European Commission, 2014; Eurostat, 2025). Strawberries can be grown in a variety of soils and a wide climate range. Strawberries prefer well-drained loamy soils that they can send runners for reproduction. Managing moisture is important for strawberries because they are susceptible to fungi (Sánchez Pineda & Ramírez Torres, 2018; Sultana, 2024). Soil forms from the breakdown of bedrock through wind, water, chemical, and pressure conditions. The superficial geology of the strawberry and

potato areas are Talus, Alluvial Fan Deposits, and Alluvium. Visiting one farmer's holdings (XF121), the soil was so shallow the choices for crops was dependent on soil depth and water supply. This farmer shared that with care for planting choice and building the soil, the holding will have a greater depth and be healthier in a 5-year period.

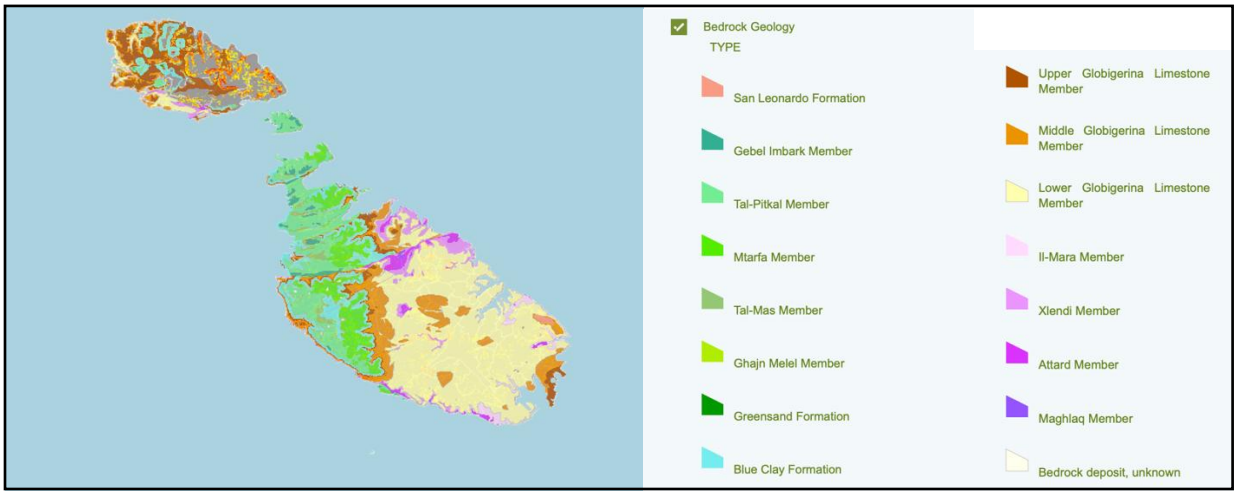


Figure 16: Bedrock of Malta(Environment and Resources Authority, 2025).

The strawberry and potato farms are found on Mtarfa Member, Tal-Mas Member, Għajn Melel Member, Greensand Formation, Blue Clay Formation, and Middle Globigerina Limeston Member. Potato farms are also found on the Lower Globigerina Limestone Member, Xiendi Member, and the Attard Member (Figure 16 & 17).

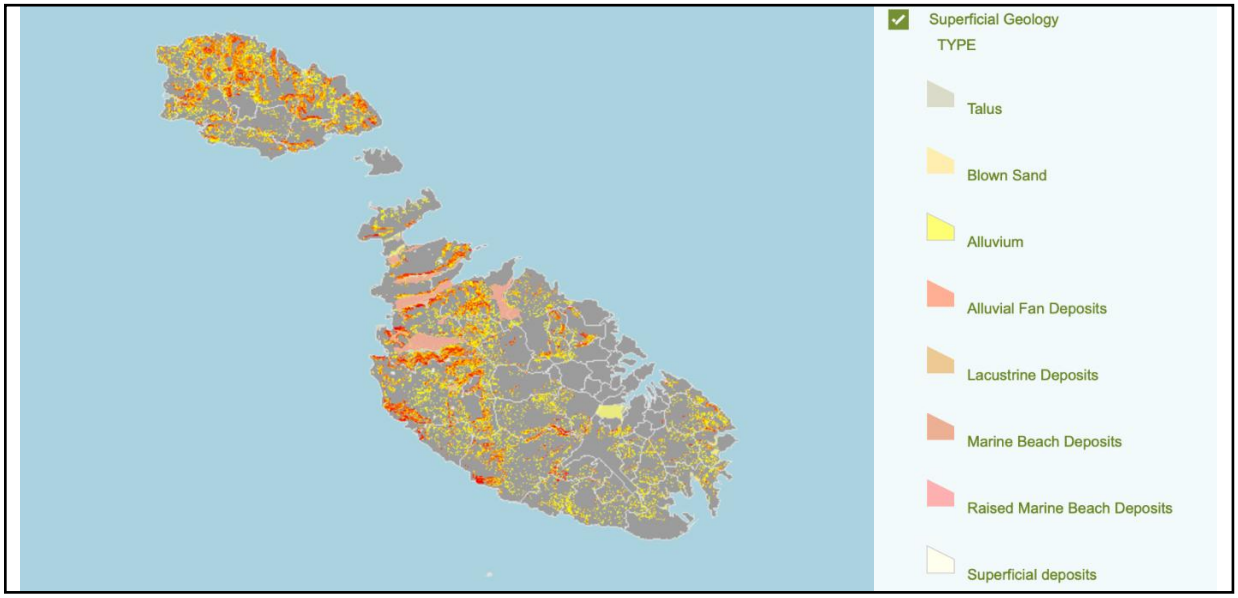


Figure 17: Superficial geology of Malta(Environment and Resources Authority, 2025)

In addition to climatic causes of soil formation, demographic factors, land use choices for economics or institutional decisions along with cultural factors. Surface soil changes are caused through agricultural activities, infrastructure manipulation, vegetation removal, and aridity (Gichuki et al., 2019).

The CAP Farm to Fork strategy has a goal of pesticide reduction by 50%, halving nutrient loss while reducing fertilizer use by 20%, and a conversion of 25% of the UAA to organic farms by 2030. Increasing companion planting, crop rotation, and polyculture will assist farmers in achieving these goals (Giuliani & Baron, 2025). The Farm to Fork strategy promotes a circular agricultural economy while strengthening the value chain.

