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CULTIVAR
Analysis and prospective studies

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Editorial

EDUARDO DINIZ

Director General of GPP

Cultivar – Cadernos de análise e prospetiva [Cultivate: Analysis and Prospective Studies] has been published on a quarterly basis since 2015 by the Ministry of Agriculture's Office of Planning, Policies and General Administration (GPP). It features analyses, statistics and studies on farming, food, forestry and territorial issues and the relevant public policies.

Throughout this period, *Cultivar* has published articles with reflections and in-depth information on topics as varied as resources (soil, water, labour, energy, technology and biodiversity), economic issues (market volatility, international trade, risks, bio-economics and macroeconomics) and more comprehensive questions such as sustainable food, gastronomy, population and territory, climate change, digitisation and agricultural education.

As Portugal takes over the Presidency of the Council of the European Union in the first half of this year, we have decided to publish Cultivar issue 22 in English so that it can be more readily accessed by our partners in the EU. For this issue, we have selected a series of articles published in earlier issues, some of which were updated. The aim is to provide an overview of the state of Portuguese agriculture in light of international market and public policy trends.

The selection criteria for the articles was to present a panorama of Portugal's agrifood and forestry sector as comprehensive as possible given the space restrictions of a single issue. The varied contributions are written by representatives of the sector, academia, and government.

Cultivar, as the various articles will show, is aimed not just at publishing technical and scientific analyses but also at creating a forum for debate and reflection. It is open to contradictory views and the constant search for knowledge founded on action and the establishment of strategies for all stakeholders in the value chain of rural products.

Section I – Major Trends

Cultivar *issue 3 – Healthy and sustainable eating. March 2016, p. 13*[1]

In response to our question on this topic – "*In a world with a continuously growing population and finite natural resources, what policies are necessary to ensure sustainable food production and a healthy diet?*" – José Lima Santos from the School of Agriculture (ISA) states that global access to food is a goal we are still far from reaching. It implies cutting food waste and considerably raising production, which is

[1] https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_3/E_book/CULTIVAR_3_Alimentacao_sustentavel_e_saudavel/14

not possible by expanding the amount of land under cultivation. The solution involves raising production per hectare without raising inputs. This paradigm shift requires public policies: basic environmental regulation; product differentiation according to eco-footprint; direct financial incentives for the environmental goods produced by agriculture; and a science- and technology-based R&D policy to intensify the ecological base.

Cultivar *issue 8 – Biodiversity. June 2017, p. 39*[2]

Biodiversity is a dynamic resource, thus requiring flexible public policies. Alongside the need for technical and scientifically consolidated knowledge, and independent monitoring, the involvement of the various stakeholders is essential. Significant experience already exists of the relationships between laws regulating or supporting biodiversity protection and farming. What can be taken from this experience is the important awareness that a tension (between regulator and user) exists simultaneously with opportunities for a significant part of Portuguese agriculture, which is characterised by diversified and extensive systems with a proven positive association with biodiversity.

Francisco Moreira and Ângela Lomba, from the Universities of Porto and Lisbon respectively, address the topic of agriculture's role in preserving the diversity of species, ecosystems and landscapes. They stress the importance of agriculture as a means of managing high nature value ecosystems to conserve threatened species while underlining the harmful effect both of excessive intensification and the abandonment of farming.

Cultivar *issue 9 – Gastronomy. September 2017, p. 23*[3]

"*Eating is an agricultural act.*"[4] Our motive for this issue was the conviction, on the one hand, that gastronomy would not exist without farm produce and a strong connection with the land, as flavour begins in the soil (or sea); and, on the other, that farmers must see gastronomy as a factor in valorising farm produce and promoting local and regional specificities.

Alexandra Prado Coelho, a journalist for the *Público* newspaper, warns about the lack of emphasis given to producers in the growing success and profile of Portuguese gastronomy. After stressing that it is a mistake to separate producers and restaurants, the journalist questions the strategy used to promote Portuguese food internationally. She concludes that the various disconnected initiatives prevent the possibility of achieving an overall view and that a more coordinated and united effort is required. She also points to the importance of increasing awareness of these themes, particularly the need to reinforce the link between the food served in schools and local produce and producers.

Cultivar *issue 10 – Work in agriculture and new labour trends. December 2017, p. 15*[5]

Work in agriculture historically differs from work in other sectors due to the importance of part-time, casual, and multi-income labour. This is explained above all by the seasonal and irregular nature of many farm jobs and the small size of most farms in Portugal. The growing outsourcing of farm labour is another issue that deserves close analysis.

In this article, José Maria Castro Caldas from the University of Coimbra notes that the current tech-

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2 https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_8/E-book/CULTIVAR_8_Biodiversidade/40/

3 https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_10/E_book/CULTIVAR_10_Trabalho_na_agricultura_e_as_novas_tendencias_laborais/16/

4 Wendel Berry, quoted in Dan Barber's book *The Third Plate*, whose review is presented in section III of this issue (no. 9) of *Cultivar*. https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_10/E_book/CULTIVAR_10_Trabalho_na_agricultura_e_as_novas_tendencias_laborais/16/

5 https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_10/E_book/CULTIVAR_10_Trabalho_na_agricultura_e_as_novas_tendencias_laborais/16/

nological paradigm shift is not the first, looking at the history of economic thought in the 19th century and the future it predicted to show that we cannot "*predict the unpredictable*". The author states that various "*institutional devices such as labour laws, trade unions and collective bargaining*" were decisive in avoiding certain more pessimistic predictions from becoming reality, concluding that "*technology in itself is not decisive … its impacts depend on the institutional context*", which in turn "*depend on political choices*".

Cultivar *issue 11 – Population and rural territory. March 2018, p. 13*[6]

This is a polarising topic within public debate, because attempts are made to find a single and preferably unique cause (poor forestry planning, depopulation, emigration, lack of facilities, closure of public services, land tenure structure, etc.) and one neat and tidy solution (indigenous-species forests, higher investment in the interior, replacement of services and facilities, decentralisation/regionalisation, etc.) for an extremely complex problem. This issue of *Cultivar* takes an approach which delves into the historical origins that explain and restrict current rural territorial organisation and aims at a demographic and socioeconomic analysis that may contribute to identifying solutions to planning problems that have emerged in rural areas, together with new risks associated with climate change.

The topic is fully addressed by João Ferrão in an article which begins by warning that rural areas have never been homogeneous, and that population changes have been affected by the relations between the three vertices of the ecology-community-economy triangle. The author stresses that depopulation is the rule in most rural municipalities and considers the idea that it is possible to reverse this demographic loss in every rural area a misconceived political message, stressing that "*right of place*" must be given equal importance as "*right of mobility*". He also notes that there is no single solution. Public policies must avoid (where it has yet to occur), resist (where it can be reversed) and manage depopulation (where it cannot be stopped).

Cultivar *issue 12 – Climate change. June 2018, p. 39*[7]

Climate change is an increasingly unavoidable topic when discussing the future of agriculture and forestry, since the sector is both highly vulnerable to its impacts and a contributor to emissions. It is essential to find innovative solutions to offset and mitigate emissions and to discover new management practices. These should include raising efficiency, producing more with less, reducing waste and implementing new forms of decarbonisation. This "accounting" should correspond to an overall assessment.

Hervé Guyomard and his team at the French Institut national de la recherche agronomique (INRA) address the best way to take into account environmental protection in the post-2020 CAP while preserving competitiveness. They discuss how the CAP has dealt with environmental concerns over the years and note that, to a certain extent, the reform process will be incomplete if these concerns are not fully incorporated. They propose solutions to improve current instruments and capitalise on existing opportunities, based on incentives to supply environmental services rather than on the fulfilment of a regulatory set of individual obligations, pitting services against disservices.

Cultivar *issue 19 – Macroeconomics and agriculture. April 2020, p. 33*[8]

As an economic sector (the first of 99 into which the Portuguese economy is currently divided in the national accounts), agriculture is important for the country's economic framework. It accounts for 1.5% of GDP but it is the basis of the agroforestry chain (from the primary sector to services) that generates 10% of GDP and 15% of exports. Portugal has a struc-

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6 https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_11/#14

7 https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_12/40/

8 https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_19/#34

tural trade deficit in food products that negatively impacts its trade balance in goods and services. Regarding inflation, food, beverages and tobacco account for almost 25% of household expenditure.

In her article, Martine Durand, former OECD statistics director, returns to the debate on GDP's limitations as an indicator of a nation's well-being and progress. She recounts the history of this important variable and the criticism it has faced. She also looks at the initiatives proposed to overcome its inadequacies, stressing that the aim of policies "*is not just to grow the economy but to improve people's lives*". The author also mentions that this is not an easy task, above all because it implies moving away from concepts and measurements to assessing the reality of people's lives.

Cultivar *issue 21 – Agroforestry systems. December 2020, p. 27*[9]

Agroforestry systems, particularly their agrogeological services, need to be better valued. However, this process is not devoid of new points of conflict. If tension previously resulted from competition for (and segmentation of) land for specialisation/mechanisation, driven by the goal of "economic efficiency", the current conflict results in the specialisation (and segmentation again) of land use driven by the goal of "environmental and climatic efficiency". The uniqueness of Portuguese agroforestry systems within the EU deserves attention, since it has often been misunderstood by the CAP (centred on a compartmentalised and uniform division of farmland) and ignored, on its integrated side, by climate policy (centred on the view of forestry and afforestation as variables in the adjustment of energy policy).

Francisco Avillez, Miguel Vieira Lopes and Gonçalo Vale characterise Portugal's agroforestry systems in terms of types of farming, Utilised Agricultural Area (UAA) and the impacts of current CAP measures, underlining their importance in fulfilling the new environmental and territorial goals and analysing their main economic results from the perspective of increasing the sustainability of the entire system.

Section II – Observatory

Cultivar *issue 2 – Soil. November 2015, p. 63*[10]

In this issue, soil is discussed as a key natural and economic resource. Since it is finite and irreplaceable, home to most of the biosphere and the planet's largest carbon sink, its preservation is crucial. For Portugal, this topic is of particular relevance given the current unfavourable circumstances, with a low rate of formation of generally thin soil and the persistence of undulating or sloping land with equally adverse geological characteristics. The consequence of these physical features present in most of Portugal is low land productivity with the inability of existing soils to supply the necessary nutrients for plant development, which is exacerbated by the risks of climate-related erosion.

In this updated analysis of the changing use of soil and land in Portugal, Rui Pereira, from the GPP, shows how different forms of land tenure and their contexts lead to different developments and different solutions.

Cultivar *issue 7 – Economic risk. March 2017, p.89*[11]

Risk is inherent to economic activity. There is always an uncertain set of elements between the decision to produce something and the moment production is converted into profit. This has been heavily studied by economic theory, especially in recent years. Primary sector activities (agriculture, forestry and fisheries) are not unique in this respect, but they have specificities due to their exposure to the environment and long production cycles in some subsectors.

GPP's Ana Rita Moura presents up-to-date economic data on the agrifood and forestry sector and draws

[9] https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_21/#28

[10] https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_2/E_book/CULTIVAR_2_O_SOLO/64/

[11] https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_7/E-book/CULTIVAR_7_O_Risco_na_atividade_economica/88/

Artur Pastor (1956), Ministry of Agriculture collection
Slide: removing dead tissue from the trunk of a fig tree, Loulé, Portugal

attention to methodological issues that must be taken into account, particularly in atypical years like 2020 when a consistent interpretation of data is not clear: higher consumption and exports and lower imports of food on the one hand and lower output on the other.

Cultivar *issue 11 – Population and rural areas. March 2018, p. 95*[12]

The transition from a rural farming society to an increasingly urban one occurred rapidly in Portugal, often without due assimilation. Discussing "rural" issues requires an integrated approach to various sectoral policies, while acknowledging not only the social dynamics at play, but also the often labyrinthine edifice of land-use planning instruments.

Wrapping up the Observatory, Rui Trindade and Manuel Loureiro use the national statistics office data to map the main variables in the changes experienced in recent decades in the country's demographic structure with a special focus on rural municipalities.

Section III – Reviews

Cultivar *issue 21 – Agroforestry systems. December 2020, p. 95*[13]

Given space constraints, we have chosen just one of our many reviews over the years of documents and books. Our choice is Orlando Ribeiro's classic work *Portugal, o Mediterrâneo e o Atlântico* [Portugal, the Mediterranean and the Atlantic], once again because we feel that though written in 1945 (but continually revised and extended by the author) this "Sketch of geographical relations" continues to present an accurate portrait of Portugal's geography and territory by one of its greatest geography reformers.

[12] https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_11/#page=96
[13] https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_21/Cultivar_21_Sistemas_Agroflorestais.pdf

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MAJOR TRENDS

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V. ***TO PREPARE THE LAND AND GROW CROPS ON IT.***

Sustainable Intensification: a new technological model in agriculture*

José Lima Santos

Full professor at the School of Agriculture (ISA), University of Lisbon

Feeding a world of 9-10 billion people with more demanding average consumption patterns than today is a challenge that we will face globally by 2050. Overcoming this implies ensuring people's access to food, an aim we are far from achieving and which therefore constitutes our most pressing task. It also implies cutting food waste, from field to plate, and considerably raising global food production.

… without the agricultural intensification of the past, we would probably be in a far weaker position as regards both food security and ecosystem services.

Attaining the necessary rise in production by simply expanding the area of cultivated land would have unacceptable costs in terms of tropical deforestation, biodiversity loss, destruction of crucial ecosystem systems and CO_2 emissions. Consequently, any acceptable solution will also mean more intensive farming, i.e. higher production per hectare on land currently cultivated, to reduce the pressure to convert natural ecosystems into new cultivated land.

However, past agricultural intensification was based on the growing use of industrial inputs…

favourable to the growth of half a dozen genetically improved plant varieties that raise productivity but require more artificial agroecosystems than traditional varieties.

The agricultural intensification of the past spared a lot of land for nature, biodiversity conservation and the maintenance and continuity of ecological processes we depend upon and which today we call "ecosystem services". In fact, without the agricultural intensification of the past, we would probably be in a far weaker position as regards both food security and ecosystem services.

However, past agricultural intensification was based on the growing use of industrial inputs, such as synthetic chemical fertilisers, pesticides, energy and irrigation. These are used to transform the agricultural environment and to make it more favourable to the growth of half a dozen genetically

* Editor's note: Originally published in CULTIVAR issue 3 – Healthy and sustainable eating, March 2016, p. 13, as "Intensificação sustentável: um novo modelo tecnológico na agricultura" https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_3/E_book/CULTIVAR_3_Alimentacao_sustentavel_e_saudavel/14/

improved plant varieties that raise productivity but require more artificial agroecosystems than traditional varieties. This intensification based on industrial inputs achieved the desired rise in productivity of cultivated land but at the cost of an increasingly inefficient use of these inputs, leading to their excessive loss. This in turn(1) expanded the emissions of polluting nitrates, phosphates, greenhouse gases and persistent pesticides; and (2) accelerated the exhaustion of useful natural resources, such as water, soil, biodiversity, energy and multiple ecosystem services.

Today, we are thus faced with the intensification dilemma. On the one hand, the decline in cultivated land due to soil degradation and urban development, the unacceptable environmental price of expanding cultivated land at the cost of the remaining natural ecosystems and the need to raise agricultural production – in response to demographic growth, changing diets in developing countries and demand for agricultural raw materials for non-food purposes such as biofuels – requires higher production per hectare of cultivated land, i.e. greater intensification. On the other hand, past intensification, based on higher industrial inputs per hectare of cultivated land, is no longer possible and/or desirable due to the clear limits we now face.

Therefore, overcoming the intensification dilemma implies producing more per hectare of cultivated land without needing to raise inputs per hectare, which requires a change in the technological model used in farming.

First, the environmental footprint from intensification based on inputs – both in terms of chemical pollution and the loss of planetary biodiversity – must be reduced.

Second, the past method to genetically improve plants seems to be facing serious limits with regard to the desired increase in plant response to fertilisers and pesticides in order to raise land productivity, cut costs and control pollution. These limits relate to the path followed in the past to raise productivity: concentrating most of the product of a cultivated plant's photosynthesis into a grain by using plants with lots of grain and little stem, and not so much to raise the photosynthetic production of the agroecosystem as a whole. It so happens that plants need roots, stalks and leaves and cannot consist merely of the ear and grain. Therefore, the powerful path to plant improvement followed until now is losing steam before an alternative of equal short- and medium-term potential has appeared (Brown, 2004).

Third, water depletion today affects numerous stretches of farmland, particularly in the most populated regions on the planet, such as China and India (Brown, 2004).

Fourth, the expected impacts of climate change on crop yields and water resources, above all in areas where those yields are already low, such as sub-Saharan Africa and the Mediterranean basin, challenge our global agricultural capacity in the future.

Fifth, dependence on cheap fossil fuels, prompted by the input-based intensification model, has made farm production highly vulnerable to energy prices, which is particularly relevant in the current structural environment of rising energy prices.

Therefore, overcoming the intensification dilemma implies producing more per hectare of cultivated land without needing to raise inputs per hectare, which requires a change in the technological model used in farming. So, first we will look at several characteristics of the current technological model – the chemical-mechanical model – on which intensification has been based. This will enable us to identify the outline of the required transition towards a new model: sustainable intensification.

However, overcoming the intensification dilemma requires more than a change in the technological model. It requires changing the behaviour of food producers, consumers and science and technology producers, which takes us into the realm of public policy. The need for new policies requires in turn that we act nor just like consumers, producers or

scientists but also as citizens asking for new policies. Therefore, in the final section of this article, I will return to this topic of the new public policies required to promote sustainable intensification.

The chemical-mechanical technological model

The technological model in agriculture includes not only the knowledge base used to create new farming techniques to respond to new challenges but also the way these techniques connect to each other to respond to these challenges (Bonny and Daucé, 1989).

In Europe and the most developed countries, and in many developing countries too, the post-war and later period was marked by a new technological model in agriculture that spread within a framework characterised by the rapid decline in the working agricultural population, which was absorbed by the expanding industrial and service sectors. Growing manpower shortages and the consequent rise in the corresponding opportunity cost placed higher labour productivity in agriculture at the heart of the new model. Labour productivity in agriculture is the product of two components: the amount of land cultivated per worker and the productivity per hectare of cultivated land. To raise labour productivity, therefore, the model proposed a dual replacement of these two components:

- Human labour and animal power with machines and engines to increase the amount of land cultivated per worker (the mechanical component of the model);
- Biological processes that occur in the agroecosystem (e.g. retaining atmospheric nitrogen by soil bacteria or pest control by biotic interactions) with industrial chemical inputs (e.g. nitrogen fertilisers or pesticides) to raise yield per hectare of cultivated land (the chemical component of the model).

Due to the importance of these two components, it has been called the chemical-mechanical model (Bonny and Daucé, 1989). Both components are based on solid global advances in science and agronomics and the use of huge quantities of cheap fossil fuel energy to produce the necessary mechanical inputs (machines and fuels) and chemicals (industrial fertilisers and pesticides). As a result, agriculture became extremely dependent on this energy subsidy. For example, the amount of fossil energy necessary to produce 1 kcal of food energy multiplied tenfold in Portugal between 1953 and 1989 from 0.17 to 1.70 kcal (Santos, 1996).

Under the chemical-mechanical model the new varieties of improved plants are generally very productive. However, this productive potential only manifests itself when these plants are incorporated into heavily modified agroecosystems where there is plentiful water and nutrients and an aseptic environment in which pests, diseases and other competing plants are suppressed by the systematic use of pesticides.

Under the chemical-mechanical model the new varieties of improved plants are generally very productive. However, this productive potential only manifests itself when these plants are incorporated into heavily modified agroecosystems where there is plentiful water and nutrients and an aseptic environment in which pests, diseases and other competing plants are suppressed by the systematic use of pesticides. More or less everywhere, a small number of these new highly productive plant varieties created by modern agricultural science replaced multiple varieties adapted to the local agroecosystem that were created over the centuries by the local knowledge of generations of farmers. The genetic basis of the chemical-mechanical model narrowed, making the model as a whole increasingly dependent on the availability of cheap energy and therefore vulnerable to its rising price.

The spread of the chemical-mechanical model implied a gradual incorporation, at the socioeconomic level, of agricultural production systems into the market economy: farm produce markets, markets in new industrial inputs and even credit markets

to buy the new inputs. In this framework, farmers – until then the main agents of local knowledge on which their production systems had been based – were made deeply dependent on global scientific knowledge. This initially belonged to the state and its research and rural extension apparatus, and later to the commercial suppliers of the new inputs.

The dual replacement of the chemical-mechanical model allowed higher food production per agricultural worker and therefore the transfer of many farm labourers to the emerging industrial and service sectors. This therefore allowed greater occupational freedom of choice which is highly valued today. Furthermore, it reduced the global risk of food insufficiency, which stems today from income inequality rather than insufficient technological potential in food production.

Agroecosystems influenced by the chemical-mechanical model are highly modified today. They are more productive, in terms of food production per hectare, and more dependent on outside energy subsidies to ensure their own functioning and stability.

Artificialising agroecosystems allowed agricultural production to rise during the second half of the 20th century chiefly by raising production per hectare (intensification) rather than by expanding the area of cultivated land. This has had evident benefits in terms of lower pressure to convert natural habitat into farmland.

The inefficient use of chemical inputs has led, however, to serious pollution problems that are far from being localised. The use of nitrogen fertilisers has doubled the overall nitrogen cycle (Vitousek *et al.* 1997) and bioaccumulative pesticides are today detectable in relatively remote areas where they have never been used, such as Antarctica.

Globally, the mainstreaming of the chemical-mechanical model, even in developing countries (the so-called green revolution), has multiplied global cereals output threefold since 1950 based on the adoption of high-yield varieties of wheat, rice and maize, multiplied irrigated land threefold and multiplied the global use of industrial fertilisers elevenfold (Brown, 2004).

A new technological model: sustainable intensification

As we have seen, the need to increase labour productivity lies behind the chemical-mechanical model in agriculture. The development of this model has led to higher land productivity (agricultural intensification) by raising the use of industrial inputs but this has generally been accompanied by lowering the efficiency with which they are used.

Agroecosystems influenced by the chemical-mechanical model are highly modified today. They are more productive, in terms of food production per hectare, and more dependent on outside energy subsidies to ensure their own functioning and stability.

Today, overcoming the dilemma of intensification implies raising land productivity (the good part of intensification) without increasing inputs per hectare (the bad part), which requires very significant gains in the efficient use of these inputs ("more crop per drop"). In fact, defined as the level of production per hectare and not as the level of inputs per hectare, intensification may, as we have seen, be the key to satisfying the growing demand for food, bioenergy and biomaterials, avoiding the mass conversion of natural habitats into farmland, which would have an unsustainable environmental cost.

Under the chemical-mechanical model, rising yields per hectare were generally achieved by increasing inputs per hectare. Therefore, agricultural use of fertilisers, pesticides, water and energy have multiplied globally by several factors over the last decades. This growth in the use of inputs has led to lower efficiency in agricultural production and a necessary increase in doses in order to obtain successive identical increases in output (the law of diminishing returns). This drop in efficiency combined with the general increase in inputs has resulted in a range of environmental problems, such as eutrophication of aquatic ecosystems,

poisoning of food chains, declining aquifers and river flows, and massive emissions of greenhouse gases. Furthermore, it has also frequently brought higher costs, lower food quality and security, lower competitiveness and greater vulnerability as we approach the end of the era of cheap energy.

Consequently, the new technological model must focus on decoupling as much as possible the rise in production per hectare from the amount of industrial inputs used per hectare. This change of tack will lead us to an agriculture which is simultaneously more competitive, more environment-friendly and more resilient to growing water scarcity and rising energy prices. The change may take the form of a tech model alternative to the chemical-mechanical version called "sustainable intensification" (Royal Society 2009).

The degree to which we will be able to decouple production per hectare from inputs per hectare in the future is not yet very clear. There are certainly limits to this tech strategy of producing more with less and therefore reducing trade-offs between the environment and the economy while increasing output per hectare. These limits are more evident in the short term and are above all due to so-called technological lock-ins (the clearest evidence of the existence of tech models). For example, the full genetic potential of the plant varieties used in agriculture today depends on simple, less competitive agroecosystems but also with lower involvement of predators and parasitoids, and therefore with greater need for pesticides. It also depends on high levels of nutrients in the soil and therefore abundant fertilisation. This example illustrates the "resistance" of the current tech model: techniques cannot be changed one by one; the shift requires the emergence of a new tech model alternative to the current one in which new techniques – based on certain fields of knowledge often side-lined by the current model – interlink with others in response to new needs and challenges.

There are at least two strategic transition paths to a new tech model in agriculture…

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The second (which is not necessarily an alternative to the first one) is based on copying and using ecological processes…

to replace purchased industrial inputs.

There are at least two strategic transition paths to a new tech model in agriculture that we can foresee today and that may decouple growth in output per hectare from input levels per hectare. The first is based on raising input use efficiency by applying them with greater precision in time and space – which is generally referred to as "precision farming", because it also includes new irrigation methods and other technologies, such as integrated protection and the sustainable use of pesticides.

The second (which is not necessarily an alternative to the first one) is based on copying and using ecological processes – predation, parasitism and disease, symbiotic nitrogen fixation, mycorrhizae, permanent and annual crop combinations, such as agroforestry systems – to replace purchased industrial inputs (pesticides, fertilisers and energy).

Techniques can be designed to harness these two paths. For example, in integrated production, the use of "cost-effective levels of attack" as a criterion for making pesticide treatments replaces "calendar" treatments (i.e. applied regardless of level of attack) characteristic of the chemical-mechanical model. Cost-effective levels of attack imply only applying treatments when the pest attack level is predicted to exceed the cost of the treatment in terms of lost production. This method allows higher pesticide input efficiency, through more careful application (first path), and, as it is less harmful to auxiliary populations of predators and parasitoids (often more vulnerable to the pesticide than the pest), enhances ecological processes which freely perform the same work as the pesticide – therefore also providing ecological replacements for inputs (second path).

The first path (efficient input use via more precise or careful application) depends above all on new information technologies (IT), including geographical information systems (GIS), sensors and remote sensing. The second path (replacement of inputs with ecological processes) is based on better knowledge of the way agroecosystems work. Both may also use biotechnologies to resolve problems of precision or replacement, respectively.

Intensification of the ecological base (second path) depends on boosting the provision of resilient pollination services, biotic pest and disease control, soil fertility and other ecosystem services. It therefore depends on healthy and functioning ecosystems to support the reduction in the current dependence of food production on increasingly expensive energy-rich industrial inputs. Ecosystem protection does not stem from their intrinsic value but from the recognition of our dependence on them to ensure food production in a new era of more expensive energy, when it is necessary to boost environmental sustainability.

… the state would primarily fund research that essentially creates public goods (e.g. knowledge on the working of agroecosystems) in which the private sector would not be interested. The private sector would focus, as today, on research that essentially produces patentable private goods

Moreover, many of the new techniques discussed above already exist or are under development. What does not yet exist is an alternative technological model that can boost the rapid development of these techniques and interconnect, complement and synergise them.

It is also important to note a relevant difference between the two strategic paths for transitioning to a new model as far as its scientific and technological development is concerned. Better knowledge of the way agroecosystems work (second path) is a public good, in the economic sense of the term. Once available, this better knowledge can be used freely by any farmer to improve his/her production system and, as a result, it is difficult to remunerate adequately whoever produced the knowledge for their R&D. Because it is knowledge, it is hard to patent, i.e. to restrict access in order to charge a price for its use. Thus, private investment in the technological R&D associated with the second strategic path will necessarily be limited.

On the other hand, higher input use efficiency via more precise application (first path) generally implies artefacts, equipment, software and seeds, such as drip irrigators, GM seeds, precision seeders and GIS software – i.e. private goods that are easier to patent and sell to recompense the technological R&D effort. The first path is therefore naturally more attractive for private R&D investment. This difference between the public and private nature of the final output of the tech R&D process explains the uneven level of development in various branches of agricultural science and technology when the essential investment in tech R&D is private.

We also note that, surprisingly, public investment priorities in science often closely coincide with those of the private sector and as a result, contrary to what might be expected, the desired complementarity (division of labour) between public and private in tech R&D financing fails to occur. This complementarity would imply that the state would primarily fund research that essentially creates public goods (e.g. knowledge on the working of agroecosystems) in which the private sector would not be interested. The private sector would focus, as today, on research that essentially produces patentable private goods (predominant in the first path of precision use of inputs). Vanloqueren and Baret (2009) used exactly this logic of the lack of complementarity to explain the incipient development of agroecological innovation when compared with the advanced state of genetic engineering within the agricultural research system. The obvious answer is that due priority in research policy is missing from areas of research that essentially produce non-patentable knowledge, such as that relating to the working of agroecosystems.

Public policies: protecting and rewarding public goods

Agricultural production occurs in the heart of modified ecosystems (agroecosystems) and not in a factory context totally separated from the environment. Therefore, agricultural techniques have profound effects on environmental quality. Some of these effects are positive – for example biodiversity associated with low intensity production systems – and others are negative – for example pollution, conversion of natural habitat and soil erosion.

Unlike the food produced, the environmental effects of agriculture are not sold on the market. Farmers and private systems of technological R&D react above all to things which have market value and reward their effort. All the rest – water quality, biodiversity, in fact all environmental sustainability – are a side effect of decisions taken according to what has value. Therefore, the market systematically fails to environmentally regulate agriculture. Adam Smith's idea of the invisible hand, according to which the market turns our self-interested decisions into the maximum public good, only works if all the consequences of our decisions have a market value (or a positive or negative incentive that regulates our choices). If some of these consequences exist, such as the environmental impacts of agriculture, which are neither exchanged in the market nor regulated by other incentives, the invisible hand no longer leads us to the maximum common good – known as market failure. This results in the privatisation of benefits (in the form of private profits from which the environmental costs are not deducted) and collectivisation of the environmental costs (which are borne by third parties), which is unfair and, above all, inefficient.

Market failure, as all economists agree, requires state intervention. In the case that interests us here, it requires public policies to deal with environmental sustainability issues in agriculture. These policies can take various forms, from simple environmental regulation to product differentiation according to the ecological footprint, in order to better guide consumers' buying behaviour, and direct financial incentives to produce environmental public goods through agriculture.

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Some public intervention, assuming one of the above, is therefore necessary to protect the ecosystem services on which sustainable intensification is based. Also, as we have seen, in the area of technological R&D policy, the argument of the public nature of much of agroecological knowledge implies a significant increase in public investment to facilitate the development of the scientific basis necessary for the intensification of the ecological basis.

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The importance of agriculture in preserving biodiversity*

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1. Agriculture and biodiversity: the "good" and the "bad"

Generally, the impact of farming on biodiversity fundamentally depends on the degree of intensification of the agricultural practices. At one end of the scale, highly intensive agriculture, with high nutrient and chemical inputs, heavy livestock density and large crop fields, is associated with low levels of diversity, common species and habitats of no conservation value. At the other end, more extensive farming practices with low livestock density and low nutrient and fertiliser inputs can lead to the creation of landscape mosaics associated with rare habitats and species of conservation value. Curiously, there is a paradox at this end of the scale, where one might expect higher levels of biodiversity in the absence of farming. However, some species and habitats are dependent on the disturbance that only farming brings, which means they could disappear if it is abandoned (which could be seen as an extreme result of extensification).

In sum, both intensification and abandonment of farming can result in a loss of biodiversity. One of the most paradigmatic examples of the negative impact of agricultural intensification is the…

In sum, both intensification and abandonment of farming can result in a loss of biodiversity. One of the most paradigmatic examples of the negative impact of agricultural intensification is the declining population trend of farmlands birds (e.g. Donald *et al*. 2001). However, many studies provide evidence of substantial negative impacts on other groups of fauna and flora (e.g. Stoate, 2001). There are also studies showing biodiversity loss as a result of agricultural abandonment. In an overall analysis of the response of European Mediterranean vertebrates to agricultural abandonment, Moreira & Russo (2007) suggest that the loss of diversity of vertebrates associated with farming areas will not be offset by the potential increase in species associ-

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ated with woods and forests. These assessments of losses and gains can, however, be highly variable depending on the geographical region (e.g., Sirami *et al*. 2008; Queiroz *et al*. 2014; Regos *et al*. 2014). In terms of plant diversity, some species are dependent on the maintenance of farming ecosystems. Illustrating this is the plant diversity on farmland in the Peneda-Gerês National Park, where Lomba *et al*. (2012) found that 20% of the species were exclusive to meadows. EU-wide, Halada *et al*. (2011) have shown that no less than 63 types of valuable conservation habitats listed in the Habitats Directive are totally or partially dependent on continued farming.

… "land sparing" advocates the total separation of productive and conservation areas, i.e. the intensification of farming for profit and production in the most suitable areas…

Another proposed approach ("land sharing") advocates the maintenance of these areas, arguing that in addition to biodiversity, they preserve other important ecosystem services…

Ecological intensification aims to maintain or raise productivity while minimising environmental impacts by incorporating ecosystem services in agricultural production systems.

Given farming's diverse (positive and negative) impacts on biodiversity, various alternative ideas exist concerning how to address this relationship (Tscharntke *et al.* 2012). One of these (known as "land sparing"[1]) advocates the total separation of productive and conservation areas, i.e. the intensification of farming for profit and production in the most suitable areas, completely setting conservation issues aside and arguing that in this way the necessary production of food can be achieved in a smaller geographical area, leaving more land for biodiversity conservation. This idea ignores the biodiversity values associated with more extensive farming areas which depend on the continuation of agriculture even in marginal and unprofitable areas. Another proposed approach ("land sharing") advocates the maintenance of these areas, arguing that in addition to biodiversity, they preserve other important ecosystem services (scenic value, traditional products, water quality, etc.) that should be valued in the context of a multifunctional landscape. There are also those who defend the adoption of management strategies to maintain biodiversity even in more intensive farming situations, from a perspective of "ecological intensification" (Bonmarco *et al*. 2013). In this context, elements of biodiversity can be used as a source of important services for farming (pest control, pollination, soil fertility) that should be enhanced as substitutes for anthropogenic inputs. Ecological intensification aims to maintain or raise productivity while minimising environmental impacts by incorporating ecosystem services in agricultural production systems. The Research Centre in Biodiversity and Genetic Resources (CIBIO) at the University of Porto is currently running several projects that address this topic and trying to quantify how far biodiversity can be an important provider of pest control services in vineyards and olive groves.

The contribution of farms using extensive practices to maintaining biodiversity has been formally acknowledged since the 1990s, when the concept of "High Nature Value farmland" was coined by Beaufoy *et al*. (1994). This concept was later incorporated into the rural development policies (Common Agricultural Policy, CAP) and implemented through subsidies (under agro-environmental and other measures) to boost the low income of these farms as compensation for the services the farmers who manage these areas provide society, particularly in preserving agricultural biodiversity.

2. High Nature Value farmland: what is it and why is it important?

High Nature Value farmlands (HNVf) include rural areas where agriculture constitutes the main (usually dominant) land use, and in which the underlying farming practices support or are related tohigh

[1] "As opposed to "land sharing".

levels of biodiversity (Beaufoy *et al*. 1994): a) a high richness of species and/or habitats; b) species with conservation status according to EU legislation; or c) both (Andersen *et al*. 2003; Lomba *et al*. 2014). In fact, several European species and habitats of high nature and/or conservation value are dependent on the continuation of specific extensive farming management practices characteristic of traditional farming systems (Lomba *et al*. 2014; Lomba *et al*. 2017). Given the multifunctional nature of traditional rural areas, HNVf are often characterised by high heterogeneity, reflected in different uses of the land within a farming matrix, including a high proportion of natural and semi-natural vegetation (Andersen *et al*. 2003; Lomba *et al.* 2014).

In the European context, it is estimated that around 30% of Utilised Agricultural Area (UAA) is HNVf (Lomba *et al*., 2014). Although they share numerous characteristics, farming systems that support these areas reflect the local climate and environmental conditions of the different socio-ecological contexts, which, in turn, leads to the diversity of European landscapes: from cattle grazing on natural pastures in northwest Ireland to the natural vegetation (pastures and/or small oak woods) in the landscape mosaics of northwest Portugal embedded in a diversified farming matrix. These differences have been used as a way of classifying and valorising these rural areas according to the nature value they support. According to Andersen *et al*. (2003; see Lomba *et al*. 2014 for a review), bearing in mind the prevailing nature values and the differences in extensive farming practices in these areas, three types of HNVf, designated as types 1, 2 and 3, can therefore be identified. Type 1 HNVf is characterised by more extensive farming practices and the dominance of natural and/or semi-natural vegetation and frequently occurring habitats listed in the Habitats Directive (Directive 92/43/EEC). This is the most common type of farmland in the EU and considered a priority in the context of the conservation of the agrobiodiversity. Type 2 includes landscape mosaics where plots of semi-natural vegetation and a high density of linear elements, such as vegetation strips and small woods, are embedded within a farming matrix. Finally, type 3 HNVf relates to farming areas that ensure an adequate habitat for one or more rare or conservation status species in the European or worldwide context, even in cases where practices are recognisably more intensive.

Overall, HNVf are areas where humankind (farmers and rural community members) and nature evolved together through time. Therefore, in addition to the acknowledged contribution of these areas in maintaining agrobiodiversity, full recognition has been given to the role they can play in reaching EU goals on environmental sustainability and also food security and human well-being. Furthermore, the multifunctional character of these areas has been associated with the provision of multiple ecosystem services, in addition to support for biodiversity, namely as relates to production (food, fibre, firewood), regulation (climate regulation, erosion) and cultural (aesthetic, symbolic capital) production. In this context, the FARSYD project – *Farming systems as tool to support policies for effective conservation and management of high nature value farmlands*–developed as a partnership between CIBIO, University of Porto, and the School of Agriculture (ISA), University of Lisbon, aimed to raise awareness about the relationship between farming systems and levels of biodiversity and the ecosystem services they provide. The project was developed in Portugal in the Peneda-Gerês National Park and the Castro Verde Special Protection Zone (ZPE de Castro Verde). Its conceptual and methodological approach was also implemented in other HNVf in Spain, Germany and Scotland. In general, the aim was to assess how farming systems can be used as an instrument

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to support conservation policies and the management of HNV farmland.

3. High Nature Value farmland in Portugal

Portugal is among those member states considered hotspots of HNVf, which relates to the way farmland has been managed over the centuries (Moreira *et al*. 2005; Oppermann *et al*. 2012). In fact, published data estimates that in 2009, 52.4% of UAA was occupied by HNV farming systems, which fell to 51.8% in 2011 (GPP, 2010). In general, four types of HNV farming systems have been described in mainland Portugal (Moreira *et al*. 2005; GPP 2010; Oppermann *et al*. 2012): extensive mountain pasture and complex polyculture systems in the north; and, pseudo-steppe cereal and cork oak farming in the south. Like most HNVf, these areas are adapted to local environmental conditions – climatic, soil and topographical – which are reflected both in terms of the farming systems themselves and the nature value associated with them.

Extensive mountain pasture systems, seen in Portugal's northern and central regions, are associated with natural grasslands such as the ones dominated by *Festuca indigesta* (habitat 6160) or *Brachypodium phoenicoides* with abundant orchid species (habitat 6210) and semi-natural grasslands dominated by *Nardus* (priority habitat 6230*). They are also related to the occurrence of Mediterranean reed-beds in non-halophytic wetlands (habitat 6420) and scrub, namely shrub thickets dominated by ericaceous plants and/or gorse (habitat 4030). The resources supported and promoted by these extensive pasture systems create conditions for various emblematic vertebrate species, namely vultures and wolfes (Moreira *et al*. 2005; Oppermmann *et al*. 2012).

As the name itself indicates, complex polyculture systems reflect a high diversity of crops, namely pastures, annual and perennial crops, which occur in a tight mosaic in a landscape where linear elements like fringe vegetation proliferate. Mostly seen in mountainous areas, these landscapes are characterised by low-altitude meadows (hay fields) (habitat 6510). In addition to these, among the habitats associated with these systems, of note are communities dominated by megaphorbic vegetation (habitat 6430), Mediterranean reed-beds in non-halophytic wetlands (habitat 6420) and *Molinia caerulea* grasslands and non-nitrophilous reed-beds (habitat 6410). Of the species associated with these farming systems, daffodils (*Narcissus pseudonarcissus* subsp. *nobilis*), Iberian endemism associated with low-altitude meadows, stand out. Animal species with conservation value associated with these systems include the red-backed shrike (*Lanius collurio*) and the hen harrier (*Circus cyaneus*).

Cork oak forests are the dominant agrosilvopastoral systems in the south of Portugal. These multifunctional systems are characterised as pastures dominated by cork oaks (*Quercus suber*) and/or holm oaks (*Quercus ilex*) under whose cover dryland cereals farming and/or Mediterranean scrub prevail. Under certain farming practices, the undergrowth on cork forests can be relatively continuous as a result of high levels of plant diversity, of which a variety are of conservation interest (eg *Linaria algarviana*, *Festuca duriotagana*, *Euphorbia transtagana*). Cork oak forests are a natural habitat of conservation interest – habitat 6310, evergreen cork oak (*Quercus spp*.) forests associated with these farming systems. Temporary Mediterranean ponds, classified as the priority habitat 3170*, are also associated with these farming systems. It should also be noted that countless vertebrate species of conservation interest are associated with these landscapes, such as the lynx, black vulture (*Aegypius monachus*) and the Spanish imperial eagle (*Aquila adalberti*).

Cereal-steppe farming, or pseudo-steppe, characterize landscapes where extensive dryland and cereal crops proliferate, normally under sheep grazing. They mostly occur in the Alentejo region and Castro Verde is one of the most important areas (Moreira *et al*. 2005). These High Nature Value farming systems are the habitat for a series of bird species whose conservation status is currently recognised as "unfavourable", thus contributing to their survival. Included among these species, for example, are the

great bustard (*Otis tarda*), little bustard (*Tetrax tetrax*) and lesser kestrel (*Falco naumanni*).

4. Conclusions

The conservation and maintenance of HNVf is dependent on the continuity of active management ensured by specific farming practices, many of which are traditional. However, these farming systems are currently under threat due to socio-ecological factors such as market changes/fluctuations, territorial competitiveness and farming abandonment, among others (Lomba *et al*. 2014). It is therefore urgent to realise how nature value, particularly the biodiversity associated with them, can be promoted in the context of their future socioeconomic sustainability, so that both the natural and human capital of the rural communities associated with them are incorporated into Portugal's territorial competitiveness and legacy.

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Let's eat what is around us – and that is just the beginning of change*

Alexandra Prado Coelho

Journalist, PÚBLICO newspaper

When I started writing about food in 2011, I was lucky enough to receive an invitation from the Food Organisation of Denmark/The Food Project to visit Copenhagen. At the time, there was talk of a "revolution" in Scandinavian food and I had the chance to observe directly what was happening at (and centred around) Noma, which the British magazine *Restaurant* later ranked for several years the best restaurant in the world.

I was part of a group of journalists invited by this organisation responsible for promoting what was going on in Danish food to take part in a programme that included not just an – unforgettable – dinner at Noma but a series of other activities that helped us to understand how the world's attention had been focused on the food of a country which, until then, could not have been said to have an important food tradition.

The trip turned out to be eye opening in a number of ways. The first was undoubtedly how the Danes were working closely with each other. The article I wrote for *PÚBLICO* when I returned to Portugal reflected exactly that. Its title was "The men behind the world's best restaurant", and it obviously talked about the chef, René Redzepi, and the researcher Lars Williams who worked on a laboratory-boat docked in front of Noma, and conducted all kinds of mad experiments in search of new flavours. It also mentioned Soren Wiuff, a farmer who grew asparagus and other products used at Noma and whom we visited on his property.

It was very interesting to discover how the communication strategy which allowed Denmark to position itself as a food destination gave just as much importance to the restaurant chef as it did to the farmer.

It was very interesting to discover how the communication strategy which allowed Denmark to position itself as a food destination gave just as much importance to the restaurant chef as it did to the farmer. At the time, that seemed decisive to me. What Redzepi talked about was something now common among all the world's greatest chefs, but that was not very usual at the time: the need to value produce and the farmers who created it. Without them, stressed Redzepi, his restaurant would not have become what it was.

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With Wiuff, we talked about some of the premises of the new Scandinavian food movement, namely the idea of foraging – the collecting of wild herbs and plants and using these ingredients in our diet. The farmer seemed a little critical of this romantic idea, arguing that if we all went out and picked wild plants, they would all soon disappear. In Wiuff's view, it would be better to start to grow them.

It is worth reproducing a paragraph from this article here which touches on another point that I think is key to the debate about the links between food and farming: "There is one thing above all that pleases Wiuff – selling his produce to those who recognise its quality. 'When you sell to a supermarket, you never hear "ahh, that's good", because if they did they'd have to pay more. It's better to sell to restaurants. They compliment you, but they also tell you when things aren't good. That's really important for your self-esteem. And producers need to have high self-esteem."

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You start to realise the importance of a close relationship between cooks and producers right there. Nowadays when chefs are given star status, it seems unfair that the work of the farmers and producers is not given more attention. Fortunately, little by little, this idea has started to take hold and, while you still won't find producers on the covers of magazines, we now have many chefs who use their high profile to promote not just themselves but also the producers they work with.

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Later on in Portugal I discovered the extraordinary work of Maria José Macedo at Quinta do Poial in Azeitão and the relationship this producer, who is now dead (but whose work is being continued by her daughter, Joana), established with various chefs. At times, it was the latter who asked her to try and produce a certain product that they wanted to add to their dishes, and at others it was she who challenged them with something she had tested in Poial. This is just one good example, but there are others, of course, although still rare. We hope they multiply. The close relationships between producers and cooks is essential for an integrated vision of what we eat and produce – that idea of an edible landscape all around us.

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Over the following years, I continued to work on and research food themes which, as a journalist for *PÚBLICO*, I always argued should be treated holistically. For me, it never made sense for "food" to be seen as a separate section in which critics wrote purely about restaurants and in a way disconnected from farming, health, the economy and culture.

I became even more convinced about this idea when I took another trip in 2012, this time to Peru, a country where people were also talking about an unfolding "food revolution". Peru's case was different from Denmark. This was a country with a strong food culture but which, for geographical reasons, was split in three: the coast and the mountain and forest regions. All three were quite different with their own food habits and ingredients, which often ignored each other.

I travelled there for Festival Mistura in Lima, the capital, and took the chance to understand how the revolution had started. I realised that there were similarities with what had happened in Denmark. Things do not happen by chance; they are the result of strategies developed by people with vision. In this case, the people were Bernardo Roca Rey, a former deputy minister of culture who became chairman of Apega, the Peruvian Food Society; and, above all, Gastón Acurio, a chef who had become a media personality and a TV presenter who travelled across the nation showing the Peruvians what people ate in the other regions of their country. He showed what people ate on the coast to those living in the forest and mountain regions and vice-versa. With this, the country began to discover itself as a gastronomic entity.

Things do not happen by chance; they are the result of strategies developed by people with vision.

Charismatic figures like Acurio in Peru and Redzepi in Denmark are essential, but of course there was a political vision that came from the desire to make Peru a food tourism destination and a reference point for anyone interested in gastronomy. Rey explained to me at the time that "The country had been divided by a major agrarian reform that had created a distance between the different sectors of society, and I realised that something needed to be done to boost Peruvian self-esteem. We had come out of a dictatorship that had banned freedom of expression and the only news was of government announcements of gigantic public works. So I'd say in my articles [in the *El Comercio* newspaper] that the history of Peru was something that we should focus on. And you wouldn't believe the success this had in such a downtrodden country."

Charismatic figures like Acurio in Peru and Redzepi in Denmark are essential, but of course there was a political vision that came from the desire to make Peru a food tourism destination and a reference point for anyone interested in gastronomy.

As strange as it might seem, in many cases and in many places, people no longer ate what was produced in their own country. They were transforming food and filling dishes with ingredients that came from far away, creating a huge carbon footprint and threatening local farming.

… cooking could be something that united all of Peru. "It's something that touches on everything: farming, fishing, industry, environment, business, national promotion abroad, culture, art."

An amateur cook, Rey invented a new concept: New Andean cuisine. He started cooking with products that were associated with the rural poor and had been long neglected. I wrote the following in my article: "He turned to grains like quinoa, kiwicha, used huge varieties of *ajís* (a kind of chilly pepper), countless kinds of potatoes and invited people to eat genuinely Peruvian food."

Once again, the essential idea was the same. As strange as it might seem, in many cases and in many places, people no longer ate what was produced in their own country. They were transforming food and filling dishes with ingredients that came from far away, creating a huge carbon footprint and threatening local farming. When someone starts suggesting we should eat what is being produced locally, it catches people by surprise.

I also interviewed Gastón Acurio and realised why he was such a charismatic personality capable of mobilising an entire country. And also why, at least at the time, he was more popular than any politician. He told me: "This is just the start of a big plan that is going to take a long time to implement and comes from young Peruvians' rightful and understandable indignation at the fact that this country rich in resources, history and opportunity is still considered Third World and just an exporter of raw materials. These young people think they can contribute in some way to make that change."

Men like Acurio and Rey realised that cooking could be something that united all of Peru. "It's something that touches on everything:

farming, fishing, industry, environment, business, national promotion abroad, culture, art." Although a famous chef himself, Acurio is not talking about promoting restaurants or star chefs. The idea goes deeper than that – and is far more generous.

"If you look at cooking as just a playful, pleasurable exercise and you don't worry about what's around you, then, yes, it is just about eating and enjoyment for those who can afford it." In a country like Peru, explained Acurio, "where affluence constantly clashes with poverty and pleasure can become immoral when there are children suffering from mal-nourishment, it was easy for chefs to recognise that cooking had to be more than just feeding those who can pay."

… it was easy for chefs to recognise that cooking had to be more than just feeding those who can pay.

Here is one practical example, among the many others I recount in my article: "In one of the debating forums for Festival Mistura, the minister for development and social inclusion, Carolina Trivelli, talked of the need to 'eat healthy, eat Peruvian food'. 'We don't just want kids to eat well; we want them to be the guardians of the traditions of their regions. Andean grains are at the centre of this strategy,' declared Trivelli, who days later signed an agreement with Apega to add various Andean products, particularly quinoa, to school menus. 'It is essential to form an alliance with local producers and cooks. Our kids need to know where their food comes from.'"

There are good examples in Portugal too [like] bisaro pork.

The indigenous bísaro breed from the north of the country was almost extinct in Portugal…

In 1995, Carla Alves, sought out the few remaining animals and started a process of restoring the breed.

Acurio reinforced the idea: "Thousands of years ago, Peru had a biodiversity which ensured people had environmental security. Kids weren't undernourished because they ate what they had. Then marketing came along and told them they had to drink milk and eat pasta and people began to abandon quinoa and other products. Public policies listened to this marketing and food aid programmes sent milk, sugar, pasta and rice from Lima to the rest of the country. Today, local production chains are being recreated through rich, healthy and coherent diets."

There are good examples here in Portugal too – just look at how many municipalities do an excellent job at praising and disseminating local products. It is impossible to talk about all of them, so I will mention just one here: *bísaro* pork. The indigenous *bísaro* breed from the north of the country was almost extinct in Portugal because it was considered less profitable than other breeds. In 1995, Carla Alves, an animal husbandry engineer aware of the problem, sought out the few remaining animals and started a process of restoring the breed.

Vinhais Municipal Council, which organizes the Feira do Fumeiro [Smoked Foods Fair], decided to support the *bísaro* pig project when concerns were raised about the fall in quality of the regional smoked products. Inspections of products on sale at the fair showed that poor quality meat was being used. There was a need to return to *bísaro* pork, but the problem was the lack of animals.

It was necessary to convince local producers to swap more profitable foreign breeds for *bísaro*, but in order to do that the latter had to be seen in a new light and to be sold at a fair price. That's when EU protection was sought for these smoked products, culminating in the awarding of Protected Geographical Indication (PGI) to the Vinhais Smokery (Fumeiro de Vinhais) and Protected Designation of Origin (PDO) to *bísaro* pork. In a work I did in 2013 on what made certain PDO products successful or not, I realised that it was this link with certified smoked products that saved the *bísaro* from extinction.

Other good examples are those that connect local products to tourism. As we know, tourists are increasingly interested in discovering not just mon-

uments but also local traditions and practices. The success of wine tourism has everything to do with this – and, once again, the wine sector showed other products how it could be done.

We need to connect what we eat to the land; we need to show where the ingredients (ideally) found in the region's restaurants come from. And whoever is interested to deepen their knowledge can take part – getting involved in farming, picking and crushing grapes during the harvest, going fishing or just going to the local market to buy fish directly from the fishmonger.

Is there a strategy to promote Portuguese food internationally? Our conclusion was that there are various unrelated initiatives but there is still no integrated strategy to extol the virtues of the entire production/food-related sector as a whole.

More recently, I wrote an article in the *PÚBLICO* with Francisca Gorjão Henriques in which we asked a question which while not directly about the connection between farming and food was near enough: Is there a strategy to promote Portuguese food internationally? Our conclusion was that there are various unrelated initiatives but there is still no integrated strategy to extol the virtues of the entire production/food-related sector as a whole.

Separating producers and restaurants is a big strategic error…

If they work together they will be much stronger.

Everything begins on the land.

We have talked about examples from other countries in this article. One of the people we talked to was Pelle Anderson, chairman of the Food Organization of Denmark (a private organisation that is 30%-publicly funded). What did he tell us? "The process coincided with a revolution in food production. Denmark is an industrial country with a very big industrial farming sector. As this movement began, many small producers – of cheese, beer and all types of products – began producing at a smaller scale." At the same time, the organic food movement started, "which was also heavily inspired by the restaurant industry".

"Here's an example: at the moment, 90% of the 50,000 meals served in Copenhagen's schools and old-age homes are made with organic ingredients," he points out. "There was a very clear reorientation of policy here: the government requested more organic produce and small organic farmers began to find greater chances to sell to institutions. This led to a structural change in food production."

Separating producers and restaurants is a big strategic error, says Anderson. There has to be a union between the food scene, wine industry and tourism: "If they work together they will be much stronger. Sometimes, the government can do this by putting a little money on the table and telling them to do something together. Someone has to unite them, someone who understands cooking, experts, because in many countries the mistake is made of putting this in the hands of tourism agencies who may know absolutely nothing about food."

In recent years, we have seen chefs who are increasingly aware of the importance of the quality of produce. Anyone following gastronomy – with all the visibility it has now fortunately gained –has also to be interested in the production side. Everything begins on the land. What reaches our plate has a story that is interesting to know – and one chefs are increasingly willing to tell, justly recognising the key work done by producers, farmers, fishers and cattle breeders.

So what is missing?

First, we need to discuss these issues more openly and identify the problems. Many chefs complain that the quality of Portuguese produce is still very inconsistent. This is above all due to scale. Small producers often struggle to ensure the same consistency as the big players.

Channels need to be created so that produce can be distributed more easily – I often hear them com-

plaining that a trip to Lisbon to sell two or three products to a restaurant "doesn't pay for the fuel". Incentivising the creation of better distribution networks (while limiting the number of middlemen who increase the price of the end product, harming producers and consumers) and local markets, supporting shops willing to pay producers a fair price and limiting authorisation to open large shopping centres which affect high street shopping is also necessary.

… it is vital to incorporate local produce, flavours, traditions and food culture into the cooking curricula of hospitality and tourism schools

… to support and incentivise study on the history of food and research on food traditions.

…to educate people about these themes …

And to valorise restaurants…

which perform an important role in promoting Portuguese produce.

Furthermore, it is vital to incorporate local produce, flavours, traditions and food culture into the cooking curricula of hospitality and tourism schools – and to do it at a national level, while also examining and exploring regional differences. It is important to support and incentivise study on the history of food and research on food traditions. It is essential to educate people about these themes – and about eating a healthier diet – in schools from the earliest age. And to valorise restaurants, whether they serve fine dining or more traditional food, which perform an important role in promoting Portuguese produce.

… boost the link between the food served in schools and local products/ producers…

Coordination, joint effort, will and the recognition of the importance of the subject are all needed.

Just like Peru and other countries, the key is to boost the link between the food served in schools and local products/producers (central purchasing is a barrier to this because large scale means lower prices, but it needs to be thought about). Avoiding the tendency for being "holier than thou", we should not pass excessive legislation that we might regard as over the top later.

All roads are open. There are countless examples from other countries – and Portugal too. Coordination, joint effort, will and the recognition of the importance of the subject are all needed. Portugal has excellent produce, a long food tradition, farmers who are guardians of ancient flavours, young people who have shown renewed interest in farming, and people who understand and study these subjects (which are generally very poorly recognised and valued – look at the difficulty in publishing food books that are anything more than recipe books).

And amidst all of this, we all have to do something simple and very pleasant: eat the edible landscape that is around us. Because if we don't, it won't survive.

Technology and unemployment: we have been here before*

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> *For if every tool could perform its own work when ordered, or by seeing what to do in advance … if thus shuttles wove and quills played harps of themselves, master-craftsmen would have no need of assistants and masters no need of slaves.*
>
> Aristotle (384–322 BC), *Politics*[1]

Machines able to perform work by themselves, either as programmed or by predicting what will be asked of them, have invaded the public realm and become a recurring theme in the media. From agriculture to a wide variety of services and obviously industry, current opinion is that (smart) machines will replace humans.

… robotics, mechanisation and automation …

The solution to the shortage of labour, jobs destruction, or destruction offset by new jobs creation?

Except for those who believe they can predict the unpredictable…

nobody knows for sure.

"With the shortage of workers, we have to develop other means to help us grow, harvest and process our crops – robotics, mechanisation and automation," announced CNN last August, citing the president of the Grower-Shipper Association of Central California. Californian agriculture, CNN explained, depends on immigrant labour. If Trump's plans go ahead and Mexican labour ceases to be available, robots will replace immigrants.[2] However, in another CNN article, American workers should also be worried: "Thirty-eight percent of jobs in the US are at high risk of being replaced by robots and artificial intelligence over the next 15 years."[3] By contrast, also on CNN, some also believe that "The

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* Editor's note: Originally published in CULTIVAR issue 10 – Work in agriculture and new labour trends, December 2017, p. 15, as "Tecnologia e desemprego: já aqui estivemos antes". https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_10/E_book/CULTIVAR_10_Trabalho_na_agricultura_e_as_novas_tendencias_laborais/16/

1 Aristotle, *Politics*, Book I, Part 4, translated by Carnes Lord, University of Chicago Press, 2013.

2 "Machines, not Americans, could replace immigrant workers", by Patrick Gillespie, CNNMoney, 18 August 2017. http://money.cnn.com/2017/08/18/news/economy/us-farmers-immigration-automation/index.html

3 "U.S. workers face higher risk of being replaced by robots. Here's why", by Alanna Petroff, 24 March 2017, CNNTech. http://money.cnn.com/2017/03/24/technology/robots-jobs-us-workers-uk/index.html

new technology will destroy a lot of jobs. But it will also create a lot of jobs."[4]

The solution to the shortage of labour, jobs destruction, or destruction offset by new jobs creation? CNN is unsure. Except for those who believe they can predict the unpredictable – the nature and consequences of adopting technologies that have not yet been tested or even invented – nobody knows for sure. We do not know if we are witnessing a wave of technology comparable in its effects to the ones experienced in the past, such as those stemming from the invention of the steam engine, electricity and combustion engine.

We do know, however, that it is not the first time that technological innovation and the consequences of the adoption of new technologies in work and employment have occupied a prominent place in the public debate.

We do know, however, that it is not the first time that technological innovation and the consequences of the adoption of new technologies in work and employment have occupied a prominent place in the public debate. We also know that the "old" controversies, tempered by real lived historical experience, may often bring more light to current debates than the unfounded and often deluded speculation that fills the newspapers today.

In the expectation that this is true, i.e. that it is possible to learn from the debates and experiences of the past, I first propose in this short article to revisit an "old" controversy about the consequences of technology on work and employment. Then I will examine the predictions of past theories in the light of real lived experience and, third, provide a short reflection on the teachings that result from the first two.

The origins

18th and 19th century Britain is where we should look if we want to reconstruct the origins of the debate about the consequences of technology on work and employment.[5] That is where, in 1779, we find the legendary Ned Ludd destroying a sock-knitting machine, as well as very real repeated episodes of workers destroying machines.

Rebellions by industrial workers against mechanisation and unemployment in Britain reached its height in 1811–1819 with the so-called Luddite movement. The movement became so widespread and so alarming that in 1812 the British government, under pressure from industrialists, passed the Frame-Breaking Act establishing the death penalty for people accused of destroying machinery. In the same year, following the destruction of a factory in the county of York, 64 workers were arrested and 13 sentenced to death.

After 1819, the influence of the Luddites waned in the factories but grew in the countryside. Between 1830 and 1833, in episodes in the South and East of Britain called the Swing Riots, farm workers destroyed mechanical threshers.

18th and 19th century Britain is where we should look if we want to reconstruct the origins of the debate about the consequences of technology on work and employment.

Although contemporaries of these dramatic events, the first political economists, for whom the use of machinery was above all regarded as providing a virtuous increase in human productive capacity, looked on with complacency.

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4 "Jack Ma: We need to stop training our kids for manufacturing jobs", by Julia Horowitz, 20 September 2017, CNNTech. http://money.cnn.com/2017/09/20/technology/jack-ma-artificial-intelligence-bloomberg-conference/index.html

5 On this subject, see Couto, J. M.; Garcia, M. F.; Freitas, C. E.; Silvestre, R. C. (2011), "Desemprego tecnológico: Ricardo, Marx e o caso da indústria de transformação brasileira (1990-2007)", *Economia e Sociedade*, vol. 20, no. 2. http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0104-06182011000200004

However, in 1817 the publication of a booklet by John Barton put an end to the indifference of political economists to the consequences of mechanisation on employment and wages and started a debate that would continue throughout the century.[6] Barton questioned the belief of political economists in Adam Smith's virtuous connection between the nation's wealth, the generous compensation provided by work and demographic growth: "a given increase of wealth does not always create an equal demand for labour" and therefore higher wages. For Barton, the cause was simple: "the manufacturer and the farmer … sometimes invest their [capital] accumulations in the construction of machinery, or in permanent improvements to the soil, calculated to give an equal produce with a smaller number of hands; at other times to hire additional workmen for the purpose of bringing to market a larger produce."[7] The level of wages, or, rather, the ratio of wage costs to the value of production would determine the proportion of investment allocated to machinery in total investment.

Following this booklet, John McCulloch – a Scottish political economist with a close affiliation to David Ricardo – published an article in 1820 in which he wrote in defence of Barton's ideas that "the fixed capital invested in a machine, must always displace a considerably greater quantity of circulating capital – for otherwise there could be no motive to its erection; and hence its first effect is to sink, rather than increase, the rate of wages".[8]

After the publication of this article, Ricardo wrote a letter to McCulloch disagreeing with his conclusion – "the employment of machinery … never diminishes the demand for labour – it is never a cause of a fall in the price of labour, but the effect of its rise" – leading to the controversy we describe below.[9]

The compensation theory

In 1821, following Ricardo's criticism, McCulloch revised his opinion, expounding what would become known as the "compensation theory": "… no improvement of machinery can possibly diminish the demand for labour, or reduce the rate of wages. The introduction of machinery into one employment, *necessarily occasions an equal or greater demand for the disengaged labourers in some other employment*."[10]

… the compensation theory became the predominant opinion of 19th-century political economists, as well as 20th-century neoclassical economists, and even today remains the "default" view of most economists.

Notwithstanding Ricardo's later change of heart and Marx's criticism, the compensation theory became the predominant opinion of 19th-century political economists, as well as 20th-century neoclassical economists, and even today remains the "default" view of most economists.

Classical economists who defended the idea of compensation and their neoclassical heirs did not, and do not, deny that mechanisation – whether at the scale of individual businesses, sectors or the economy as a whole – can lead to the destruction of jobs. However, they believe that these effects are only short term. To a greater or less degree of sophistication, they argue that other effects exist which off-

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6 Barton, John (1817) "Observations on the Circumstances Which Influence the Conditions of the Labouring Classes of Society", London: John and Arthur Arch. John Barton (1755–1789) was a political economist with philanthropic leanings. He founded Birkbeck College, called London Mechanics' Institution, whose original purpose was to educate the working class.

7 *Ibid.*, p. 17.

8 Quoted in Sraffa, Piero (2004), "Introduction", Piero Sraffa (Ed.), "The Works and Correspondence of David Ricardo", Vol I, Indianapolis: Liberty Fund, p. lviii.

9 *Ibid.*, p. lviii.

10 McCulloch, John (1821), "The Opinions of Messrs Say, Sismondi, and Malthus, on the Effects of Machinery and Accumulation, Stated and Examined", *Edinburgh Review*, March 182, p. 115.

set the short-term destruction of employment and restore employment levels in the long term. These offsetting effects include: (a) jobs involved in making machines; (b) reinvestment by capitalists of the savings from replacing workers with machines; (c) lower wages caused by short-term unemployment and the consequent reabsorption of the unemployed at lower "wage costs"; (d) lower consumer goods prices enabled by mechanisation and the resulting rise in real income and demand; (e) the creation of new products and the resulting creation of jobs to make them.[11]

Technological unemployment

In 1821, after the publication of McCulloch's second article, Ricardo came to the conclusion that the ideas he had defended with regard to the consequences of introducing machinery were wrong. In a new chapter to the 3rd edition of *On the Principles of Political Economy and Taxation*, he criticised the "compensation theory", concluding that the "use of machinery may be attended with a diminution of gross produce [intended to pay wages]; and whenever that is the case, it will be injurious to the labouring class." In short, it could cause unemployment and lower wages.[12]

Ricardo's use of the word "may" is important, since despite everything, he actually continued to believe that circumstances existed when the destruction of employment could be compensated by new investment. He believed above all that "The employment of machinery could never be safely discouraged in a State, for if a capital is not allowed to get the greatest net revenue that the use of machinery will afford here, it will be carried abroad …"[13]

In the section of *Capital* criticising the "compensation theory", Marx praises Ricardo for the "scientific partiality and love of truth characteristic of him"[14] and targets other "bourgeois political economists" such as James Mill, McCulloch, Torrens, Senior and John Stuart Mill, who "insist that all the machinery that displaces workmen, simultaneously and necessarily sets free an amount of capital adequate to employ the same identical workmen".[15] In contrast, Marx argues that: (a) the destruction of jobs due to the introduction of machinery into the productive process cannot be compensated for by the creation of employment to make the same machinery;[16] (b) the destruction of work due to the mechanisation of an industry may be accompanied by the creation of jobs in other industries of a number (higher or lower than that of the jobs destroyed) that depends on changes to the length of the working day in different industries and the ratio of components of constant capital (applied to the means of production) to variables (applied to wages).

Chapter 25 of *Capital* is dedicated exactly to an analysis, firstly, of the effect of capital accumulation on employment in conditions in which this accumulation occurs while the ratio between the constant and variable elements of capital remains constant (i.e. if labour were not replaced by machinery) and, secondly, in conditions closer to the historical experience in which the ratio between constant capital and total capital increases.

Marx concludes by saying that if capital accumulates while the ratio between the constant and variable elements of capital remain constant (without the replacement of labour by machinery), the relation-

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11 Piva, Mariacristina and Vivarelli, March (2017), "Technological Change and Employment: Were Ricardo and Marx Right?", IZA DP No. 10471, IZA – Institute of Labor Economics.

12 Ricardo, David (1817), *On the Principles of Political Economy and Taxation*, 3rd Edition (1821). London, John Murray, Albemarle Street, p. 454. To McCulloch's shock, Ricardo granted that "the opinion entertained by the labouring class, that the employment of machinery is frequently detrimental to their interests, is not founded on prejudice and error, but is conformable to the correct principles of political economy" (*ibid.*, p. 456). In reply, McCulloch wrote that if Ricardo's new opinions were correct "the laws against the Luddites are a disgrace to the Statute book" (quoted in Sraffa, *ibid.*, p. lviii, note 6).

13 Ricardo, *ibid.*, p. 480.

14 Marx, Karl (1867), *Capital: A Critique of Political Economy*, Vol. 1, Chapter XV, note 132.

15 *Ibid.*, Chapter XV, section 6.

16 "The new labour spent on the instruments of labour … must necessarily be less than the labour displaced by the use of the machinery; otherwise the product of the machine would be as dear, or dearer, than the product of the manual labour." Marx, *ibid.*

ship of dependence of labour on capital may be "bearable". Unemployment might not increase and wages might even rise.

However, in the more realistic case of capital growth being accompanied by the replacement of labour by machinery, things would be different. In this situation, "The greater the social wealth … the absolute mass of the proletariat and the productiveness of its labour, the greater is the industrial reserve army … But the greater this reserve army relative in proportion to the active labour army, the greater is the mass of a surplus population, whose misery is in inverse ratio to its torment of labour. The more extensive, finally, the lazarus layers of the working class, and the industrial reserve army, the greater is official pauperism. *This is the absolute general rule of capitalist accumulation*. Like all other laws it is modified in its working by many circumstances, the analysis of which does not concern us here."[17]

In sum, for Marx, capital accumulation through mechanisation, unemployment (growth of an industrial reserve army) and impoverishment of workers were linked through a chain of causality. Machines themselves are not responsible for cutting "off the workmen from their means of subsistence". However, the same machines that represent "a victory of man over the forces of Nature, but in the hands of capital, makes man the slave of those forces."[18]

Possibilities for our grandchildren

In 1928, John Maynard Keynes gave several talks about the future which were revised and published in 1930 during the Great Depression as *Economic Possibilities for our Grandchildren*.[19] In this essay, Keynes sought to rid himself of the pessimism caused by the "prevailing world depression" and "take wings into the future".[20] "What are the economic possibilities for our grandchildren?" he asked.

"We are being afflicted with a new disease of which some readers may not yet have heard the name, but of which they will hear a great deal in the years to come – namely technological unemployment. This means unemployment due to our discovery of means of economising the use of labour outrunning the pace at which we can find new uses for labour."

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However, for Keynes, increased technical efficiency whose short-term consequence was unemployment would signify in the long term "that mankind is solving its economic problem", i.e. the problem of scarcity.[22] The author predicted that "the standard of life in progressive countries one hundred years hence will be between four and eight times as high as it is today".[23] Assuming a society that did not have insatiable desires and would be happy with a living standard eight times higher than in 1930, the necessary product could be obtained, sharing work as much as possible, if each person worked three hours per day, fifteen hours per week.

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17 *Ibid*., Chapter XXV, section 4.

18 *Ibid*., Chapter XV, section 6.

19 Keynes, John M. (1930), "Economic Possibilities for our Grandchildren", *Essays in Persuasion*, New York: W.W. Norton & Co., 1963, pp. 358–373.

20 *Ibid*.

21 *Ibid*.

22 *Ibid*.

23 *Ibid*.

From predicting the future to historical experience

What can we expect from technological evolution or revolution? According to "compensation theory", higher labour productivity and the temporary destruction of employment in some sectors offset by investment growth in others and the resultant creation of jobs. From the Marxist perspective, structural unemployment (long-lasting) and the poverty of those with and without jobs. In Keynes' optimistic outlook, a society that resolves the problem of scarcity frees itself from the cogs of accumulation and divides labour between moderate daily shifts of three hours per person a day, five days a week.

Over eighty years now separate us from all these attempts to predict the future. How can we assess them according to the lived experience of almost a century?

Over eighty years now separate us from all these attempts to predict the future. How can we assess them according to the lived experience of almost a century?

Let us start with compensation theory. The 20th century, which witnessed important waves of technological innovation, was far from being uniformly characterised by low levels of unemployment. On the contrary, there was mass unemployment in the more developed capitalists countries at times, particularly between 1929 and Wold War II. However, this had more to do with crises originating in the financial sector than with technological changes.

It is therefore plausible that during the 20th century, circumstances occurred that countered a trend inherent to capitalism. What circumstances might these be?

… a set of institutional devices such as labour laws, trade unions and collective bargaining whose origins lay in political developments not strictly governed by economic factors.

Keynes
… his forecasts of growth were not wrong, but his predictions about shorter working hours were.

In the long period that followed World War II, rises in productivity from technological innovation were accompanied by proportional increases in wages, demand and product compatible with relatively low levels of unemployment.

However, somewhere around the late 1970s, there was a decoupling of wage growth from productivity growth. Real wages stagnated and unemployment, though subject to cyclical fluctuations, began to trend upwards. Wealth and income inequalities grew. This scenario, while not the "absolute pauperism of the working class", is very similar to Marx's idea of "relative pauperism" in *Capital*.

The 150 years that separate us from the first edition of *Capital*, notwithstanding the episodes of mass unemployment and the most recent trend towards increasing inequalities and rising unemployment, can hardly be described as a whole as a period in which the industrial reserve army and impoverishment of the working class has continuously risen. Was Marx's prediction wrong?

In fact, the laws formulated by Marx are poorly adapted to forecasting. According to Marx, these laws, including the "absolute general law of capitalist accumulation", were always subject to modification by many circumstances. It is therefore plausible that during the 20th century, circumstances occurred that countered a trend inherent to capitalism. What circumstances might these be? What made it possible in the 30 years following World War II for productivity growth and wage and demand growth to be closely linked? It certainly was not because of the mechanisms of a "flexible" labour market. Rather it was a set of institutional devices such as labour laws, trade unions and collective bargaining whose origins lay in political developments

not strictly governed by economic factors. What explains the decoupling of wages from productivity from the late 1970s? Among other things, the weakening of these very devices in the name of flexibility, also politically determined.

… three points: the pleasure of work and fear of inactivity, necessity and insatiability.

As we near the hundredth anniversary of Keynes' article, and therefore the end of his forecasting horizon, we can see that Keynes was mistaken. How? According to Robert (and Edward) Skidelsky[24] – an authority on Keynes' work – his forecasts of growth were not wrong, but his predictions about shorter working hours were. Working hours did fall on average in the developed capitalist countries, but if current trends continue, we will be working an average of 35 hours in 2030 and not 15 as Keynes predicted.

We do not know if we are experiencing a technological wave comparable in effect to those of the past. "Robots might be everywhere," as the media report, "but they take time to appear in the statistics."

Skidelsky's explanation for Keynes' forecasting error lies at the intersection between the following three points: the pleasure of work and fear of inactivity, necessity and insatiability. As they explain, "Keynes's mistake was to believe that the love of gain released by capitalism could be sated with abundance, leaving people free to enjoy its fruits in civilised life … [he] did not understand that capitalism would set up a new dynamic of want creation…"[25]

… the "compensation" of employment destroyed by mechanisation depends on institutions able to align labour productivity growth with wages and not free market mechanisms.

… technology in itself is not the decisive game changer that we thought. Its impacts depend on the institutional context in which innovation takes place.

In conclusion

We do not know if we are experiencing a technological wave comparable in effect to those of the past. "Robots might be everywhere," as the media report, "but they take time to appear in the statistics." [26] In fact, economic data for the world's most technologically advanced country – the USA – show a drop in productivity growth between 1995 and 2014. However, the public realm is saturated with announcements of the arrival of battalions of smart robots ready to produce lots of things very cheaply and push humans into the ranks of the industrial reserve army.

We have examined past controversies in the aim of contributing to improving the quality of the debate on the consequences of new technologies for employment and labour. The first thought that springs to mind, but as no more than an interesting fact, is that the talk of the end of work that fills the media being derived from past theories applies much more to Marx than to economists who are unconditional apologists for technological progress and are behind most media-driven economics commentary.

Secondly, the "compensation" of employment destroyed by mechanisation depends on institutions able to align labour productivity growth with wages and not free market mechanisms.

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[24] Skidelsky, Robert and Skidelsky, Edward (2013), *How Much is Enough? – Money and the Good Life*, London: Penguin Books.

[25] *Ibid*., p. 41-42.

[26] Carvalho da Silva; Manuel, Hespanha, Pedro; Teles, Nuno and Caldas, José Castro (2017), "Introdução" in Carvalho da Silva; Manuel, Hespanha, Pedro e Caldas, José Castro (Coords.) (2017), *Trabalho e Políticas de Emprego – um Retrocesso Evitável*, Lisbon: Actual, pp. 16–33.

Thirdly, technology in itself is not the decisive game changer that we thought. Its impacts depend on the institutional context in which innovation takes place.

If living work (by humans) is increasingly replaced by dead work (by robots) in productive processes in the future, three scenarios take shape. First, depending on growth, productivity gains will be absorbed proportionally by wages and turned into demand for more (and eventually other) goods and services. Second, regardless of growth, the right to work is ensured through an equitable sharing of social labour. Third, work and employment become a privilege and those denied the right to work are paid subsidies funded by taxes on the income of those who work and the profits of the owners of the robots.

And the evolution of the institutional context depends on political choices.

Technology, as we know, brings about risks that should be more closely scrutinised than they currentlyare. But robots, whether smart or not, are not themselves responsible for the consequences they may have on employment. These depend on the institutional context in which innovation takes places. And the evolution of the institutional context depends on political choices.

Depopulation in rural areas: between inevitability and the ability to change*

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The long demographic cycle of traditional rural Portugal: rise and fall

Rural areas have never been demographically homogeneous – in Portugal or in any other country. Why? The reasons have not necessarily been the same over time. It is important to have a grasp of this change, even in brief, in order to better understand the present and, in particular, envisage what must be done – or, more modestly, to identify what can be done – aiming at creating rural areas that have a future in their diversity.

In the long historical period spanning the invention of agriculture until the industrial revolution that began in Britain at the end of the 18th century, the demography of different rural areas can be basically understood in terms of the interdependencies between ecology on the one hand and community and economy on the other. These were mediated by three main elements: power relations (political, religious and civil), property structure and technical knowledge (agricultural, hydraulic, etc.). In rural societies, given the centrality of agriculture and silvopastoral methods and their dependence on biophysical factors, the "ecology" component is essential when defining these interdependencies. History clearly shows that no deterministic relationship exists between ecology, community and economy. However, it is also clear that in these societies factors such as climate conditions, orography, soil quality and water availability crucially contribute to limit the possibility of occupying and using rural territories.

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For centuries, the evolution in inhabitants and human settlement patterns in Portugal's rural areas reflected the existing ecological conditions and the way in which the three mediation systems – power, property and

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knowledge – reshaped the relationships between the three points on the ecology-community-economy triangle: by public decision, by initiative of the social and economic elites, or by necessity and capacity of the local communities. On the other hand, given the early establishment of the country's political borders in the European context, the geostrategic role of systematic occupation of the national territory through settlement policies, while important in military terms, had limited impact in time and space. In this context, the demographic history of the country's rural areas – occupation (density), age and family structure, social composition, migratory movements and evolutionary dynamics – essentially reflects their ecological conditions and how the socioeconomic responses developed over time, locally or from outside (the Douro Valley perhaps being the best example), countered, enhanced and overcame these biophysical conditions, or simply succumbed to them.

… the demographic history of the country's rural areas

… reflects their ecological conditions and how the socioeconomic responses developed over time

… countered, enhanced and overcame these biophysical conditions, or simply succumbed to them.

This traditional rural Portugal – the country of geo-history, of the opposition between Atlantic Portugal and Mediterranean Portugal (Orlando Ribeiro), between feudal Portugal and the Portugal of municipalities (José Mattoso) or, more prosaically, between North and South – was the demographic Portugal that endured until the mid-20th century. With the exception of time-limited periods of circumstantial events (wars, epidemics), the population gradually grew in most rural areas, albeit at varying speeds. This was due to continued high birth rates that offset both high infant mortality and the rural exodus to the cities, more dynamic rural areas or even abroad.

Depopulation as a structural problem therefore began as a consequence of the exhaustion of a model of rural society founded on agricultural systems whose survival was only possible if based on extreme poverty and harsh living conditions.

The municipality of Pampilhosa da Serra was a pioneer in breaking this centuries-long trend, with the resident population reaching its height in the 1940 census (around 15,500 people) and systematically declining ever since. Located in the central mountain chain (Cordilheira Central) and with particularly hard biophysical and access conditions, in 2011 total inhabitants were recorded at less than 4,500, i.e., fewer than 1/3 of the number seventy years earlier. Even more striking was the fall in the number of children aged under 14 between 1900 (around 4,300) and 2011 (321).

Pampilhosa da Serra is not the only municipality whose demographic zenith occurred almost eight decades ago. The same trend is visible, albeit in less dramatic form, in many other municipalities – particularly in the Alentejo region, where the damage of the soils caused by the *Campanha do Trigo*[1] in the 1930s began a cycle of demographic shrinkage influenced by different factors over time. Depopulation as a structural problem therefore began as a consequence of the exhaustion of a model of rural society founded on agricultural systems whose survival was only possible if based on extreme poverty and harsh living conditions. Unsurprisingly, this population crash first expressed itself in areas where the ecology and responsiveness of local communities heavily limited the possibility or capacity to build a new ecology-communi-

[1] Translator's note: a campaign from 1928 to 1938 during the period of the dictatorship in Portugal whose aim was to achieve self-sufficiency in wheat/bread production.

ty-economy relationship able to maintain positive demographic dynamics.

The demographically perverse effects of two generations of agricultural modernisation

Alongside the effect of the exhaustion of a model of rural society unable to respond to negative ecological circumstances and isolation, and which public attempts at domestic settlement were unable to counteract, must be added the impacts of the country's late modernisation, in particular from the 1950s onwards. In contrast to the dominant rural society of the time, there emerged a two-tier society, to use Adérito Sedas Nunes' term: on the one hand, an attractive emerging modern urban and industrial country, with increasing infrastructure and higher levels of education and literacy; on the other, a demographically, economically and socially contracting country with a traditional rural society afflicted by emigration and migration to the cities, by declining agriculture, and by poor accessibility and physical and social mobility. It is in this context that the word "interior" became widespread as a term to denote the opposite of "coastal" rather than the more traditional definition of "inland", i.e., those areas which were neither along the coast nor the border. Farming mechanisation, growing competition from imported foodstuffs and the social image of agriculture as "yesterday's" sector, and thus unappealing to young people, competed among other factors to exacerbate the demographic decline of municipalities where exhaustion of the traditional rural model was felt earlier, spreading afterwards to many others where agriculture played an important social and economic role.

The emergence of an urban-industrial society and technical-scientific advances reshaped the interactions between ecology, community and the economy in rural areas, with evident demographic impacts. On the one hand, farming modernisation aimed to overcome ecological limitations, introducing species deemed more suitable and new forms of land use and water management. At the same time, agricultural production gradually moved away from local communities, dismissing its knowledge and even its people. In sum, the economy of agricultural and agrifoods systems sought to "free itself" from local ecological and social restrictions, recreating interactions where productivity gains and competitiveness implied a radical shrinkage in the farming population and, more generally, a growing decoupling between rural areas and agriculture. What thus emerged was what some have called the post-agricultural rural society, not in the sense that farming had become irrelevant but rather to stress its loss of social, economic and political importance in structuring rural areas.

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In recent decades, more intensive and super-intensive farming using increasingly sophisticated precision solutions – as well as ever more complex production and consumption networks organised by diverse and powerful actors at a multiscale level that far surpasses regional and national borders – have further exacerbated the divorce between the economy component and the ecology and community components in large areas of rural Portugal.