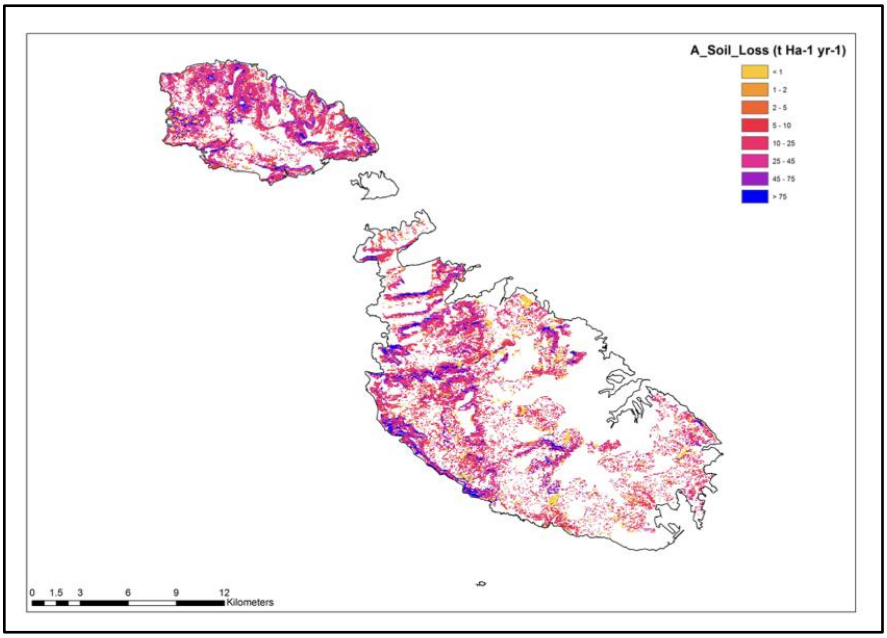
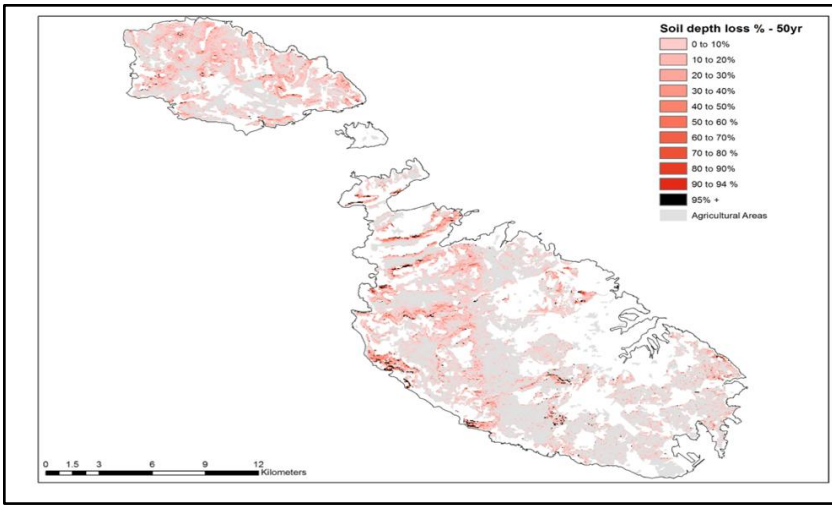


Figure 18: Annual soil erosion per hectare per year (Sultana, 2024).

Annual erosion loss is the greatest in the areas of potato and strawberry production (Figure 18). An estimation of 10 tonnes/ha/yr to 75 tonnes/ha/yr of soil is lost. Several causes of erosion can be attributed to slope and lack of rubble wall maintenance, land abandonment of holdings with poor soil, or poor farming practices. Land can be abandoned because of lack of interest in farming by younger generations, or land ownership that is being contested in the courts among family members according to government official YG162.

Over the past fifty years, Malta has lost 10% of soil from 41.32 km2 to 20% of soil from 17.19 km2 (Figure 19). The soil loss is in agricultural areas that have rubble wall keeping the soil from moving. When the rubble walls are no longer maintained soil erosion is the result. Also, when land is abandoned and the land remains bare, the soil is exposed to heavy rains causing further erosion.



50 year % soil depth removed	Area (km^2)
0–10%	41.32
10–20%	17.19
20–30%	6.66
30–40%	3.20
40–50%	1.81
50–60%	1.14
60–70%	0.74
70–80%	0.52
80–90%	0.42
90–94%	0.10
95%+	**1.53**
% MT agric. area lost	**0.5**

Figure 19: Percent soil depth change over the a 50 year timespan (Sultana, 2024).

On average 11.6kg/ha/year of pesticides are added to Malta's soil (2002-2022) according to WBG Data 360 (Food and Agriculture Organization of the United Nations, 2025). Looking at Figure 18 fungicide use outpaces herbicide, insecticide and molluscicides. A reduction in pesticides is noticeable from a peak usage in 2012 of 123,000 kg/ha to 62,000 kg/ha.

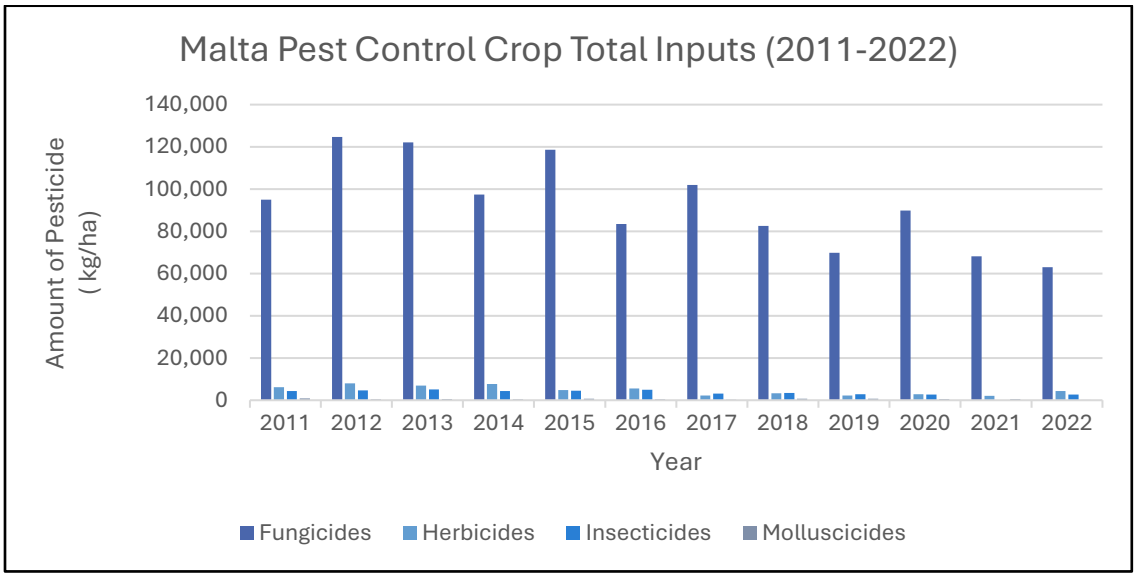


Figure 20: Comparison of pesticides on Malta farmland irrespective of crop type. Fungicide use dominates the pests farmers need to control compared to weeds, insects, and snails. https://ec.europa.eu/eurostat/cache/metadata/en/aei_pestuse_esms.htm

Pesticide use effects pollinator populations negatively. Strawberry and potato crops are less dependent on pollinators compared to tomatoes, wheat, and rapeseed (Bugin et al., 2022). In addition, tourists using plant protection products affects insect numbers (Degabriele et al., 2023).

FERTILIZER INPUT

Malta's young soils and lack of surface waters make farming challenging in addition to being on an island. The organic matter of Malta's alkaline soils remained at approximately 2.2% - 2.5% when tested from 2003 to 2013 (Anthony, February 6 notes). Farmers maintain the organic content matter in the soil. The top portion of the soil measures 6% organic matter but the deeper soil organic measurements are 1.5%. Farmers maintain the soil reducing degradation by salinity or erosion. Malta contains an uneven distribution of soils when thinner tend to be planted in the winter and not the summer because of the lack of water retention by the thin soil. Soils with higher clay content hold more water, or areas that have a mixed soil structure affect farmer planting decisions. In addition, the limestone composition of the parent material tends to make the soil resistant to changes in pH.

The diverse soil types, small farms, and groundwater sources require different nutrient supplement applications. Applying inorganic fertilizers directly on the soil can lead to ground water contamination of nitrogen. Farmers use green manure that is crop residue that is tilled into the soil to return nitrogen from the plants back to the soil. Crop rotation is also practiced for example after beans have been harvested, strawberries are planted next per farmer XF161. High nutrient soils can support aubergine and melon crops. Therefore, farmers are planting various crops in addition to the strawberries and potatoes. Livestock manure mixed with organic material can be placed on the fields from March – October, in the dry season. This limits the amount of nitrogen that can runoff into the coastal areas, or leach into the groundwater causing water contamination. A government representative, YG162 states that farmers typically are producing 5 to 6 different products each year.

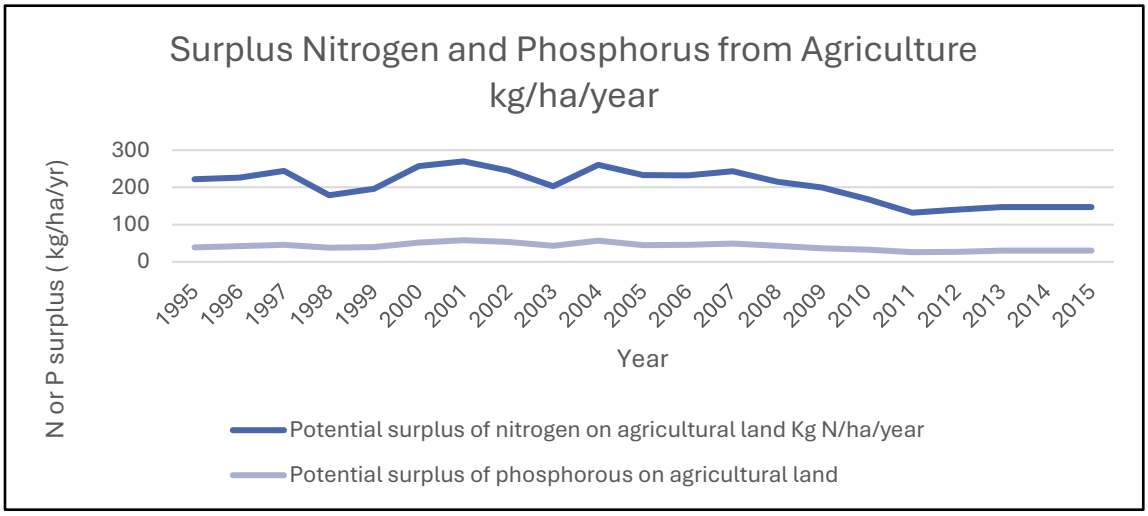


Figure 21: Inorganic fertilizer surplus on farmland in Malta. Nitrogen use has decreased approximately 130 kg/ha/yr from its highest levels of 270 kg/ha/yr in 2001 (European Commission, 2025a).

Cropping techniques for strawberries and potatoes include mounding the soil in ridges that allows for water infiltration and water soil management. Clay soils slow down water infiltration while sand or silty soils allow water to move faster into the bedrock. Potatoes tend to grow well in the clay soils found near Ir-Rabat. Plasticulture is used to maintain soil moisture for strawberries by reducing evaporation rates.

Strawberry soils are silty or sandy as found in Il-Mġarr. The tunnel covers and the below ground watering system also reduce evaporation rates.

Changes in farmland management has changed for Maltese farmers beginning in 2004 when Malta joined the EU decoupling production from subsidies. Malta's farmers had previously been protected by policy limiting competing imports of foods. Malta's farmers were also rewarded for the quantity over quality of crops produced. In joining the EU, farming practices by Maltese farmers required adaptation. Competition from other EU food imports was one adjustment for the farming community. With the subsidies available to farmers, many were able to upgrade technologies like drip irrigation systems. Malta's farmers were able to receive a Single Farm Payment (SFP) that focused on environmental compliance. In keeping in line with required CAP agricultural practices, the reduction of nitrogen pollution along with crop diversification while increasing soil fertility. More recently the focus of the CAP was to reduce pesticide use by 50% in 2030. The CAP focus is now on organic farming including benefits to ecosystem services, biodiversity, culture and landscape that the farmer provides for the community (Bugin et al., 2022).

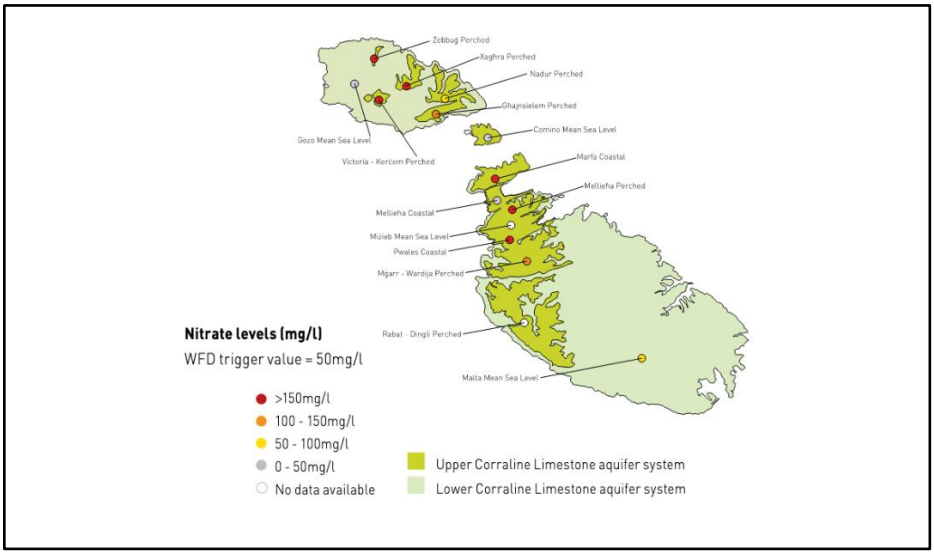


Figure 22: Nitrate levels (mg/l) in groundwater bodies.(Camerelli, n.d.)