Given these two waves of modernisation in agricultural and agro-industrial production and the agrifood production-distribution-consumption chains, and in a context in which the so-called post-agricultural rural society is clearly finding it hard to create alternative economic systems beyond rural and nature tourism, the demographic decline of many rural areas seems inevitable. In some cases, this is also a consequence of dismantling what remains of the old rural societies and in others a result of production regimes that dispense with local people and use seasonal labour from distant countries (East-

ern Europe, Asia and, more recently, Sub-Saharan Africa) recruited via transnational networks. Though caused by a variety of reasons, depopulation of both types of rural areas is inevitable and structural: the uncoupling of a mutually beneficial territorial interdependence between ecology, community and the economy.

Today, depopulation is the rule in most rural municipalities in the so-called "interior". Many are forecast to see demographic decline of more than 20% by 2030, a figure all the more surprising when one considers that several of these have been losing population for decades and some for almost 100 years. The exceptions fall into three main categories: (i) rural municipalities which have historically had mixed economies of agriculture, industry and services in geographical contexts marked by scattered demographic patterns and the fragmentation of property (e.g. municipalities in the Northeast region); (ii) rural municipalities with a strong farming base located within the direct area of influence of large and medium-sized cities, i.e. close to important markets, knowledge centres and qualified infrastructure and equipment (e.g. municipalities in the West region); (iii) rural municipalities where specific biophysical conditions (soil, water) allow the development of competitive export-based farming with a robust local base (e.g. part of the Fundão municipality).

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The brief description above stresses the existence of a diverse range of rural areas; the structural nature of depopulation both in more ecologically fragile and geographically remote rural areas and in rural areas heavily impacted by first-generation (urban industrial) and second-generation (urban financial) economic development; and the existence of rural agricultural and post-agricultural municipalities with positive demographic dynamics associated with particular contexts in terms of productive structure, settlement patterns, distance to urban centres and biophysical conditions.

In this context one can understand why reversing the structural trend in demographic loss in many rural parts of the country is hard if not impossible. Added to this trend are new risks and threats, such as climate change and its consequences in terms, for example, of exacerbating periods of severe drought and wildfires. Yet, at the same time new opportunities appear to be emerging from the creation of a new ecology-community-economy relationship, such as the valuing and paying of ecosystem services or establishment of new food production-consumption chains oriented by aims of food security and safety, environmental sustainability, social justice and territorial cohesion, and therefore more locally rooted in ecological and social terms. However, it is not clear whether the impacts of these innovation fronts will be able to reverse the structural trends in demographic loss. In fact, it is not unreasonable to imagine that these impacts may be as limited as the effects of the heritage-based approaches advocated for rural areas grounded on the certification of local products and on nature,

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cultural and rural tourism, or the consequences of attracting neo-rurals to mitigate depopulation but insufficient to stop or, even more so, reverse it.

Between inevitability and transformation: what to do?

The debate on the depopulation of rural areas, and those in the "interior" in particular, is systematically associated with two ideas: the repopulation of the "interior" and the anchoring of local populations. Both ideas are misconceived. The former, if looked at in general, contains a dangerous delusion and the wrong political message: that it is possible to reverse demographic loss in all rural areas, unrealistically ignoring the structural diversity of existing situations. The latter, if wrongly interpreted, seems like an imposition that not only fails to take account of the fact that the right to the place (i.e., to remain in the town or municipality one lives in) is as important as the right to mobility (i.e., to seek desired personal, professional and family opportunities elsewhere by choice) but does not bear in mind that the important point is to provide conditions for each citizen to choose his/her preferred option – neither "forced to remain or leave".

the wrong political message: that it is possible to reverse demographic loss in all rural areas, unrealistically ignoring the structural diversity of existing situations.

… the right to the place (i.e., to remain in the town or municipality one lives in) is as important as the right to mobility (i.e., to seek desired personal, professional and family opportunities elsewhere by choice)

Of course, rejection of the simplistic use of these two ideas does not assume the acritical acceptance of their opposite: the inevitable depopulation of rural areas and, consequently, the denial of public responsibility because inevitably doomed to fail; the inevitable closure of essential facilities and services based on a financial rationale and, consequently, the natural departure of those who no longer find their needs satisfied at the local level.

All official documents, from both international and national organisations, argue for more resilient rural areas by promoting growth, job creation and generational turnover in relevant activities, particularly agriculture. However, these general aims clash with diverse rural realities, as exemplified above, and highly unequal capacities to adapt to change and transformation. How far then can public policies counteract the depopulation of rural areas?

There is no single or magical answer to this question that guarantees success. However, several measures can and must be taken:

i) A generalised reversal of depopulation in rural areas is impossible, therefore a differentiated and selective approach is needed.

ii) This approach implies a robust prior assessment based on thorough information and multidisciplinary knowledge of the current and foreseeable relationship between ecology, community and economy to develop strategies, policies and instruments aimed at: (a) increasing the sustainability of areas with a positive or stable demographic evolution; (b) reversing trends in areas with a slight population loss; and (c) proactively managing areas of structural population loss (which in planning instruments in countries like Italy or Spain are called "open spaces", i.e., scarcely populated but neither forgotten nor abandoned).

iii) The prior assessment must allow a selective identification of types of rural areas and sub-regional territorial units that are relevant for public intervention.

iv) Given the historical relationship between rural areas and farming, rural development policies, namely under the Common Agricultural Policy (CAP), tend to extend this relationship, preventing a more suitable vision for post-agricultural rural areas.

v) Moreover, and given the relevance of the (good) "Leader" methodology in Pillar 2 of the CAP, the

current rural development policy is more like a local development policy, thus revealing difficulty in encompassing more complex multilevel and multiscale issues.

vi) The situation in point v) is especially simplistic in a context marked by the growing importance of cities as actors in food policy and dynamic drivers of rural areas; by the expansion of financialization and intensification of a large part of agrifood systems; and, finally, by rising exposure and vulnerability to external factors like climate change and its effects, particularly advancing desertification.

vii) In an increasingly complex and unpredictable context, and one in which the cycle of production modernisation starting with the urban industrial revolution has reached its end point (see the case of fossil fuels), the future of rural areas and their relationship with demographic processes must be seen from a dynamic perspective of transition and transformation towards new models of growth and development. We understand now the demographic effects for rural areas of the failed traditional rural development model. Yet, we have to take on board its visible and potential consequences at the conceptual and policy formulation level stemming from the first generation (urban industrial) and, above all, second generation (urban financial) of Portuguese social and economic modernisation.

viii) According to the observations above, rural depopulation must be avoided (where it has yet to occur), resisted (where it seems reversible or controllable) or managed (where it is hard to stem) using an integrated approach to territorial development benchmarked against a national strategic vision like the National Programme for Spatial Planning Policy (PNPOT).

… rural depopulation must be avoided (where it has yet to occur), resisted (where it seems reversible or controllable) or managed (where it is hard to stem)

The structural changes cannot be solved by good will and even less by naivety. The demographic dynamics in rural areas are the result of complex interactions between local and general biophysical characteristics and socioeconomic models of development. Public policies have an important but limited role to play in regulating these interactions. In fact, as explained in previous sections, the geographically diverse nature of historical demographic evolution in rural areas depends more directly on societal and economic choices than on political decisions or policy actions. This statement is not intended to minimise the importance of public measures or to remove state responsibility, which would be ethically unacceptable. On the contrary, this is an appeal to recognise that structural changes will be needed to overcome structural problems. Depopulation in many of the country's rural areas is the inevitable result of the growth models that have prevailed in successive historical periods. Between inevitability as a legacy of the past and the present, and transformation as an imperative for the Portugal of tomorrow, we will have to find the wisdom and vision to build new interdependencies between ecology, society and the economy allowing, through a combination of both fast and incremental changes, to pursue transition paths leading to new sustainable geographies, some with a dense and dynamic population, and others with scarce human occupation but with healthy ecosystems adapted to new global biophysical challenges.

The structural changes cannot be solved by good will and even less by naivety. The demographic dynamics in rural areas are the result of complex interactions between local and general biophysical characteristics and socioeconomic models of development. Public policies have an important but limited role to play in regulating these interactions.

CAP post-2020: improving environmental protection while preserving the necessary competitiveness of European agriculture*

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The Common Agricultural Policy (CAP), the European Union's (EU) most important policy in budgetary terms, has remained stable for almost three decades, during which its primary objective was the development of domestic agricultural production. The CAP was then based on producer price support through market intervention at guaranteed prices, import protection and export promotion. However, since 1992, more than 25 years ago now, this policy has been under permanent reform.

… the CAP reform process was subsequently guided by better distribution of support among countries, regions, productions and farm holdings and correction of the adverse effects of an over-intensive agriculture on natural resources and the environment.

The environment in the CAP

In 1992, the CAP reform process was first driven by external considerations under the influence of the World Trade Organisation (WTO) and the need to reduce trade distortions. Subsequently, the process was guided by internal considerations of two kinds: (i) better distribution of support among countries, regions, productions and farm holdings and (ii) correction of the adverse effects of an over-intensive agriculture on natural resources and

* Editor's note: Originally published in CULTIVAR issue 12 – Climate Change, June 2018, p. 39, https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_12/40/ as "PAC pós-2020: melhorar a proteção do ambiente preservando a necessária competitividade da agricultura europeia", a translation from the original French article, *ibid*., p.45, "Comment mieux prendre en compte la protection de l'environnement dans la PAC de l'après-2020 tout en préservant la nécessaire compétitivité de l'agriculture européenne?". https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_12/46/

** Editor's note: INRA has become the Institut national de recherche pour l'agriculture, l'alimentation et l'environnement (INRAE) in January 2020.

the environment. Over-intensification is understood here as the use of chemical inputs (mineral fertilisers, synthetic pesticides, etc.) above the absorption capacity of crops and ecosystems. It also includes the specialisation of farm holdings and agricultural territories, and the simplification of production systems. All these developments have adverse effects on the environment that are now well established and are difficult to dispute. In addition, they are increasingly compounded by health and overnutrition considerations.

… environmental protection is currently ensured by two broad types of measures. The first fall under the first pillar and are mandatory.

The other type of measures fall under the second pillar and are optional.

There are also specific aids for farms in areas with natural handicaps…

Under the CAP, environmental protection is currently ensured by two broad types of measures. The first fall under the first pillar and are mandatory. They aim to ensure a minimum level of protection through compliance with environmental standards and directives, the maintenance of land in Good Agricultural and Environmental Condition (GAEC) and, since the last reform in 2015, the three greening measures, which make the granting of around one third of first-pillar support conditional on compliance with three criteria to guarantee: (i) a minimum diversity of crops, (ii) the maintenance of permanent pasture and (iii) the maintenance of Ecological Focus Areas (EFA) on each farm holding. The other type of measures fall under the second pillar and are optional. They are subscribed by farmers in the form of multi-annual contracts including further environmental objectives with monetary compensation for additional costs and/or income losses. There are also specific aids for farms in areas with natural handicaps, and therefore with lower yields and profitability.

An unfinished CAP reform process

The CAP reform process is far from complete. Although the 2014-2020 CAP only came into force in January 2015, just over three years ago, a new reform is already under construction, and environmental protection is once again at the heart of the debate.[1] It must be recognised that despite the increasing importance of environmental objectives and instruments in the CAP, and the efforts of all stakeholders, the adverse effects of agriculture on the environment remain too great, in terms not only of diffuse pollution in the soil, water and air, due to the use of chemical inputs above the absorption capacity of the ecosystems, but also of the degradation of biodiversity and net agricultural greenhouse gas emissions.

… it must be recognised that despite the increasing importance of environmental objectives and instruments in the CAP, and the efforts of all stakeholders, the adverse effects of agriculture on the environment remain too great …

This demand for European agriculture to be even more economical in the use of natural resources and ever more environment-friendly translates into a need for changes in agricultural practices and systems that make it possible to improve the environmental performance of farms, production chains and the areas of activity in which these farms are included. Obviously, performance cannot be limited to the environmental dimension alone, and must also include production, economic, health and social aspects. This multi-performance objective is set in

[1] European Commission, 2017, The Future of Food and Farming. Communication from the Commission to the European Parliament, the European Economic and Social Committee and the Committee of the Regions. European Commission, COM(2017) 713 final, Brussels, 29.11.2017, 27 pages:
https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52017DC0713&from=EN

a difficult economic and budgetary context both at the EU level and in a large number of Member States (MS). Indeed, for several years now, farm holdings, upstream and downstream, have faced very volatile markets and prices and an increasing number of income crises. On the budgetary front, the BREXIT will automatically lead to a reduction in the EU budget and, likely, to a decrease in the CAP budget too, not to mention the fact that many voices are calling for greater attention and therefore increased budgetary support for priorities deemed more important, such as economic growth, education, migration policy, etc. In other words, the CAP budget is and will remain under pressure.

It is within this threefold framework – increased consideration of environmental objectives in the CAP, simultaneous consideration of other objectives and pressure on the EU budget … that the review of the environmental dimension of the CAP… should be carried out.

It is within this threefold framework – increased consideration of environmental objectives in the CAP, simultaneous consideration of other objectives, in particular competitiveness and economic performance objectives, and pressure on the EU budget and more specifically on the budget that will be allocated to the CAP in the future –, that the review of the environmental dimension of the CAP, and more generally of all the measures in this policy, should be carried out.

How can environmental protection be better taken into account in the CAP?

Environmental protection requires improving and completing the currently available toolbox. Generally speaking, the aim is to encourage virtuous developments that increase the supply of environmental services and discourage practices and systems that generate environmental disservices, by means of incentive measures rather than obligations and within a framework of increased solidarity within sectors and territories.

… we should allow remuneration for positive environmental services above minimum levels …

Such developments will be facilitated by the shift from an obligation of means to be implemented (current situation) to an obligation of results (impacts on environmental services) …

Improving current instruments: moving from an obligation of means to an obligation of results, and furthering payments for environmental services

Certain technical shortcomings of the current CAP can be corrected within the framework of the instruments applied today, and such corrections do not necessarily have a negative impact on farm incomes: for instance, the implementation of the greening measure relating to EFAs on a territorial scale greater than that of the farm could be envisaged, with compensation for farmers who would be obliged to have a larger EFA (because this is an environmentally relevant obligation) by those who would implement a smaller EFA.

Likewise, the agri-environmental and climate measures (AECMs) of the second pillar would benefit from being implemented over longer periods of time than at present. Their spatial continuity should be encouraged, for instance in the form of agglomeration bonuses granted to neighbouring farmers making a collective commitment. More importantly, the constraint of only compensating for additional costs and/or income losses should be overcome by allowing remuneration for positive environmental services above minimum levels defined by either the legislation or the conditionality and greening criteria of the first pillar. Such developments will be facilitated by the shift from an obligation of means to be implemented (current situation) to an obligation of results (impacts on environmental services), although the actual difficulties of that shift are clear. The shift would simultaneously facilitate the development of markets for environmental services and payments for environmental services (PES) provided by the intermediate and/or final

user. The aim is to encourage the establishment of non-market PES (financed by the taxpayer) and market PES (financed by the user), the latter also aiming to reduce the budgetary constraints mentioned above.

The application of the polluter-pays principle also calls for the taxation of negative externalities from agriculture so that farmers' choices are based on all costs, both private and public, and not only on private costs. In order not to hinder competitiveness, this tax would be applied at EU level and its proceeds kept within the agricultural sector to finance other measures, and above all to encourage virtuous practices and discourage bad ones via, for instance, a *bonus-malus* system for good and bad performers respectively.

A better link is necessary between changes in practices and investments in the framework of multi-year farm projects aiming at multi-performance, particularly in economic and environmental terms.

Taking advantage of the opportunities offered by green finance

Budgetary constraints call for increased recourse by agriculture to the financial markets and the development of financial instruments whose primary objective is to encourage the transition of the various forms of agriculture towards multi-performance, in particular environmental and economic. This transition requires changes in practices and often in production systems, changes that in turn involve organisational modifications within the farm holding, with work that is often harder, more complex and more technical. Very often it also requires investments, probably to a greater extent in livestock farms (buildings) than in farms with permanent and annual crops. However, even in the latter, investment needs are not negligible, whether it is about modernising equipment (for instance, replacing chemical crop protection by mechanical protection equipment), investing in more diversified and increased value-added outlets and incomes, or precision farming. Finally, on all farms, the transition to multi-performance requires intangible investments linked to new skills to be acquired.

A better link is therefore necessary between changes in practices and investments in the framework of multi-year farm projects aiming at multi-performance, particularly in economic and environmental terms. The creation of guarantee funds (guaranteed by the European public authorities) and/or debt funds that would also be guaranteed by EU authorities is a lever to be used for this purpose in order to take advantage of the opportunities offered by financial markets (and in particular in the EU framework by the Juncker Plan), and to relax certain constraints of the current funding channels (for example, on the duration of loans or their guarantee mechanism). However, it is not question of funding any kind of project as soon as a farmer or a group of farmers request it. Rather, it is a matter of favouring projects that have a double benefit in the long term, both economically and environmentally. In this perspective, it is therefore necessary to ascertain, *ex ante* and along the way, the economic and environmental impacts of investment projects and changes in practices. This impact analysis will be facilitated by the above-mentioned shift from an obligation of means to an obligation of results, which requires a comprehensive and reliable information system. The application of digital technology and big data to agriculture should facilitate the implementation of such an information system. Green finance is now booming. Agriculture should not be left out of this opportunity.

Basing the development of the CAP environmental component on the notion of services rendered and disservices avoided

The inclusion of environmental objectives in the CAP, and more generally in public policies, via the notion of services, disservices, packages of services and disservices, and payments for environmental services, is auspicious, particularly because it may make it possible to base instruments on services provided and disservices reduced or avoided. It thus make it

possible to better legitimise the CAP in the eyes of the society as a whole. However, the operationality of the concept is still partial, mainly due to the difficulty in associating a value to services, the dependence of the latter on agricultural practices and systems, economic and environmental conditions, and the variability of that value according to the preferences of stakeholders. Consequently, there is a huge need for research, experimentation and innovation. This relates in particular to the issues of identification, measurement (including the causal relationships between implemented practices and systems and the levels of services and disservices; these relationships also vary according to temporal and spatial contexts), and valuation (depending on the preferences of stakeholders). The approach based on packages of services in a given territory naturally raises the question of the rules for aggregating single services/disservices, as well as the delimitation of the relevant territories. Given the environmental importance of this territorial dimension, it is recommended that the post-2020 CAP should encourage the implementation of territorial pilot projects (experiments) that would make it possible to collect valuable information on the causal relationships between policy instruments, practices and systems, and impacts regarding all services relating to the three dimensions of sustainable development.

… the difficulty in associating a value to services, the dependence of the latter on agricultural practices and systems, economic and environmental conditions, and the variability of that value according to the preferences of stakeholders.

The shift from an essentially individual CAP to a much more collective and territorial one is a challenge.

The shift from an essentially individual CAP to a much more collective and territorial one is a challenge. This territorialisation does not mean the end of a common policy on a EU scale, and in this context it is relevant to better distinguish between, on the one hand, global public goods that require funding and governance on a European scale, and, on the other hand, local public goods that will be better managed through co-financing and co-governance on a smaller geographical scale. But even within this framework, there is nothing to prevent (in fact, quite the opposite is true) global environmental concerns, such as the fight against climate change or the preservation of biodiversity, from being taken into account in territorial projects, by adapting the measures to this scale according to the specificities of the territories. The question also arises as to the appropriateness of penalising disservices: if remuneration, whether non-market (by the taxpayer) or market (by the intermediate or final user), for ecosystem services provided by farmers is in line with the beneficiary-pays principle, its counterpart, i.e. penalising disservices generated by agricultural activities in application of the polluter-pays principle, deserves to be examined, if only for the sake of the coherence and legitimacy of public policies. In this context, it is possible to ensure that the application of the polluter-pays principle does not penalise, or hardly penalises, the competitiveness of European agriculture, for instance by retaining the proceeds of the tax within the agricultural sector, and redistributing them from the bad to the good performers according to a *bonus-malus* system; also by applying border adjustment mechanisms for greenhouse gas emissions and the biodiversity.

Time to focus on what matters: an agenda for measurement and policy*

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Measuring well-being and progress "beyond GDP"

For many decades, the traditional approach for assessing countries' success has largely been by using indicators of economic growth (GDP) as a proxy measure for overall well-being and progress. In the 1930s, the economists Simon Kuznets, in the U.S., and Richard Stone, in the U.K., developed the system of national accounting, on which GDP is based. They were not really concerned with measuring overall welfare or progress – their main goal was to make it easier for policy makers to manage a national economy at a macroeconomic level. By adding the value of all final goods and services that are produced and traded for money within a given period of time, typically a quarter or a year, GDP represents a good measure of market production. It has the advantage of allowing to aggregate entities with different units and to summarize them in one single monetary figure. Moreover, once the figure is adjusted per capita and purchasing power parity, it can be easily compared across nations.

At the level of society as a whole, GDP interprets every expense as positive and does not distinguish welfare-enhancing activities from welfare-reducing ones.

The rationale behind using GDP as a proxy measure for overall well-being or progress is that GDP growth can be associated with other important aspects of societal progress, such as increased life expectancy, reduced child mortality, and higher literacy rates. This correlation is far from perfect however, and GDP growth and better living standards are not synonymous: if the benefits of growth are too highly concentrated, or if growth comes with high social and environmental costs, for example, the relationship between growth and well-being can be put at risk.

Indeed, GDP presents many shortcomings as a measure of well-being. At the level of society as a whole, GDP interprets every expense as positive and does not distinguish welfare-enhancing activities from

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welfare-reducing ones. For example, environmental damages such as an oil spill increases GDP because of the associated cost of clean-up and remediation, but it obviously detracts from overall well-being. GDP also leaves out many components that enhance well-being but do not involve monetary transactions and therefore fall outside the market. For example, the act of picking vegetables from a garden and cooking them for family or friends is not included in GDP, while buying a similar pre-prepared meal in a grocery store involves an exchange of money and a subsequent increase in GDP. Moreover, at the level of the person, GDP says nothing about how economic resources are distributed across population groups nor on the many aspects beyond monetary metrics that are important for their well-being, such as the need to feel valued and respected by others, the extent to which aspirations are fulfilled, and the care and affection that are provided by close family and friends. It says nothing either about the sustainability of economic activities, in particular whether these occur at the expense of the natural environment.

In fact, GDP's inventor, Simon Kuznets, warned against the misuse of GDP. He stressed that GDP is a measure of output, not of well-being. And in 1968, in one of his most famous speeches, Senator Robert Kennedy eloquently highlighted the limitations of traditional economic metrics:

[Gross National Product] measures everything ... except that which makes life worthwhile.

"[Gross National Product] counts air pollution, and cigarette advertising, and ambulances to clear our highways of carnage…It counts the destruction of the redwoods and the loss of our natural wonder in chaotic squall…Yet, [it] does not allow for the health of our children, the quality of their education, or the joy of their play… It measures neither our wit nor our courage neither our wisdom nor our learning, neither our compassion nor our devotion to our country. It measures everything in short except that which makes life worthwhile."

When the first criticisms to GDP were raised in the 1970s, amid worries about ecological limits to growth, some attempts were made to correct GDP for its most evident flaws. In the late 70s, however, the interest in alternatives approaches to GDP diminished, with other issues taking centre stage, such as stagflation or rapid increases in unemployment rates.

Interest in alternatives or complements to GDP resumed progressively during the 1990s. Emblematic of this new trend was the creation of the United Nations *Human Development Index* (HDI), which combines GDP with measures of health and educational achievement. Although synthesising only a limited amount of information and being more relevant for comparisons of developing countries than for comparisons of more advanced countries, it remains one of the few composite indexes that are regularly compiled and widely disseminated to allow systematic cross-country comparisons. In 1992, the *UN Earth Summit* in Rio de Janeiro brought the notion of Sustainable Development into the policy debate and promoted the use of sustainable development indicators. This was followed by the adoption of Agenda 2030 by all UN countries in 2015 who agreed on 17 Sustainable Development Goals, 169 targets and a set of 232 indicators

The 2008 financial crisis gave further impetus to the quest for more comprehensive measures of well-being and progress. The perception that the economic growth of the early 2000s had not lifted all boats, and that the costs of the crisis have disproportionately fallen upon those who had least benefited from the preceding economic expansion has progressively led to a re-assessment of the goals of human progress. In recognition of GDP's inadequacy to capture many of the critical dimensions of human lives, a strong movement has emerged to go "beyond GDP" and bring into greater focus other measures that capture people's living conditions and the quality of their lives. The discussion and research on well-being measures has found expression in a number of initiatives. The report by the Commission on the Measurement of Economic Performance and Social Progress, (the Stiglitz-Sen-Fitoussi report) published in 2009 concluded that the time was "*right to shift emphasis from measuring economic production to measuring*

people's well-being". A significant body of research and statistical work has thus been developed aiming to provide alternative or complementary metrics of human progress. Many countries have developed frameworks for measuring various aspects of well-being, aimed at gaining a better understanding of people's lives at the individual, household, community and territorial levels. At the international level, other initiatives, such as the European Commission's *Beyond GDP,* added to the impetus to look for – and to use – new approaches to the measurement of quality of life and progress.

Indeed, ultimately, the goal of most governments is not just to grow economies, but rather to improve the lives of citizens.

In 2011, the OECD, which had been leading the international work on well-being measurement and policy for over a decade, launched a new project to produce better indicators of progress across the different areas that matter for people's well-being. The *OECD Better Life Initiative* takes a broad approach to defining social progress by focusing on 11 dimensions of individual well-being, *i.e.* income and wealth; work and job quality; housing; health; knowledge and skills; environmental quality; subjective well-being; safety; work-life balance; social connections; and civic engagement. In line with the recommendations in the Stiglitz-Sen-Fitoussi report, *the OECD Better Life Initiative* : i) focuses on the individuals, rather than on the economy, ii) considers the distribution of well-being in the population alongside average achievements in each country; iii) is multidimensional; and iv) balances objective measures and subjective judgements. Importantly, it also stresses the need to assess both current and future well-being, considering the latter in terms of a number of key resources (economic, social, natural and human capital) that have the potential to generate well-being over time.

"The real difficulty in changing any enterprise lies not in developing new ideas, but in escaping from old ones".

The *OECD Better Life Initiative* has been an ambitious undertaking, but an important one, as its aim is not only to produce well-being evidence using the best currently-available data, but also to ensure that over time the new metrics are effectively used to inform policy-making. Indeed, ultimately, the goal of most governments is not just to grow economies, but rather to improve the lives of citizens. And while GDP growth is critical for achieving a number of important objectives, including adequate financing of social programmes and public investments, it should always be recognized as a means to other ends rather than as a goal in itself, and that the quality of economic growth matters, not just its quantity.

From measurement to policies

One reason the 2008 financial crisis morphed into a social and political crisis is that relying on GDP not only gave a false picture of the overall state of well-being, it also contributed to the decline of trust in governments and experts, as people saw that their own situation was not improving despite the fact that, based on GDP figures, it was stated that a recovery was underway. If we had used better metrics, we might have realized that the effects of the crisis on people's economic well-being and quality of life were much deeper than the GDP statistics indicated. And if that had been the case, perhaps governments would have responded more strongly to mitigate the negative impacts of the crisis.

Indeed, measuring well-being cannot be an end in itself. For well-being indicators to contribute to better lives, they must be used in decision-making by policy makers and by the general public. Although more and more countries have taken on the challenge of developing well-being frameworks, less have taken steps to use these indicators more systematically in their policy settings and decisions. While developing a better 'compass' or a new 'GPS' is essential to provide a more comprehensive diagnosis of the state of a country now and in the future, it would be naïve to think that indicators and statistics will be the only factor at play. As noted by J.M. Keynes, "The real difficulty in changing

any enterprise lies not in developing new ideas, but in escaping from old ones".

What is needed is a new dashboard of well-being indicators combined with a new approach to policy-making that takes a more holistic view of policy challenges and puts in place more integrated mechanisms for addressing them. Building on the 2009 Stiglitz-Sen-Fitoussi report and subsequent work by the OECD and others, last year, the *High-Level Expert Group on the Measurement of Economic Performance* (HLEG) published a report highlighting the need for both further improvements in well-being measurement in a number of areas (such as income and wealth inequalities, economic insecurity, inequality of opportunity, subjective well-being, trust, and sustainability and resilience), and for anchoring these new measures in policy processes that survive the vagaries of electoral cycles.

The world today faces profound challenges. While in some respects, well-being has improved since 2010 when the impacts of the financial crisis continued to be deeply felt in many countries, including Portugal, much more needs to be done. According to the just released OECD *How's Life 2020* report, reductions in greenhouse gases emissions in the OECD are far from sufficient to meet climate policy goals while in almost half of OECD countries, more species are at risk of extinction. And nearly two-thirds of people in OECD countries are exposed to dangerous levels of air pollution. Life remains financially very precarious for many households across the OECD, with almost 40% at risk of falling into poverty if they had to forego three months of their income, and 21% reporting having difficulties making ends meet in European countries.

Economic growth cannot continue to be the primary goal of economic policy, from which it is assumed other objectives will flow. Social and environmental considerations can no longer be dealt with 'after the event' but should be integral to economic policy.

At the same time, rapid technological change is transforming many aspects of our lives. Digitalisation brings new opportunities, from new consumer goods to new ways of doing business. But there are significant challenges too. The development of automation technologies, particularly artificial intelligence, is changing both the numbers and kinds of jobs our economies generate and the ways they are organised, leading to widespread concerns about the 'future of work'. There is also an increasing debate about how new technologies are impacting our quality of life, ranging from cybersecurity to less family interactions and increasing mental health disorders. In addition, many developed countries are ageing very rapidly, raising questions about the ability of those of working age to support non-working age populations, not only financially: older people are almost three times more likely to lack social support, relative to younger people, underscoring the importance of addressing old-age loneliness.

Inequalities persist in most countries, with people in the top 20% of the income distribution still earning more than five times more than people in the bottom 20%, and women earning on average 13% less than men. Wealth inequality is even more concentrated than income, with the wealthiest 10% of households owning 52% of total wealth on average in the OECD. Regional well-being disparities are also widespread, weighing on social cohesion, and while trust in government has increased since 2010, less than half the population across OECD countries trust their institutions, with only 1 in 3 people feeling they have a say in what the government does.

Overall, from financial insecurity in households, through to climate change, biodiversity loss and threats to social cohesion and how democratic institutions perform their functions, there is a need to take bold and integrated action to ensure continued prosperity for people and the planet. Many of the policies which have been implemented across the OECD, not just over the last decade but over the last forty years or so, appear no longer able to improve economic and social outcomes in the ways they once promised. Economic growth cannot continue to be the primary goal of economic policy, from which it is assumed other objectives will flow. Social

and environmental considerations can no longer be dealt with 'after the event' but should be integral to economic policy. New economic theories, evidence and techniques need to be developed. Since 2012 the OECD's *New Approaches to Economic Challenges* (NAEC) initiative has attempted to bring together much of the new thinking in this field and these reflections need to continue.

Some examples of mechanisms for applying a well-being lens to policy-making

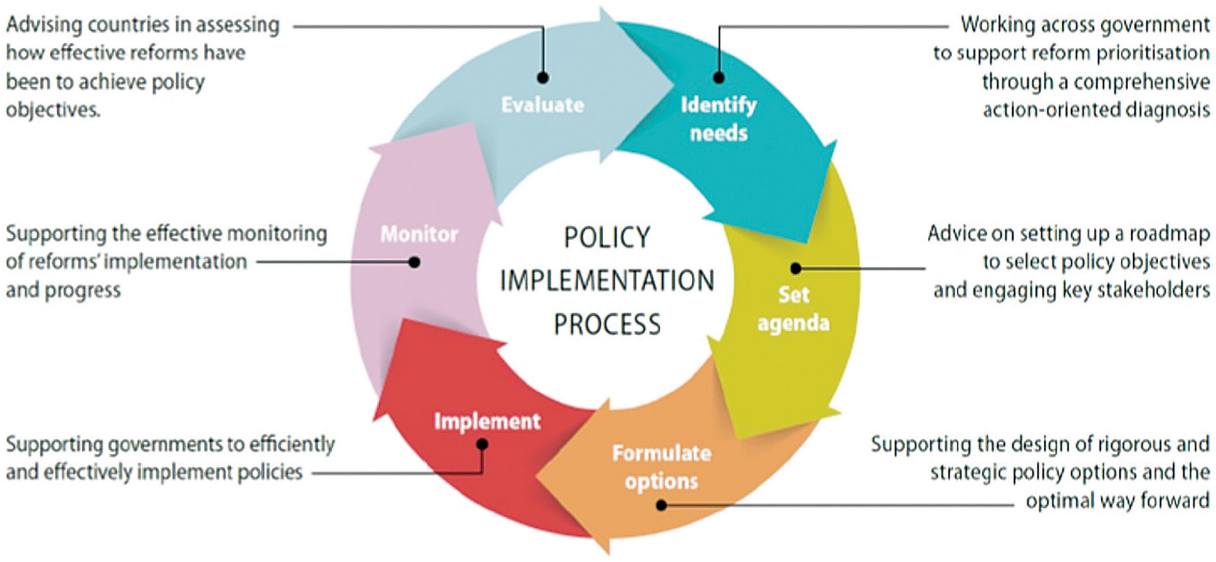
Several governments have developed formal and concrete mechanisms to embed well-being and sustainability metrics beyond GDP in their policy processes in a structured and integrated way. When it comes to formulating and testing policy options, it is important to think about interdependencies among outcomes and anticipate both positive and negative externalities. These mechanisms can target a specific stage of the policy cycle depicted below. They provide a good entry for a *Beyond GDP* analysis as they allow to ascertain whether adequate weight and attention is given to various aspect of well-being beyond economic efficiency.

When it comes to formulating and testing policy options, it is important to think about interdependencies among outcomes and anticipate both positive and negative externalities.

Taking the specific case of *agricultural policies* for instance, such an approach allows to give appropriate weights to environmental and social impacts, not just economic impacts as would be the case with traditional cost-benefit analysis that would effectively give a negligible weight to environmental impacts several years from now.

A well-being lens can be applied to understand specific policy challenges, such as those related to agriculture, from a multidimensional perspective, an approach that has been used in a range of OECD analysis. Examples include the OECD's work on digitalisation, which uses the OECD well-being framework as a way to understand the various threats and opportunities created by digitalisation; and that on climate mitigation, where the same well-being approach has been used to broaden the assessment of how climate mitigation actions could impact on people's lives, beyond their effects on GDP. A well-being approach has also been used in OECD analysis of migration and housing policy in certain countries, and of how government procurement can be used to support well-being and growth objectives.

Well-being metrics support an integrated policy-making process



At the more macro level, the budget process and the allocation of resources represent a powerful mechanism to broaden decision making "beyond GDP". This includes monitoring a dashboard of well-being indicators to frame (ex ante) the budget discussion, and to complement the standard economic and fiscal reporting that typically accompanies the budget. Steps in this direction have been taken in France since 2015 (the "New Wealth indicators", led by the Prime Minister's Office); in Italy since 2017 (the "Economic and Financial Document", led by the Ministry of the Economy and Finance) and in Sweden also since 2017 ("New Measures for Well-being", developed by Statistics Sweden and coordinated by the Ministry of Finance). In some countries (e.g. Italy), budget proposals are also assessed for their expected impact on different well-being outcomes over a certain period, as compared to a business-as-usual scenario.

In New Zealand, the government used an analysis of well-being evidence, including the Treasury's new Living Standards Framework Dashboard, to identify five priorities for the 2019 "Wellbeing Budget". At a more granular level, the New Zealand Treasury adapted their cost-benefit analysis template for ministerial submissions of spending proposals to explicitly include well-being and sustainability considerations.

Focusing on a longer term perspective, well-being indicator dashboards have also been developed to reflect the way a country thinks about progress and what it means to have a good life today and in the future. Countries that have explicitly introduced well-being frameworks and indicators into their long-term strategic development planning, often aligned to the UN Sustainable Development Goals, include Colombia (through "Presidential Dashboards" developed by the Ministry for National Planning), Slovenia (in the Slovenian National Development Strategy 2030, adopted by the Slovenian Government in 2017), and Latvia 2030 (Sustainable Development Strategy of Latvia until 2030).

Finally, some countries have created new institutional positions or structures to promote the use of well-being evidence in government and to give a central place to well-being metrics in public policies. These institutions allow to break the silo approach that prevail in most countries, and promote an integrated view of objectives and means of reform implementation. Examples of the creation of specific high-level positions include the Future Generations Commissioner in Wales or the What Works Centre for Wellbeing in the United Kingdom. New responsibilities can also be assigned as part of reforms to existing structures, such as giving the Treasury or Ministry of Finance a cross-cutting responsibility for well-being or sustainability, as has happened to some extent in New Zealand and Italy.

Conclusions

The 2009 Stiglitz-Sen-Fitoussi (SSF) report was hugely influential within the statistical community, leading to a range of national and international initiatives to implement its recommendations. Almost 10 years later, two reports by the OECD-hosted "High-Level Expert Group on the Measurement of Economic Performance and Social Progress" (HLEG) take stock of the developments in the '*Beyond- GDP*' agenda that were sparked by the SSF report and provide a roadmap for the decade ahead.

… what we measure affects what we do.
… measurement issues are not only technical, but go to the root of how our democratic system functions.

If measurement is the point of departure of these reports, their ambition goes much wider. Their central message is rather that *"what we measure affects what we do. If we measure the wrong thing, we will do the wrong thing. If we don't measure something, it becomes neglected, as if the problem didn't exist"*. In other terms, measurement issues are not only technical, but go to the root of how our democratic system functions.

This is not to dismiss the importance of GDP, which is a critical measure for assessing economic conditions and the effects of a range of policies. But GDP keeps being used for purposes that it was not designed to meet,

i.e. as the single yardstick to gauge the overall success of a country and the well-being of its people. What is needed is a broader range of well-being statistics, including more granular and timely data that better capture the state of the economy, the diverse situations of different population groups and regions, and the threats to the long-term sustainability of our development model.

Having the right set of indicators and diagnosis is just the beginning. What matters is to ensure that these measures are actually used in the design of policies.

But while better measures of progress are needed, they are surely not enough. Having the right set of indicators and diagnosis is just the beginning. What matters is to ensure that these measures are actually used in the design of policies. Several countries have recently engaged in using well-being indicators in the different phases of the policy-making process, from identifying priorities for action, to assessing the advantages and disadvantages of different strategies in a more holistic way. While recent, these experiences hold the promise of delivering policies that, by going beyond traditional silos, are more effective in improving people's life and ensuring sustainability.

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Agroforestry systems in mainland Portugal*

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AGRO.GES

1. Introduction

In recent decades, agroforestry systems have grown in importance in terms of the occupation of land in mainland Portugal.

These systems include areas covered by different forestry species associated with plant and/or animal production.

The economic viability of these systems is highly dependent on the current subsidies in Pillars 1 and 2 of the Common Agricultural Policy (CAP) whose continuation will be essential to achieve the various key environmental, climatic and territorial objectives (KOs) contained in its proposed post-2020 reforms:

- KO4 – Contribute to climate change mitigation and adaptation, as well as sustainable energy;
- KO5 – Foster sustainable development and efficient management of natural resources such as water, soil and air;
- KO6 – Contribute to the protection of biodiversity, enhance ecosystem services and preserve habitats and landscapes;
- KO8 – Promote employment, growth, social inclusion and local development in rural areas including bio economy and sustainable forestry.

The economic viability of these systems is highly dependent on the current subsidies…

whose continuation will be essential to achieve the various key environmental, climatic and territorial objectives …

Given this context, the aim of this article is to answer the following questions:

- What is meant by agroforestry systems and how can they be classified?
- Where are they located in Portugal and what are their main characteristics?
- What role can they play from a productive, environmental and social point of view?
- What impacts might CAP reform have on the future of these systems in mainland Portugal?

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https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_21/#28

2. What is meant by agroforestry systems and how can they be classified?

Agroforestry systems in mainland Portugal are areas where cork oaks, holm oaks, chestnut trees, stone pines and carob trees grow in single-species or mixed stands that are mainly associated with non-irrigated arable crops within long rotations and/or extensive beef cattle rearing and/or small ruminants.

Depending on the type of activities practised, agroforestry systems can be classified as:

- Agrosilvicultural systems;
- Silvopastoral systems;
- Agrosilvopastoral systems.

… nowadays [agroforestry systems are] almost exclusively silvopastoral in type, in particular cork and holm oak forest systems (montado).

The evolution in prices and agricultural markets in Portugal over recent decades has called into question the economic viability of the type of plant-based farming that has tended to be associated with agroforestry systems. For this reason, we consider these systems nowadays to be almost exclusively silvopastoral in type, in particular cork and holm oak forest systems (montado).

Cork and holm oak forest systems (montado) can be classified into pasture and non-pasture systems, of which only the former is of interest to us here.

As far as the silvopastoral systems analysed here are concerned, we can also classify them as more extensive or more intensive depending on the pasture model used.

… the three other regions defined in this study – Norte Atlântico, Norte Transmontano and Transição – have very little importance in terms of the agroforestry systems … in mainland Portugal

The more extensive pasture model is based on stocking rates of 0.1 to 0.5 livestock units (LUs) per hectare and is associated with unimproved and unseeded grassland or permanent pasture. The more intensive pasture model is based on stocking rates of over 1 LU per hectare and is almost always associated with improved and seeded grassland or permanent pasture.

Therefore, this article will focus on silvopastoral-type agroforestry systems with an extensive or intensive pasture model in which cork and holm oak forest systems (montado) are of particular importance.

3. Location and main characteristics of agroforestry systems

To locate and characterise the agroforestry systems in question, we based our analysis on the distribution of grasslands and permanent pastures (GPPs) under forestry cover in the different regions of mainland Portugal and the various types of farming and classes of Utilised Agricultural Area (UAA) in the respective holdings.

From the data available in the 2016 Farm Structure Survey (FSS), it can be concluded that over 95% of total GPPs under forestry cover are located in the farming regions of Beira Interior, Ribatejo e Oeste, and Alentejo (797,500 ha). This figure is even more significant when improved or seeded GPPs (99%) and poor GPPs (96%) are considered separately.

If broken down by NUTS III regions, around 90% of total GPPs under forestry cover in mainland Portugal are located in just 6 of the 23 NUTS III regions in question. Therefore, we will focus our analysis on around 635,000 hectares of GPPs under forestry cover in the NUTS III regions of Beira Baixa, Lezíria do Tejo, Alto Alentejo, Alentejo Litoral, Alentejo Central and Baixo Alentejo.

The area occupied by these 6 NUTS III regions essentially corresponds to the Sul-Montado region identified by Pedro Reis *et al*[1] in their article in the SCAP

[1] Pedro Reis *et al*: "Sistemas agroflorestais em Portugal Continental. Parte I: Economia e distribuição geográfica", *Revista da Sociedade de Ciências Agrárias de Portugal* (SCAP), no. 37 (2), 2014

Journal in 2014, since the three other regions defined in this study – Norte Atlântico, Norte Transmontano and Transição – have very little importance in terms of the agroforestry systems in mainland Portugal, regardless of the ecological and socioeconomic relevance of pastures under chestnut tree and marsh cover.

From the 2016 FSS data on farming types, around 80% of GPPs in mainland Portugal correspond to holdings predominantly oriented towards bovine (milk and meat), small ruminant and mixed farming, most of which only relate to extensive bovine (meat), small ruminant and mixed (93%) types of farming (Table 1). Therefore, we will just focus on the agroforestry systems in these 5 different types of holdings in the context of the aforementioned 6 NUTS III regions.

According to 2018 IFAP data, the following conclusions can be made with regard to the main characteristics of the different types of holdings with the agroforestry systems in question.

First, they are mostly located in the 4 NUTS III regions in the Alentejo, whose number and UAA respectively account for around 82% and 88% of the total of all 6 NUTS III regions analysed.

Second, there is a clear predominance in holdings focused on extensive bovine (meat) farming and small ruminants as a whole, both in number and area (75%), as a share of the types of farming in question.

Third, the average area of these holdings (136.4 ha of UAA) is almost 8.5 times greater than the national average (15.9 ha of UAA), which also applies to all UAAs considered (Table 2).

Fourth, over 80% of the UAA of these holdings as a whole is covered by forage areas, of which 63% correspond to GPPs.

Table 1 – Grassland and permanent pastures (GPPs) under forestry cover on holdings predominantly oriented towards livestock production

Type of farming	Improved or seeded GPPs			Poor GPPs*			Total GPPs		
	ha	%	%	ha	%	%	ha	%	%
Bovine (milk)	9,766	6.6	57.4	7,254	1.1	42.6	17,020	2.1	100
Bovine (meat)									
intensive	4,825	3.3	41.0	6,944	1.1	59.0	11,769	1.5	100
extensive	69,251	47.1	21.5	252,134	38.8	78.5	321,385	40.3	100
Small ruminants	26,702	18.2	16.5	135,229	20.8	83.5	161,931	203	100
Mixed	20,008	13.6	16.2	103,345	15.9	83.8	123,353	15.5	100
Total livestock farms	**130,552**	**88.8**	**20.5**	**504,906**	**77.6**	**79.5**	**635,458**	**79.7**	**100**
Total farms	**147,101**	**100**	**18.4**	**650,406**	**100**	**81.6**	**797,507**	**100**	**100**

*Unimproved and unseeded GPPs
Source: FSS 2016

Table 2 – Average area of holdings with agroforestry systems by class of UAA

Class of UAA	No of holdings	UAA (10^3 ha)	UAA/farm (ha)	
			AA	Total
< 5 ha	2,595	6.5	2.5	1.7
5–25 ha	2,816	39.6	14.1	8.2
25–200 ha	3,636	343.0	94.3	53.3
200–1,000 ha	2,041	879.1	430.7	357.1
> 1,000 ha	157	265.8	1,693.1	1,477.2
Total	**11,245**	**1,534**	**136.4**	**15.9**

Source: IFAP 2018

Fifth, the holdings in question as a whole represent 60% of all existing ruminants in mainland Portugal, a percentage that rises to 71% for suckler cows, of which around 59% belong to extensive bovine (meat) holdings and around 75% to holdings of over 200 ha of UAA.

Sixth, the financial results of the agroforestry areas (AAs) are highly dependent on direct payments to farmers (DPFs) from Pillars 1 and 2 that together amounted in 2018 to around €303m, of which around 77% is related to Pillar 1 subsidies.

Pillar 1 DPFs (€231.9m) are most prevalent in the Basic Payment Scheme (BPS) (42%) and grants for suckler cows (19%), sheep and goats (8%).

… with the exception of bovine (milk) and, partly, mixed holdings … all other types of agroforestry systems are more heavily dependent on the current DPFs than the average holding …

Table 6 shows the amounts paid in 2018 in decoupled payments, production-coupled payments and agro-environmental measures (MAAs) and MZDs as a whole to holdings corresponding to the different types of farming in question, as well as their average values per hectare, per holding and the respective percentage in the Gross Farm Income (GFI) and Net Entrepreneurial Income (NEI).

Analysing the data, we can conclude, with the exception of bovine (milk) and, partly, mixed holdings, that all other types of agroforestry systems are more heavily dependent on the current DPFs than the average holding in mainland Portugal.

Table 3 – Pillar 1 and 2 DPFs to farms classified by most representative types of farming in agroforestry systems in 2018

Type of farming	Pillar 1 DPFs			Pillar 2 DPFs			DPFs per		DPFs as %	
	Total (10^6€)	Decoupled payments (%)	Coupled payments (%)	Total (10^6€)	MAA (%)	MZD (%)	ha of UAA (€)	Holding (€)	GFI	NEI
Bovine (milk)	7.0	67	33	0.3	56	44	640	78,215	8.5	55.2
Bovine (meat)										
intensive	21.9	64	36	4.4	74	26	312	29,193	16.8	221.4
extensive	105.9	73	27	33.6	83	17	189	58,075	37.4	86.1
Small ruminants	55.5	65	35	17.2	63	37	180	12,126	27.8	160.7
Mixed	41.6	72	28	15.6	84	16	195	30,921	25.8	45.9
Total	231.9	71	29	71.1	78	22	198	26,943	26.9	84.9
Total in mainland Portugal	580.7	78	22	265.7	58	42	241	4,947	17.5	63.3

Fonte: IFAP 2018

For Pillar 2 DPFs (€71.1m), the key measures in 2018 were payments for integrated production (PRODI) (31%), organic production (MPB) (18%), extensive grazing (5%) and native breeds (4%), as well as support for disadvantaged areas (MZD) (22%).

Seventh, as regards the financial results of the holdings in question, the following aspects must be noted (Table 4):

- with the exception of bovine (milk) holdings, land productivity of all agroforestry systems in 2018 was far lower than the national average;

Table 4 – Main financial results of farms from the most representative types of farming in agroforestry systems in 2018

Type of farming	Productivity		Financial results (€/farm)		
	Land[1] (€/ha)	Labour[2] (€/AWU)	OVPprod[1]	GFI	NEI
Bovine (milk)	1,530.9	20,779.0	840,548.4	918,763.4	141,569.8
Bovine (meat)					
intensive	156.0	1,986.8	144,968.9	173,462.8	13,187.6
extensive	125.1	9,307.3	109,141.5	167,216.8	67,479.8
Small ruminants	99.1	4,034.9	31,415.8	43,531.7	7,537.7
Mixed	330.1	18,949.2	89,011.9	119,934.5	67,326.3
Total	169.7	7,120.3	73,280.9	100,223.7	35,534.2
Total in mainland Portugal	522.0	6,182.0	23,347.0	28,292.8	7,812.5

1) Gross Added Value (GAV) at producer prices per hectare of UAA
2) GAV at producer prices per hectare of Annual Working Units (AWUs)
3) Output value at producer prices
Source: IFAP 2018

- with the exception of intensive bovine (meat) holdings, labour productivity of all agroforestry systems in 2018 was far higher than the national average;
- with the exception of small ruminants, the financial results for all other types of holdings in 2018 were far higher than the average in mainland Portugal.

4. Main purposes of agroforestry systems

Silvopastoral-type agroforestry systems are responsible for different types of forestry-related products (grassland and pasture biomass), animal products (milk and meat) and forestry products (wood, cork, pine nuts, etc.) whose production methods will have implications for the types of environmental problems faced by Portuguese agriculture and forestry in the coming decades.

In the context of drafting the Common Agricultural Policy Strategic Plan (CAPSP), the following environmental problems were identified:

- climate change, which will imply the adoption of adequate measures to decarbonise (mitigation and sequestration) and adapt;
- agricultural and forestry soil degradation as a result of low organic matter content and the respective risks of erosion;
- adequate quantity and quality of water for plants which will be influenced negatively by lower and more irregular annual rainfall and higher temperatures, which in turn will cause drier soils and greater evapotranspiration in plants;
- water quality for its potential contribution to reducing nitrogen leaching and phosphorus stemming from conventional production methods;
- air quality stemming from pollutant emissions from production activity;
- biodiversity losses resulting from the abandonment and intensification of the systems of occupation and use of agricultural and forestry land;
- degradation of farmland, also stemming from the abandonment and intensification of the use of agricultural land.

Today, the consensus is that agroforestry systems, if managed sustainably, can provide society with valuable ecosystem services as they help to solve the environmental problems mentioned.

… agroforestry systems, if managed sustainably, can provide society with valuable ecosystem services …

- Climate regulation services that may result both in increased soil organic matter content and, consequently, improved carbon sequestration capacity and in lower fire risk with its contribution to resolving CO_2 emissions.
- Soil protection services that are essential for erosion control.
- Services to regulate water balance and the retention of nutrients with positive effects therefrom for both the availability and quality of water.
- Both functional and emblematic biodiversity services able to perform key ecological functions of high cultural value.
- Services associated with the promotion of agricultural and forestry landscapes to ensure both their ecological continuity and the maintenance of their scenic and cultural value.

So that these different types of ecosystem services can be provided by agroforestry services, it will be essential not only for the respective economic agents to adopt the sustainable management of their different plant, animal and forestry components but also a set of policy measures that can incentivise their general adoption.

The management of cork and holm oak forest (montado) areas faces two main problems that can be summed up as soil degradation and the loss of vitality of the tree cover. In response to these two problems, measures have emerged that may be more efficient than classical cork oak forest management:

- Installation of improved pastures – able to substantially raise soil organic matter, benefitting pastures and trees with clear economic and environmental benefits.
- Use of dolomitic limestone and phosphorus – a solution that improves the nutritional capacity of soils as a means of development and increased organic matter content.
- Regenerative or holistic grazing techniques – the management options here imply the use of animals in specific management strategies to add organic matter to the soil.

These strategies very effectively improve the quality of soils, namely through the incorporation of organic matter and protection against erosion, protecting tree cover through the best known strategy – improvement of its phytosanitary condition. However, cork and holm oaks, but chiefly the former, have been battered in recent years by climate change and sudden death phenomena. With regard to this, there are biotic factors (such as *phytophtera cinnamoni* and *platypus cylindrus*) with important negative impacts, but technical solutions are still necessary.

5. Agroforestry systems in the context of the post-2020 CAP

The ongoing CAP reform points, in our opinion, to the three following main strategic guidelines with implications for the future of Portuguese agroforestry systems.

The ongoing CAP reform points to greater equity in the distribution of income support

… an increase in the future resilience of agrifood chains

… the adoption of a consistent and effective set of eco-scheme payments and MAAs …

First, greater equity in the distribution of income support by adopting a process of total internal convergence (flat rate) by 2026, the end of the historical model of assigning BPS rights and application of redistributive and MZD payments exclusively or pre-

dominantly to smaller holdings than the national average.

Second, an increase in the future resilience of agri-food chains which, in addition to the negative impacts of the pandemic, will be more penalised by a process of total internal convergence (milk, rice and tomatoes), as well as greater self-sufficiency in those products highly dependent on imports (cereals). Therefore, it will be necessary in our opinion both to boost production-coupled support for some sectors which already benefit from it today (rice, tomatoes, suckler cows, sheep and goats) and introduce coupled payments for autumn/winter cereals and grain maize and fodder. This will result in an additional cost that could be covered by either a transfer of funds from Pillar 2 to Pillar 1 or the elimination of grants for suckler cows whose loss of income should be fully offset by suitable eco-scheme payments.

Third, the adoption of a consistent and effective set of eco-scheme payments and MAAs that in the context of the new conditionalities contribute to fighting climate change, improving the efficient use of soil and water resources, and promoting the landscape and biodiversity.

… it should be stressed that whichever scenario is considered, it is likely that the financial results of the agroforestry systems analysed as a whole will benefit from improvements in the respective Pillar 1 DPFs with increases of between 12% and 23% by 2027.

In the case of agroforestry systems, it will be necessary (with possible adjustments to eligibility criteria and support rates) to keep many of the current MAAs (extensive grazing, native breeds, agroforestry management, riparian galleries, etc.).

The new eco-schemes may, however, come to be the most effective way to support the environmental and climatic functions expected to be performed by agroforestry systems in the next decade.

For that purpose, it will be essential to introduce an eco-scheme payment aimed at the future expansion of both natural grassland and biodiverse seeded pastures rich in leguminous plants that contribute significantly and in a sustained manner to increase the organic matter content of the respective soils and consequently:

- improve their fertility;
- increase their capacity to retain water;
- increase their capacity to sequester CO_2.

It could be argued that the payments in question may be incorporated into the MAAs, since the rule here is multiannual commitments. However, as top-up payments are not possible, the incentivising effect that we consider decisive for significant spread of this type of support will be lost, which, in our opinion, will jeopardise the possibility of achieving the different specific environmental and climatic objectives and, in particular, carbon neutrality.

Of the different scenarios for the post-2020 CAP produced by AGRO.GES, it can be concluded that the application of a flat rate, without further alterations to the other types of intervention, will be highly prejudicial to the finances of holdings focused on bovine (milk) and intensive bovine (meat) production but will be highly beneficial for the other agroforestry systems analysed. Introducing the proposed changes to production-coupled payments and eco-scheme payments will allow a partial recovery of the losses at stake for bovine (milk) farming but not for the other type of farming.

Finally, it should be stressed that whichever scenario is considered, it is likely that the financial results of the agroforestry systems analysed as a whole will benefit from improvements in the respective Pillar 1 DPFs with increases of between 12% and 23% by 2027.

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Dynamics of agricultural land use in Portugal*

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1. Background

Agricultural and forestry activities occupy a large part of the Portuguese territory, and consequently the dynamics of land use resulting from these activities have a decisive impact on the sustainability of territorial management.

The agricultural production fabric is undergoing a continuous and lengthy process of change as a result of a wide range of factors both internal and external, such as the economic development of the various territories and public policies regarding production, multifunctionality, extensification, environmental conservation, small farmers or high nature value systems.

This article aims to analyse how agricultural activity in Portugal has used land, a very important resource, as well as the main dynamics of its use, by looking at the main structural characteristics of farm holdings and trying to highlight some of the factors that most influenced that change.

The analysis is based on some statistical sources, namely structural information from the Agricultural Censuses (AC), in particular the 2019AC just published by Statistics Portugal (INE) on 31 March 2021.[1] The censuses enable the observation of the land ownership structure, production systems and agricultural labour and population, allowing for examining comparative changes in these variables and assessing long-term structural trends.

2. Summary

Land is the physical support of the territory where a large number of activities take place. These activities are extremely diverse in nature, whether economic, social, environmental or other.

As in most countries, particularly in Europe, much of the Portuguese territory is occupied by agriculture and forestry, and these activities and their dynamics are very important for good land management.

The results of the 2019 Agricultural Census (2019AC) show the continuation of a process of restructuring

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* Editor's note: Update of the article originally published in CULTIVAR issue 2 – Soil, November 2015, p.63 as "Dinâmicas da utilização do solo pela agricultura". https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_2/E_book/CULTIVAR_2_O_SOLO/64/

1 Data collection field operations for the 2019AC took place between October 2019 and May 2020. https://ra2019.ine.pt/xportal/xmain?xpgid=ra2019_main&xpid=RA2019&xlang=en

of the agricultural sector, reinforcing the three major trend lines already identified in the past, associated with different types of agriculture. On the one hand, a process of extensification associated with increasing pasture area in large farms, on the other hand, a process of abandonment associated with smaller farms, which appears increasingly attenuated, and also a process of marked sector restructuring leading to the emergence of new farms with strong market orientation, high production potential and modern and technologically differentiated production systems.

The 2019AC shows that farmers are responsible for managing about 5.0 million hectares of area (about 56% of the Portuguese mainland territory), of which 3.8 million hectares are Utilised Agricultural Area (UAA). However, regional disparities are wide (share of UAA throughout the territory varies between 11% and 79%) as a result, in particular, of the different importance of forestry activity, the concentration/dispersion of land ownership, and soil characteristics. All these factors have also led to different developments.

On the other hand, compared to 2009, the total area of farm holdings increased by more than 400 thousand hectares, now occupying 55.5% of the total area. The UAA increased by +8.1%, countering the slight downward trend of the last two decades, with a slowdown in abandonment processes (-4.9% of farms in the last decade vs. -26.6% between 1999 and 2009) and a strong momentum of the sector associated with entrepreneurial farming. The entrepreneurial nature of agriculture has thus intensified, with agricultural companies managing 1/3 of the Utilised Agricultural Area (27.0% in 2009) and more than half of Livestock Units (41.1% in 2009).

Large farms, with more than 50 hectares, manage 69% of the UAA, whereas small farms (less than 5 ha) represent 73% of all farm holdings. These characteristics have seen contrasting developments: a 57% decrease in the number of small farms and a 34% decrease in medium-sized farms, while the number of large farms increased by 34%.

Permanent pasture represents more than half of the UAA, arable land 27% and permanent crops 22%. This predominance of grassland over arable land is the result of a long process, which has become even more visible in the last 20 years. In terms of land cover, there was a very sharp and widespread drop in the area occupied with arable land (-57% between 1989 and 2019), since much of this area was converted to permanent pasture.

In addition to a strong sector response to policy stimuli, 2019AC results show a set of elements highly relevant for characterising the sector dynamics. Some of them were expected, others are new.

The economic and technological development and the public policies that accompany it lead, in general, to a reallocation of resources that implies a decrease in the relative importance of agricultural activity, more marked in terms of economic variables (such as output and employment) than physical variables (such as land cover). Intrasectoral competition, more intense when Portuguese agriculture is integrated into increasingly larger economic areas, has elements that lead to the concentration of land ownership.

These are long-term dynamics, common to both developed and developing countries, which have also occurred in Portugal. However, these trends were regionally diversified, depending on the type of land and the historical structure of land ownership.

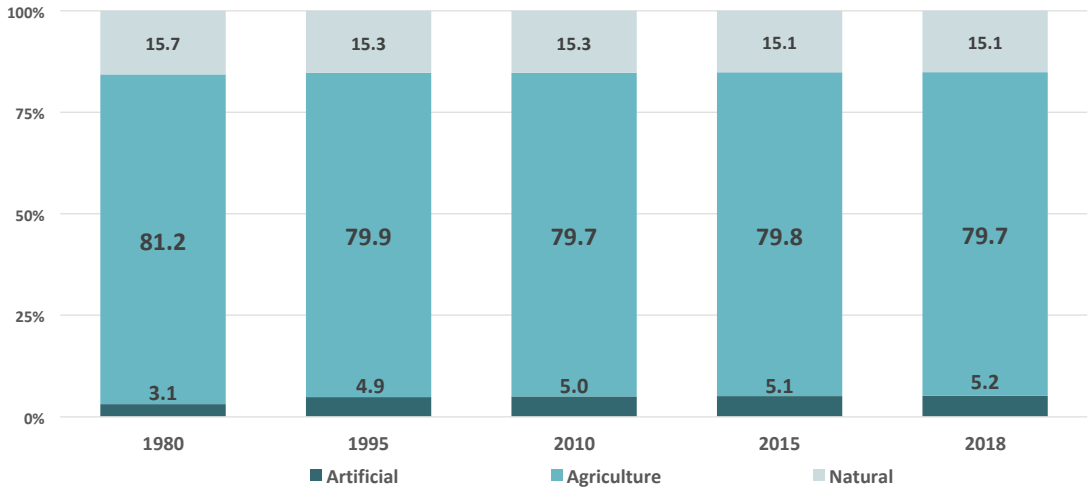
Where there was a land structure with parcels large enough to support an extensification process, the poorest soils were integrated into the UAA for grazing. Between 1989 and 2019, in the Alentejo, there was a 16.4% increase in the Utilised Agricultural Area. In Beira Litoral there was a 44% fall in the UAA, while Entre Douro e Minho and the Algarve fell by almost 26%.

3. Information analysis

3.1. Land use in mainland Portugal

The territory of mainland Portugal occupies approximately 8.9 million hectares.

Figure 1 – Changes in land cover in mainland Portugal (1980-2018)

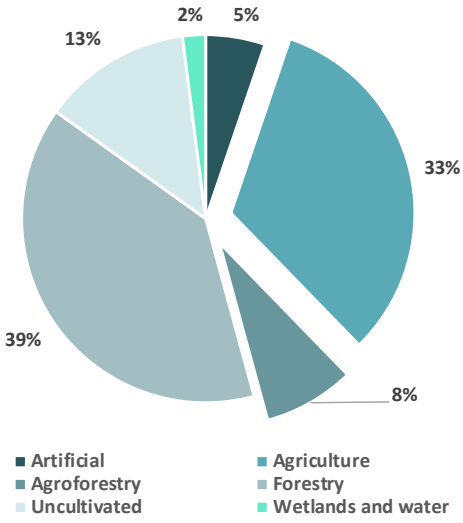


Source: DGT – Land Cover Map

According to the Portuguese Directorate-General for the Territory (DGT)[2], land in mainland Portugal has to a large extent been used and managed by agents linked to forestry and agricultural activities. These two activities have together occupied around 80% of the territory in recent decades (Source: DGT, 2013).

Land is a finite resource and therefore its sustainable management is crucial. Since most of the Portuguese territory is occupied by agriculture and forestry, these activities are important for good land management.

Figure 2 – Land cover structure in mainland Portugal (2018)



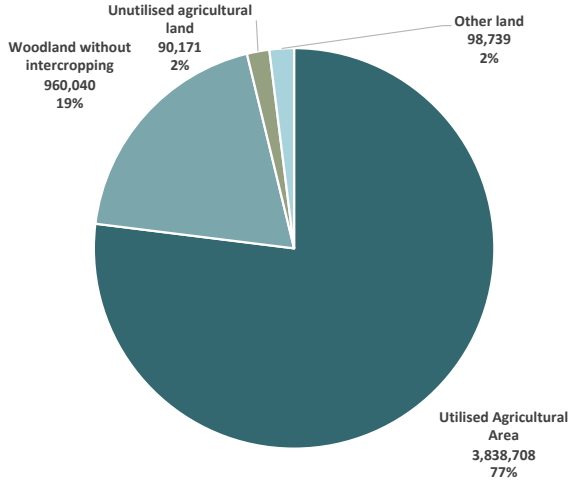
Source: DGT – COS2018

Agricultural activity, together with the portion of land used simultaneously by agriculture and forestry (8%), is responsible for the occupation of about 41% of the territory. (Figure 2).

3.2. Utilised Agricultural Area (UAA)

The 2019AC shows that farmers are responsible for the management of around 5.0 million hectares of land (400 thousand hectares more than in 2009), i.e. the 266 thousand existing farm holdings, with the

Figure 3 – Area managed by farm holdings per type of land use (2019)



Source: INE, 2019AC

[2] DGT – Carta de Ocupação do Solo (COS – Land Cover Map): https://www.dgterritorio.gov.pt/Carta-de-Uso-e-Ocupacao-do-Solo-para-2018

agricultural, forestry and other types of land that they manage, occupy and are responsible for the use of 56% of mainland Portugal. The largest share of this land is Utilised Agricultural Area (UAA), with 3.84 million hectares (an increase of 296 thousand hectares from 2009).

i) Regions

The importance of Utilised Agricultural Area in land use varies greatly in the different areas of the country. Although it occupies around 43% of mainland Portugal as a whole, it differs greatly from region to region: in the Beira Litoral region it occupies only 11% of the land, whereas in the Alentejo it exceeds 78%.

ii) Physical size

Results also show that there is a high concentration of UAA on a limited number of farms. Holdings larger than 50 ha, although they represent only 4% of all farm holdings, account for more than two-thirds of the UAA (69%).

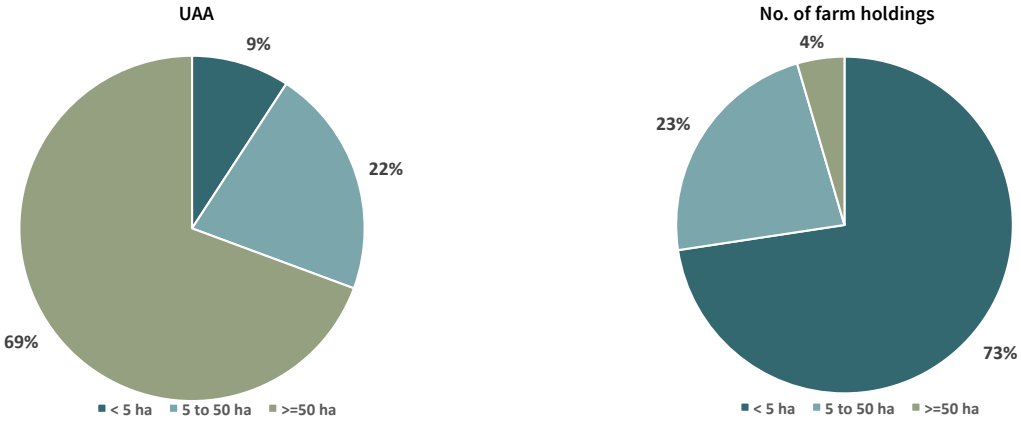
By contrast, small farm holdings with less than 5 ha, occupying only 9% of the UAA, are the most representative in number, corresponding to 73% of all farms. This numerical representation is evidence of the variety of situations that make up the Portuguese agriculture, with characteristics and purposes very different from each other.

Table 1 – Land and agricultural area by region (1989 and 2019)

Agricultural Region	Land area (ha)	1989			2019		
		Utilised Agricultural Area (ha)	Percentage of UAA in total land (%)	Average UAA per holding (ha)	Utilised Agricultural Area (ha)	Percentage of UAA in total land (%)	Average UAA per holding (ha)
Mainland	8 910 216	3 879 579	43,5	7,0	3 838 708	43,1	14,4
EDM	900 624	289 624	32,2	2,6	212 639	23,6	4,8
TM	1 227 964	489 133	39,8	6,1	450 701	36,7	6,9
BL	1 171 529	231 458	19,8	1,8	129 848	11,1	2,9
BI	1 195 784	433 947	36,3	7,2	391 754	32,8	11,7
LVT	1 181 642	456 544	38,6	4,6	409 095	34,6	11,9
ALE	2 732 993	1 842 094	67,4	39,2	2 144 066	78,5	68,9
ALG	499 680	136 77	27,4	5,2	100 605	20,1	7,9

Source: 1989AC and 2019AC

Figure 4 – Distribution of UAA and the number of farm holdings by UAA class (2019)



Source: 2019AC

Table 2 – Distribution of the number of farm holdings and UAA by physical size class (1989 and 2019)

	1989					2019				
	Farm Holdings		UAA		SAU média	Farm Holdings		UAA		Average UAA
	Nº	(%)	Ha	(%)		Nº	(%)	Ha	(%)	
< 5 ha	450 405	81,8	731 458	18,9	1,6	193 179	72,6	353 291	9,2	1,8
5 to 50 ha	91 424	16,6	1 090 803	28,1	11,9	60 776	22,8	823 120	21,4	13,5
>=50 ha	9 050	1,6	2 057 316	53,0	227,3	12 084	4,5	2 662 297	69,4	220.3
Mainland	550 879	100,0	3 879 577	100,0	7,0	266 039	100,0	3 838 708	100,0	14,4

Source: 1989AC and 2019AC

iii) Land cover

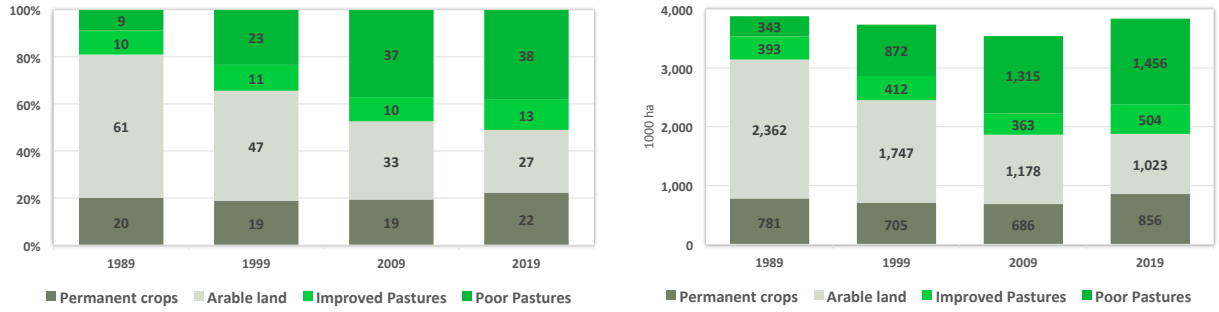
Permanent pasture, namely natural permanent pasture, has increased sharply and in 2019 accounts for more than half of the UAA, while arable land, which accounted for about 61% of the UAA in 1989, now occupies 27%, and permanent crops increase from 20 to 22%.

1.1. Main changes

i) Regions

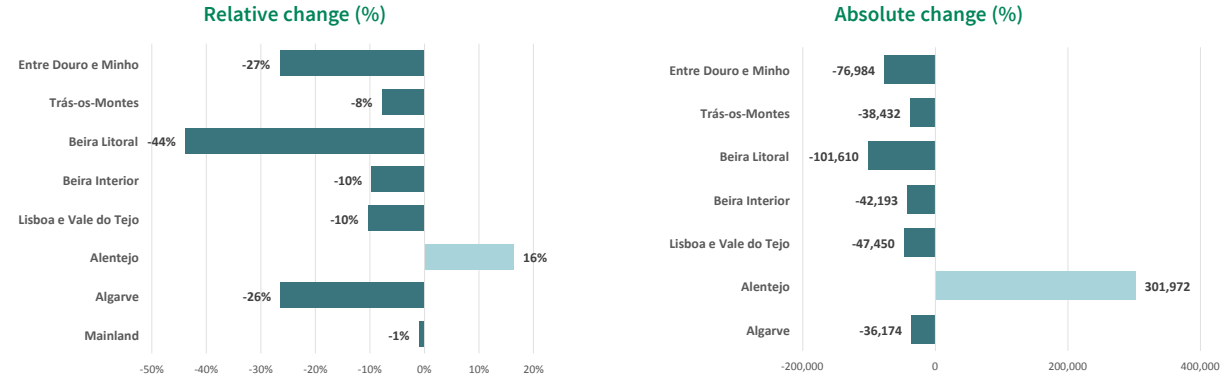
The different regional situations are also subject to very different dynamics. Although overall the UAA, after a slight fall, returned to values close to those of 1989, this evolution is also the result of contrasting regional realities. Beira Litoral (BL) suffered a 44% fall in UAA (102,000 ha less, but +3.5% between 2009

Figure 5 – Changes in the composition of farm area in mainland Portugal (1989-2019)



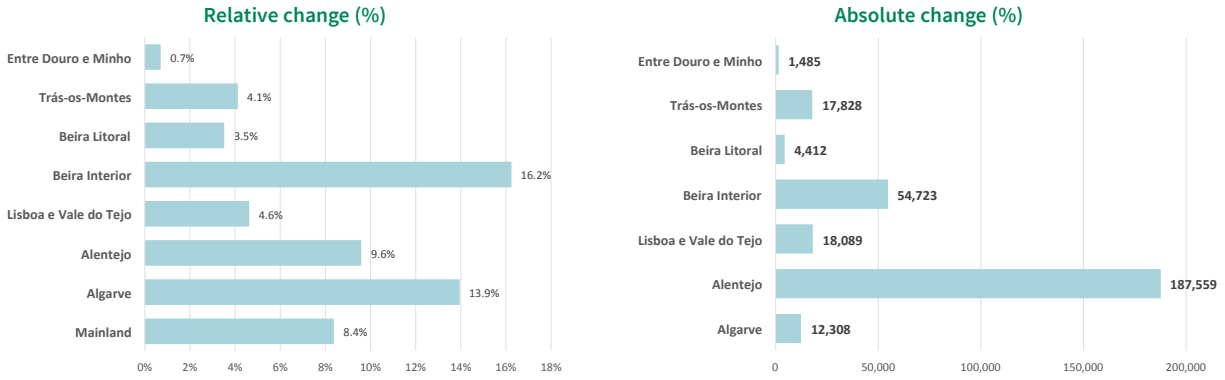
Source: 1989AC, 1999AC, 2009AC and 2019AC

Figure 6 – Change in UAA by Agricultural Region (2019-1989)



Source: 1989AC and 2019AC

Figure 7 – Change in UAA by Agricultural Region (2019-2009)



Source: 2009AC and 2019AC

and 2019) and Entre Douro e Minho (EDM) and the Algarve, 26% falls (with increases in the last decade). On the other hand, in the same period, the Alentejo showed an increase of 16.4%, i.e. 302,000 ha more of Utilised Agricultural Area.

These different developments are explained on the one hand by the equally different agrarian structures, namely farm size and soil characteristics that affect their use, and on the other hand by the different territorial environment of each region.

ii) Agrarian structures

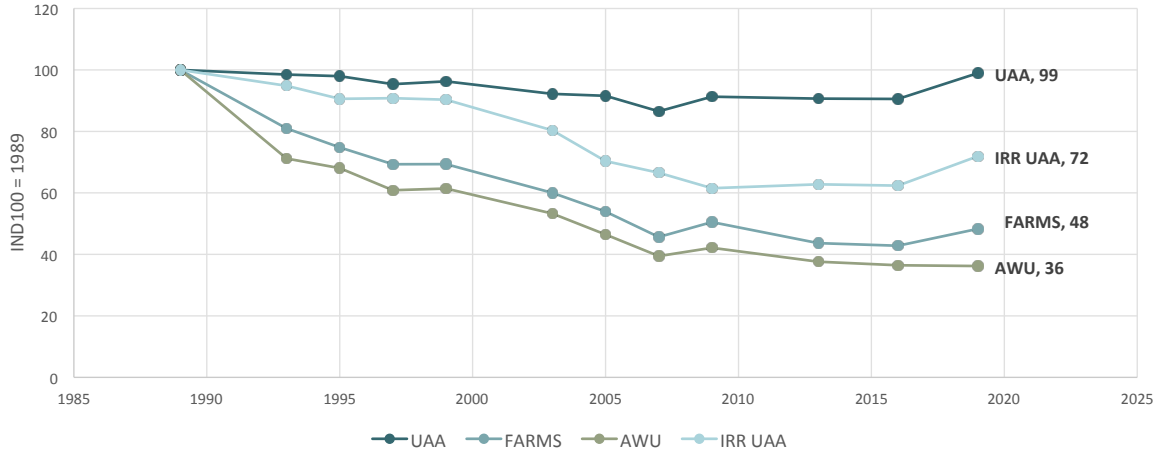
The 1% drop in UAA over 30 years demonstrates the resilience of this variable, especially when compared with the other structural variables.

In 2019, the number of farm holdings was only 48% of the same number in 1989. The volume of work, measured in Annual Work Units (AWU) fell to 36% (64% less than in 1989) and the irrigable area to 72% of 1989. However, in the last 10 years there has been a reversal of the latter downward trend.

This structural adjustment is linked to the land ownership structure of farm holdings. The significant disappearance of holdings, which essentially occurs in small farms, has dragged down the other variables.

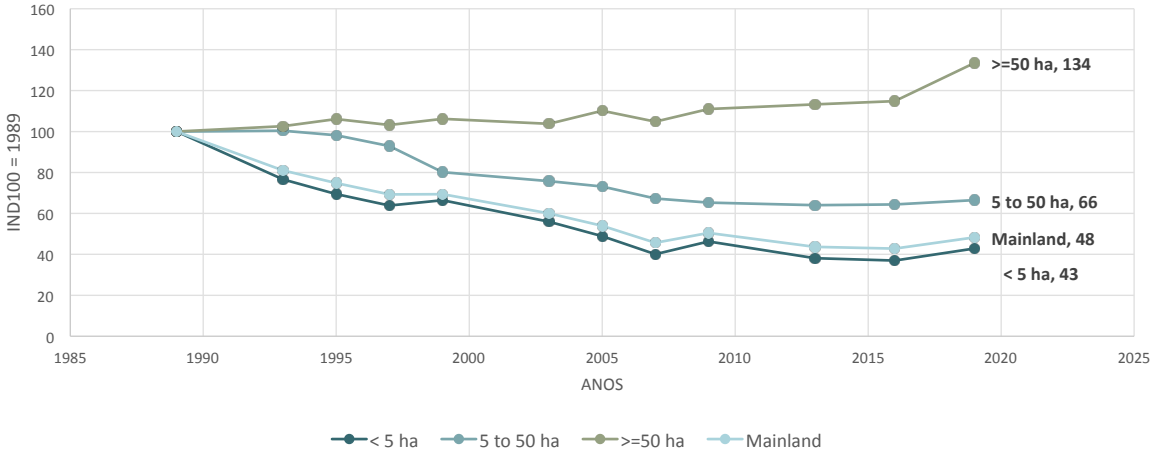
Figure 9 shows these uneven changes according to farm size: there is a significant decrease in the number of small farms (a drop of 57%) and medium-sized farms (-34%), while larger farms registered a 34% increase.

Figure 8 – General trends of the main structural characteristics of farm holdings (Index 100=1989)



Source: 1989AC, 1999AC, 2009AC and 2019AC and intermediate Farm Structure Surveys (FSS)

Figure 9 – Number of farms in mainland Portugal by UAA class (Index 100=1989)



Source: 1989AC, 1999AC, 2009AC and 2019AC and intermediate FSS

Changes in the number of AWUs per hectare of UAA also show that this restructuring trend is part of a process of modernisation and/or extensification. For each hectare of UAA much less labour is used, a sign of more extensive farming in some cases and more modern/mechanised farming in others.

It should be recalled that the analysis of a set of farm variables back in 1990 showed a clear structural weakness in a wide range of holdings. This weakness, combined with the producers' difficulty in organising themselves in order to concentrate supply, has hugely complicated processes of succession and continuity of farm holdings, in addition to hindering the ability to generate an acceptable income.

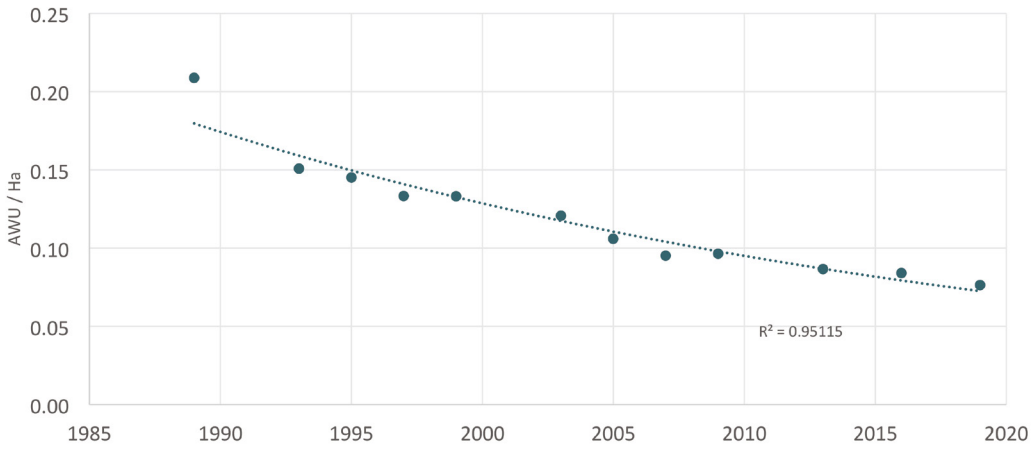
It should also be noted that in 1989 the producers' average age ranged from 55 to 60 years, with only 4% having completed secondary or higher education (3.0% in BL and 2.9% in EDM). Management practices were also very poorly developed: more than 94% of the farms did not keep accounts nor any systematic record of income and expenditure, and in Beira Litoral and Entre Douro e Minho this figure reached 97% and 96% respectively.

iii) Land cover

Examining changes in the main types of area that make up UAA shows yet another type of dynamics. Regardless of the region, there is a very sharp drop in the area occupied by arable land. In mainland Portugal, between 1989 and 2019, there was a 56.8% decrease (a 13.1% drop between 2009 and 2019), and in the Algarve it fell by more than 70%. In the Alentejo, the 60.2% drop in arable land represents nearly 770,000 ha that changed its use.