Fertilizer balance is the number of inputs of nitrogen or phosphorus synthetically or organically that are removed from harvesting, grazing, or residual removal. Surpluses represent the amount of nitrogen or phosphorus remaining on the land after harvesting is completed (European Environment Agency, 2000). The most recent CAP plan for Malta 2018-2020 (2022) involve training for farmers to reduce nitrogen inputs and offer alternative methods for maintaining soil nutrients while reducing the risk of aquifer contamination. Figure 19 shows a reduction in nitrogen fertilizer surplus while phosphorus potential surplus has remained steady. Nitrogen potential surplus was at a high in 2004 and has decreased since Malta joined the EU. Nitrogen pollution of the aquifer and coastal environments from runoff causes increased algal blooms. These algal communities are fast growing and harm ecosystems through the food web.

The heaviest nitrogen levels are in the agricultural districts where the upper aquifer is located (Figure 22). The overall nitrogen levels are less than 10mg/l for Malta, yet there are regions that test greater than 150mg/l.

The commitment to reducing nutrient pollution has led to the EU to encourage and support organic and other niche food production like hydroponic. Figure 15 indicates an increase in both commitment and conversion to organic agriculture.

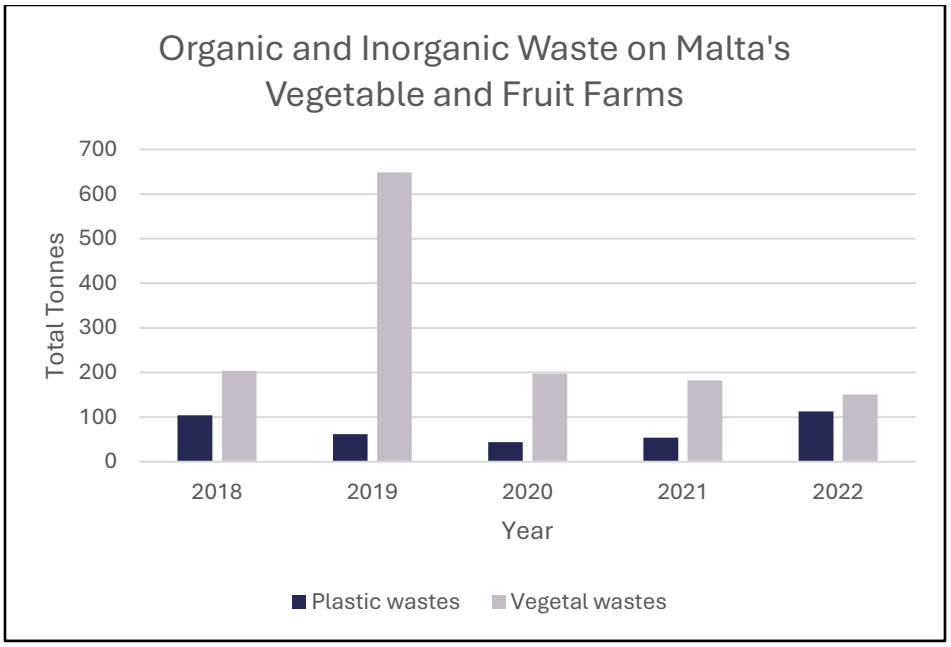


Figure 23: Non-hazardous wastes generated by farms in Malta from 2018-2022. Vegetal waste is composted or tilled into the soil. Plastic waste is used for weed suppression, soil temperature regulation, and protection of plants. Strawberry farming utilizes plastics (NSO Malta, 2023a).

SUSTAINABLE USE/NON-SUSTAINABLE USE QAGĦAQ TAL-GĦASEL

Malta's food history includes a richness of agricultural practices, trade influences, and cultural shifts over time. From the Neolithic Age, early inhabitants cultivated wheat, olives, and raised livestock for milk, to the Bronze Age's production of wheat and barley, food production evolved with each civilization. The Phoenicians linked Malta to Spain and Sicily expanding agriculture with cereals, honey, figs, and nuts from these other areas. In the Roman era, wheat, oil, honey, and salt were central to food security and regulated by the government. Arab influence introduced citrus, almonds, sugar cane, and water irrigation/extraction techniques. The feudal period saw a decline in farming, increasing food imports, relying on Sicily in crucial times of support during food shortages. Under the Knights of St. John, Malta exported honey and citrus, and by the end of the 17th century, American imports like chocolate and tomatoes arrived. British rule brought more food imports, especially for the navy. In the 20th century, wartime victory gardens, post-war imports, and economic changes led to a mix of tradition and global influences. By the 1990s, local fast food like pasitzzi gained in popularity, tourism promoted traditional cuisine, and initiatives like food festivals and cookbooks to preserve and celebrate Malta's culinary heritage. The conglomeration of 5

independent milling companies was important for Malta's food security stabilizing wheat prices and bread availability (L-Furnar, 2025; Vincenti, 2023).

Today many of the ingredients for local production of qagħaq tal-għasel are imported from the EU. The filling is black treacle, sugar, semolina, anise, cinnamon, clove, nutmeg, orange blossom water, citrus zest, honey, and cocoa depending on the recipe. Semolina is imported from Italy as durum wheat, a spring wheat, that is ground into flour used in the filling. Malta imports 7,5610 kg from Italy (2022) annually according to the World Integrated Trade Solution (World Bank, 2025b). Malta imports most of the sugar for the black treacle filling from Brazil, the Netherlands, Mauritius, and Italy. Honey is imported primarily from Spain, Italy, and Ireland. Molasses is imported from the United Kingdom and Italy. If cocoa powder is used this is imported from the Netherlands, Italy, and the United Kingdom. Filling spices cinnamon, nutmeg, cloves, and anise are imported from Italy, Sri Lanka, the Netherlands with cinnamon also imported from France. The citrus components orange, lemon, and orange blossom water are available in Malta. Table 1 illustrates the percentage of imports from these locations in terms of USD in millions of trade value in 2023 (World Bank, 2025c). According to the baker (ZP131), chocolate prices have increased over 400% in the last three years. Shipping costs have increased 200% since COVID-19.

The pastry is made from eggs, butter, milk, sugar, and flour. The eggs and milk, if not acquired locally, are imported from Italy. Butter is imported from Ireland and Italy if the quantities required are unavailable on the island. Any wheat or wheat flours arrive from Ukraine or Kazakhstan, and Latvia, Italy, or Estonia. Barley imports are from Croatia and Greece (Simoes & Hidalgo, 2023). Cooperatives for dairy and eggs are successful in Malta and provide a reliable source for production of the qagħaq tal-għasel.

Traditionally, qagħag tal-għasel would be made during the Christmas holidays as a special sweet treat. Most of the ingredients were sourced locally on Malta but these are labor intensive desserts as one producer shared (ZP131). In the past the black treacle was once melted down honeycombs, or burnt sugar, anise, coriander, fennel, lavender, Malta wheat or Durum Wheat, orange blossom water was available. The spices—cinnamon, clove, turmeric, nutmeg, and cocoa-- were imported from India, Turkey, Sri Lanka, Indonesia, and China easily accessible because the shipping lanes had been used for centuries. The pastry is made from flour, butter, sugar, and egg yolks (Aceline Media, 2025; Malta Tourism Authority, 2025; Morana, 2020). The pastry would be rolled and filled by hand. The dough is heavy and difficult to work by hand. The ingredients like wheat, semolina, and sugar were expensive and the labor intensive, therefore this dessert was saved for special occasions.

Today a dough rolling machine is used to make qagħaq tal-għasel daily and filling is mixed in large quantities. The pastry that used to be made in two weeks, now can be made in two hours (ZP131) allowing for daily supply. The qagħaq tal-għasel is finished by hand by this dessert store. In supermarkets and bakeries, qagħaq tal-għasel are available from several producers that are making this treat in their home kitchen, to an upscaled production setting. Small scale production is sent to local bakeries while large scale producers can place their product in supermarkets. Labor is the most expensive component (ZP131).

Item	Trade Value (USD M)	Year	Total Other	Percentage Imported

Milk	$	7,794,345.00	2023	$	1,898,690.00	24.36
Butter	$	4,862,289.00	2023	$	3,212,203.00	66.06
Eggs	$	4,871,307.00	2023	$	407,501.00	8.37
Honey	$	1,281,525.00	2023	$	719,574.00	56.15
Cinnamon	$	102,191.00	2023	$	44,948.00	43.98
Cloves	$	39,694.00	2023	$	23,095.00	58.18
Nutmeg, mace and cardamons	$	63,175.00	2023	$	19,573.00	30.98
Spices	$	1,577,875.00	2023	$	976,573.00	61.89
Wheat	$	23,536,679.00	2023	$	15,325,696.00	65.11
Barley	$	4,188,695.00	2023	$	3,604,081.00	86.04
Wheat Flours	$	6,750,444.00	2023	$	4,578,218.00	67.82
Raw Sugar	$	15,763,171.00	2023	$	11,915,420.00	75.59
Molasses	$	153,993.00	2023	$	118,139.00	76.72
Cocoa Powder	$	468,796.00	2023	$	286,249.00	61.06
Chocolate	$	29,703,400.00	2023	$	14,384,897.00	48.43
Total	$	101,157,579.00		$	57,514,857.00	56.86

Table 1: The trade value for qaghaq tal-ghasel ingredients that are imported in USD Millions derived. Major import countries include Italy, Netherlands, Sri Lanka, United Kingdom, Ireland, Spain, Ukraine, Kazakhstan, Latvia, and Estonia. Derived from (Simoes & Hidalgo, 2023).

For large scale producers, many of the ingredients are sourced outside of Malta because of quantity required, an economic benefit of buying direct to provide consistency of product. ZP131 makes a many of different desserts, and they do try to source locally when possible. A purveyor is used for butter, eggs, and milk that could potentially source these items on Malta. Any items bought in bulk are shipped to Malta by ferry from Europe. This baker is more concerned about consistency of their product that buying in bulk provides. Qagħaq tal-għasel is not locally sustainable ecologically, but culturally this dessert goes back centuries to 1762. A painting by Pasquale Leonetti is the first image of this dessert (The Phoenicia Malta, 2020).

The building is designed to be sustainable with solar panels and insulated rooms with high ceilings. The high ceilings allow the heat to rise, and the desserts produced on the ground level remain cool. The heat is captured by water and recycled by a heat pump. Even with solar panels, and insulated walls the electric and water bill is about 3,000 per month. Plastic wrap is recycled if food has not touched it. The qagħag tal-għasel are sold on the island, because it is too expensive to export to other countries. Also, because this shop produces many products, they cannot compete with a mechanized shop that only produces one or two dessert items (ZP131). Quality is done in house by procuring items in bulk and weighing the final product.

Labor is required for planting, harvesting, processing the harvest, making the pastry and filling, packaging, shipping, and selling qagħag tal-għasel, strawberries and potatoes.

A traditionally worked farm uses small horsepower tractors with 54.5% of the tractors less than 35 horsepower. Other farming machinery includes rotovators and water pumps. Plant protection applicators are another tool generally owned by farmers (NSO Malta, 2023a). Organic farmers such as XF122 buys second-hand tools. They said that tools for weeding are hard to come by in Malta and need to be imported. Cardboard is used to cover the ground to prevent weeds.

Soil preparation may be done mechanically, or by hand depending on the soil. In the summer the soil becomes lighter and easily baked according to XF121. The planting and harvesting of strawberries is done by hand and is labor intensive. One farmer, XF141 mentioned they were up at 3:00 in the morning with headlamps, picking the ripe fruit. They shared with me that family members also worked the strawberry fields on the weekends, by coercion.

FOOD VALUE CHAIN

The value chain for strawberries from production to consumption involves the transport of plantlets from Spain and Italy, overland and sea to Malta. Trucks, drivers, plantlet production (seed, water, soil, fertilizer, labor), ferry, driving to cooperatives for distribution to farmers. Once on Malta, the farmers soil preparation includes tilling with gasoline powered mechanized tools or small tractors, plastics for solarization and tunnels, drip irrigation systems, pumping of water from boreholes by electricity to strawberries, fertilizers added to the water system or green manure tilled into the soil, tilling of cover plants into the soil, planting by hand, continued labor, spraying of fungicide, and harvest of strawberries by hand. Large water bowsers are placed on fields that are rain filled and used for water storage. Plant residues are left in place to protect soil until preparation for the next crop. Greenhouse strawberries and large tunnel strawberries are grown on plastic trays off the ground. Once the strawberries are harvested and washed, the farmers take them to the Pitkali Cooperative market, sell to local venders like the Mġarr Cooperative that then distribute the fruit to local stores. There are the hawkers that buy the fruit from the cooperatives and sell it out of a mobile truck. Small stores known as grocers go to the cooperatives to purchase the strawberries for sale in local neighborhoods distanced from the farmers' fields. The strawberries are sold in plastic containers to the local buyer. Restaurants and hotels go direct to the Pitkali to purchase their strawberries. Rubble walls are maintained by the farmers and need to be opened and closed to get equipment to the fields depending upon the location of the field.