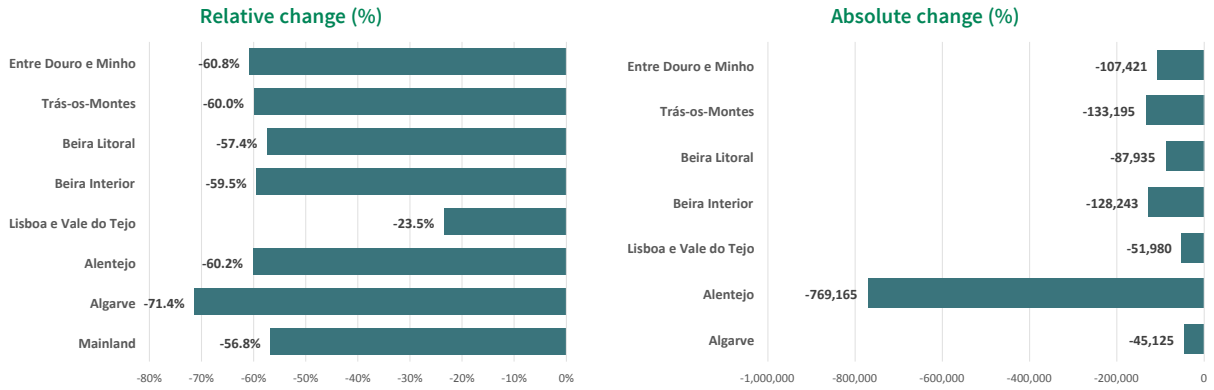
Much of the area occupied by arable land was converted into permanent pasture, and the widespread increase in this type of area should be highlighted: 166% in mainland Portugal (16.8% between 2009 and 2019) and more than 234% in the Alentejo (16.7% between 2009 and 2019), corresponding in this region to an increase of about 918 thousand ha of grassland.

Figure 10 – Annual Work Units per hectare of UAA (1989-2019)



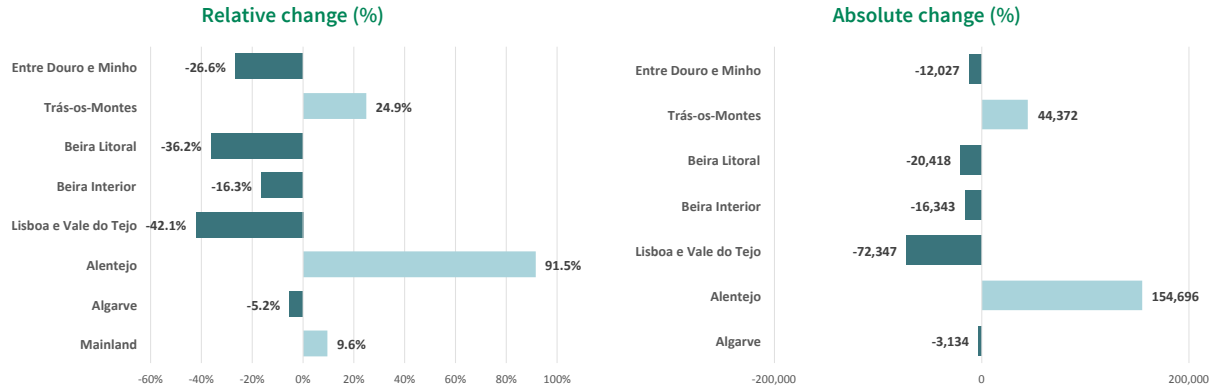
Source: 1989AC, 1999AC, 2009AC and 2019AC and intermediate FSS

Figure 11 – Change in arable land by Agricultural Region (2019-1989)



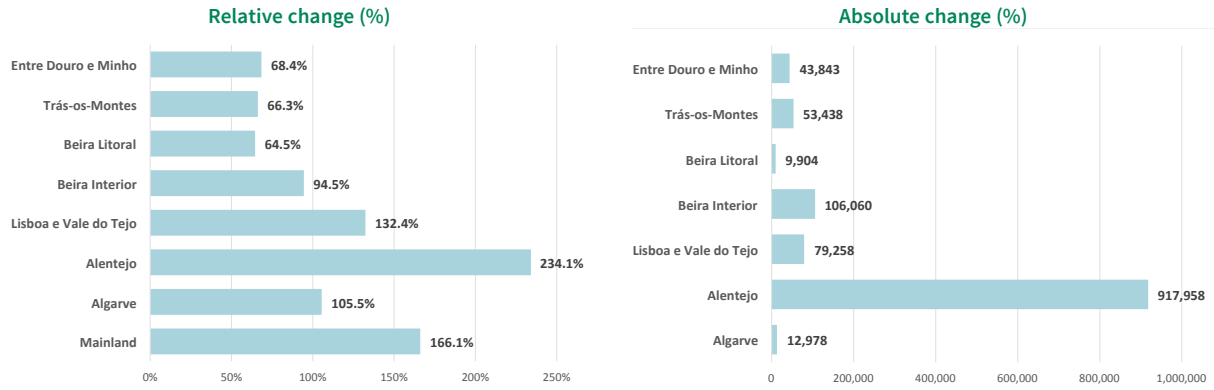
Source: 1989AC and FSS2019

Figure 12 – Change in permanent crops by Agricultural Region (2019-1989)



Source: 1989AC and FSS2019

Figure 13 – Change in permanent pasture by Agricultural Region (2019-1989)



Source: 1989AC and FSS2019

The impact of the policies inherent to the Portuguese accession to the European Union (EU) in 1986, and the resulting opening of the markets, played a substantial role in this change. Among such consequences, we should highlight first the decrease in producer prices for arable crops and, subsequently, the decoupling of support for this type of crops, associated with the maintenance of coupled payments to suckler cows, and sheep and goats. These policies had a particularly relevant impact on the poorest soils and soils with lower yields, thus promoting a change in their use.

Many of these soils were now used for new functions, which also differed in their dynamics. Where the land-ownership structure involved parcels large enough to support an extensification process, the poorest soils were integrated into the UAA for grazing. A more detailed analysis also shows that, in some cases where land tenure is associated with the availability of water and business specialisation, new farms have emerged with strong market orientation, high production potential and modern, technologically differentiated production systems, such as the new areas of modern olive groves, vineyards and other permanent crops in the Alentejo and Trás-os-Montes.

These phenomena can be observed through the clear connection in regional changes between types of land cover and predominant land ownership structures in each region.

When the land structure of the farm holding does not include parcels large enough to support extensification, nor to guarantee the conditions to ensure appropriate succession, this land is withdrawn from production, leading to the disappearance of the holdings and hence a decrease in the UAA.

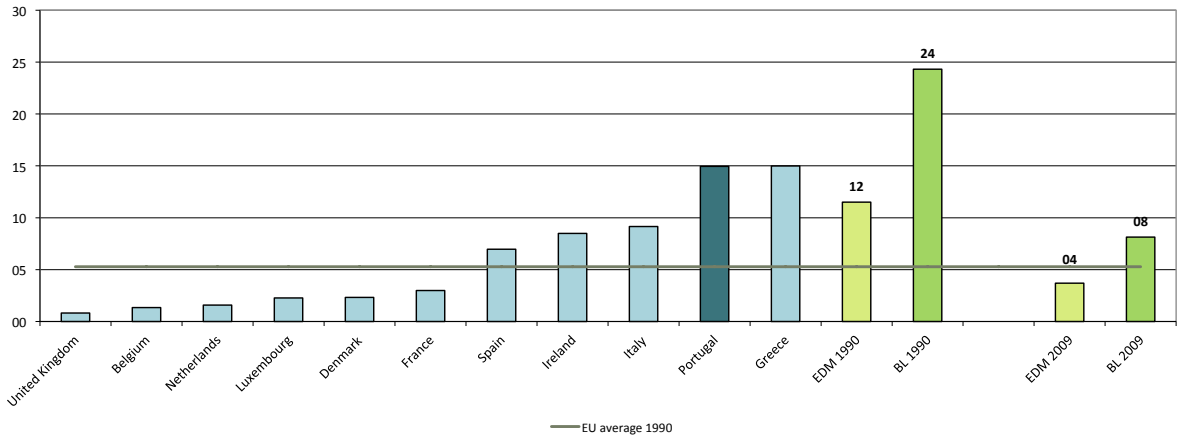
iv) The importance of the territorial environment of agriculture in the dynamics observed

As previously mentioned, in terms of external factors, we have, on the one hand, new market conditions resulting from the accession to and integration in a single market, with increasingly open borders, and therefore increasingly demanding levels of competition; and, on the other hand, the guidelines provided by public policies, chiefly the Common Agricultural Policy (CAP), with among other measures the decoupling of certain coupled payments, and the focus on multifunctionality, extensification, environmental protection and high nature value systems.

This structural adjustment and modernisation of agriculture is largely the result of the impacts of joining a single market that is more competitive in terms of the structural characteristics of farm holdings, but it is also the consequence of economic development, where other economic sectors show greater capacity to attract people.

Once again, it should be noted that, in Portugal in 1990, 15% of the resident population worked on family farms (Figure 14), a very high value when compared with other more developed economies (United Kingdom 0.8%; France 3.0%; Spain 7.0%) or even the EU average of 5.7%. In Beira Litoral, this indicator reached 24.3%, i.e. a quarter of the population in this region was part of the farm household and participated in farm work. Thus, the very social and economic development of the territories naturally led a considerable proportion of the people who were active in agriculture to leave for other sectors with more capacity to attract them, through either better incomes or better overall working conditions.

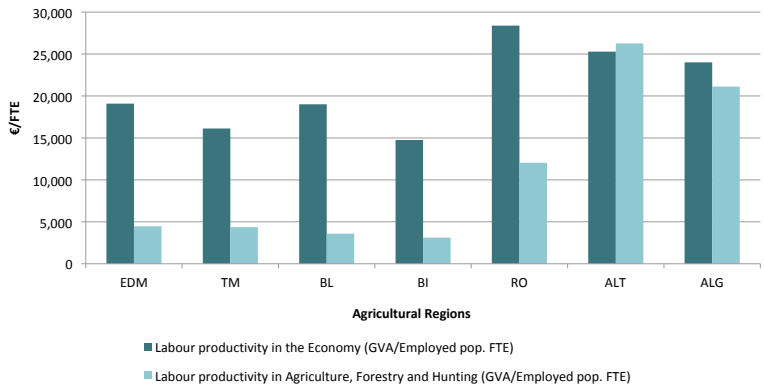
Figure 14 – Share of family farm population working in farm holdings in total Portuguese resident population



Source: 1989AC/90, 2009AC/10 and Resident Population Estimates

On the other hand, in some regions labour productivity levels in agriculture are low when compared with the average of the economy as a whole, which results in very little capacity to ensure comparable incomes. This is yet another factor to make succession processes difficult for these small farmers. Figure 15, which compares labour productivity in the primary sector and in the whole economy, shows that the regions with the greatest differences in labour productivity between Agriculture, Forestry and Hunting and the whole economy average suffered the greatest impacts in terms of loss of UAA and number of holdings. In Beira Litoral, the productivity of the whole economy is 5.3 times that of Agriculture, Forestry and Hunting, revealing the competitive difficulty between the sector and other sectors in attracting labour and investment to these areas.

Figure 15 – Labour productivity in Agriculture, Forestry and Hunting vs. the whole economy by Agricultural Region (average 2000-2001-2002)



FTE – Full-time equivalent
Source: Regional Economic Accounts for Agriculture

As mentioned above, this set of factors has promoted a significant restructuring in the Portuguese agricultural production fabric, with both the disappearance of a large number of farms over time, and the subsequent difficulty in continuing to use their land, and the readjustment in the remaining farms, as well as the new investments made by the new farm holdings meantime created.

3. Conclusions

The economic and technological development of the territories and the public policies that accompany it lead, in general, to a reallocation of resources that implies a decrease in the relative importance of agricultural activity, more marked in terms of economic variables (such as output and employment) than physical variables (such as land cover). Intrasectoral competition, more intense when Portuguese agriculture is integrated into increasingly larger economic areas, has elements that lead to the concentration of land ownership.

These are long-term dynamics, common to both developed and developing countries, which have also occurred in Portugal. However, these trends were regionally diversified, depending on the type of land and the historical structure of land ownership.

Where there was a land ownership structure with parcels large enough to support an extensification process, the poorest soils were integrated into the UAA for grazing. Between 1989 and 2019, in the Alentejo, there was a 16.4% increase in the Utilised Agricultural Area. In Beira Litoral there was a 44% fall in the UAA, while Entre Douro e Minho and the Algarve fell by almost 26%.

Where parcels of a certain size coexist with access to land, entrepreneurial and financial capacity, and availability of water for irrigation, farms with high production potential emerge, with modern and technologically differentiated production systems, where irrigation is more effective, but which are subject to social pressure regarding their environmental performance.

Where the land structure of the holding does not include parcels large enough to support extensification or modernisation processes, coupled with the producers' difficulty in organising themselves in order to concentrate supply, leading to a lower ability to generate an acceptable income, and thus not guaranteeing the conditions to ensure an appropriate generational succession, these farm holdings

withdraw from production. It should also be noted that many of these holdings consisted of agro-forestry systems, where stand-alone forest was integrated into farm management. Their disappearance as an entity managing the territory led to the abandonment of many forest areas.

Annex

Main results of the Agricultural Censuses and the Farm Structure Surveys 1989-2019

Mainland	1989	1993	1995	1997	1999	2003	2005	2007	2009	2013	2016	2019
FARM HOLDINGS (No.)												
Mainland	550 879	446 146	412 064	381 793	382 163	330 656	297 046	251 547	278 114	240 527	235 774	266 039
Entre Douro e Minho	111 505	86 967	79 916	73 048	67 546	58 757	52 696	45 848	49 037	41 601	39 651	44 560
Trás-os-Montes	80 551	75 678	72 248	70 098	70 006	64 963	61 649	56 339	61 804	57 224	56 228	65 211
Beira Litoral	125 307	97 459	88 547	80 217	79 806	66 060	58 823	47 542	49 424	38 356	39 462	44 245
Beira Interior	60 386	49 533	45 878	42 841	48 313	40 788	35 749	30 357	33 763	30 862	29 065	33 617
Ribatejo e Oeste	99 938	78 609	71 430	64 874	61 615	52 375	43 850	33 225	39 875	31 450	31 217	34 486
Alentejo	47 049	37 491	36 114	34 722	35 906	31 830	29 558	26 032	31 828	29 478	28 424	31 131
Algarve	26 143	20 409	17 931	15 993	18 971	15 883	14 721	12 204	12 383	11 556	11 728	12 789
Holdings by UAA class (no.)												
> 0 to <5 ha	446 184	343 780	311 525	286 550	296 010	249 826	218 948	179 656	207 062	170 929	165 331	189 254
5 to 50 ha	91 424	91 810	89 783	84 931	73 258	69 253	66 865	61 534	59 667	58 536	58 861	60 776
> 50 ha	9 050	9 287	9 601	9 340	9 612	9 393	9 971	9 485	10 047	10 249	10 395	12 084
TOTAL AREA OF HOLDINGS (ha)												
Mainland	5 157 213	4 999 731	4 929 405	4 800 054	5 039 569	4 719 438	4 632 024	4 272 503	4 571 531	4 492 242	4 515 890	4 987 658
Utilised Agricultural Area	3 879 579	3 821 319	3 800 379	3 700 161	3 736 140	3 578 034	3 552 347	3 357 019	3 542 305	3 517 740	3 513 006	3 838 708
Woodland without intercropping	965 676	867 336	803 967	801 053	997 497	878 078	838 801	707 750	837 431	800 482	822 722	960 040
Unutilised agricultural area	243 534	215 329	218 610	208 216	201 084	180 743	158 346	134 587	125 283	99 394	96 491	90 171
Other land	68 425	95 747	106 448	90 624	104 848	82 584	82 531	73 146	66 512	74 626	83 671	98 739
UAA (ha)												
Mainland	3 879 579	3 821 319	3 800 379	3 700 161	3 736 140	3 578 034	3 552 347	3 357 019	3 542 305	3 517 740	3 513 006	3 838 708
Entre Douro e Minho	289 624	257 684	239 465	243 450	215 675	233 702	232 260	220 371	211 154	214 554	198 415	212 639
Trás-os-Montes	489 133	493 229	495 965	462 230	457 881	467 158	473 530	474 617	432 873	432 056	454 719	450 701
Beira Litoral	231 458	220 532	205 702	179 896	169 779	154 781	151 949	135 986	125 436	117 387	122 929	129 848
Beira Interior	433 947	443 745	441 138	435 052	418 977	390 252	384 005	352 257	337 031	341 976	356 488	391 754
Ribatejo e Oeste	456 544	498 887	483 831	494 427	447 853	381 558	412 093	349 237	391 006	370 390	378 010	409 095
Alentejo	1 842 094	1 766 678	1 800 535	1 757 360	1 924 043	1 836 215	1 792 285	1 721 795	1 956 508	1 949 142	1 906 874	2 144 066
Algarve	136 779	140 565	133 743	127 745	101 932	114 368	106 225	102 756	88 297	92 234	95 570	100 605
UAA by UAA class												
<5 ha	731 458	625 118	574 760	527 529	513 791	463 738	401 651	335 945	382 341	325 926	318 159	353 291
5 to 50 ha	1 090 803	1 133 878	1 126 281	1 070 249	928 258	891 107	860 460	805 855	777 505	797 420	798 835	823 120
> 50 ha	2 057 316	2 062 323	2 099 337	2 102 382	2 294 091	2 223 188	2 290 236	2 215 219	2 382 459	2 394 395	2 396 012	2 662 297
UAA distribution												
Arable land	2 330 327	2 258 395	2 111 584	2 082 578	1 725 887	1 513 900	1 228 939	1 066 583	1 158 805	1 081 311	1 019 186	1 007 264
Kitchen garden	31 765	29 826	27 176	25 574	20 965	19 274	20 712	17 830	18 991	14 473	15 690	15 719
Permanent crops	780 966	748 594	739 153	700 068	705 232	676 598	643 520	592 393	686 221	704 302	700 353	855 767
Permanent pastures	736 521	784 504	922 465	891 940	1 284 056	1 368 262	1 659 175	1 680 214	1 678 288	1 717 653	1 777 776	1 959 958
of which Poor pastures:	343 025	294 075	317 110	364 843	872 378	1 041 709	1 251 051	1 266 034	1 315 241	1 267 891	1 381 157	1 455 897
Temporary crops (1) (ha)												
Total	1 869 929	1 667 685	1 600 085	1 483 750	1 378 415	1 177 310	992 324	859 525	923 537	840 993	853 885	843 477
Cereals for the production of grain	896 507	702 538	675 457	649 423	601 003	479 372	383 912	303 307	345 556	305 390	254 957	234 530
Pulses for the production of grain	80 711	41 902	38 484	28 508	25 246	21 684	13 858	15 467	13 152	9 257	18 043	18 666
Temporary meadows	73 865	47 210	45 348	43 112	37 246	45 280	49 219	64 718	31 652	35 532	91 874	105 802
Forage crops	565 460	641 601	623 571	589 063	528 049	487 696	466 300	389 993	442 320	414 201	406 626	406 264
Potatoes	103 652	81 496	77 462	55 454	47 313	36 561	24 356	20 685	17 331	11 879	10 953	12 586
Sugar beet	39	0	0	0	7 551	5 115	7 012	2 108	0	0	0	
Industrial crops	63 960	83 433	76 965	57 082	74 400	50 964	8 880	17 473	24 764	19 007	19 837	10 507
Vegetable crops	61 709	51 305	54 492	50 161	49 708	42 286	36 000	37 519	46 367	41 205	47 268	50 509
Flowers and ornamental plants	633	841	813	1 077	1 004	1 195	1 375	1 614	1 525	2 588	1 265	1 828
Other temporary crops	23 393	17 358	7 491	9 870	6 889	7 157	1 413	6 641	870	1 934	3 063	2 786
Fallow land (ha)	830 303	921 836	809 120	858 969	562 646	517 973	373 654	325 044	341 465	333 031	251 744	224 368
Cultivated area	2 706 251	2 605 408	2 674 149	2 476 349	2 301 116	2 018 352	1 927 642	1 765 941	1 885 599	1 916 818	1 880 105	2 158 443
PERMANENT CROPS (ha)	780 966	748 595	739 153	700 067	705 232	676 599	643 519	592 392	686 221	704 303	700 351	855 767
Fresh fruit (except citrus fruits)	75 715	76 218	70 493	62 439	52 342	46 465	40 230	36 800	39 746	42 667	46 515	51 292
Citrus fruits	25 598	25 089	23 890	23 557	22 428	19 802	19 101	18 083	16 389	17 424	17 709	19 146
Sub-tropical fruits	1 042	1 297	1 122	1 094	1 197	1 038	1 390	1 469	1 764	2 412	3 525	6 145
Nuts	73 738	69 964	71 345	74 698	80 281	72 820	70 951	68 877	114 980	139 750	142 523	228 487
Olive groves	340 514	321 675	330 337	308 731	335 028	324 061	317 046	292 162	335 841	340 284	325 755	377 234
Vineyards	262 025	252 015	239 722	227 375	211 821	210 314	192 846	172 765	175 773	160 424	160 674	171 111
Other permanent crops	2 334	2 337	2 244	2 173	2 135	2 099	1 955	2 236	1 728	1 342	3 650	2 351
PERMANENT GRASSLAND (2) (ha)	754 825	808 586	950 879	919 058	1 331 033	1 419 417	1 706 263	1 723 221	1 721 587	1 773 304	1 828 714	2 003 795

(1) Includes successive crops and intercropping with permanent crops

(2) Includes grazing under permanent crops

Mainland	1989	1993	1995	1997	1999	2003	2005	2007	2009	2013	2016	2019
Irrigable area												
Mainland	871 590	826 628	789 727	791 355	787 236		613 209	580 164	536 127	547 119	543 745	626 820
Entre Douro e Minho	225 517	206 876	189 320	186 069	148 305		118 667	115 633	94 829	106 476	90 938	91 281
Trás-os-Montes	99 854	115 563	113 943	112 582	93 101		67 215	53 153	46 666	46 675	43 953	42 658
Beira Litoral	143 821	137 292	121 984	108 008	104 609		82 996	76 595	61 116	57 133	56 385	55 615
Beira Interior	112 734	95 693	84 986	88 021	92 717		69 918	61 928	49 580	38 008	45 571	55 897
Ribatejo e Oeste	144 692	143 313	145 815	146 604	154 509		109 076	116 336	112 539	111 985	114 330	126 084
Alentejo	110 753	93 551	99 870	115 652	163 983		140 376	136 856	155 123	169 573	175 410	232 627
Algarve	34 218	34 340	33 809	34 419	30 012		24 962	19 663	16 274	17 269	17 158	22 658
Livestock (Livestock Units)												
Mainland	**2 244 750**	**2 172 008**	**2 153 381**	**2 137 756**	**2 326 716**	**2 141 186**	**1 870 284**	**1 818 513**	**1 986 998**	**1 821 369**	**2 003 127**	**2 267 450**
Entre Douro e Minho	388 240	362 528	370 666	355 515	338 093	312 049	264 036	252 849	262 882	250 374	250 272	237 876
Trás-os-Montes	171 436	149 289	155 925	156 310	146 251	128 966	113 109	111 591	105 501	100 703	131 956	94 804
Beira Litoral	451 737	429 439	420 307	409 316	421 915	377 544	347 084	322 546	340 199	276 747	323 201	418 735
Beira Interior	153 055	141 195	144 140	146 145	139 043	131 171	112 322	106 514	107 103	103 087	108 232	132 886
Ribatejo e Oeste	578 619	613 489	566 832	557 618	660 006	585 432	441 481	437 883	510 485	456 473	506 302	658 868
Alentejo	446 631	437 198	458 583	477 532	581 052	569 037	566 410	561 773	641 608	614 835	664 301	707 171
Algarve	55 033	38 870	36 926	35 320	40 358	36 983	25 841	25 357	19 222	19 149	18 863	17 112
Livestock (Livestock Units)												
Mainland	**2 244 750**	**2 172 008**	**2 153 381**	**2 137 756**	**2 326 716**	**2 141 186**	**1 870 284**	**1 818 513**	**1 986 998**	**1 821 369**	**2 003 127**	**2 267 450**
By species												
Equines	112 690	88 753	81 551	75 016	72 435	60 874	46 866	39 804	42 594	36 843	32 460	30 384
Cattle	869 750	782 593	858 047	825 150	845 530	835 827	783 377	776 740	840 627	816 716	917 913	906 929
Sheep	291 204	276 866	276 623	272 575	291 772	267 620	252 600	233 457	221 117	205 730	219 001	217 175
Goats	69 747	59 248	56 611	53 442	51 902	42 583	43 191	37 950	40 563	36 943	37 850	35 946
Poultry	326 654	332 315	310 583	323 692	478 407	423 382	301 785	311 728	392 820	301 723	368 668	566 045
Pigs	565 212	624 125	562 408	581 231	579 978	504 746	437 229	414 078	444 066	420 122	425 140	507 671
Rabbits	9 493	8 108	7 558	6 650	6 692	6 154	5 236	4 756	5 211	3 292	2 095	3 300
LABOUR INPUT (AWU)												
Mainland	810 005	576 661	551 197	492 999	497 537	431 521	376 370	319 369	341 502	304 677	295 316	293 236
Entre Douro e Minho	218 450	153 824	150 023	127 545	122 487	103 124	88 050	74 273	78 758	68 404	58 000	56 658
Trás-os-Montes	99 162	81 023	81 412	73 226	81 566	77 400	67 260	65 072	69 330	68 998	71 193	62 774
Beira Litoral	188 075	127 288	121 948	105 164	107 553	88 993	79 738	59 518	65 502	48 669	46 289	47 053
Beira Interior	85 447	52 671	47 625	46 443	49 193	44 165	42 588	33 624	33 552	30 355	26 215	27 098
Ribatejo e Oeste	126 898	93 835	89 504	83 768	75 630	63 629	50 047	42 447	47 269	40 832	38 663	41 752
Alentejo	61 913	48 043	43 524	42 942	44 162	40 862	35 491	32 918	35 659	35 617	41 838	44 182
Algarve	30 061	19 976	17 161	13 911	16 946	13 348	13 197	11 515	11 432	11 801	13 117	13 720
Type of labour												
Agricultural family labour	687 485	484 712	460 220	406 351	408 224	352 376	309 759	260 110	272 783	230 012	212 771	196 990
Producer	311 206	231 524	221 960	200 648	206 241	180 870	163 899	138 618	147 342	123 072	116 335	109 949
Agricultural non-family labour	122 520	91 948	90 977	86 647	89 313	79 145	66 611	59 258	68 718	74 664	82 545	96 246
Permanent	58 932	46 524	44 232	41 976	43 962	40 758	38 402	35 820	38 960	46 010	52 488	57 110
Seasonal	60 565	43 112	44 590	42 655	42 525	35 967	26 351	21 677	26 000	23 795	26 093	28 990
AGRICULTURAL POPULATION (No.)												
Mainland	1 799 736	1 408 613	1 261 088	1 133 401	1 123 418	935 316	787 102	656 296	709 928	604 926	564 670	599 497
Entre Douro e Minho	466 783	345 726	306 268	274 338	248 443	203 845	175 226	145 511	150 588	124 339	110 068	114 401
Trás-os-Montes	255 688	227 653	212 261	198 007	196 960	174 969	155 729	138 630	151 529	138 731	132 411	143 317
Beira Litoral	426 328	325 453	286 032	251 190	246 329	197 024	168 002	133 515	134 174	106 486	103 862	106 829
Beira Interior	163 719	129 743	118 858	109 048	121 920	101 031	83 230	68 638	78 470	73 147	65 889	72 361
Ribatejo e Oeste	295 495	229 219	202 173	176 355	170 116	140 110	106 022	84 673	96 111	76 290	70 309	76 016
Alentejo	121 804	95 794	88 222	83 601	91 678	79 884	65 591	57 425	69 849	61 473	56 795	59 051
Algarve	69 919	55 025	47 274	40 861	47 972	38 453	33 302	27 904	29 207	24 460	25 336	27 522
FARMERS (No.)												
Men	462 535	368 061	335 627	306 245	289 291	248 858	216 600	180 885	186 194	156 995	147 962	168 459
Women	83 534	73 350	71 413	70 052	86 647	75 665	73 896	64 395	84 313	72 973	75 543	82 156
Farmer age group												
15-44 years old	107 122	72 074	62 146	51 852	55 538	35 871	29 417	21 858	24 403	17 842	14 914	24 151
45-64 years old	282 161	222 105	201 020	181 582	176 575	134 653	120 906	102 461	112 932	88 447	83 576	90 767
> 65 years old	156 786	147 232	143 874	142 863	143 825	154 000	140 172	120 960	133 172	123 680	125 015	135 697
Farmer level of education												
None	255 187	190 085	165 348	146 863	129 360	105 666	84 731	61 900	60 040	43 102	36 127	26 704
Basic	268 772	231 253	228 016	215 583	228 474	201 224	188 739	168 350	186 768	159 711	158 991	174 793
Secondary/Post-secondary	16 041	13 567	6 143	6 635	8 230	7 980	7 338	6 476	11 361	13 784	14 755	25 017
Higher	6 069	6 507	7 533	7 216	9 874	9 653	9 687	8 554	12 338	13 372	13 633	24 101
Farmer agricultural training												
Practical only	n.d.	429 831	394 406	360 809	353 898	295 947	257 273	213 773	240 285	194 177	118 615	131 980
Agriculture-related training course	n.d.	10 069	11 031	13 838	19 273	25 820	30 494	29 272	27 400	32 515	101 819	113 974
Full (secondary or higher agricultural training)	n.d.	1 511	1 603	1 650	2 767	2 756	2 729	2 234	2 822	3 277	3 073	4 661

Source: 1989AC, 1999AC, 2009AC, 2019AC and intermediate FSS

Main results of the 1989 Agricultural Census

1989	Mainland	EDM	TM	BL	BI	LVT	ALE	ALG
FARM HOLDINGS (No.)	550 879	111 505	80 551	125 307	60 386	99 938	47 049	26 143
Holdings by UAA class (no.)								
> 0 to <5 ha	446 184	101 131	52 952	118 763	45 225	83 508	24 909	19 696
5 to 50 ha	91 424	9 925	26 845	6 156	14 065	14 154	14 286	5 993
> 50 ha	9 050	128	660	62	1 030	912	6 039	219
TOTAL AREA OF HOLDINGS (ha)	5 157 213	464 133	646 279	425 922	654 570	684 184	2 007 281	274 845
Utilised Agricultural Area	3 879 579	289 624	489 133	231 458	433 947	456 544	1 842 094	136 779
Woodland without intercropping	965 676	160 966	73 494	180 590	168 428	200 065	124 548	57 585
Unutilised agricultural area	243 534	6 418	70 570	7 357	47 225	16 262	17 216	78 486
Other land	68 425	7 126	13 082	6 517	4 970	11 313	23 423	1 995
UAA (ha)	3 879 579	289 624	489 133	231 458	433 947	456 544	1 842 094	136 779
UAA by UAA class								
<5 ha	731 458	161 763	106 275	167 716	85 372	128 885	47 458	33 989
5 to 50 ha	1 090 803	81 260	322 576	55 156	173 795	160 121	226 550	71 347
> 50 ha	2 057 316	46 600	60 282	8 587	174 780	167 538	1 568 086	31 444
UAA distribution								
Arable land	2 330 327	176 575	222 025	153 148	215 620	221 287	1 278 436	63 237
Kitchen garden	31 765	3 816	8 003	6 505	5 938	3 593	2 562	1 348
Permanent crops	780 966	45 160	178 449	56 460	100 177	171 795	169 037	59 888
Permanent pastures	736 521	64 072	80 656	15 345	112 212	59 870	392 059	12 306
of which Poor pastures:	343 025	39 897	24 813	5 652	76 852	16 894	172 627	6 288
TEMPORARY CROPS[1] (ha)								
Total	1 869 929	349 411	184 551	233 010	189 099	213 333	660 920	39 606
Cereals for the production of grain	896 507	86 367	110 916	82 590	81 866	86 699	424 335	23 734
Pulses for the production of grain	80 711	36 503	2 662	18 789	8 797	4 804	6 215	2 942
Temporary meadows	73 865	17 200	1 974	2 806	10 970	10 646	28 544	1 725
Forage crops	565 460	164 798	42 634	96 883	70 781	59 329	127 413	3 622
Potatoes	103 652	19 266	25 778	26 106	14 276	14 918	1 742	1 566
Sugar beet	39	0	0	1	3	34	0	0
Industrial crops	63 960	68	100	384	1 075	3 267	58 997	70
Vegetable crops	61 709	4 304	438	4 429	881	32 789	13 136	5 733
Flowers and ornamental plants	633	144	2	65	7	342	5	68
Other temporary crops	23 393	20 760	48	956	444	504	533	147
Fallow land (ha)	830 303	495	61 746	4 209	58 943	31 129	645 844	27 938
CULTIVATED AREA	2 706 251	249 232	402 574	221 597	298 152	408 521	1 023 623	102 553
PERMANENT CROPS (ha)								
Fresh fruit (except citrus fruits)	75 715	2 709	7 985	4 457	10 215	38 857	5 275	6 217
Citrus fruits	25 598	937	483	851	593	4 391	3 560	14 783
Sub-tropical fruits	1 042	621	5	138	30	62	58	128
Nuts	73 738	297	38 399	876	5 065	605	1 886	26 610
Olive groves	340 514	2 660	61 744	15 439	59 300	48 725	144 957	7 689
Vineyards	262 025	37 809	69 743	33 558	24 865	78 826	12 777	4 448
Other permanent crops	2 334	128	90	1 142	109	328	525	13
PERMANENT GRASSLAND [2] (ha)	754825	65233	82171	16207	113429	65049	398617	14120
IRRIGABLE AREA	871 590	225 517	99 854	143 821	112 734	144 692	110 753	34 218
Livestock (Livestock Units)	2 244 750	388 240	171 436	451 737	153 055	578 619	446 631	55 033
By species								
Equines	112 690	4 096	39 131	12 770	22 747	13 334	12 979	7 632
Cattle	869 750	277 599	66 415	162 070	48 806	117 524	181 308	16 029
Sheep	291 204	13 369	28 970	19 594	36 636	35 207	150 531	6 897
Goats	69 747	8 006	11 637	11 099	13 954	8 198	14 061	2 792
Poultry	326 654	45 834	7 988	121 503	10 989	127 110	8 070	5 160
Pigs	565 212	36 559	16 522	122 197	19 253	275 019	79 325	16 337
Rabbits	9 493	2 777	773	2 504	670	2 227	357	186
LABOUR INPUT (AWU)	810 005	218 450	99 162	188 075	85 447	126 898	61 913	30 061
Type of labour								
Agricultural family labour	687 485	199 995	79 175	174 620	76 041	97 431	34 695	25 529
Producer	311 206	77 518	39 038	71 686	37 326	50 633	20 764	14 240
Agricultural non-family labour	122 520	18 455	19 987	13 454	9 406	29 467	27 218	4 533
Permanent	58 932	8 791	6 992	5 213	3 057	15 072	16 894	2 913
Seasonal	60 565	9 149	12 318	7 763	6 078	13 893	9 852	1 512
AGRICULTURAL POPULATION (No.)	1 799 736	466 783	255 688	426 328	163 719	295 495	121 804	69 919
FARMERS (No.)								
Men	462 535	84 012	67 120	107 945	51 559	89 002	40 660	22 237
Women	83 534	26 802	12 934	17 034	8 576	9 498	5 046	3 644
Farmer age group								
15-44 years old	107 122	26 302	15 660	27 835	8 216	18 524	7 603	2 982
45-64 years old	282 161	58 131	40 492	67 177	28 148	52 932	22 913	12 368
> 65 years old	156 786	26 381	23 902	29 967	23 771	27 044	15 190	10 531
Farmer level of education								
None	255 187	54 217	39 205	51 342	31 037	42 312	22 884	14 190
Basic	268 772	53 391	37 143	69 879	26 847	51 420	19 758	10 334
Secondary/Post-secondary	16 041	2 191	2 556	2 919	1 587	3 622	2 145	1 021
Higher	6 069	1 015	1 150	839	664	1 146	919	336
Farmer agricultural training								
Practical only	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Agriculture-related training course	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Full (secondary or higher agricultural training)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

(1) Includes successive crops and intercropping with permanent crops

(2) Includes grazing under permanent crops

Source: 1989AC

Main results of the 1999 Agricultural Census

1999	Mainland	EDM	TM	BL	BI	LVT	ALE	ALG
FARM HOLDINGS (No.)	382 163	67 546	70 006	79 806	48 313	61 615	35 906	18 971
Holdings by UAA class (no.)								
> 0 to <5 ha	296 010	60 380	46 124	74 145	36 091	48 148	17 140	13 982
5 to 50 ha	73 258	6 830	22 984	5 061	10 857	11 370	11 529	4 627
> 50 ha	9 612	152	722	88	1 231	1 027	6 205	187
TOTAL AREA OF HOLDINGS (ha)	5 039 569	374 832	637 104	316 646	618 526	706 000	2 158 882	227 578
Utilised Agricultural Area	3 736 140	215 675	457 881	169 779	418 977	447 853	1 924 043	101 932
Woodland without intercropping	997 497	133 236	101 797	131 795	160 471	220 126	189 789	60 284
Unutilised agricultural area	201 084	7 745	61 925	8 142	31 543	15 374	14 158	62 196
Other land	104 848	18 176	15 501	6 930	7 535	22 647	30 892	3 166
UAA (ha)	3 736 140	215 675	457 881	169 779	418 977	447 853	1 924 043	101 932
UAA by UAA class								
<5 ha	513 791	97 140	96 078	111 917	65 446	84 106	33 707	25 397
5 to 50 ha	928 258	64 978	287 293	50 293	144 511	136 405	190 137	54 642
> 50 ha	2 294 091	53 557	74 510	7 569	209 020	227 342	1 700 200	21 893
UAA distribution								
Arable land	1 725 887	106 780	152 660	99 158	152 390	204 970	975 840	34 090
Kitchen garden	20 965	2 627	5 473	4 479	3 585	2 750	1 265	788
Permanent crops	705 232	35 529	192 795	48 292	93 058	117 592	161 657	56 309
Permanent pastures	1 284 056	70 739	106 953	17 850	169 945	122 542	785 282	10 746
of which Poor pastures:	872 378	60 529	48 793	8 266	130 180	29 986	585 295	9 328
TEMPORARY CROPS(1) (ha)								
Total	1 378 415	201 585	115 365	144 367	149 942	182 744	564 221	20 190
Cereals for the production of grain	601 003	44 914	57 288	51 856	41 645	70 617	325 832	8 852
Pulses for the production of grain	25 246	5 274	1 153	6 390	1 641	1 940	8 031	817
Temporary meadows	37 246	7 910	2 608	2 620	2 332	8 214	12 756	807
Forage crops	528 049	126 449	40 588	67 414	96 213	55 044	136 253	6 087
Potatoes	47 313	7 096	13 094	11 490	4 733	9 377	863	660
Sugar beet	7 551	0	0	211	2	4 333	2 906	100
Industrial crops	74 400	31	58	377	2 793	3 727	67 301	113
Vegetable crops	49 708	3 726	516	3 504	501	28 920	9 975	2 566
Flowers and ornamental plants	1 004	225	45	171	5	370	122	66
Other temporary crops	6 889	5 955	16	332	77	203	181	125
Fallow land (ha)	562 646	459	50 162	2 874	30 744	33 820	429 328	15 259
CULTIVATED AREA	2 301 116	154 687	358 926	158 639	258 053	384 047	909 420	77 345
PERMANENT CROPS (ha)								
Fresh fruit (except citrus fruits)	52 342	1 868	9 051	3 563	6 769	24 614	2 686	3 791
Citrus fruits	22 428	696	585	631	415	2 789	2 188	15 124
Sub-tropical fruits	1 197	780	4	173	4	12	7	217
Nuts	80 281	674	46 334	996	4 276	746	1 997	25 258
Olive groves	335 028	1 126	72 288	17 585	60 325	36 829	138 084	8 791
Vineyards	211 821	30 231	64 294	24 494	21 148	52 084	16 580	2 991
Other permanent crops	2 135	154	239	850	121	519	115	138
PERMANENT GRASSLAND (2) (ha)	1331033	71533	107673	19896	175831	126077	818302	11721
IRRIGABLE AREA	787 236	148 305	93 101	104 609	92 717	154 509	163 983	30 012
Livestock (Livestock Units)	2 326 716	338 093	146 251	421 915	139 043	660 006	581 052	40 358
By species								
Equines	6 692	1 686	837	2 140	585	1 168	200	76
Cattle	845 530	239 711	56 678	113 204	41 015	109 057	277 601	8 264
Sheep	291 772	14 088	32 552	18 973	45 379	26 324	147 634	6 822
Goats	51 902	6 620	7 352	8 247	10 796	4 656	11 995	2 235
Poultry	478 407	39 716	8 245	151 940	9 963	245 489	19 904	3 151
Pigs	579 978	30 283	16 149	120 378	18 367	264 957	113 608	16 238
Rabbits	72 435	5 989	24 438	7 033	12 938	8 355	10 110	3 572
LABOUR INPUT (AWU)	497 537	122 487	81 566	107 553	49 193	75 630	44 162	16 946
Type of labour								
Agricultural family labour	408 224	109 319	64 975	98 414	42 453	54 397	25 021	13 644
Producer	206 241	49 181	32 538	47 351	23 008	30 023	16 051	8 090
Agricultural non-family labour	89 313	13 168	16 591	9 139	6 740	21 233	19 140	3 302
Permanent	43 962	6 661	5 481	4 136	2 476	11 312	11 835	2 061
Seasonal	42 525	6 011	10 408	4 626	4 017	9 488	6 825	1 151
AGRICULTURAL POPULATION (No.)	1 123 418	248 443	196 960	246 329	121 920	170 116	91 678	47 972
FARMERS (No.)								
Men	289 291	43 726	53 202	59 607	37 508	51 358	28 585	15 305
Women	86 647	22 854	15 906	19 659	10 431	8 586	5 860	3 351
Farmer age group								
15-44 years old	55 538	12 072	11 302	11 420	5 351	8 634	5 160	1 599
45-64 years old	176 575	32 688	31 594	41 748	19 752	28 663	14 461	7 669
> 65 years old	143 825	21 820	26 212	26 098	22 836	22 647	14 824	9 388
Farmer level of education								
None	129 360	25 418	24 504	24 106	18 637	17 708	11 695	7 292
Basic	228 474	38 733	40 869	52 845	27 146	39 050	19 561	10 270
Secondary/Post-secondary	8 230	1 035	1 485	1 130	922	1 708	1 366	584
Higher	9 874	1 394	2 250	1 185	1 234	1 478	1 823	510
Farmer agricultural training								
Practical only	353 898	60 957	65 599	76 051	46 362	55 260	31 948	17 721
Agriculture-related training course	19 273	5 359	3 038	2 980	1 323	4 106	1 670	797
Full (secondary or higher agricultural training)	2 767	264	471	235	254	578	827	138