The value chain for potatoes is much the same as for strawberries except the seed potatoes are bagged in Holland, placed on a ship and are unloaded at the dock by longshoreman in Freeport. Seed potatoes are cut and set to dry in a well-ventilated area until the wound dries to reduce fungal infection. Potato planting does not use plastics like strawberry farming, but the earth is mounded, and drip irrigation systems are in place below ground. The distribution of the potatoes once harvested either by hand or machinery is like that of strawberries for local consumption. The difference is when the potatoes are harvested for export, they are washed and placed in bags, loaded into trucks and taken to Freeport to be shipped to Holland, Belgium, and Germany.

Produce that is not sold can go to soup kitchens depending upon quality or the unsold produce goes into a compost pit according to a government official (YG162). The compost pit is monitored by Malta's Environment and Resource Authority (ERA). The compost is sampled for bacteria, pesticide residues, hazardous waste such as mercury, lead, and arsenic. Organic nitrogen, carbon, copper and zinc along with stability either as oxygen uptake rate (OUR), or self-heating factor. WasteServ Malta is manageing a 15 tonnes composter that can produce 8 tonnes of compost per cycle. One cycle is approximately two weeks (ACR+, 2023). The month of May is highly productive for farmers, so much so that a lot of perishable fruits and vegetables are put into the compost pit near the Pitkali. Strawberries are highly perishable, but potatoes have a long shelf life and can be stored for later sale and consumption. YG162 mentioned that solar panels are being placed in the reservoir next to the Pitkali as there is not enough rooftop space for the energy demand from solar energy. One building that housed a family is being carved into 4 to 6 separate units housing a family in each as one woman shared with me on a bus ride. Times of Malta (Grima, 2012) reports that the changes to the building are at the discretion of the owner using gypsum or concrete block to create the desired number of apartments. The goal is to create the maximum number of apartments that is financially reasonable for the space (Grima, 2012). Buildings are being built up making the use of rooftop solar panels inefficient so the wider space of the reservoir will most likely be maintained.

TOURISM

Tourism adds pressure to an already stressed food system. Government policy to invest in marketing Malta as a prime destination location has been successful (Calderwood & Soshkin, 2019b). Tourism is a source of growth and development: economic growth, population growth, land use changes, infrastructure development, and historical restoration in Malta. While enhancing economic opportunities, GDP, and cultural exchanges there is a socio-economic cost, along with negative environmental and ecological effects. One Maltese couple shared with me that the only time they get access to the small patches of beach in Malta during the summer is at 6:00 am because of the number of tourists. An increase in visitors increases small business development, increasing the need for younger workers that are sourced from outside the island. Construction has increased at the expense of agricultural land to increase road width, or new apartment accommodations for visitors and workers alike. More people mean more waste to manage and more water resources to support visitors and the local inhabitants (Connell, 2018). The plethora of 9-to-5 job choices reduce the number of people who are interested in farming because farming in Malta is done on a small scale.

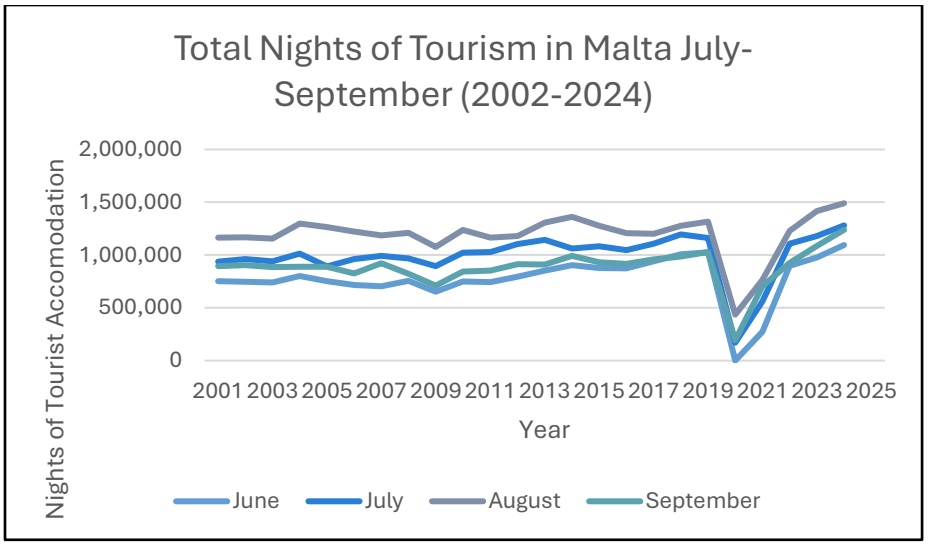


Figure 24: Malta hosts the greatest number of visitors from June-September. The year 2020 indicates the effect of COVID-19 on the tourism industry. https://nso.gov.mt/key-indicators-for-malta-compared-with-eu27/

The total number of tourists for 2024 year recorded by the Malta National Statics office is 2,434,153 (Malta NSO, 2025). The number of visitors is increasing each year with the month of August having the greatest number of visitors (Figure 24).

ECOLOGICAL ISSUES FOR QAGĦAQ TAL-GĦASEL, STRAWBERRIES, AND POTATOES AND THE CAP

The ecological issues for qagħaq tal-għasel involve sourcing ingredients from other countries that can support large scale agriculture without the water restrictions, with large mechanization capability. Large machinery contributes to greenhouse gasses (GHGs) along with nitrogen and pesticide use. Processing and shipping of the individual ingredients adds to the GHGs and the packaging increases waste.

Strawberry production requires the use of plastics for plasticulture, fertilizer, fungicides, and water use in a stressed aquifer. If mechanized tilling takes place, GHGs are added into the atmosphere.

Potatoes require fertilizer, fungicides, and aquifer water usage. Mechanization of soil preparation adds GHGs much the same as for strawberries.

The value chain for strawberries and potatoes is much shorter than the value chain for qagħaq tal-għasel ingredients. The value chain for qagħaq tal-għasel production is short. The export of potatoes adds to the value chain for Malta, but food is being provided to countries like Holland and Belgium that cannot grow their own potatoes in the winter months.

The CAP aims to train farmers in sustainable nutrient management practices, and alternatives to pesticides using crop rotation methods. Farmers will receive direct funding to equate with pay in other professions. Rural communities will receive funding from the CAP for modernization of irrigation equipment. The CAP now recognizes farmers as managers of the landscape the adds to the ambiance and

biodiversity of rural areas that would otherwise be developed or abandoned (European Commission, 2014). Developing varieties that are heat and drought resistant is a niche area that is being funded in the CAP along with a shift to organic production. Non-productive areas that are not planted will be covered by the CAP to recoup ecological benefits provided by the farmer. Transparency and the value chain are part of the investment of the CAP for quality control.

DISCUSSION

SUPPORT

Farmers have had government support for agricultural production prior to joining the EU. The government restricted imports, valued high yield, and incorporated imported goods sparingly onto the local markets. Farmers had access to land for farming by owning their land or leasing their land from the government, or a private landowner.

Mechanization led to changes in agriculture. The Maltese ox needed to be fed, had a bad temper, and helped the farmer plow the fields. One Maltese ox is still alive and kept at the Government Experimental Farm in Gozo as a reminder of the past. Prior to gasoline powered tools, the land was worked by hand by all the family members. Malta was left food insecure during WWII with bombings, blockades, and feeding soldiers. Food rationing was commonplace throughout the island, so when chemical fertilizers were introduced to grow a lot of crops quickly to reduce the food insecurity, the government bought inputs, fertilizer, seed, pesticides, etc. in bulk and distributed them to the farmers. Feeding the stationed British soldiers brought economic reward to farmers for those that could produce yields beyond their family's need.

Using machinery to work the land meant there was no need to grow fodder for the Maltese ox. Land was freed up for crops for human consumption. But the use of machinery and the reliance on the government changed the role of the farmer and the perception of the farming community.

As the population grew after WWII, support for the implementation of new technologies, and imports from other countries continued to support a greater number of people on the island. Farmers prices were protected because agricultural imports were blocked except for wheat and sugar. Wheat was required for Maltese bread and desserts at the holidays. Spices such as cinnamon, nutmeg, and clove had always been imported. While the island does not have a wealth of exportable resources other than potatoes, shipping infrastructure was in place for centuries. It made sense that the government decided to direct its efforts towards becoming a tourist destination spot once the British military was no longer an economic resource for the island.

Tourism provided opportunities for jobs in the service sector. An increase in restaurants, hotels, small businesses, and local grocery stores became new sources of income for farmers. The demand for agricultural products existed, but the farmers needed to work their fields and could not market their wares. The agriculture middleman became more important in this new economic market, making connections with new clients and taking a payment from the farmer. The farmer, becoming reliant on the middleman, saw a reduction in profits. In the past, the middleman had one client in the British military, now many clients required establishing new relationships. The costs for the farmer remained the same,

but the expenses were growing. Many farmers either aged out of farming or quit all together. If the farmer owned their land, they leased it out to other farmers. The farmers' enticed their children to choose other professions and did not pass on their knowledge. While the opportunity for a different lifestyle arose because of tourism, and then the gaming industry, this choice came at the expense of understanding the importance the farmer plays in everyone's life. Economic prosperity arrived in Malta, an increasing GDP, and access to new goods created an illusion of plenty. Farmers were finding it more difficult to earn a quality of life commensurate to other industries.

When the government decided to join the EU in 2004, the farmers received a boost from the CAP. Those who were farming were able to make upgrades and invest in new technology like drip irrigation for strawberries and potatoes, or greenhouse construction for strawberries. The access to these funds worked well for many farmers, but not all. Malta's agricultural market was no longer protected, and the farmers were now competing with large scale producers off island. A consistent quality product was demanded, and if quality was not found locally, imported produce replaced the local. More farmers left their fields and as the population continued to increase, imports increased, and land was sold at a great profit to the farmer. The Pitkali market established in 2013 was created as a response to having the farmer having a closer relationship to the consumer.

A competition dynamic was at odds with population size, housing demand, and land management as the economy grew. Even with the CAP, farming was becoming increasingly uncertain, creating more anxiety with climate change. The dependence on imported agricultural goods, and tourism placed Malta at risk economically, increasing the existing but nonapparent food insecurity. Cut to the pandemic, a time when much of the world stopped. No ships coming into port, no tourists to spend their cash in hotels, restaurants closed because of restrictions, and no more imported produce. The government recognized the untenable situation of the dependence on imports on food security. In response the government created local farmers markets in Ta'Qali and Birgu that sold direct to the consumer further shortening the value chain.

The EU CAP began to value the farmer as a steward of the land beyond providing sustenance for human beings. Government agencies such as MAFA and MFA have been put in place to support farmers as avenues to share information. This information could be about access to funding, receiving technical expertise, and support. The cooperatives are voluntary organizations that give farmers access to the market. Education alone is insufficient to support farmers in knowledge transfer or implementation of new technologies. The officials must have practical experience, understanding the psyche of the farmer; the concerns, and effect of changing climate patterns, or problem-solving unexpected issues that arise on a regular basis.

Resolving access to land for farmers goes beyond leasing a piece of land but truly owning it for future generations. Land in and of itself is seen as wealth, where future generations think they do not need to work because they own land and can sell it at any time for what appears to be a large amount of money according to one official (YG162). The change in mindset about land as a source of wealth creates an added complication for farmers who wish to work the land.

QUALITY CONTROL

The best product from the earth comes from the best practices. Caring for the soil, investing in the plant life, and initiating an agricultural circular economy make for consistent and delicious product. A small island with a small population that received inputs from ships passing through its ports, while providing sustenance for community members ensured tradition and pride for the farmers. What was sold to ships moving on, may or may not have been of consistent or best quality. The relationships of the farmers and the Maltese people was the driver for quality that we see today.

Over time, change in climate, reduction of groundwater, industrialization of farming practices, and an increasing population forced quantity over quality in agriculture as a definition of success. With the British military stationed on the island, a ready-made captive clientele required no marketing expertise for agricultural goods. Having a large dependent consumer of agricultural goods reduced the need to provide the best product and created a take it or leave it relationship that permeates consistent quality mindset resistant to change.

The farmers I met take great pride in their ability to produce food that nourishes people. To see a space that can be used for the benefit of many by providing what is essential to life. The high-quality produce from younger farmers, and those who are currently farming is to be celebrated. Bringing in third country produce that imitates the Maltese farmer label is a disservice to the farmer and the people of Malta. The Maltese farmer cares for the land, changes the landscape by providing new fruits, vegetables, and is solving climate sustainability issues in their holdings to ensure a high-quality product. Gone are the days when a ship was out to sea only to find the food they had purchased was of lesser quality. Today's farmer knows the value of their product and they are waiting for the public and the government to acknowledge their expertise.

The Pitkali is a good start to managing quality control of strawberries and potatoes. Individual farmers are managing themselves through the cooperative process. The ERA manages the soil and water testing for nutrient levels. Maltese Utilized Agricultural Area (UAA) focuses on soil composition and erosion issues. The threat of soil loss from land abandonment, rubble wall maintenance, reclamation of agricultural areas, and dumping are issues that farmers must have support to maintain quality strawberries and potatoes. Quality product means biologically active soils rich in biological organic matter. The soils on the island have been cared for in some regions and mistreated in others. Knowledge and care of transforming poor quality soil into agricultural rich soil requires dedication, hard work, and commitment to an unrelenting life of problem solving.