(1) Includes successive crops and intercropping with permanent crops

(2) Includes grazing under permanent crops

Source: 1999AC

Main results of the 2009 Agricultural Census

2009	Mainland	EDM	TM	BL	BI	LVT	ALE	ALG
FARM HOLDINGS (No.)	278 114	49 037	61 804	49 424	33 763	39 875	31 828	12 383
Holdings by UAA class (no.)								
> 0 to <5 ha	207 062	42 732	41 227	44 966	24 855	29 979	14 706	8 597
5 to 50 ha	59 667	5 943	19 750	4 094	7 693	8 464	10 184	3 539
> 50 ha	10 047	191	735	101	1 179	1 095	6 535	211
TOTAL AREA OF HOLDINGS (ha)	4 571 531	312 756	619 172	222 136	503 126	543 222	2 205 930	165 189
Utilised Agricultural Area	3 542 305	211 154	432 873	125 436	337 031	391 006	1 956 508	88 297
Woodland without intercropping	837 431	91 139	141 138	87 108	133 621	133 716	204 104	46 605
Unutilised agricultural area	125 283	3 543	40 223	5 822	24 674	8 331	14 593	28 096
Other land	66 512	6 920	4 937	3 770	7 800	10 169	30 724	2 191
UAA (ha)	3 542 305	211 154	432 873	125 436	337 031	391 006	1 956 508	88 297
UAA by UAA class								
<5 ha	382 341	73 356	88 640	71 587	46 245	56 041	29 656	16 815
5 to 50 ha	777 505	62 390	239 503	44 853	105 715	109 168	170 840	45 036
> 50 ha	2 382 459	75 409	104 729	8 995	185 071	225 797	1 756 013	26 446
UAA distribution								
Arable land	1 158 805	85 759	101 615	70 547	100 001	166 379	612 176	22 327
Kitchen garden	18 991	3 181	5 030	4 557	2 476	1 944	1 176	628
Permanent crops	686 221	26 932	191 614	33 979	74 049	93 628	221 013	45 007
Permanent pastures	1 678 288	95 282	134 614	16 353	160 505	129 055	1 122 142	20 335
of which Poor pastures:	1 315 241	82 563	78 774	6 355	122 438	67 575	939 771	17 766
TEMPORARY CROPS(1) (ha)								
Total	923 537	139 237	66 830	85 425	92 269	139 840	391 742	8 193
Cereals for the production of grain	345 556	28 895	29 404	34 150	16 630	57 035	177 223	2 219
Pulses for the production of grain	13 152	1 228	442	1 674	659	944	8 131	73
Temporary meadows	31 652	7 352	1 129	2 055	4 087	5 595	11 377	57
Forage crops	442 320	96 712	30 413	41 545	68 779	37 842	162 639	4 390
Potatoes	17 331	2 059	4 927	2 923	1 321	5 592	347	162
Sugar beet	0	0	0	0	0	0	0	0
Industrial crops	24 764	22	26	110	383	1 098	23 119	6
Vegetable crops	46 367	2 542	438	2 749	309	31 089	8 214	1 026
Flowers and ornamental plants	1 525	317	31	142	6	467	414	147
Other temporary crops	870	110	20	77	95	177	278	113
Fallow land (ha)	341 465	3 851	40 585	5 787	18 995	32 180	225 721	14 346
CULTIVATED AREA	1 885 599	124 740	313 514	113 294	195 598	291 251	791 016	56 185
PERMANENT CROPS (ha)								
Fresh fruit (except citrus fruits)	39 746	1 666	7 754	1 929	5 999	16 567	2 477	3 355
Citrus fruits	16 389	451	472	307	248	1 525	1 852	11 533
Sub-tropical fruits	1 764	1 161	8	316	4	8	10	257
Nuts	114 980	982	46 920	890	4 319	12 295	29 528	20 046
Olive groves	335 841	881	75 266	14 341	47 336	25 540	164 078	8 399
Vineyards	175 773	21 708	60 907	15 467	16 076	37 220	22 998	1 396
Other permanent crops	1 728	82	288	728	67	473	69	21
PERMANENT GRASSLAND (2) (ha)	1 721 587	95 992	134 964	17 779	164 528	133 477	1 153 264	21 584
IRRIGABLE AREA	536 127	94 829	46 666	61 116	49 580	112 539	155 123	16 274
Livestock (Livestock Units)	1 986 998	262 882	105 501	340 199	107 103	510 485	641 608	19 222
By species								
Equines	42 594	7 350	12 463	2 850	4 952	5 819	7 672	1 488
Cattle	840 627	194 015	45 498	66 640	44 718	94 524	389 893	5 338
Sheep	221 117	12 915	26 973	14 387	35 920	17 380	109 042	4 501
Goats	40 563	5 482	5 701	6 424	6 617	4 866	9 916	1 558
Poultry	392 820	27 506	7 224	156 531	6 791	187 136	6 500	1 132
Pigs	444 066	13 830	6 638	91 857	7 737	200 333	118 489	5 183
Rabbits	5 211	1 784	1 004	1 510	368	427	96	22
LABOUR INPUT (AWU)	341 502	78 758	69 330	65 502	33 552	47 269	35 659	11 432
Type of labour								
Agricultural family labour	272 783	70 348	56 740	58 888	29 459	31 174	17 252	8 924
Producer	147 342	34 818	30 836	30 561	16 238	18 373	11 204	5 314
Agricultural non-family labour	68 718	8 410	12 591	6 614	4 093	16 095	18 407	2 509
Permanent	38 960	5 127	4 641	4 075	1 699	10 268	11 440	1 710
Seasonal	26 000	2 929	7 219	2 271	2 215	5 570	5 186	610
AGRICULTURAL POPULATION (No.)	709 928	150 588	151 529	134 174	78 470	96 111	69 849	29 207
FARMERS (No.)								
Men	186 194	26 733	40 455	32 574	23 423	31 135	22 748	9 126
Women	84 313	21 200	20 524	16 187	9 901	6 930	6 544	3 027
Farmer age group								
15-44 years old	24 403	5 533	6 071	3 422	2 095	3 470	3 150	662
45-64 years old	112 932	22 236	26 056	22 363	12 050	15 369	10 956	3 902
> 65 years old	133 172	20 164	28 852	22 976	19 179	19 226	15 186	7 589
Farmer level of education								
None	60 040	12 184	13 661	9 803	8 441	6 280	6 386	3 285
Basic	186 768	32 592	41 163	36 276	21 986	28 569	18 448	7 734
Secondary/Post-secondary	11 361	1 434	2 707	1 404	1 353	1 815	2 058	590
Higher	12 338	1 723	3 448	1 278	1 544	1 401	2 400	544
Farmer agricultural training								
Practical only	240 285	42 159	52 780	44 420	30 639	33 040	25 886	11 361
Agriculture-related training course	27 400	5 480	7 656	4 143	2 427	4 523	2 477	694
Full (secondary or higher agricultural training)	2 822	294	543	198	258	502	929	98

(1) Includes successive crops and intercropping with permanent crops

(2) Includes grazing under permanent crops

Source: 2009AC

Main results of the 2019 Agricultural Census

2019	Mainland	EDM	TM	BL	BI	LVT	ALE	ALG
FARM HOLDINGS (No.)	266 039	44 560	65 211	44 245	33 617	34 486	31 131	12 789
Holdings by UAA class (no.)								
> 0 to <5 ha	189 254	38 052	43 260	38 919	23 484	24 606	12 215	8 718
5 to 50 ha	60 776	5 518	20 624	4 229	8 355	7 950	10 555	3 545
> 50 ha	12 084	282	874	187	1 455	1 340	7 672	274
TOTAL AREA OF HOLDINGS (ha)	4 987 658	339 921	677 888	226 117	585 281	559 369	2 399 558	199 523
Utilised Agricultural Area	3 838 708	212 639	450 701	129 848	391 754	409 095	2 144 066	100 605
Woodland without intercropping	960 040	104 118	199 031	84 483	169 451	129 508	203 428	70 022
Unutilised agricultural area	90 171	4 410	18 093	5 136	16 372	5 531	13 912	26 716
Other land	98 739	18 754	10 063	6 651	7 704	15 235	38 151	2 180
UAA (ha)	3 838 708	212 639	450 701	129 848	391 754	409 095	2 144 066	100 605
UAA by UAA class								
<5 ha	353 291	63 010	92 818	61 592	46 208	46 683	25 768	17 213
5 to 50 ha	823 120	62 487	253 718	49 925	120 119	106 836	183 631	46 405
> 50 ha	2 662 297	87 142	104 166	18 331	225 427	255 575	1 934 668	36 988
UAA distribution								
Arable land	1 007 264	69 154	88 830	65 213	87 377	169 307	509 271	18 112
Kitchen garden	15 719	2 437	4 957	3 344	2 271	1 211	1 045	455
Permanent crops	855 767	33 133	222 821	36 042	83 834	99 448	323 733	56 754
Permanent pastures	1 959 958	107 915	134 094	25 249	218 272	139 128	1 310 017	25 284
of which Poor pastures:	1 455 897	90 707	84 367	13 731	152 929	98 242	995 047	20 871
TEMPORARY CROPS[1] (ha)								
Total	843 477	100 037	51 070	64 585	73 122	146 221	396 323	12 120
Cereals for the production of grain	234 530	17 439	20 812	26 291	13 195	49 904	104 293	2 596
Pulses for the production of grain	18 666	584	1 329	1 225	1 575	1 291	12 556	106
Temporary meadows	105 802	3 941	2 900	2 803	9 191	7 331	77 978	1 659
Forage crops	406 264	73 342	22 692	28 622	47 943	46 610	180 896	6 158
Potatoes	12 586	1 434	2 355	1 938	745	5 228	803	83
Sugar beet								
Industrial crops	10 507	112	52	77	62	1 524	8 533	148
Vegetable crops	50 509	2 767	867	3 355	308	32 534	9 763	915
Flowers and ornamental plants	1 828	345	23	108	10	502	564	276
Other temporary crops	2 786	73	40	166	94	1 298	937	178
Fallow land (ha)	224 368	5 186	38 925	9 606	18 940	28 193	117 489	6 029
CULTIVATED AREA	2 158 443	116 746	327 409	106 511	219 885	282 660	1 031 530	73 705
PERMANENT CROPS (ha)	855 767	33 133	222 821	36 042	83 834	99 448	323 733	56 754
Fresh fruit (except citrus fruits)	51 292	3 404	10 411	2 675	8 804	17 042	5 213	3 744
Citrus fruits	19 146	820	438	371	386	1 283	1 898	13 951
Sub-tropical fruits	6 145	2 564	55	916	23	295	355	1 937
Nuts	228 487	1 941	71 907	2 949	11 033	24 680	89 797	26 179
Olive groves	377 234	1 085	81 691	15 440	49 373	22 609	197 628	9 409
Vineyards	171 111	23 193	58 218	12 861	14 097	32 933	28 295	1 513
Other permanent crops	2 351	126	100	832	118	606	548	21
PERMANENT GRASSLAND [2] (ha)	2003795	108213	134164	25952	223452	143450	1343020	25545
IRRIGABLE AREA	626 820	91 281	42 658	55 615	55 897	126 084	232 627	22 658
Livestock (Livestock Units)	2 267 450	237 876	94 804	418 735	132 886	658 868	707 171	17 112
By species								
Equines	30 384	5 387	6 430	2 256	3 009	6 782	5 314	1 206
Cattle	906 929	180 991	41 409	50 626	59 965	104 359	462 997	6 583
Sheep	217 175	9 007	23 638	11 831	34 634	20 082	113 957	4 027
Goats	35 946	4 578	4 861	5 568	5 835	5 106	8 562	1 437
Poultry	566 045	25 867	10 049	238 399	20 376	266 078	4 494	782
Pigs	507 671	11 041	7 562	109 258	8 806	256 139	111 799	3 066
Rabbits	3 300	1 005	855	797	261	322	48	11
LABOUR INPUT (AWU)	293 236	56 658	62 774	47 053	27 098	41 752	44 182	13 720
Type of labour								
Agricultural family labour	196 990	45 104	48 235	38 928	21 712	20 030	15 847	7 134
Producer	109 949	23 292	26 734	20 760	12 189	12 153	10 487	4 335
Agricultural non-family labour	96 246	11 554	14 539	8 125	5 386	21 722	28 335	6 586
Permanent	57 110	6 975	5 539	5 493	3 067	14 447	17 833	3 755
Seasonal	28 990	3 942	7 244	2 206	1 924	5 773	6 945	958
AGRICULTURAL POPULATION (No.)	599 497	114 401	143 317	106 829	72 361	76 016	59 051	27 522
FARMERS (No.)								
Men	168 459	24 950	40 517	29 255	21 898	24 188	19 311	8 340
Women	82 156	17 095	22 787	13 420	10 526	7 192	7 346	3 790
Farmer age group								
15-44 years old	24 151	4 754	5 801	3 361	2 493	3 291	3 457	994
45-64 years old	90 767	16 852	23 102	15 829	10 387	11 615	9 511	3 471
> 65 years old	135 697	20 439	34 401	23 485	19 544	16 474	13 689	7 665
Farmer level of education								
None	26 704	5 156	7 170	3 771	4 266	2 260	2 519	1 562
Basic	174 793	29 872	43 356	32 744	21 771	22 806	16 159	8 085
Secondary/Post-secondary	25 017	3 481	6 245	3 528	3 198	3 590	3 671	1 304
Higher	24 101	3 536	6 533	2 632	3 189	2 724	4 308	1 179
Farmer agricultural training								
Practical only	131 980	19 933	34 851	18 439	20 115	13 734	16 371	8 537
Agriculture-related training course	113 974	21 524	27 625	23 813	11 874	16 850	8 853	3 435
Full (secondary or higher agricultural training)	4 661	588	828	423	435	796	1 433	158

(1) Includes successive crops and intercropping with permanent crops

(2) Includes grazing under permanent crops

Source: 2019AC

The Agroforestry Complex in the Portuguese Economy – 2020*

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1. Background

This analysis addresses the economic evolution of the agroforestry complex, which comprises the components of agrifood[1] and forestry[2], with particular mention for the agricultural sector.

In methodological terms, the production of public goods is not booked under sectoral added value and attention should be drawn to the difficulties in delimiting agriculture, manufacturing and services. It should be highlighted that the impact of growth in "Other Goods and Services" in agricultural intermediate consumption heavily affected the production trajectory, a fact that should be regarded with caution when analysing the data for Gross Value Added (GVA).

The analysis is based on the statistics contained in the National Accounts (NA) and Economic Accounts for Agriculture (EAA) (base 2016) from the Portuguese national statistics office (INE – Statistics Portugal), updated on February 2021 in accordance with the methodology used by the Office of Planning, Policies and General Administration (GPP).

2. Summary

- Gross Value Added (GVA) for the agroforestry complex in the 2010–2020 period was moderately positive (0.2% per year in volume) due to growth in the agrifood complex, which was up by an annual average of 0.5%, although the forestry complex registered a decline (-0.5% per year).

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* Editor's note: Earlier articles on this topic or related topics were published in CULTIVAR issue 1 – Volatility in agricultural markets, June 2015, p.63, "A evolução da economia agrícola portuguesa", https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_1/E_book/CULTIVAR_1_Volatilidade_dos_Mercados_Agricolas/64/ CULTIVAR issue 4 – Technology, June 2016, p.91, "O setor agroalimentar na economia portuguesa", https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_4/E_book/CULTIVAR_4_Tecnologia/92/ and CULTIVAR issue 7 – Risk in economic activity, March 2017, p.89, "Evolução económica do setor agroalimentar" https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_7/E-book/CULTIVAR_7_O_Risco_na_atividade_economica/88/

1 The agrifood complex includes the following sectors in the National Accounts (Base 2016): Agriculture: sector 01 (Agriculture, animal rearing, hunting and activities in related services) and Food, beverages and tobacco manufacturing: sector 10 (Food manufacturers), sector 11 (Beverage manufacturers) and sector 12 (Tobacco manufacturers).

2 The forestry complex includes the following sectors in the National Accounts (Base 2016): Agriculture: sector 02 (Products of forestry, logging and related services) and Forest-based industries: sector 16 (Wood and products of wood and cork, except furniture, articles of straw and plaiting materials), sector 17 (Paper and paper products) and sector 18 (Printed and recorded matter).

- 2020 was a particularly bad year for the economy as a whole (GDPmp was down 7.6% in volume and 5.3% in value) due to the COVID-19 pandemic. GVA for the agroforestry sector declined (-7.4% in volume and -6.6% in value), with both agrifood and forestry down. Analysis of GVA variation must take into account the fact that these are estimates, so caution should be urged, taking into account the adopted methodology (see methodological note at the end).
- As far as international agroforestry trade in 2010–2020 is concerned, exports grew more rapidly than imports (3.6% per year as opposed to 2% per year) with a positive effect on the trade deficit, growing at a faster rate than the economy as a whole.
- In 2020, at the height of the pandemic, international agroforestry trade fell, though less significantly than the economy as a whole, with growth in agricultural and agro-industrial exports.
- Specifically, GVA growth in volume in the agricultural sector was interrupted in 2020 (-10.4%) due above all to unfavourable weather conditions in the fruit sector, as well as the occurrence of frost and hail, attacks of mildew and heatwaves in the wine sector.
- Farm labour productivity rose above all due to a pronounced dip in work volume (-3.3% per year).
- Specifically in 2020, the indicator fell 5.1% due to a large drop in GVAmp in volume (-10.4%) mitigated by a decline in the volume of farm work (-5.6%).
- Farm income, which relates GVAfc, deflated by GDP, to the volume of work, has grown since 2010 (3% per year). This has been positively impacted by the growth in GVAmp (0.8% per year) in value, higher subsidies less taxes (1% per year) and lower Annual Work Units (AWUs) (-3.3% per year).
- In particular, 2020 saw a decline in farm income (-3.2%) which was due to a combination of a large downturn in agricultural product (GVAmp in value: -10,1%), though mitigated by higher subsidies less taxes (7.8%), a pronounced decline in work volume (-5.6%) and higher GDP implicit prices (2.5%).
- Between 2010 and 2019, agricultural investment grew in volume contrary to the economy as a whole (1.7% compared to -0.4% per year), which has not yet recovered to its pre-pandemic trajectory.

3. Statistical analysis

A) Evolution of the Agroforestry Complex

The agroforestry complex, which includes an agrifood component (agriculture and food, beverages and tobacco manufacturers) and a forestry

Table 1 – Importance of the Agroforestry Complex in GDP, Employment, Exports and Imports of the Economy in 2020* (%)

	GVA		Employment*		Exports		Imports	
	million EUR	%	thousand people	%	million EUR	%	million EUR	%
Agriculture	2 720	1,5	390,2	7,9	1 411,3	1,9	3 138	4,0
Food, Beverages and Tobacco	4 169	2,4	115,4	2,3	5 508,3	7,4	6 916	8,8
Forestry	838	0,5	15,3	0,3	63,9	0,1	277	0,4
Forest Industries	2 335	1,3	60,0	1,2	3 847,8	5,2	1 899	2,4
Agrifood Complex	6 889	3,9	506	10,3	6 920	9,3	10 053	12,8
Forestry Complex	3 172	1,8	75	1,5	3 912	5,3	2 176	2,8
Agroforestry Complex	10 062	5,7	581	11,8	10 831	14,6	12 230	15,6

* Employment figures are for 2018.

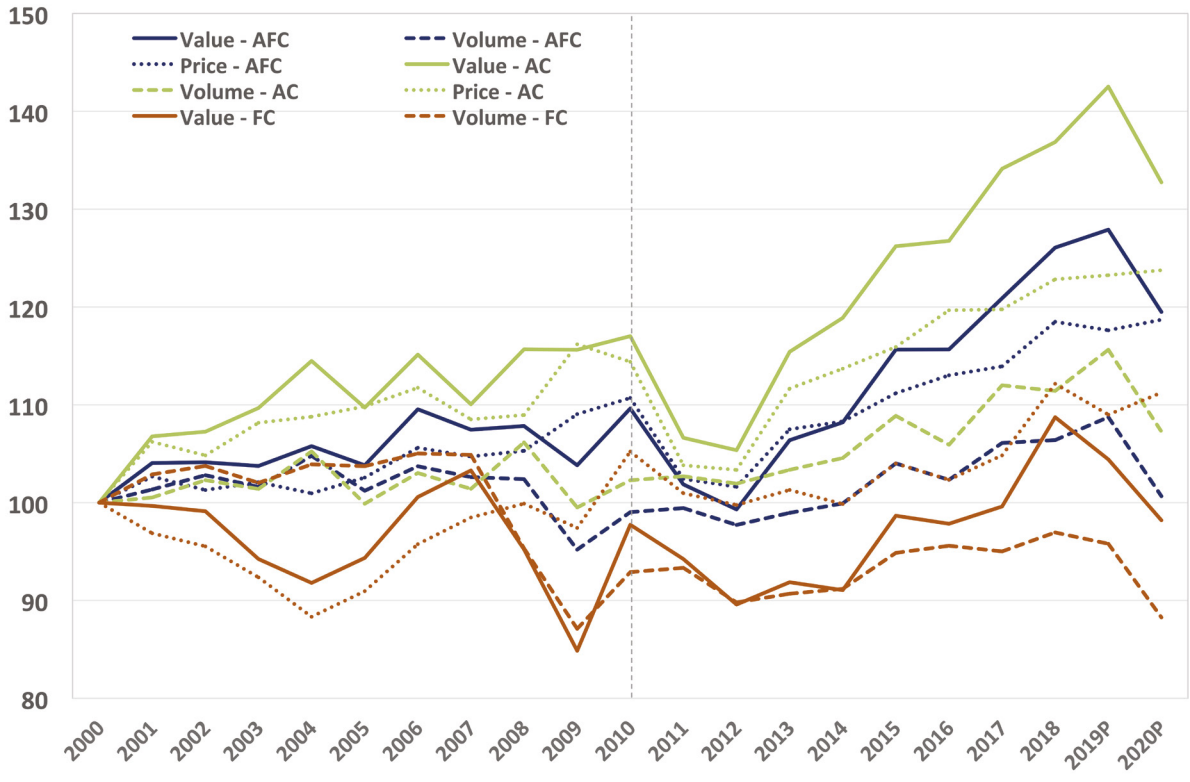
Source: GPP, from the NA, INE (Base 2016)
Data last updated: 26 February 2021

component (forestry and forestry industries), is important to the national economy as an indigenous resource and producer of tradeable goods accounting for 5.7% of national value added (around EUR 10b at current prices), 11.8% of employment (approx. 581,000 people), 15.6% of imports and 14.6% of exports (the highest figure since 2000) of goods and services. In 2010–2020, the GVA of the agroforestry complex, in volume, grew by an annual average of 0.2% due to growth in the agrifood component (0.5% per year), although the forestry component declined (-0.5% per year). It should be noted that agroforestry GVA growth in value (0.9% per year), with successive growth from 2012 interrupted in 2020, is due above all to a variation in implicit prices (0.7% per year) and, to a lesser degree, to a variation in GVA in volume (0.2% per year).

Specifically in 2020, the agroforestry complex slowed significantly (-7.4%), in line with the rest of the economy (-7.6%), with negative performance in both components (-7.2% in the agrifood complex and -7.9% in the forestry complex).

Like other sectors of the economy, agriculture was negatively affected by the COVID-19 pandemic, particularly those crops most impacted by transportation and storage, as well as more perishable goods like horticultural products. In animal rearing, changes to Portuguese consumption habits during the lockdown influenced demand for these products.

Chart 1 – GVA of the agroforestry complex and respective components in value, volume and price (2000=100)



P – Provisional data

Source: GPP, from the NA (Base 2016), INE
Data last updated: 26 February 2021

Table 2 – GVA of the agroforestry complex and the economy (million EUR)

	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019P	2020P	Average annual growth rate (%)		Rate of change (%)
														2000-2020P	2010-2020P	2019P -2020P
GVA Agroforestry																
current prices	8 420	8 742	9 231	8 578	8 362	8 958	9 112	9 738	9 739	10 179	10 615	10 770	10 062	0,9	0,9	-6,6
constant prices 2016	9 517	9 633	9 425	9 465	9 301	9 418	9 509	9 899	9 739	10 098	10 126	10 349	9 581	0,0	0,2	-7,4
Implicit Price Index (IPI)	88	91	98	91	90	95	96	98	100	101	105	104	105	0,9	0,7	0,9
GVA Agrifood																
current prices	5 190	5 694	6 073	5 534	5 468	5 990	6 170	6 550	6 578	6 961	7 103	7 397	6 889	1,4	1,3	-6,9
constant prices 2016	6 211	6 204	6 353	6 379	6 331	6 419	6 494	6 762	6 578	6 956	6 920	7 182	6 662	0,4	0,5	-7,2
IPI	84	92	96	87	86	93	95	97	100	100	103	103	103	1,1	0,8	0,4
GVA Agriculture																
current prices	2 723	2 512	2 506	2 116	2 114	2 480	2 426	2 696	2 495	2 823	2 840	3 025	2 720	0,0	0,8	-10,1
constant prices 2016	2 847	2 666	2 641	2 529	2 475	2 553	2 559	2 801	2 495	2 804	2 684	2 900	2 599	-0,5	-0,2	-10,4
IPI	96	94	95	84	85	97	95	96	100	101	106	104	105	0,5	1,0	0,3
GVA FBT																
current prices	2 466	3 182	3 568	3 418	3 354	3 509	3 744	3 854	4 083	4 138	4 263	4 372	4 169	2,7	1,6	-4,6
constant prices 2016	3 363	3 538	3 712	3 850	3 856	3 867	3 935	3 961	4 083	4 152	4 236	4 282	4 063	0,9	0,9	-5,1
IPI	73	90	96	89	87	91	95	97	100	100	101	102	103	1,7	0,7	0,5
GVA Forestry Complex																
current prices	3 230	3 048	3 158	3 044	2 894	2 968	2 942	3 187	3 161	3 218	3 513	3 373	3 172	-0,1	0,0	-6,0
constant prices 2016	3 306	3 430	3 072	3 086	2 969	2 999	3 015	3 137	3 161	3 142	3 206	3 168	2 919	-0,6	-0,5	-7,9
IPI	98	89	103	99	97	99	98	102	100	102	110	106	109	0,5	0,6	2,1
GVA Forestry																
current prices	676	695	700	771	792	861	867	914	907	896	912	953	838	1,1	1,8	-12,1
constant prices 2016	739	774	764	821	844	883	868	909	907	889	851	912	819	0,5	0,7	-10,2
IPI	92	90	92	94	94	97	100	101	100	101	107	104	102	0,6	1,1	-2,1
GVA Forestry Industry																
current prices	2 554	2 353	2 458	2 273	2 102	2 107	2 075	2 273	2 254	2 322	2 600	2 420	2 335	-0,4	-0,5	-3,5
constant prices 2016	2 568	2 656	2 308	2 266	2 125	2 116	2 147	2 227	2 254	2 253	2 354	2 256	2 100	-1,0	-0,9	-6,9
IPI	99	89	106	100	99	100	97	102	100	103	110	107	111	0,6	0,4	3,6
GDPmp																
current prices	128 414	158 553	179 611	176 096	168 296	170 492	173 054	179 713	186 490	195 947	205 184	213 949	202 709	2,3	1,2	-5,3
constant prices 2016	177 302	185 111	190 667	187 432	179 828	178 169	179 580	182 798	186 490	193 029	198 529	203 470	188 032	0,3	-0,1	-7,6
IPI GDPmp	72	86	94	94	94	96	96	98	100	102	103	105	108	2,0	1,4	2,5

P – Provisional data

Source: GPP, from the NA, INE

Data last updated: 26 February 2021

In terms of employment, measured in number of people, the agroforestry complex continued the downward trend of the last decade (-2.4% per year), while the economy has remained relatively stable (0.1% per year). Last year (2018), there was a relative pick-up in employment, even though it fell in the agroforestry complex (-1.3%) due to the agrifood component (-1.8%), but rose 2.1% in the forestry complex, on a par with the economy as a whole (2.3%).

Table 3 – Employment in the agroforestry complex and the economy (thousands of people

Employment	2000	2005	2010	2015	2016	2017	2018	Average annual growth rate (%)		Rate of change (%)
								2000-2018	2010-2018	2017-2018
Agroforestry	842	784	708	609	593	588	581	-2,0	-2,4	-1,3
Agrifood	730	685	628	536	520	515	506	-2,0	-2,7	-1,8
Forestry	112	100	80	73	73	74	75	-2,2	-0,7	2,1
Economy	5 042	5 041	4 871	4 576	4 650	4 803	4 914	-0,1	0,1	2,3

Source: GPP, from the NA, INE

Data last updated: 26 February 2021

Table 4 – Exports, imports and trade balance in the agroforestry complex and the economy (million EUR)

	2000	2011	2012	2013	2014	2015	2016	2017	2018	2019P	2020P	Average annual growth rate (%)		
												2000-2020P	2010-2020P	2019P-2020P
Agroforestry Complex														
Exports	4 690	8 268	8 638	9 241	9 623	9 963	10 129	10 407	10 965	11 103	10 831	4,3	3,6	-2,4
Imports	7 158	10 783	10 328	10 720	10 637	11 087	11 497	12 167	12 802	12 994	12 230	2,7	2,0	-5,9
Trade balance	-2 468	-2 515	-1 690	-1 479	-1 015	-1 124	-1 368	-1 761	-1 837	-1 891	-1 398			
Agrifood Complex														
Exports	1 968	4 757	5 056	5 488	5 840	5 996	6 160	6 331	6 624	6 758	6 920	6,5	4,9	2,4
Imports	5 438	8 830	8 568	8 871	8 667	9 058	9 387	9 925	10 389	10 555	10 053	3,1	2,2	-4,8
Trade balance	-3 469	-4 073	-3 512	-3 383	-2 826	-3 062	-3 226	-3 594	-3 765	-3 797	-3 134			
Agriculture														
Exports	207	680	753	744	873	973	1 028	1 146	1 253	1 338	1 411	10,1	7,7	5,5
Imports	1 793	2 752	2 686	2 740	2 568	2 731	2 828	2 967	3 149	3 096	3 138	2,8	2,3	1,4
Trade balance	-1 586	-2 072	-1 933	-1 996	-1 694	-1 759	-1 800	-1 820	-1 897	-1 758	-1 726			
FBT														
Exports	1 761	4 077	4 303	4 744	4 967	5 023	5 132	5 184	5 371	5 420	5 508	5,9	4,3	1,6
Imports	3 645	6 078	5 881	6 131	6 099	6 327	6 558	6 958	7 239	7 459	6 916	3,3	2,1	-7,3
Trade balance	-1 884	-2 001	-1 579	-1 387	-1 132	-1 304	-1 426	-1 774	-1 868	-2 039	-1 408			
Forestry														
Exports	67	121	106	122	97	48	52	56	62	72	64	-0,3	-4,7	-10,7
Imports	271	216	208	264	267	253	267	272	284	281	277	0,1	3,9	-1,7
Trade balance	-204	-94	-102	-141	-170	-206	-215	-215	-222	-210	-213			
Forestry Industry														
Exports	2 654	3 390	3 476	3 631	3 686	3 920	3 916	4 020	4 279	4 273	3 848	1,9	1,9	-10,0
Imports	1 449	1 737	1 553	1 585	1 704	1 776	1 843	1 971	2 129	2 157	1 899	1,4	0,9	-11,9
Trade balance	1 205	1 653	1 923	2 045	1 982	2 144	2 073	2 049	2 150	2 116	1 948			
Forestry Complex														
Exports	2 722	3 511	3 582	3 753	3 782	3 968	3 969	4 076	4 342	4 345	3 912	1,8	1,7	-10,0
Imports	1 720	1 953	1 761	1 849	1 970	2 029	2 110	2 243	2 413	2 439	2 176	1,2	1,2	-10,8
Trade balance	1 001	1 558	1 822	1 904	1 812	1 939	1 858	1 833	1 928	1 906	1 736			
Economy bens e serviços														
Exports	36 219	60 674	63 579	67 526	69 595	72 991	74 989	83 717	89 144	93 163	74 302	3,7	3,2	-20,2
Imports	50 401	68 052	64 411	65 653	69 336	71 662	72 849	81 739	88 194	92 349	78 313	2,2	1,5	-15,2
Trade balance	-14 182	-7 378	-833	1 873	259	1 329	2 140	1 978	949	814	-4 010			
Share of the Agroforestry Complex in the international trade of goods and services (%)														
Exports	12,9	13,6	13,6	13,7	13,8	13,7	13,5	12,4	12,3	11,9	14,6			
Imports	14,2	15,8	16,0	16,3	15,3	15,5	15,8	14,9	14,5	14,1	15,6			

P = Provisional data

Source: GPP, from the NA and Economic Accounts for Agriculture (EAA) (Base 2016), INE
Data last updated: 28 February 2020

In terms of the international agroforestry trade, exports of goods and services grew at a faster rate (3.6% per year) than imports (2% per year) in 2010–2020, with a positive effect on the agroforestry trade balance and, consequently, the economy.

It should be noted that from 2014, with the economic recovery and consequent pick-up in income, there was a reversal of the trend in export and import variables for goods and services, namely higher growth in exports than imports across the economy as a whole, particularly in the agroforestry sector, with impacts on the trade balances. However, in 2020, at the height of the Covid-19 pandemic, agroforestry imports fell 5.9% (due above all to a downturn in imports of fish and meat)[3] and exports fell 2.4% (due to a downturn in exports of paper and paperboard and fish).[4] Even so, these figures are lower than for the economy as a whole, which saw imports of goods and services decline heavily (-15.2%) and

[3] Fish and meat exports contributed, respectively, by -2.64 p.p. and -1.49 p.p. to the variation in agroforestry imports in 2020 (Source: GPP, from international trade statistics, INE).

[4] Paper and paperboard and fish exports contributed, respectively, by -2.29 p.p. and -1.65 p.p. to the variation in agroforestry exports in 2020 (Source: GPP, from international trade statistics, INE).

exports even more so, especially in the tourism sector, with the trade balance registering a deficit (-€4b) after consecutive surpluses from 2013.

In 2020, the agroforestry complex, which includes agriculture and agrifood manufacturers, saw export growth (2.4%), contrary to the economy as a whole, and a drop in imports (-4.8%), with an improvement in the corresponding trade balance. International trade in the forestry complex dropped significantly (-10% in exports of goods and services and -10.8% in imports) to a level close to the economy as a whole, although it maintained a positive trade balance.

In terms of the export/import ratio, the percentage of foreign purchases offset by sales abroad in the agroforestry complex was positive, rising from 65.5% in 2000 to 88.6% in 2020.

B) Agricultural Economy

In the period from 2010 to 2020, GVA in the agricultural sector grew by an annual average of 0.8% in value, falling slightly in volume (-0.2% per year). Notably, the change in GVA in volume was due above all to higher growth in intermediate consumption (1.9% per year) than in agricultural output (1.1% per year). On implicit prices, there was higher growth in production (0.8% per year) than in intermediate consumption (0.6% per year). In particular, 2020 was marked by a downturn in agricultural GVA, with a steep drop in value (-10.1%) and in volume

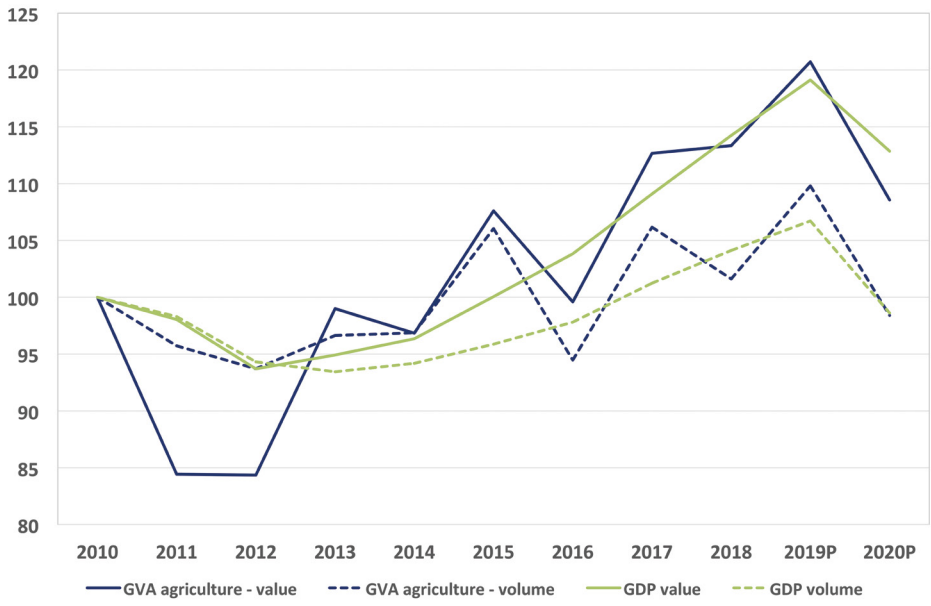
Table 5 – Average annual variation in production, intermediate consumptionGVA and GDP of agriculture(%)

	2010/2020P			2019P/2020P		
	Volume	Price	Value	Volume	Price	Value
Agricultural production$_{mp}$	1,1	0,8	1,9	-4,0	0,5	-3,5
Intermediate consumption	1,9	0,6	2,5	-0,1	0,6	0,5
Agricultural GVA$_{mp}$	-0,2	1,0	0,8	-10,4	0,3	-10,1
GDP$_{mp}$	-0,1	1,4	1,2	-7,6	2,5	-5,3

P = Provisional data

Source: GPP, from the NA and EAA (Base 2016), INE
Data last updated: 28 February 2020

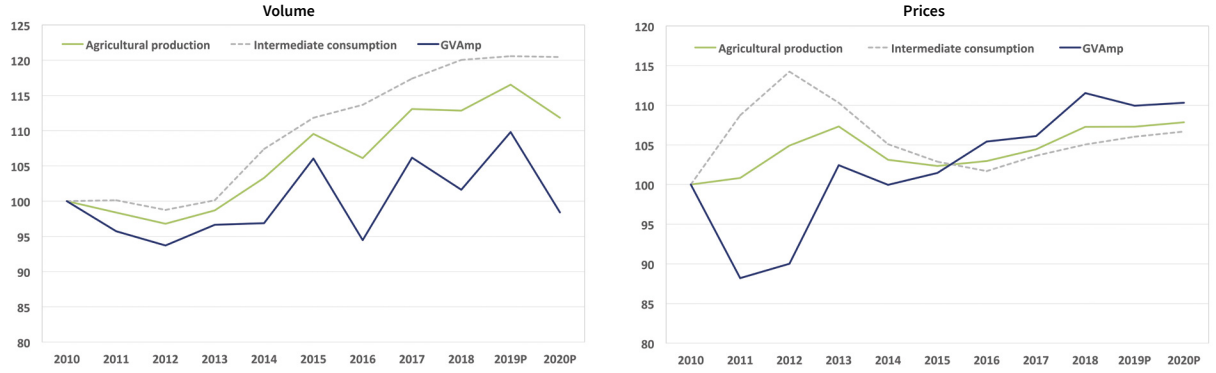
Chart 2 – agricultural GVA and GDP in volume and value (2000=100)



P = Provisional data
Source: GPP, from the NA and EAA (Base 2016), INE
Data last updated: 28 February 2020

(-10.4%), that was more pronounced than the drop in GDP (-5.3% in value and -7.6% in volume). The drop in value stemmed essentially from the drop in volume in agricultural output (-4%), above all due

Chart 3 – Production, intermediate consumption and GVA of agriculture, in volume and prices (2010=100)



P = Provisional data
Source: GPP, from the NA and EAA (Base 2016), INE
Data last updated: 28 February 2020

Table 6 – Annual rate of change in some indicators of agricultural activity (%)

	2001	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019P	2020P	Average annual growth rate (%)	
														2000/2020P	2010/2020P
Productionpm															
current prices	6,9	-6,8	4,1	-0,8	2,4	4,3	0,6	5,2	-2,5	8,1	2,5	3,3	-3,5	1,4	1,9
constant prices 2016	3,8	-7,2	0,6	-1,6	-1,6	2,0	4,7	6,0	-3,1	6,6	-0,2	3,3	-4,0	0,6	1,1
Implicit Price Index (IPI)	2,9	0,4	3,5	0,8	4,1	2,3	-3,9	-0,8	0,6	1,4	2,7	0,0	0,5	0,8	0,8
Intermediate consumption															
current prices	9,4	-2,6	5,5	8,9	3,6	-2,1	2,2	1,9	0,5	5,2	3,7	1,4	0,5	2,4	2,5
constant prices 2016	6,2	-2,2	1,7	0,1	-1,4	1,4	7,3	4,1	1,6	3,3	2,3	0,4	-0,1	1,2	1,9
IPI	3,0	-0,5	3,8	8,7	5,1	-3,4	-4,7	-2,1	-1,2	1,9	1,4	0,9	0,6	1,1	0,6
GVA_{pm}															
current prices	4,0	-11,8	2,0	-15,6	-0,1	17,4	-2,2	11,1	-7,4	13,1	0,6	6,5	-10,1	0,0	0,8
constant prices 2016	1,2	-13,2	-1,1	-4,3	-2,1	3,1	0,2	9,5	-10,9	12,4	-4,3	8,1	-10,4	-0,5	-0,2
IPI	2,8	1,6	3,1	-11,8	2,1	13,8	-2,4	1,5	3,9	0,7	5,1	-1,4	0,3	0,5	1,0
GDP_{mp}															
current prices	5,7	4,1	2,4	-2,0	-4,4	1,3	1,5	3,8	3,8	5,1	4,7	4,3	-5,3	2,3	1,2
constant prices 2016	1,9	0,8	1,7	-1,7	-4,1	-0,9	0,8	1,8	2,0	3,5	2,8	2,5	-7,6	0,3	-0,1
IPI	3,7	3,3	0,6	-0,3	-0,4	2,2	0,7	2,0	1,7	1,5	1,8	1,7	2,5	2,0	1,4
Subsidies less taxes	20,3	5,7	22,0	-8,5	13,7	-11,7	-3,5	-8,4	53,5	-22,7	4,1	1,9	7,8	2,5	1,0
GVAfc (current prices)	7,1	-7,5	6,7	-13,6	3,9	8,2	-2,5	6,1	6,0	1,7	1,5	5,4	-5,8	0,6	0,9
Employment (AWU)	0,4	-2,6	-8,4	-3,3	-1,0	-5,0	-5,8	-2,6	-2,8	-4,4	-0,6	-1,7	-5,6	-3,2	-3,3
"Productivity															
GVAmp volume /AWU"	0,8	-10,8	8,0	-1,0	-1,1	8,5	6,4	12,4	-8,3	17,6	-3,7	10,0	-5,1	2,9	3,2
Income															
Real NVAfc[1]/AWU	4,1	-10,3	16,6	-14,0	7,5	14,6	1,2	8,6	8,0	4,2	0,0	5,9	-3,2	1,7	3,0
Investment Effort[2]															
current prices	3,5	-5,1	0,1	15,3	-8,8	-5,1	10,6	4,4	-8,0	8,6	-1,0	-1,9			
constant prices	9,1	-1,5	5,5	2,0	-2,8	-0,9	5,0	2,3	9,6	-4,5	4,8	-6,0			

[1] Deflated by IPI GDPmp; [2] GFCF/GVAfc
P = Provisional data

Source: GPP, from the EAA (Base 2016), INE
Data last updated: 26 February 2021

Table 7 – Investment in agriculture and the economy as a whole

	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019P	Average annual growth rate (%)		Rate of change (%)
													2000-2019P	2010-2019P	2018-2019P
GFCF Agriculture (million EUR)															
current prices	810	825	837	834	790	811	874	968	945	1 043	1 048	1 084	1,5	2,9	3,4
constant prices 2016	1 005	918	861	842	801	817	863	964	945	1 014	1 018	1 035	0,2	2,1	1,7
GFCF Economy (million EUR)															
current prices	35 960	36 668	36 953	32 437	26 631	25 150	26 013	27 886	28 893	32 888	35 953	38 839	0,4	0,6	8,0
constant prices 2016	44 057	39 953	37 526	32 801	27 319	26 006	26 601	28 176	28 893	32 213	34 204	36 044	-1,1	-0,4	5,4

P = Provisional data

Source: GPP, from the NA and EAA (base 2016), INE
Data last updated: 26 February 2021

to a decline in the production of fruit (-11.1%), vegetables and horticultural products (-7,9%), and wine (-5%), sectors comprising 46% of agricultural output.