Extension agents themselves should have experience in farm management, being able to communicate with farmers and having the respect of farmers because of practical experience. Accepting the implementations of new techniques requires the extension agent to understand risk-taking from the farmers' point of view. Understanding and identifying the concerns farmers have about change in current techniques from nutrient management to plant variety choice requires dialog to get to the root of the farmers' concern. Demonstration holdings can be used as training for the extension agents, evidence of successes and challenges, and an opportunity for the extension agent to ask questions based on the trials and tribulations of working the land. Having quality extension agents that farmers respect would allow for a valued relationship between agricultural policy managers and the farmers.

Qagħaq tal-għasel quality is monitored from within. The baker is concerned with the consistency of the product over quantity. The economy of scale and access to local ingredients make this dessert reliant on imported goods, but it is sold locally. The personal commitment to quality and consistency along with

available production capacity and distribution on Malta keep this culturally important dessert in the mainstream. This traditional dessert is available year-round to Maltese and tourists. The risk of reduced production is the increasing prices for the imported ingredients whether it's a single ingredient like cocoa, or overall shipping costs that can compromise the quality of the qagħag tal-għasel.

SUSTAINABILITY

The history of land use change on this 316 km^2 island, in the middle of the Mediterranean Sea has benefitted from imports from the East, North Africa, and Europe. Initially the forests were used for ship building, and the cleared land was used for growing cotton, sugar, wheat, and orchards, or pasture for livestock. Herbs grew wild and were incorporated into culinary recipes. Kitchen gardens were common and sustainable agriculture was practiced. Livestock roamed freely providing nutrients for the soil and rains recharged the aquifers for the next planting season. Rubble walls were built as new land was cleared for agriculture, and old walls were repaired and maintained. The caring for the land and habit of using all the resources available was ingrained in resource use: soil, water, waste, etc. WWII changed a mindset of sustainability to one of mass production.

Using all available land to produce food for the people as fast as possible, irrespective of the consequences, produced an island culture of short-term thinking. Trading local crop varieties for higher yield, faster growing varieties began the change of crop genetic diversity in Malta. The endemic strawberry while sweet, was small in size so the yield was much lower than an imported variety. Increase in yield required greater water input. Drilling boreholes was easier with mechanization, so more wells were drilled where needed. Reservoirs that were traditionally used for rainwater collection, were filled with abstracted groundwater.

Changes in soil management lead to erosion and silting of the wieden, channels that collected and moved rainwater during the rainy season, changing water distribution patterns. The soil loss and soil degradation has increased the pumping of water from the aquifers. Promoting soils that retain soil moisture and drainage are key for strawberry and potato crops along with a reduction in fungicide use.

The value chain for strawberries is dependent on varietal imports from Spain and Italy. Developing local varietals and restoring genetic diversity into the strawberry population and may improve response to climate change challenges. Hydroponic varietals could be another answer to sustainable strawberry production.

The local farmers markets are an excellent access to reducing the value chain while giving the farmer direct access to the consumer. Left over produce is collected by the MFA representative to be distributed to the homeless or food insecure in Malta. Composting of unsold strawberries along with other unsold food products that are rotting returns lost nutrients to the soil. Turning vegetal waste into the soil and adding compost and green manure are sustainable practices that most farmers are practicing.

The growing population and number of tourists visiting the island is unsustainable for food security. While farmers can sell their products locally, through the Pitkali, or direct to their clients, imports are required to meet demand.

RESILIENCY

Malta's history is one of adaptive capacity and resiliency. The Maltese people had several masters and many sojourners with whom they exchanged culture and goods. Malta's location in the Mediterranean is a strategic area for ships traveling through to other locations that required food, shelter, water, and later fuel. These regular exchanges have made Maltese welcoming, enjoying exchanges with their guests, being the gracious host.

Festa Frawli, the strawberry festival is a method of celebrating Malta's success in agriculture. A local product celebrated for its nutritious and delicious flavor in a multitude of products—pastries, cold drinks, and fresh—incorporated into the school curriculum.

Potatoes have a longer shelf life than strawberries, but they are impacted by soil humidiy changes causing an increase in the need for fungicide. The kitchen vegetable farms are successful, but more farmers are resorting to keeping their produce, not selling it.

Resiliency is the ability to absorb the shock of changes and respond accordingly. Malta's farmers have always been resilient, but today the shocks are arriving at an increasing rate for the farmer: climate change, water insecurity, population increase, soil degradation, and competition for land development.

While the prices for land rental is low, the opportunity to purchase land now as it has become more expensive is out of the range of most farmers, except for the wealthiest. Labor costs have been identified by farmers and pastry chefs as one of their greatest expenses. Long hours of physical labor is unappealing compared to other opportunities to earn a wage.

One area to be explored is creating a relationship with gyms that like to hold challenge competitions. These gyms have a structure in place for tracking milestones and accomplishments. The people working out are interested in investing in their health given they are working out and may be following a healthy diet. I would call this the Farm Strong Program where gym members haul farmer crates from the fields to the flatbed. This Farm Strong Program would create a relationship between the farmer and those who are interested in maintaining their health. The people in this program will better understand the time and dedication of the farmer in relationship to what goes onto their plate. The farmer will get the benefit of forming a direct relationship with the public committed to their health who can provide labor for the small farmer. Being part of the Farm Strong Program aligns with the government's policies on healthy lifestyles, supporting young farmers, and increasing organic farming practices. Youthful energy is one of the areas to channel the desire for a healthy lifestyle, improvement in physical health and well-being while creating a tie to the farmer, the source of healthy food choices.

CONCLUSION

The risks to food security begins with farmers and their holdings. Climate change, stressed water resources, over application of fertilizer, and lifestyle are daily stressors for farmers. Loss of knowledge as

older farmers pass away, or do not have heirs interested in farming are detrimental to the farming community and Malta overall. Loss of the tradition for making cultural foods like qagħaq tal-għasel in lieu of ready-made processed foods is evident. Information is not being passed from generation to generation presently.

Increasing population to support tourism and gaming are economic drivers for the government. Importing goods is a common practice that goes back historically with trade routes. The reliance on imported goods has changed the Maltese diet by bringing in processed foods. These foods are high in sugar and fat that has translated into an obesity issue in the younger population. The imported goods also undercut the local farmers capacity to receive a fair wage for their work.

Most people do not know, or understand the time, knowledge, care, and problem-solving that goes into feeding a nation. The farming community has learned to do more with less: bowsers collect rainwater for future use during the dry season, arable land is not planted if it cannot be irrigated, rotational planting is practiced, and crops are planted in holdings appropriate to soil type. Both potatoes and strawberries grow in a range of soils, and climatic conditions. It is not the farmers that must adjust, but those of us who rely on their hard work and dedication to the land. They maintain the soil, the landscape, and provide opportunities for an independence of decision making at the state level.

Farmers markets and the Pitkali offer a farm to fork practice shortening the value chain. Bakers that produce qagħal tal-għasel give tourists and Malta's residents the opportunity to taste a cultural tradition that was once only eaten at Christmas. These are the people who are keeping Maltese culture and Maltese land accessible for future generations.

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