Agricultural labour productivity has tended to grow since 2010 (3.2% per year), with agricultural GVA in volume declining at an average annual rate of -0.2% and input of labour falling 3.3% per year. In 2020, there was a drop in productivity (-5.1%), to which contributed a fall in GVAmp in volume (-10.4%) and agricultural labour input of -5.6%, less than the average for the decade (-3.3% per year), with paid labour, which had not fallen since 2011, down 9.3% and non-paid labour 3.5%.

In terms of farm income, measured as the ratio of real factor income (real NVAfc) to agricultural labour input, there has been a 3% annual growth since 2010 due to the combination of higher labour productivity (up 3.2% per year) and subsidies less taxes (up 1% per year). In 2020, income fell (-3.2%) after consecutive years of rises due to declining agricultural production (-10.4%) since subsidies less taxes grew significantly (7.8%) – both subsidies less taxes on production (6.4%) and on products (14.5%) – mitigating the impact of GVA on income.

In 2010–2019, agricultural investment grew 2.1% per year in volume as opposed to the economy as a whole, which fell 0.4% per year. In 2019, agricultural investment grew 1.7%, lower than the figure for the economy as a whole (5.4%), maintaining the growth trend seen since 2013. Attention should be drawn to the fact that in recent years purchases of fixed capital goods in farming have been replaced by the hiring of equipment and facilities, which is one of the reasons behind the large growth in purchases of other goods and services.

In the 2010–2020 period,[5] agricultural output measured at basic prices grew in volume (1.9% per year) and, more noticeably, in value (2.9% per year) due to price evolution (1% per year). Decisive to this rise in volume, on the crop production side, was growth in fruit production (up 5% per year), the largest component of agricultural production (20.5%), in vegetables and horticultural products (up 1% per year) and in wine (up 1.4% per year), while on the animal production side, it was pig production (up 2.5% per year) and poultry (up 2.3% per year).

It should also be noted that the production of fodder plants (-0.9% per year) and cattle (-2.6% per year) made a negative contribution to agricultural production in volume. Also notable was the growth in cereals in volume (3.6% per year) due above all to higher maize production (1.3% per year). Albeit less important to the structure of production, the increased output in value of olive oil (2.2% per year), industrial crops (4.6% per year), other plant products (5.1% per year), sheep and goat rearing (2.3% per year), and other animal products (2.3% per year), which have gained greater weight in Portuguese agricultural output, also stands out.

[5] Three-year averages were used to analyse this evolution.

Table 8 – Structure of agricultural output at basic prices and respective changes (%)

	Production structure (%)			Average annual growth rate - average 1999/01 and average 2018/20P (%)			Average annual growth rate - average 2009/11 and average 2018/20P (%)			Rate of change 2019P-2020P (%)		
	average 2009/10/11	average 2018/19/20	Change p.p.	Volume	Price	Value	Volume	Price	Value	Volume	Price	Value
Production of the Agricultural Industry (basic prices)	100,0	100,0		0,6	0,7	1,3	1,9	1,0	2,9	-3,9	0,8	-3,2
Production of agriculture (basic prices)	97,5	97,2	-0,3	0,6	0,7	1,3	1,8	1,0	2,9	-3,9	0,8	-3,1
Production of agricultural goods	95,2	94,7	-0,4	0,6	0,6	1,2	1,8	1,0	2,9	-4,0	0,7	-3,4
Crop Output	**54,9**	**57,8**	**2,9**	**0,9**	**0,3**	**1,2**	**2,7**	**1,0**	**3,7**	**-6,9**	**2,3**	**-4,8**
Cereals (including seeds)	4,0	3,0	-1,0	2,3	-5,7	-3,5	3,6	-4,5	-1,1	-6,2	3,5	-2,9
Industrial crops[1]	0,5	0,9	0,4	-5,3	3,0	-2,5	4,6	6,4	11,4	-1,0	10,0	8,9
Forage Crops	4,3	3,2	-1,0	-2,5	1,4	-1,1	-0,9	-0,2	-1,1	10,2	-0,3	9,9
Plants and Vegetable Products	16,5	15,5	-1,0	1,1	1,2	2,4	1,0	1,0	2,0	-7,9	-0,4	-8,3
Potatoes (including seeds)	1,6	1,6	0,0	-1,4	2,0	0,6	0,7	2,1	2,9	-0,2	-20,9	-21,0
Fruit	15,7	20,5	4,8	2,6	0,7	3,3	5,0	1,9	6,9	-11,1	7,6	-4,3
Wine	10,7	10,8	0,1	-1,2	0,5	-0,7	1,4	1,7	3,1	-5,0	0,7	-4,3
Olive oil	0,9	1,3	0,4	4,1	2,9	6,9	2,2	5,8	8,1	-6,0	14,4	7,5
Other crops[2]	0,7	0,9	0,2	0,4	6,4	6,8	5,1	0,8	5,8	0,0	-12,9	-12,9
Animal Output	**40,3**	**37,0**	**-3,3**	**0,1**	**1,1**	**1,3**	**0,6**	**1,1**	**1,7**	**0,6**	**-1,8**	**-1,1**
Cattle	8,9	7,9	-1,0	-2,0	4,1	1,9	-2,6	3,8	1,2	6,6	-3,1	3,3
Pigs	7,8	7,7	-0,1	1,8	-0,3	1,5	2,5	0,2	2,7	-2,2	-1,2	-3,3
Sheep and goats	1,8	1,8	0,0	-0,8	0,0	-0,9	2,3	0,7	2,9	-10,0	4,5	-5,9
Poultry	7,3	6,4	-0,9	1,7	0,3	2,0	2,3	-1,1	1,1	-1,2	-2,5	-3,7
Milk	10,4	9,0	-1,5	-0,4	0,6	0,3	0,0	0,7	0,7	1,5	-0,5	1,0
Other livestock production[3]	4,0	4,1	0,1	2,8	-0,4	2,4	2,3	1,0	3,3	1,6	-5,2	-3,7
Agricultural Services	**2,3**	**2,5**	**0,2**	**2,4**	**2,2**	**4,7**	**2,8**	**1,2**	**4,1**	**0,0**	**5,8**	**5,9**
Secondary Non-Agricultural Activities (non-separable)	**2,5**	**2,8**	**0,3**	**-0,6**	**0,9**	**0,3**	**4,1**	**0,2**	**4,3**	**-3,6**	**0,0**	**-3,6**

[1] The "industrial crops" component includes "Oil seeds and oleaginous fruits" (e.g. rapeseed, sunflower and soya), "Protein crops (including seeds)", "Unprocessed tobacco", "Sugar beet" and "Other industrial crops" (e.g. fibre plants and hops);

[2] The "other plant products" component includes "Materials for plaiting", "Seeds", "Sweet potatoes", "Aromatic plants" and "Other plant products: other";

[3] The "other animal products" component includes "eggs", "honey", "snails", "other animal products" (e.g. raw wool, silkworm cocoons), "other animals" (e.g. equidae)

Note: Figures n this table refer to agricultural output at basic prices, which includes product subsidies, and therefore does not coincide with tables 1 and 2 with agricultural output at market prices, which does not include the aforementioned subsidies.

Source: GPP, from the EAA (Base 2016), INE

Data last updated: 26 February 2021

In particular in 2020, agricultural output at basic prices fell 3.2% in value due above all to a fall in volume (down 3.9%). The following is of note:

- Crop output saw a drop in value (-4.8%) due to lower output in volume (-6.9%), namely of fruits[6] (-11.1%), vegetables and horticultural products[7]

[6] On the fruit production side, there was a large decline in volume (-11.1%) with negative contributions by fresh fruit (-16.2%), grapes (-5%), which suffered a regionally uniform decline, and olives (-5.3%), in a year of poor harvests and problems of setting. This drop in fresh fruit output was contributed to by lower production of apples (-25%), after a very good campaign in 2019, and pears (-35%), whose harvest was the lowest of the last decade, affected namely by poor weather conditions. Also of note, on the nuts side, was the fall in almond production, with lower non-irrigated almond tree yield in the northern inland region, and the maintenance of chestnut production. The implicit prices of fruit rose (5.3%), with higher cherry, almond and citrus prices, mitigating the drop in value (-4.3%).

[7] Vegetables and horticultural products, which account for 15.5% of farm output, fell in volume (-7.9%), reflecting a decline in fresh horticultural produce (-14.8%), namely tomatoes for processing (-15.0%), with the fall in the installed area, as well as average yield (note that the 2019 tomato harvest for processing had the highest unit income since regular records exist). Flower production grew in volume (0.5%), despite being one of the sectors most affected by Covid-19, with a drop in demand and closing of markets.

Table 9 – Structure of intermediate consumption and respective changes (%)

	Structure of Intermediate consumption (%)			Average annual growth rate - average 1999/01 and average 2018/20P (%)			Average annual growth rate - average 2009/11 and average 2018/20P (%)			Rate of change 2019P-2020P (%)		
	average 2009/2011	average 2018/2020P	Change (p.p.)	Volume	Price	Value	Volume	Price	Value	Volume	Price	Value
Total	**100,0**	**100,0**		**1,2**	**1,2**	**2,5**	**2,8**	**0,6**	**3,4**	**-0,1**	**0,6**	**0,5**
Seeds and plants	3,5	3,4	-0,1	-0,1	0,5	0,3	2,0	1,0	3,0	0,0	0,4	0,4
Energy and lubricants	7,6	7,3	-0,3	1,3	3,4	4,8	0,5	2,3	2,8	1,0	-7,1	-6,1
Fertilisers and soil conditioners	4,8	4,3	-0,5	-0,7	3,0	2,4	1,4	0,4	1,8	7,6	-3,9	3,4
Plant protection products	3,1	3,3	0,2	1,1	2,3	3,5	0,9	3,1	4,1	7,6	2,9	10,7
Veterinary expenses	0,6	0,7	0,2	3,2	1,6	4,9	7,0	0,3	7,3	0,5	1,7	2,2
Animal feed	48,9	43,4	-5,6	0,3	1,4	1,7	1,3	0,2	1,6	0,5	1,5	2,0
Maintenance and repair of equipment and tools	2,7	4,3	1,6	3,0	1,4	4,4	11,6	-1,0	10,4	1,6	0,9	2,5
Maintenance and repair of farm buildings and other structures	3,2	3,5	0,2	3,6	0,1	3,8	6,8	-2,3	4,3	0,0	2,1	2,1
Agricultural Services	3,7	4,4	0,7	4,5	1,7	6,2	5,5	0,5	6,0	0,0	5,8	5,9
Financial intermediation services indirectly measured (FISIM)	1,7	1,4	-0,3	0,2	1,4	1,6	-2,4	2,5	0,1	-5,2	6,5	1,0
Other goods and services	20,2	24,0	3,9	3,2	-0,4	2,8	5,4	0,6	6,0	-4,0	0,5	-3,5

P = Provisional values

Source: GPP, from the EAA (Base 2016), INE
Data last updated: 28 February 2020

(-7.9%) and wine[8] (-5%), given that prices rose 2.3%, particularly for fruits (7.6%).

- Animal output in particular fell in value (-1.1%) as a result of lower prices (-1.8%), namely implicit prices for cattle (-3.1%), pig (-1.2%) and poultry (-2.5%) production, while volume was slightly up (0.6%). The latter rise was due to higher cattle (6.6%) and milk (1.5%) output which offset the decline in pig (-2.2%), poultry (-1.2%) and sheep and goat (-10%) output. The COVID-19 pandemic negatively affected animal output, given the decreasing restaurant demand. However, this effect was somewhat mitigated by increasing exports of live animals.

The structure of intermediate consumption is characterised by the predominance of the components of animal feed (43.4%), other goods and services (24%), and energy and lubricants (7.3%). In the last decade, animal feed has lost ground (-5.6 p.p.) to other goods and services (+3.9 p.p.) and the maintenance and repair of materials and tools (+1.6 p.p.).

In 2010–2020,[9] intermediate consumption grew by an annual average of 3.4% in value due above all to higher volume of intermediate consumption in farming (2.8% per year), in particular purchases of other goods and services (5.4% per year),[10] the second largest component in the structure of intermediate consumption after animal feed, maintenance and repair of materials and tools (11.6% per year),

[8] Specifically, wine output declined in volume (-5.0%), alongside the drop in the production of wine grapes.

[9] Three-year averages were used to analyse this evolution.

[10] Agricultural industrialisation is a phenomenon that already dates back several years. In highly integrated sectors, such as wine, olive oil and meat, where farmers are also processors of agricultural products, the allocation of producer prices is complex and arbitrary. More recently, there has been greater integration in the fruit and vegetable sector. Furthermore, the allocation of some costs raises problems, generally leading to a diminution of the primary sector. For example, the value of wine and olive oil are based on wine "after pressing", but the costs associated with bottles, labels and marketing are booked under the agricultural sector as they are borne by agricultural cooperatives.

maintenance and repair of farm buildings and other works (6.8% per year), and other agricultural services (5.5% per year).

In 2020, intermediate consumption grew 0.5% in value due to positive price evolution (0.6%). Evolution in volume was impacted negatively by other goods and services (-4%) and positively by fertilisers and soil improvers (7.6%), phytosanitary products (7.6%), and maintenance and repair of materials and tools (1.6%). In value, growth in fertilisers and soil improvers (3.4%), phytosanitary products (10.7%) and animal feed (2%) stand out.

Methodological Note

- Statistics Portugal (INE) regularly publishes statistics that are used as the basis for analysing the Portuguese economy, namely the agroforestry complex and its agrifood and forestry components.
- The INE statistics used to analyse the agroforestry complex are the National Accounts (NA). It should be noted that the final figures in the NA for a variable in a certain year are only published after two years – the GDPmp figures for 2020, for example, will only be known in 2022. Until then, therefore, figures are deemed provisional, since they are based on estimates calculated on the basis of the known information and processed up until that moment.
- For example, the 2020 GVA in the agrifood complex, which includes the agricultural sector and agrifood manufacturers of beverages and tobacco (IABT), is estimated on INE data for the respective components. The 2020 GVA for the agricultural sector stems from the Economic Accounts for Agriculture (EAA) (satellite accounts), published by INE, with the first estimate announced at the end of 2020 and the second in February 2021, and point towards a drop in GVA. GVA for 2020 for IABT is estimated by GPP from the INE's industrial production indices and shows a drop in IABT production between 2019 and 2020.
- However, other INE statistics seem to suggest growing demand in foodstuffs, as well as an upturn in exports accompanied by a downturn in agrifood imports, though it is difficult to fully explain these variations relative to the variation in the former GVA. Note that the methodology of "2016 constant prices" used to analyse GVA in volume assumes some stability with regard to the price structure for the base year. However, as 2020 was a non-typical year, there may be some inconsistencies in the analysis of volume. For example, a large variation in oil prices in 2020 and 2016 (altered price structure) may partly explain these differences.

Purchase of services allocated to the farming sector has grown exponentially in recent years, particularly due to the expansion of vertical integration in the food industry to include marketing, the replacement of farm equipment (vehicles, machines, tools and barns) that were included in fixed capital, the purchase of transport, repair and conservation services, and the indirect hiring of labour through companies.

Rural population in mainland Portugal*

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This article will provide a brief analysis of data from the 2001 and 2011 Housing and Population censuses, some indicators produced by the national statistics office (INE – Statistics Portugal) and also data from the General Agricultural Census (RGA) 2009.[1] The analysis uses parish-level data to provide an overview of the issues relating to population and the reality of rural life in mainland Portugal vis-á-vis these variables.

This graphic parish-level presentation includes those rural parishes defined by the Rural Development Programme for mainland Portugal for 2014–2020 (PDR2020),[2] bearing in mind the administrative division of 2012 into 4,050 parishes for closer alignment with the 2001 and 2011 census data.

Percentage of the resident population by large age groups

- In 2001, the districts with the largest percentage of people aged under 15 were Porto and Braga. In the district of Porto, this can be seen in the border around the city consisting of the municipalities of Amarante, Paredes, Penafiel, Lousada and Paços de Ferreira. In Braga, the municipalities are Guimarães, Barcelos and Braga. Inversely, the parishes with the smallest percentage of people aged under 15 are in the northeast, central inland and Algarve highland regions.
- Data from the 2011 census show an older population. Compared to 2001, there are 363 fewer parishes (-86%) in the >20% (over 20% of the resident population) category pertaining to the under-15 age group. Only 59 parishes are included and these are scattered across the districts of Braga, Porto and Lisbon.

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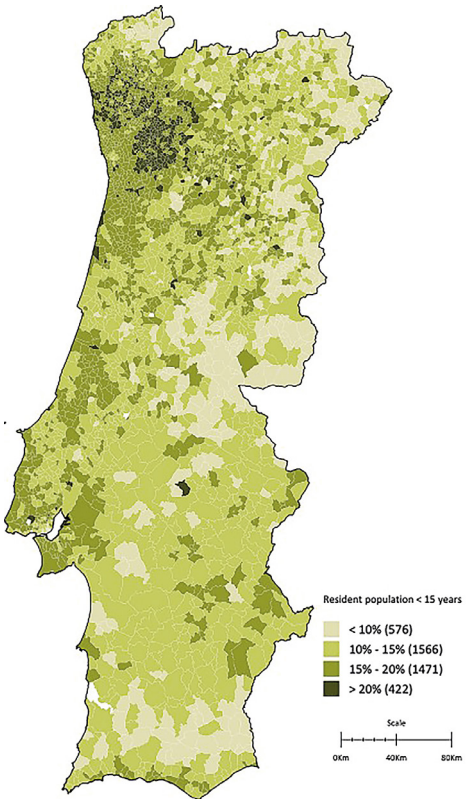
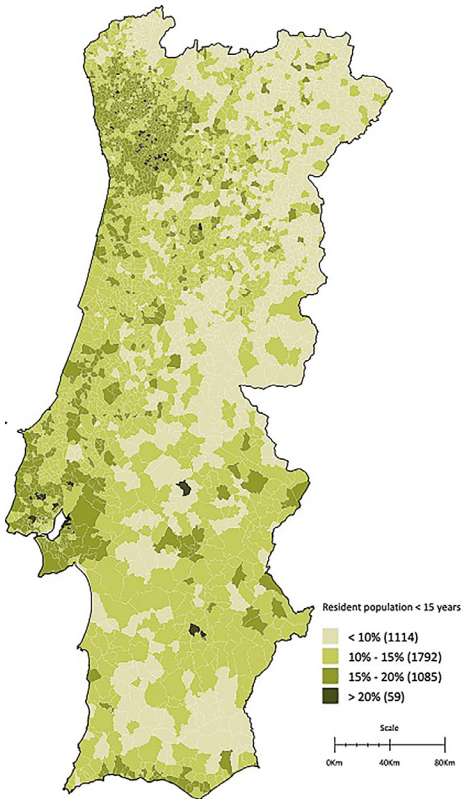
* Editor's note: Originally published in CULTIVAR issue 11 – Population and rural territory, March 2018, p. 95 as "Evolução da população rural no Continente" https://www.gpp.pt/images/GPP/O_que_disponibilizamos/Publicacoes/CULTIVAR_11/#page=96

1 In addition to the 2001 http://censos.ine.pt/xportal/xmain?xpid=INE&xpgid=censos_historia_pt_2001 and 2011 censuses http://censos.ine.pt/xportal/xmain?xpgid=censos2011_apresentacao&xpid=CENSOS, information was also taken from the 1991 General Population Census for the age structure and the 2012 https://censos.ine.pt/xportal/xmain?xpid=INE&xpgid=censos_historia_pt_1991 Official Administrative Map of Portugal (CAOP) by the Directorate General for the Territory (DGT) (vectoral information).

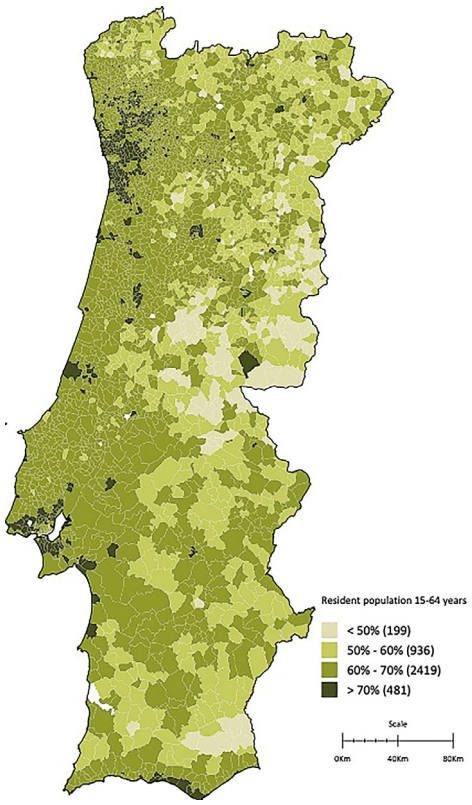
2 Programa de Desenvolvimento Rural do Continente para 2014-2020 (p. 89) http://www.pdr-2020.pt/O-PDR2020

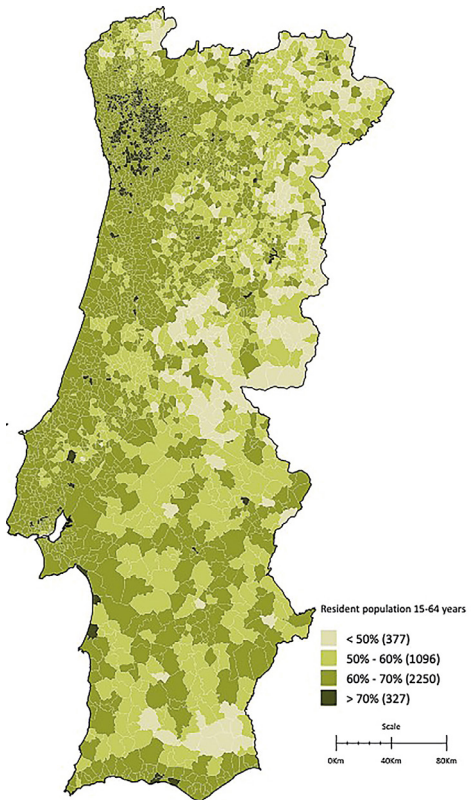
Population aged under 15 as a percentage of the parish total – 2001 and 2011



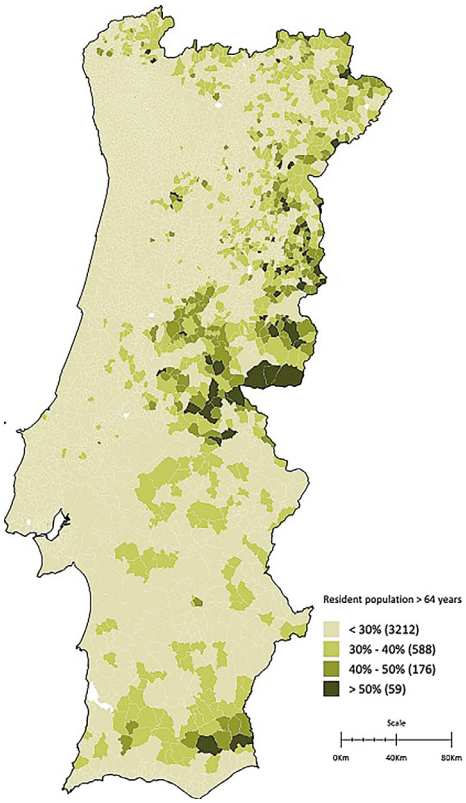


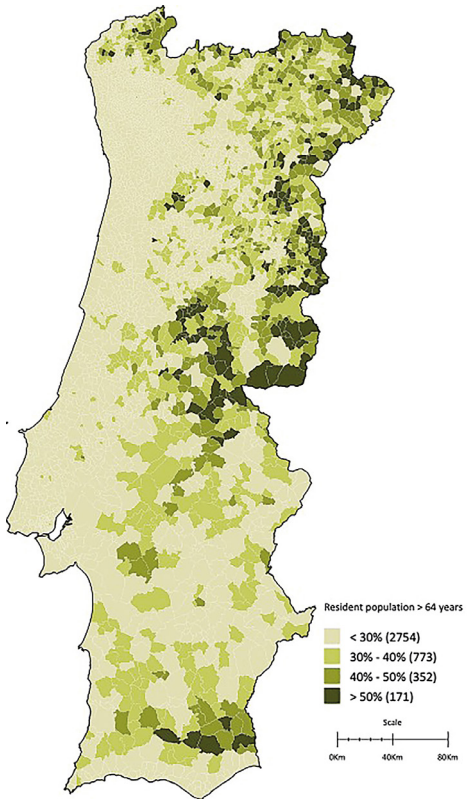
Population aged 15–64 as a percentage of the parish total – 2001 and 2011





Population aged over 65 as a percentage of the parish total – 2001 and 2011

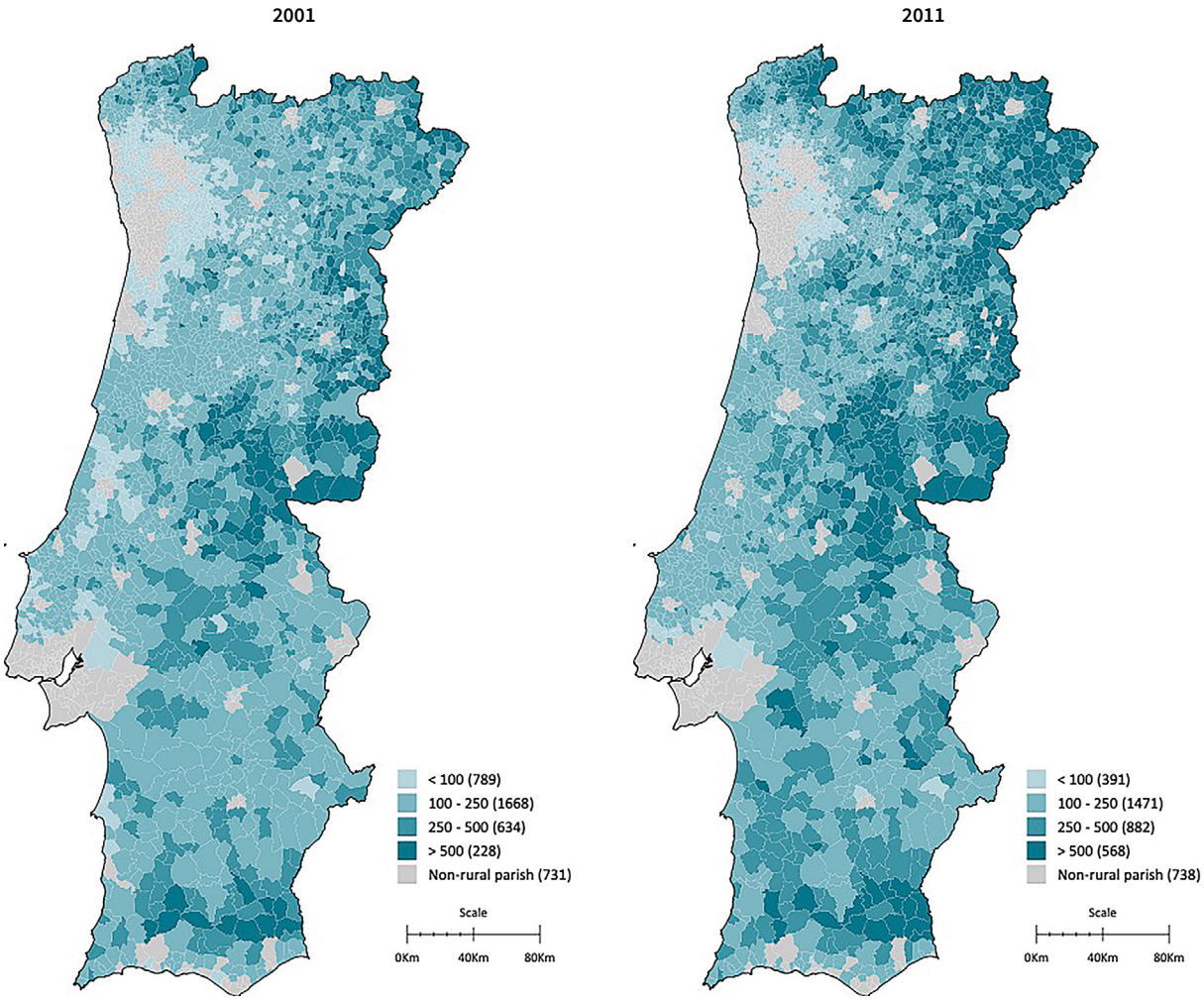




- In the northern inland and central regions and the Algarve highlands, the number of parishes with less than 10% of the resident population aged under 15 rose substantially from 576 to 1,114 (+93.4%).
- A general ageing of the population throughout the country can therefore be seen. The percentage of parishes with more than 20% of the population aged under 15 is practically inexistent in comparison with 2001.
- In 2001, the working age population (15–64) was most evident (>70%) in parishes located around big cities (Lisbon and Porto), district capitals and the municipalities closest to the coast between Viana do Castelo and Sines. In 2011, the number of parishes in this category declined compared to 2001 from 481 to 327.
- In the central inland and northern region, there was a drop in the working age population, with the <50% category rising from 199 to 377 parishes. This decline is also large in the >70% category, dropping from 481 to 327 parishes.
- The number of parishes where the population over 65 as a percentage of the total is less than 30% fell from 3,212 in 2001 to 2,754 in 2011, a variation of -14.3%. The number of parishes in 2001 with between 40 and 50% of their population in this age group grew by 100%, doubling from 176 to 352.
- The previous points confirm the distribution of the data on the percentage of the population aged over 64, which is most prevalent in the northeast, central inland and Algarve highland regions.

Ageing Index in rural parishes

For rural parishes, the AI was used $\left(Ageing\ Index = \frac{Population\ aged\ 65\ or\ over}{Population\ aged\ under\ 15} \times 100\right)$[3] and the following results were obtained:



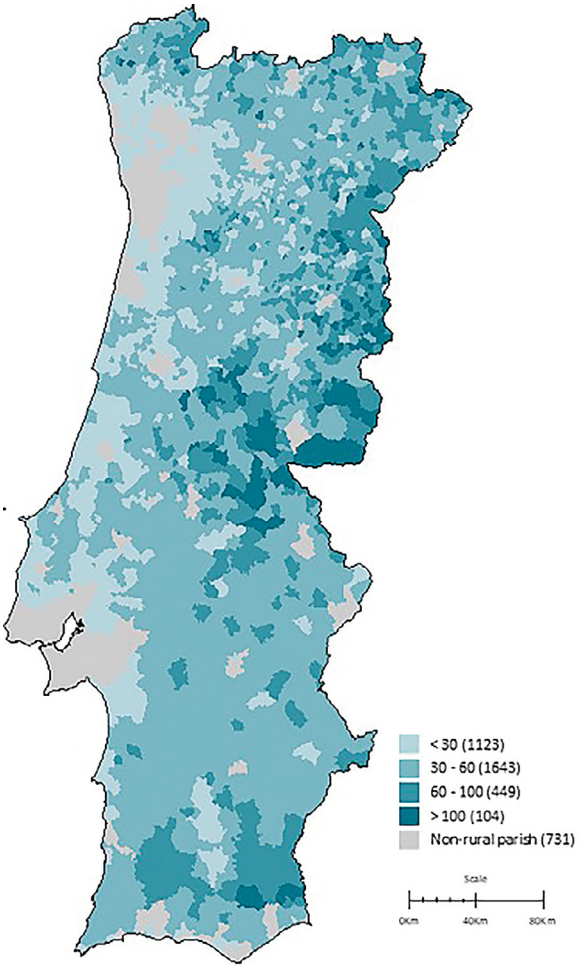
- In 2001, 789 parishes had an AI of <100, most of which were located around the Porto Metropolitan Area (AMP) in the strip between Viana do Castelo and Aveiro, and around Leiria;
- Parishes with AI >500 numbered 229 and were mostly located in the central inland and Algarve highland regions;
- In 2011, the number of parishes with AI <100 (389) fell to less than half of the figure for 2001 and were found in the eastern part of the AMP, between Porto and Braga and to the north of the Lisbon Metropolitan Area (AML);
- Parishes with AI >500 (where the number of those aged over 65 is at least five times higher than the number of those aged 15 and under) followed the opposite trajectory, more than doubling relative to 2001 (568). These stretched from the northeast region and were more noticeable in the central inland and Algarve highland regions.

[3] A figure below 100 signifies a lower number of people aged over 64 than under 15.

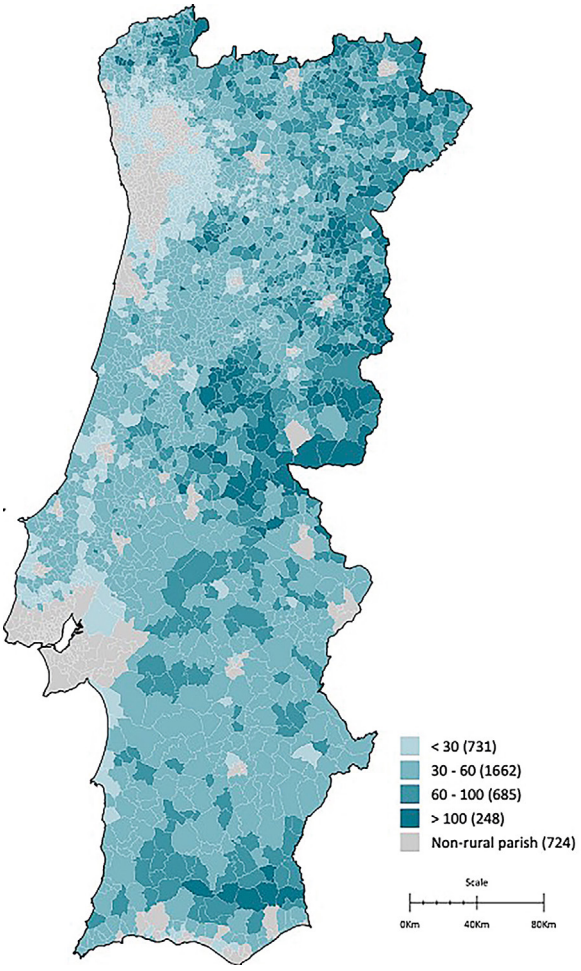
Old-Age Dependency Ratio in rural parishes

$$\text{OADR} - \textit{Old – Age Dependency Ratio} = \frac{\textit{Population aged 65 or over}}{\textit{Population aged 15 to 64}} \times 100$$ [4]

2001



2011

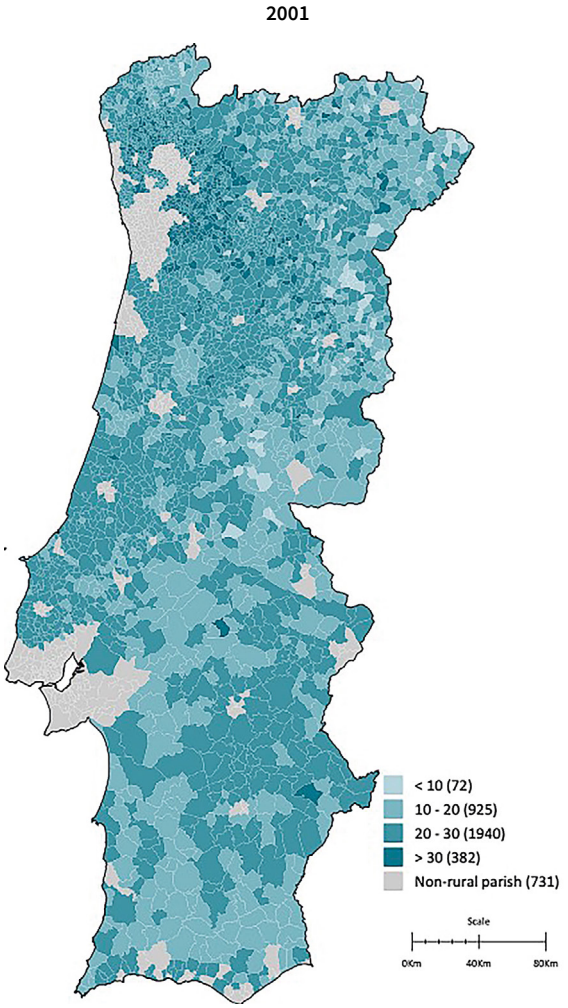


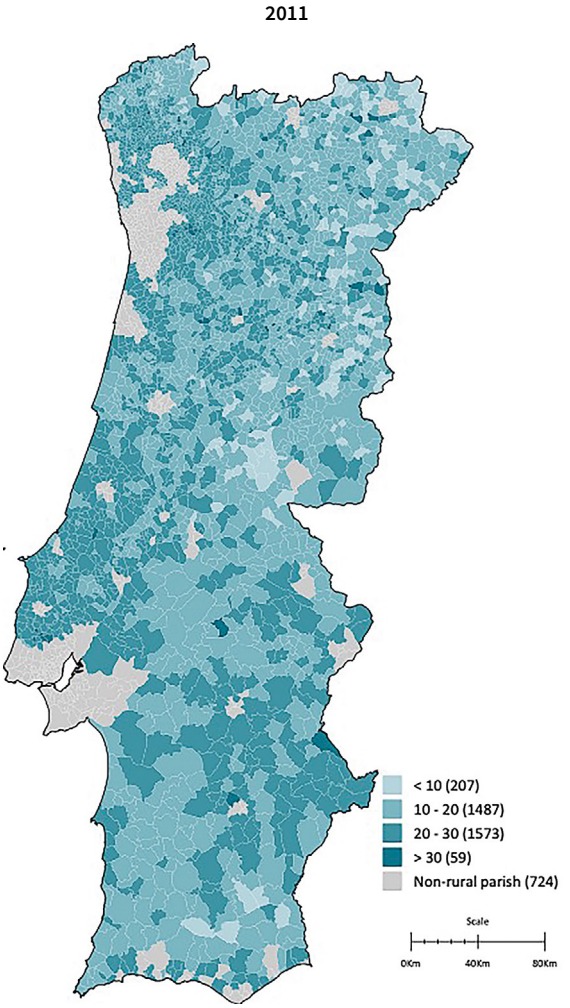
- The clear ageing of the population seen in 2001 in the northeast, central inland and Algarve regions is also reflected in the OADR, which, in this census, included 104 rural parishes with a figure over 100.
- There was a lower OADR in the parishes closest to the coast between Viana do Castelo and Setúbal, which account for over 1/3 of total rural parishes;
- In 2011, the OADR showed a country that was older, exacerbating the situation seen in 2001 in the northeast, central inland and Algarve highland regions. There was a pronounced change in the number of parishes with OADR >100 (+138.5%), rising from 104 to 248.
- Inversely, parishes with OADR <30 declined from 1,123 to 731 (-34.9%) and are now only notable around the AMP and Braga and in the northern areas of the Lisbon district.

[4] A figure below 100 signifies a lower number of old people (>64) than people of working age (15–64).

Youth Dependency Ratio in rural parishes

$$\text{YDR} - \textit{Youth Dependency Ratio} = \frac{\textit{Population aged 0-14}}{\textit{Population aged 15-64}} \times 100$$ [5]



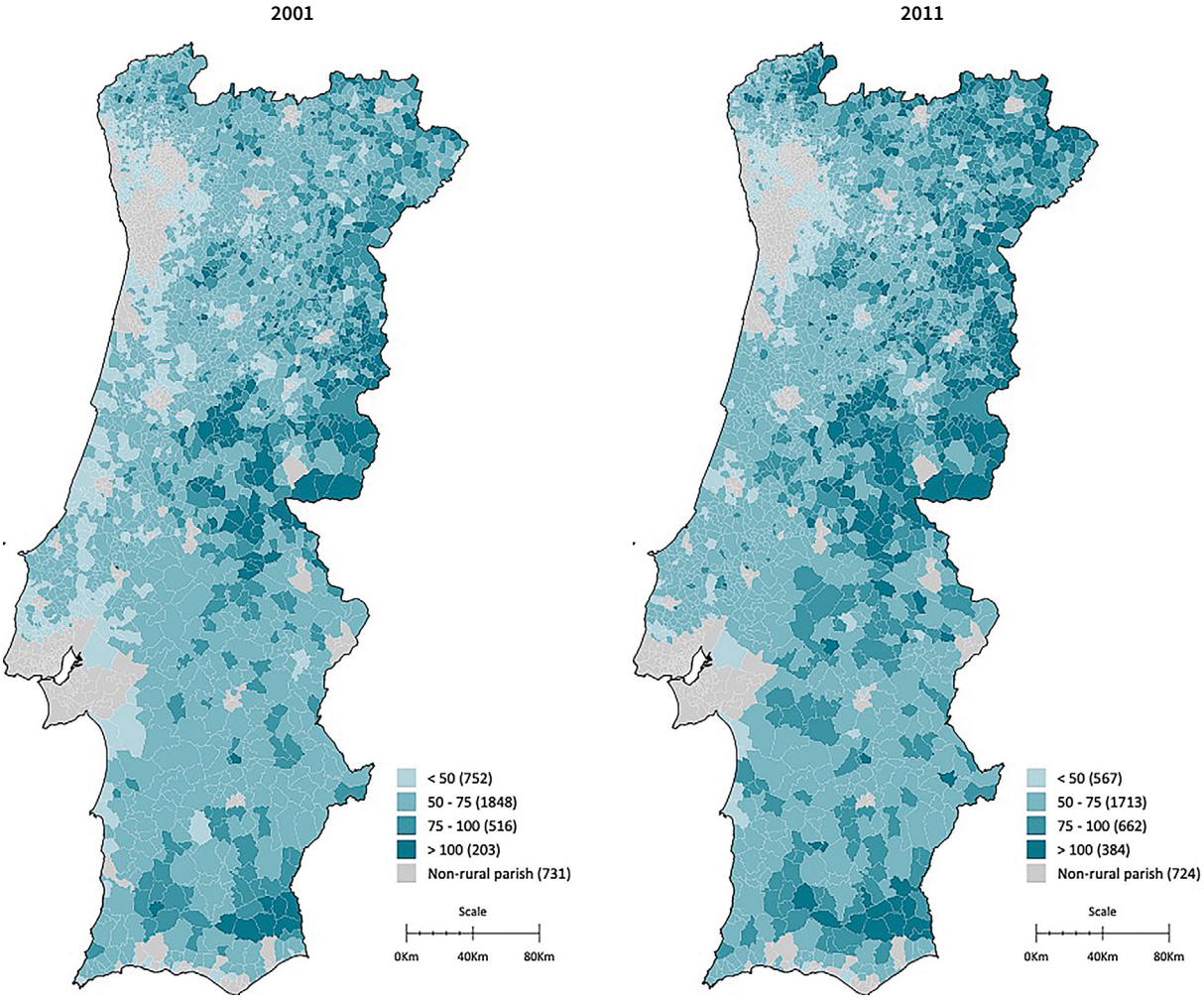


- In 2001, most of the 382 parishes with YDR higher than 30 were in the districts of Braga and Porto. 58.5% of rural parishes were in the category immediately below and located in an arc between the districts of Viana do Castelo and Lisbon, extending to Vila Real and Viseu. This category also included many parishes in the Alentejo districts of Portalegre, Beja and, above all, Évora.
- Given that the population has aged, the 2011 census reveals a very different situation. The two categories with the lowest ratios, which accounted for 30% of all rural parishes in 2001, accounted for 51% in 2011, a +69.9% change.
- The highest YDR was in the districts of Braga, Porto, Aveiro, Leiria, Lisbon and Évora.
- Despite there being only 382 parishes with YDR >30 in 2001, by 2011 this number had fallen to just 59.
- In 2011, only 207 parishes had a ratio of <10. However, this was almost triple the number of 72 in 2001.

[5] A figure under 100 signifies fewer young people (under 15) than people of working age (15–64).

Total Dependency Ratio in rural parishes

$$\text{TDR} - \textit{Total Dependency Ratio} = \frac{\textit{Population aged 0-14} + \textit{Population aged 65 and over}}{\textit{Population aged 15-64}} \times 100$$ [6]

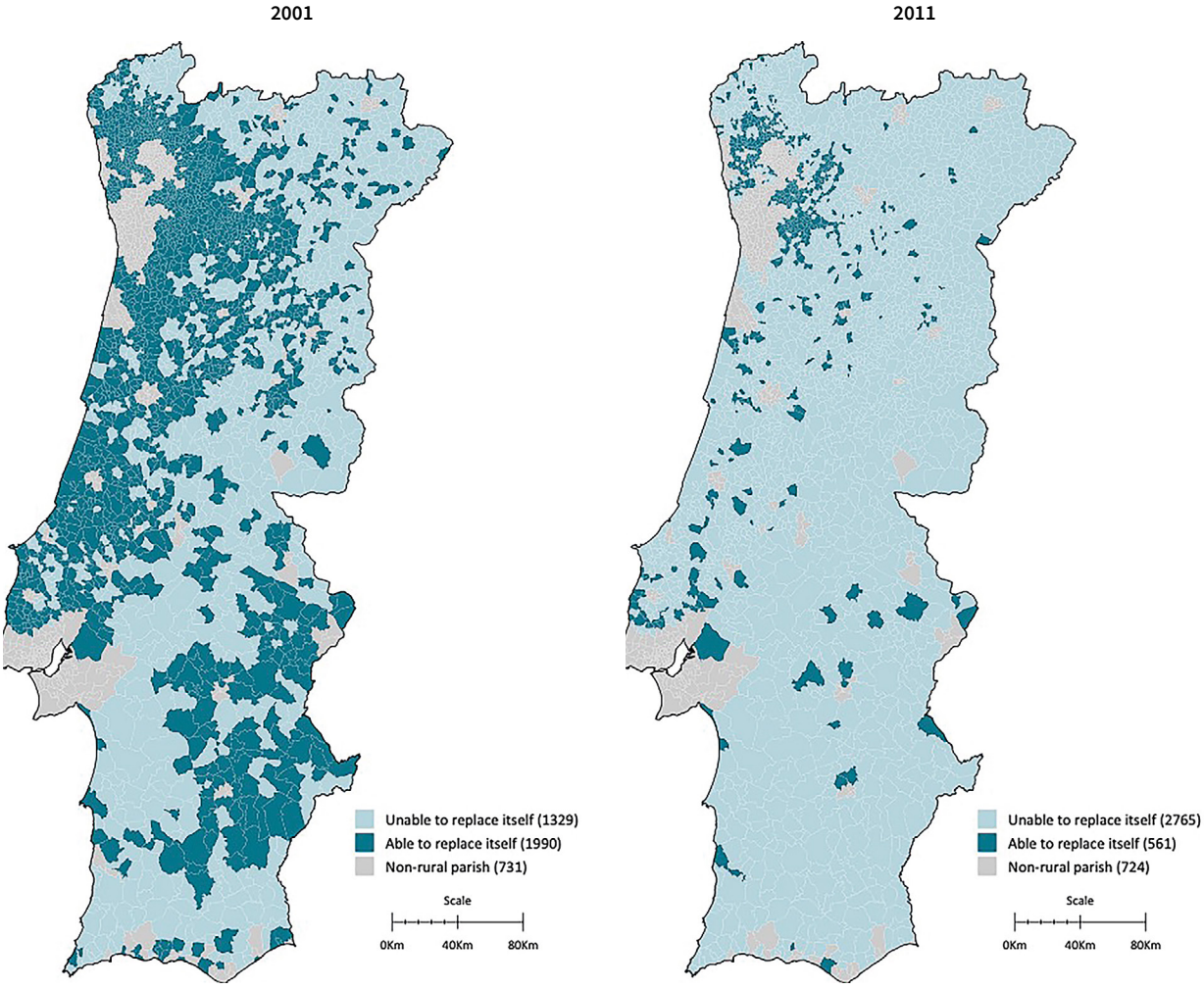


- In 2011, in the central inland and northeast regions of mainland Portugal, as well as the Algarve hinterland, there had been a rise in the number of parishes with TDR >100: up around 181 as compared to 2001. This denotes a growing level of old and young people dependent on the working age population.
- Looking at earlier ratios helps to show that it is mainly the greater proportion of old people that has influenced the results of TDR >100. Consequently, the 248 parishes with OADR >100 are included in TDR >100.

[6] A figure under 100 signifies fewer young and old people (aged under 15 and over 64) than people of working age (15–64).

Generational Replacement Ratio in the working age population in rural parishes

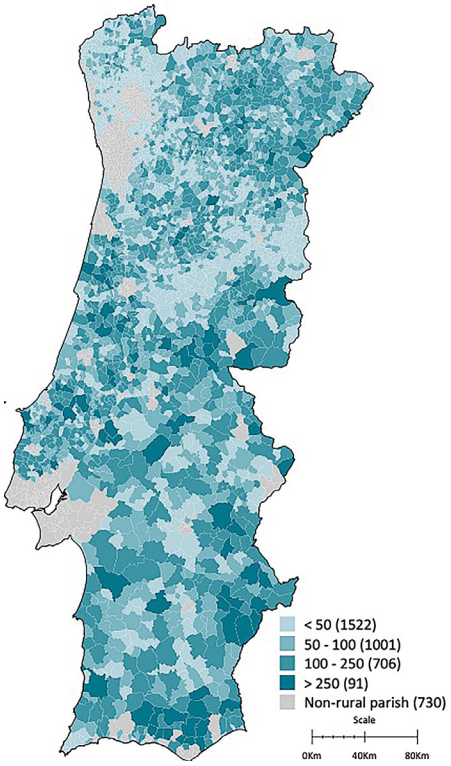
GRR – *Generational Relacement Ratio in the working age population* = $\frac{\textit{Population aged 15-39}}{\textit{Population aged 40-64}}$



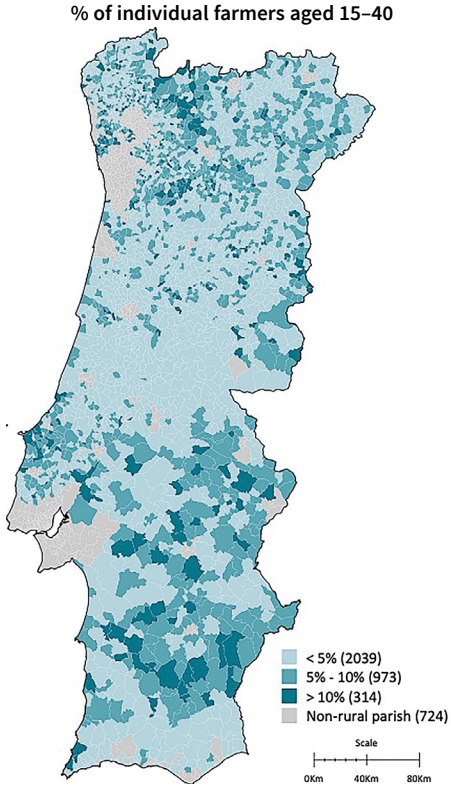
If this ratio is lower than 1, it signifies that the population is "unable to replace itself". The general panorama therefore very clearly suggests a loss of replacement capacity in working-age generations between 2001 and 2011.

Individual farmers (2009 RGA data)

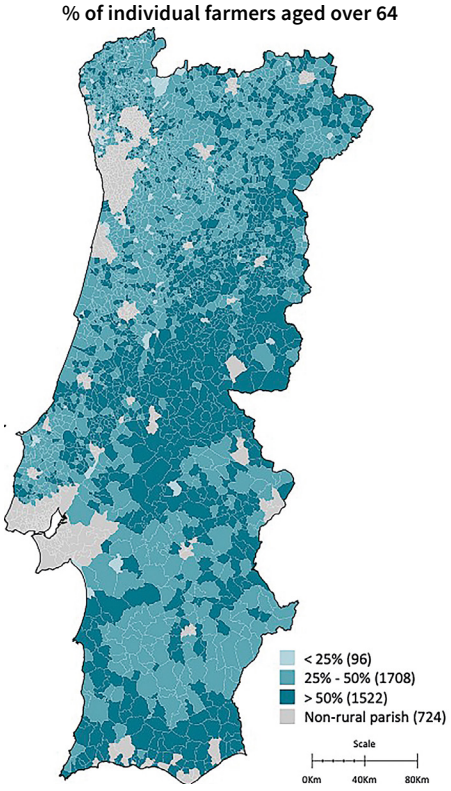
No. of individual farmers



% of individual farmers aged 15–40

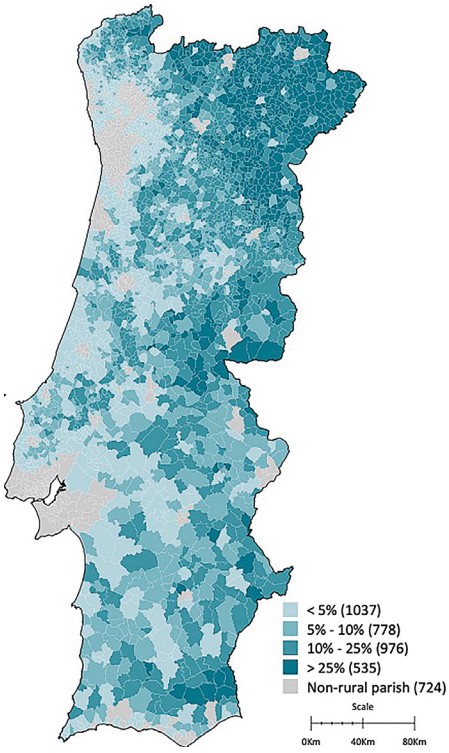


% of individual farmers aged over 64

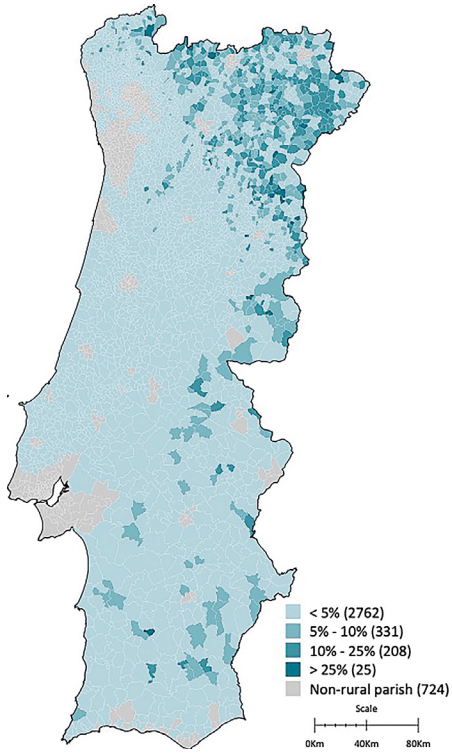


- Young farmers are more heavily represented in the rural parishes in the Alentejo and West regions and in Cávado, Ave and Alto Tâmega in the north. However, it is possible to see that individual farmers are mostly old (aged over 64), as over 50% of all farmers are in this age group in 45.8% of rural parishes. Furthermore, over 25% of individual farmers across 97.1% of the territory are aged over 64.

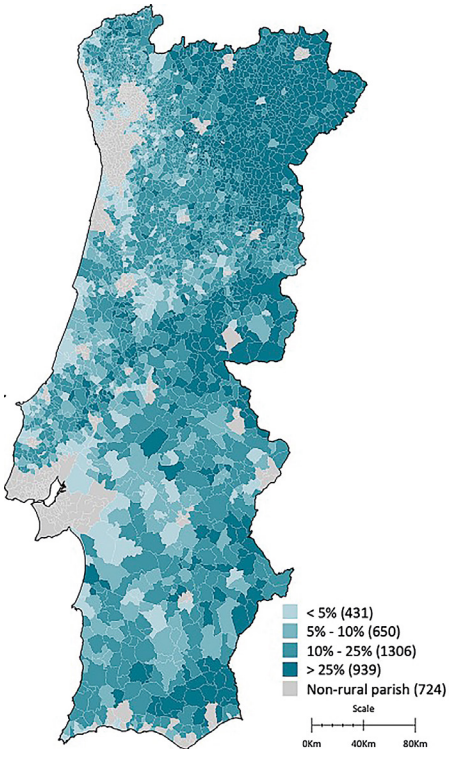
% of all individual farmers (2009) in resident population (2011)



% of individual farmers aged 15–40 (2009) in resident population aged 15–40 (2011)

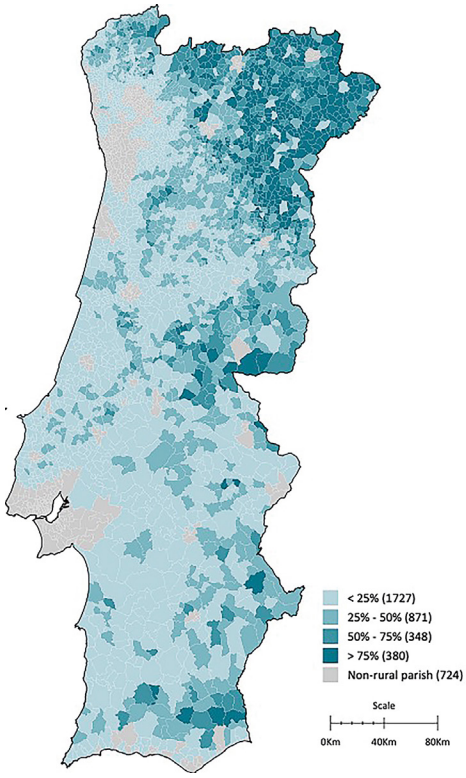


% of individual farmers aged over 64 (2009) in resident population aged over 64 (2011)



- Over 25% of the population over 64 in the northern inland and central region and the Algarve highlands are individual farmers according to the 2009 RGA. This means that farming is practised above all as a means of subsistence or to supplement a pension. It is also in the northeast region where most young farmers (aged under 40) are concentrated compared to the resident population in the same age group.

Percentage of total family farm population (2009) in resident population (2011)

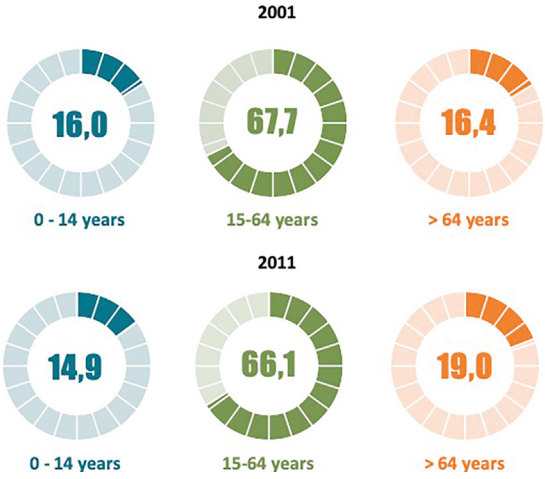


- This map shows that there are 728 parishes where family farm population accounts for over 50% of the resident population and 380 where it is over 75%.
- The parishes where these statistics apply are concentrated in the hinterland of the eastern Algarve and the districts of Castelo Branco, Guarda, Bragança, Vila Real and part of Viana do Castelo.
- The decline in the young and working age population was evident between 2001 and 2011, reflected in the higher population aged over 64. The same occurred in the rural areas under analysis, although to a higher degree.
- In 2011, out of 4,050 parishes in mainland Portugal, 3,326, or 82.1%, were defined as rural. The ageing of the population in these parishes has occurred at a faster rate than in the rest of mainland Portugal. Therefore, the youngest and working age populations are less well represented in the resident population in these parishes as a whole, while the oldest group (over 64) is better represented.

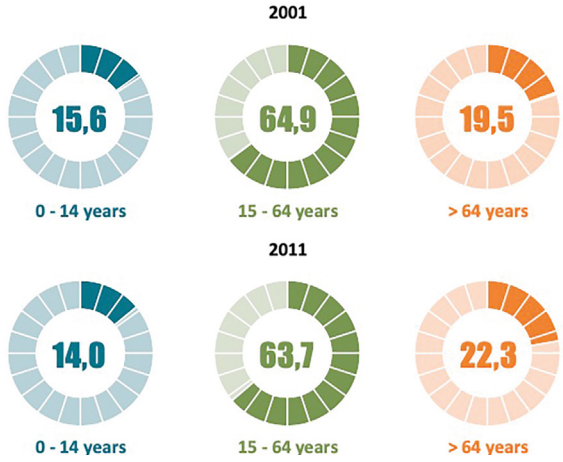
Age structure 1991–2011

- In the period between 1991 and 2011, the respective age pyramids show that there was a clear ageing of Portuguese population. In 1991, there was already a notably low birth rate, as can be seen by the base of the pyramid for that year, where the age groups up to 15 are smaller than the following age group. However, this chart shows a population that is still young.

Percentage of population by large age groups – 2001 and 2011

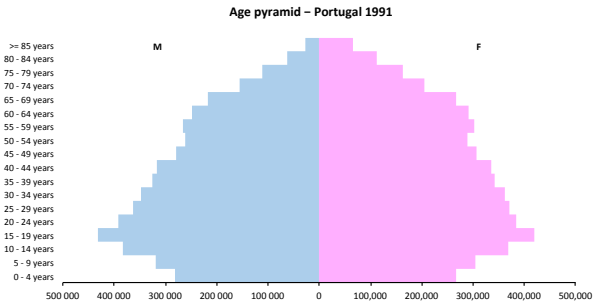


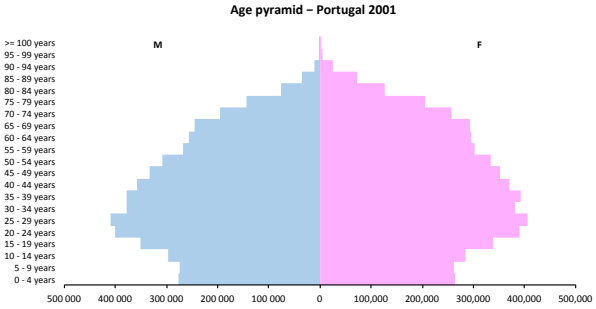
Percentage of population by large age groups in rural parishes – 2001 and 2011

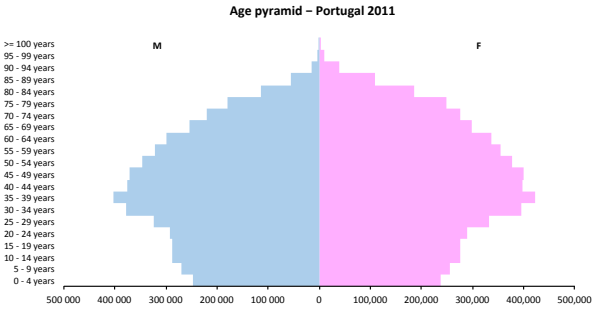


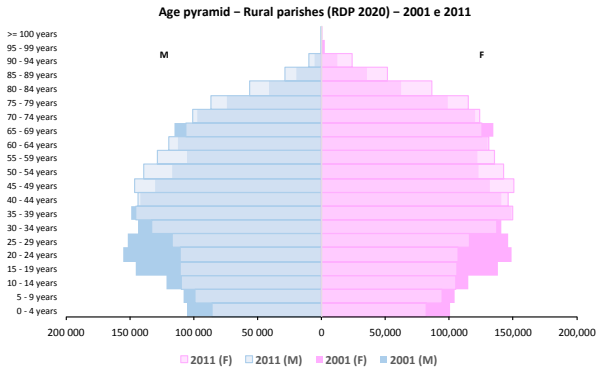
- In 2001, the age groups up to 15 are smaller than in 1991, which reflects an even lower birth rate and, consequently, an older population. The predominance of the 20–39 age groups shows an adult pyramid that reflects a low birth rate and rising average life expectancy.
- In the last census held in 2011, Portugal clearly shows an ageing (population) pyramid. The birth rate is substantially lower than in previous censuses and therefore there is a low proportion of young people, while average life expectancy is high, implying a high proportion of old people. With fewer young people and more old people, the pyramid looks increasingly inverted, which is characteristic of this type of population evolution, typical of developed countries.
- Comparing the age pyramids for rural parishes from 2001 to 2011, it is very visible that there was a drop in population, with an even narrower pyramid base and therefore a decline in the young population. The working age population only reflects the ten years spanning the censuses, which is marked by an increase in the old-age population (over 64).
- In the last chart, the total national age pyramid for 2011 is compared to the age pyramid for the population of the rural parishes. A substantial difference – an almost tubular pyramid – can be seen. This expresses many of the previous observations. In rural parishes, population ageing is matched by a small working population and an even smaller young population.
- The change in these age structure pyramids for the population in rural parishes reveals that there is no population renewal and that the base of the pyramid is becoming increasingly narrow.

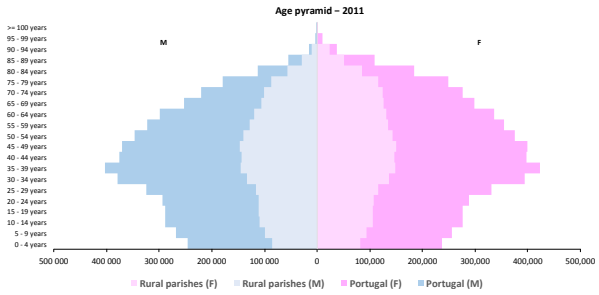
Age pyramids 1991–2011











No. 22 〉 April 2021

REVIEWS

CULTIVAR = CULTIVAR

n. Botany. ***A VARIETY OF A PLANT THAT HAS BEEN DELIBERATELY DEVELOPED BY BREEDING.***

Portugal, the Mediterranean and the Atlantic: A Geographical Study

Office of Planning, Policy and General Administration (GPP)

Reference

TITLE: *Portugal, o Mediterrâneo e o Atlântico. Estudo Geográfico*
AUTHOR: Orlando Ribeiro
PUBLISHER: Livraria Letra Livre
INTRODUCTION: Suzanne Daveau
LANGUAGE: Portuguese
NUMBER OF PAGES: 227
YEAR PUBLISHED: 2011 (8th edition); (original: 1945, Coimbra Editora)

Key words: rural Portugal; geography; Mediterranean; Atlantic; identity; culture; landscape; rural population; agriculture; fishing; crops; settlement

Portugal, o Mediterrâneo e o Atlântico. Estudo Geográfico [Portugal, the Mediterranean and the Atlantic: A Geographical Study] is Orlando Ribeiro's look at the Portugal of the past and of today. It provides an anatomy of the country, examining the territory's natural and human architecture, and describes the country's contrasts and identities, past and present, from the highlands to the valleys, from the flora to the fauna, from the ocean-lapped coast to the inland regions shadowed by the central mountain chains. Ranging from the mountainous north to the flatlands of the south, the book examines the diverse climates and habitats that shape the character of its people and places, describing the current and past inhabitants of this corner of the Iberian Peninsula bathed by the Atlantic and formed by the Mediterranean. It examines where they live and how they live; their sources of livelihood (farming, animal husbandry and fishing); and the marks they have left from pre-historic times to Castro culture. This journey in time and space takes in the Roman and Moorish influence and the Christian reconquest, and continues all the way to the present day.

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Miguel Torga – Message
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Chapter II – Mediterranean Portugal
Chapter III – Atlantic Portugal
Chapter IV – The Variety and Unity of Portugal
Conclusion
Maps

Chapter I – The Mediterranean World examines the geological (coastal and highland), climatic, plant and human dynamics (ways of life, population and settlement) characteristic of the lands bordering the Mediterranean Sea on the three continents of Europe, Africa and Asia. This region is considered one of the oldest in human civilisation, marked by relationships of convergence (e.g. trading relations) and divergence (e.g. wars) between peoples. These past actions have influenced the landscape of today.

The geology of the Mediterranean stretches from the jagged and jutting coast of Europe – *"a complex array of peninsulas and archipelagos, inlets and deep gulfs"* that offer perils or protection to vessels traversing it – to the highlands formed by tectonic movements in earlier and more recent times, and to the deserts of northern Africa.

The climate of hot, dry summers and cold, rainy winters characteristic of the Mediterranean also includes various typologies. The climate is affected by both latitude and altitude and the effects of proximity to other diverse climate zones. While Portugal, located at the most westerly point of continental Europe, is not touched directly by the Mediterranean, it is influenced by both it and the Atlantic. In this chapter, it is noted that *"treatises distinguish the special nature of the **Portuguese climate**, which is characterised by gentle winters, moderate summers, albeit hot and always dry, with low annual variability. In fact, it has various climates which, when combined in various degrees along the Iberian Atlantic coast, abate its Mediterranean character, which blurs under the damp, cool pressure of the great breath of the Atlantic".*

The Mediterranean-style climate is suited to certain plant species. For example, the hot and dry summers prefer evergreen species or thorny, or small and leathery, or fleshy plants which can withstand the loss of water by transpiration (xerophytic adaptations). Many of these (exotic) plants were introduced from other continents and have adapted well, flourishing and spreading across the landscape. In fact, human influence on this region is old. Man has transformed it since the melting of the last glaciers to obtain the resources he needs, particularly food. *"By introducing a great variety of **crops** in different eras, it was man who enriched the vegetation and transformed the landscapes. So profound was his effect that it can be hard to separate what stems from his actions and what preceded or escaped them."* These plants range from Mediterranean species, such as olive and fig trees, to those from other origins, such as common wheat, vines and pome fruit (from Asia), maize and potatoes (from the Americas), and sweet orange (brought from China by the Portuguese). *"Every great civilizational push is marked by the enrichment of the agricultural heritage."*

The lands bathed by the Mediterranean were crucial to human settlement. However, this region is hard to farm, *"demanding man's constant labour"* to work *"soil that is generally thin and poor with a hard and hostile bedrock".* Higher areas, where arable land is easily washed away in winter, require terraces to sustain the soil. The plains that flood with rainwater and salty seawater need to be drained. Seen from above, the Mediterranean landscape is described as *"an intricate puzzle of multi-use fragments constantly broken by rocky outcrops, thickets and woods, in soils that cannot support regular cultivation".*

Two systems of cultivation stand out in the Mediterranean – dry and irrigated. The former uses more extensively grown resistant crops adapted to the climate, enabling the soil to naturally recover. The latter requires frequent work *"in which man must labour constantly around the plant and bestow upon it, like in the art of gardening, infinite care and toil".* A more intensive regime is adopted where as much as possible is produced in a limited space in a short period of time, a system that emerges in more densely populated regions close to sources of water.

In addition to agriculture, the peoples of the Mediterranean managed to develop sheep farming (associated with transhumance) and fishing, establishing trading relations with other peoples through maritime trade from ports, one of the bases of human life.

Chapter II examines Mediterranean Portugal, characterised above all by three influences – the inland

Mediterranean Sea, the great expanse of the Atlantic and the inland high country. *"Portugal is Mediterranean by nature, Atlantic by location."* These are the influences that determine the contrasts between the country's various regions, from the geography and fauna and flora to the population. This contrast is also one of altitude – from the mountain chains in the north to the plains in the south – and of climate – hot and dry Mediterranean summers that are more moderate near the coast and cold and damp Atlantic winters, especially in the northern highlands. Contributing to the creation of Mediterranean Portugal is the way its population adapts to the natural elements of the land – slopes, heat and dryness, vegetation layer and natural calamities (flooding, earthquakes and water-borne endemics). The land and its people have been influenced by ancient civilisations – Roman, Phoenician, Greek and Arabic – in the architecture, language, organisation of settlements, farm constructions to gather water, etc.

The way of life of the Portuguese in the mid-20th century was based above all on agricultural and pastoral activity. For the rural population, food essentially came from growing cereals for bread and also from other less important crops. *"The fields bear the most vigorous stamp of Portugal's farming landscape … While bread, wine and olive oil are the three pillars of the diet in Mediterranean countries, cereals, the traditional foundation of our farming, occupy first place."* Of cereal production, 48% is of wheat (Alentejo and Estremadura), which *"is supplanting others"*, 38% maize (Minho, Beira Alta and Litoral) and 14% rye (Trás-os-Montes and Beira Interior). Cereal cultivation has transformed the landscape into different field types: the meadow-fields in Minho where irrigated maize is grown; open fields with fallow land in the remote northeast and south; open fields with no fallow land; enclosed dry fields; and intercropped fields in the Ribatejo, Estremadura and Algarve with dry cereal cultivation between tree and shrub crops (e.g. vines and olive trees).

Vines and olive trees are common features in the rural landscape: *"**Vineyards** today occupy a large part of our farming landscape … The main incentive for clearing poor, sloping and sandy land was to plant vines … Sandy land and slopes lend themselves well to growing vines and can be used for little else; even on poor land, the results are worth it … Vines today cover 344,000 hectares, 10% of all cultivated land … Portugal is the world's fifth largest wine producer; it accounted for around a ¼ of the value of exports before the war and Port wine is without doubt the product that has earned most universal acclaim."*

In relation to olive trees, he says: *"The area covered by **olive groves** rose 85% between 1874 and 1934 … The number of olive trees today is over 40 million across 370,000 hectares, around 11% of farmland … The tree can be found everywhere and it adapts to all soils and climates, although it clearly prefers limestone soils and hot regions protected from sea winds … Estremadura, Ribatejo and the Alentejo produce 60% of all olives."*

In addition to these, irrigated crops are also important: irrigated maize in Minho with its short summers and heavy rainfall; and rice fields bathed by the waters of the Mondego and Sado rivers. Further south, the climate, particularly in the summer, is not conducive to irrigation, forcing man to find ways to capture water. Irrigated crops include citrus fruit in the Algarve and vegetable gardens around the country, especially in more densely populated areas, small spaces where various vegetables are grown as a staple diet. *"The problem of water has concerned our greatest minds since the 17th century. The major effects of climate variations leading to disastrous flooding and long droughts can still be felt and only large-scale irrigation can mitigate them."*

Land ownership varies essentially between the smallholdings in the north and centre, split into clearly defined small parcels, and the estates in the south, with large open areas of cultivation in the Alentejo plains where the first farm machinery replacing manual labour can be glimpsed. On these fields generally toil labourers from the poorest regions of the country, such as the *"ratinhos"* [mice] from the Beiras who *"come from the poorest mountains in Portugal"* to reap the cereals of the Alentejo, and the *"caramelos"* [toffees] of the Mondego Baixo and Ria de Aveiro who work the rice fields in the Sado val-

ley. *"In the **northwest**, the Romans were responsible for the radical transformation of a wilderness into a cultivated, productive land … These transformations missed out the **mountain** and **tramontane** regions, with their isolated farming and livestock communities … Property is divided but the farms group together in mutual assistance … As we have seen, the large estates in the **Alentejo** also date back to Roman times … The cereal monoculture accompanied by extensive grazing and use of forestry products contrasts with an even stronger trend in Mediterranean farming: **polyculture or mixed farming**",* which combines tree and shrub crops in two "layers" in a small space.

Alongside crop farming, livestock husbandry and extensive grazing generally on uncultivated and fallow land is common: "large" livestock (cattle) in the short summers of the northwest and "small" livestock increasingly as one moves further south and east – sheep in the driest eastern regions and goats on the poorer land of the centre and Algarve. *"The most characteristic form of grazing can be seen in mountain regions … sheep from the villages begin to climb the rocky summits when the snow melts around April time … With the first snowfall at the end of October or November, they seek out grazing lower down, where they can remain outdoors throughout the winter under the eye of the same mountain shepherds."* The animals produce milk and meat (cattle, sheep and goats) and wool (sheep) and help with farm work (tilling the land) and carrying loads. *"Only one animal is used just for food: the pig"*, reared in sties in the north and in the open air in the south.

In **Chapter III – Atlantic Portugal,** Ribeiro starts with an overview of the Atlantic influence, which heavily regulates the climate, natural elements, such as vegetation (Atlantic scrub and trees, notably the maritime pine that *"covers 45% of forested areas today"*), and altitude, since *"the distinction between wet and arid regions in Portugal has much to do with the contrast in altitude"*. A highland economy exists in the northern and central regions, with higher population in the rainy northwest, and greater Romanisation in lowland areas, namely in the south. In this chapter, the maize revolution is also highlighted, which implied *"large cultivated fields, an increased irrigated area …"* and also the *"irredeemable decline in community spirit, an individualism that leads to the enclosing of land, multiplication of hedges, walls and partitions, and dispersal of houses, all of which maize favoured, permitted or caused".* The author also refers to the economy and population of the coastal region whose livelihood is dependent on fishing and the maritime trade.

In **Chapter IV – The variety and unity of Portugal,** Ribeiro states that despite the contrasts in climate, plant cover and landscape (northern Atlantic, northern tramontane and south), the country is like an *"old, solid trunk"*. Unifying factors include natural circumstances, ancient roots, the Christian reconquest and population exoduses.

Conclusion:

The book is a fascinating analysis of Portugal and its people in the 1940s and even further back. It is a memoire of the past and of the people who inhabited the country essential to understand Portuguese history and geography, with its links to the Mediterranean world of ancient civilisations and the vast Atlantic. This is not just a descriptive book limited to the author's observations. In places, Ribeiro observes and opines. For example, *"Whereas the population has grown quickly in the last half a century, the land is owned by only a few, clustered through marriage, held by a class who, in general, was only concerned about enjoying the income from it. The estates are let for short periods and to maximise their profits, the tenants exploit the land and have no interest in improving a transitory good."*

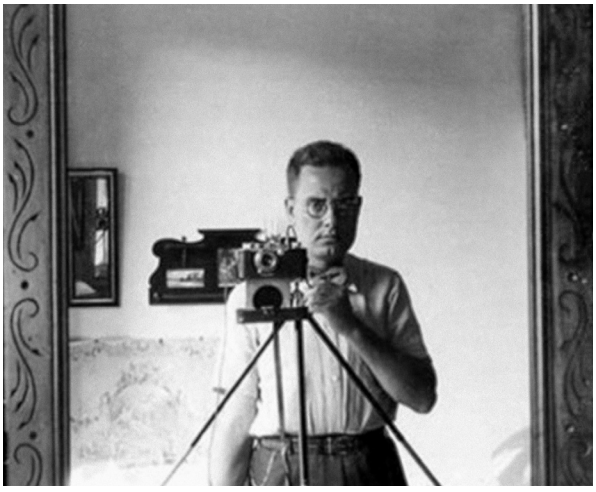
And also: *"This technical progress was not matched by reform of product distribution and the foundations of ownership, which the disastrous farming developments of the last century have shattered or concentrated excessively. Meanwhile, as new trends emerge, our farm labourers trundle along in their carts, down rough and doubtful trails, while digging their wheels ever deeper into extreme poverty."*

And he further adds: *"The ponds caused by dry summers, the high temperature and high relative humidity*

along the coast and low in inland areas, the development of flooded rice fields, the periodic migrations of labourers that work in them, the rarity of cattle sheds, an outdoor life lived in rickety cottages or dark houses where mosquitoes dwell during the day seem like key factors in the development or continuation of fever endemics … On the map of these diseases, Portugal is quite well represented."

The book remains relevant on many aspects of the economy and rural landscape. Olive trees and vines remain decisive in terms of the landscape and diet. Portugal is still defined by smallholdings in the north and centre and large estates in the south. The trend in depopulation in rural areas has continued alongside the outsourcing of the economy. In fact, low incomes associated with farming still fail to attract people, above all the educated young who prefer to work and live in urban areas. Depopulation leads to the ageing of rural populations, deserted villages and abandoned farming areas. In terms of the forestry sector, cork continues to dominate in Portugal *"…as the leading cork-producing country, accounting for around half of world production"*.

Agriculture is now less important for the economy but has become more modernised, especially after Portugal joinied what was then the EEC. Human labour has been replaced by machinery. Cereals have been overtaken by vegetable and fruit crops. Maize has supplanted wheat as a cereal, above all as animal feed, when previously it was used to make bread. More productive irrigated crops are beginning to prevail over dry crops. Farm labour has become better educated. In 1945, most of the population worked in agriculture, the basis of their subsistence. In 2020, only a small part does so as a living or as a complement to their main source of income. Eucalyptus trees, rarely mentioned in the book, have gained ground over the maritime pine and the agricultural and pastoral activity once widespread in the central region. *"Only pine and lately eucalyptus woods are gaining ground, rising up the wooded slopes, surrounding the cultivated land of villages, in small clusters or thick monotonous and interminable woods."*



Orlando Ribeiro: a self-portrait

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