ETF Working together Learning for life

European Training Foundation

THE FUTURE OF SKILLS

A case study of the agri-food sector in Morocco

THE EU AGENCY SUPPORTING COUNTRIES TO DEVELOP THROUGH LEARNING

Manuscript completed in March 2021.

PREFACE

In November 2018, at an international conference, the European Training Foundation (ETF) initiated a dialogue on how global trends such as digitalisation, globalisation, migration and climate change are impacting the education and employment systems in developing and transition economies and on how such countries can respond. The conference – Skills for the Future: Managing Transition – concluded that monitoring and understanding evolving skills demand is an essential component in how countries should equip their societies for the future.

The ETF and its partners found that countries could best anticipate emerging skills needs by combining both traditional methods of data collection and analysis with newer approaches made increasingly possible through data science.

The ETF commissioned the present study as part of its follow-up to the conclusions reached at the conference. It is one of several surveys, studies and analyses ongoing and pursued by ETF experts in skills demand, all aimed at gathering and analysing information on evolving skills needs. It investigates how various drivers of change – principally technological – impact skills demand in the agri-food sector, and how education and training will need to adapt to meet those needs. The choice of the sector was based on several considerations. First, in many countries, including Morocco, the agricultural sector employs a substantial share of the workforce, both directly in the fields and indirectly, in food processing, for example. Second, agri-food is typically considered to be a labour-intensive but low-skilled sector, with limited use of advanced technologies. Accordingly, the take-up of new technologies such as precision agriculture techniques may well have disruptive consequences for skills demand and employment numbers in the sector. Third, the use of new technologies in the agri-food sector has important implications for environmental sustainability.

This study concentrates on changing skills needs and documents changes in the occupational composition of jobs resulting from technological change. In other words, it looks at how the skill content of jobs is changing. It does not assess potential changes in the volume of labour or skills demand or number of workers in the sector resulting from technological change. The focus is very much on identifying the skills which people working in the agri-food sector will increasingly need to acquire. The study also provides information on how companies adapt to technological change and acquire the associated skills. As such, it gives an indication of how supply of skills is keeping pace with technological advances in the sector. Ultimately, the aim of the study is to raise awareness about changes in skills demand and stimulate discussion among policy-makers and practitioners in the field so that the findings can inform the adaptation of education and training provision, for example in curricula, teaching and qualifications.

The study is one of a series of studies that the ETF has been implementing in its partner countries focusing on economic sectors that present niches of innovation and potential for further development. It is based on a new methodological approach which combines traditional research methods (desk research, data analysis and interviews) with the use of big data text mining techniques. The use of big data analysis is gaining traction in skills research. Despite some limitations (e.g. coverage, representativeness and applicability), it provides new insights as well as real-time information on recent trends and complements more traditional approaches to skills anticipation. By using a mixed methodology, the research can offer insights that might otherwise be missed. The result is a consistent set of findings corroborated by different research tools on emerging trends related to technology and skills.

Fondazione Giacomo Brodolini and Erre Quadro have been working with the ETF to conduct a series of sector studies in several countries. They have been directed by the ETF's team of experts and assisted by international and national experts as well as stakeholders in each respective country.

This study was carried out between June 2020 and November 2020. This report was drafted by Riccardo Apreda, Liga Baltina, Riccardo Campolmi, Chiara Fratalia and Terence Hogarth with inputs from the national expert Rachid Mrabet and was extensively commented on by ETF experts Francesca Rosso, Ummuhan Bardak and Anastasia Fetsi. The report also benefitted from inputs from a wider set of ETF experts, including Romain Boitard, Xavier Matheu de Cortada, Abdelaziz Jaouani and Michael Graham.

The report documents all steps of the research and presents the findings in a detailed manner. This is because the ETF wants to raise awareness of all stakeholders in the partner countries, be they researchers, practitioners or policy-makers, of the changing skills needs at the sectoral level. The findings are designed not only to raise awareness but also to provide food for thought, especially in relation to the ability of education and training systems to face changing skills demands and prepare workers for the jobs of the future. Shorter and more targeted papers (e.g. policy briefs, infographics, a methodological note) are published in parallel. Further discussion papers reflecting on the different case studies implemented across countries will follow at a later stage after the full series of cases has been completed.

Last but not least, the ETF would like to thank all the public and private institutions, individuals and companies in Morocco (see list in Annex) for sharing information and opinions on the topic, and actively participating in the ETF's online workshops organised in June and November 2020. This report would not have been possible without their significant contributions.

CONTENTS

EXECUTIVE SUMMARY

In many countries, the agricultural sector is important, accounting for a substantial share of overall employment both directly and indirectly through its links to food processing and food distribution. This report focuses on the agri-food sector in Morocco. Activities that take place in the agri-food sector in Morocco are those which involve farming and the sale of products from Moroccan farms to final consumers. As such, it involves the processing of produce from Moroccan farms into food for sale. This will include, for example, the processing of Moroccan-grown sugar beet into sugar, the production of orange juice from oranges, and the pressing of olives to make olive oil. It thereby includes value-adding activities related to agriculture. It forms an ecosystem whereby agricultural producers are interlinked with food processing ones. The agri-food sector is not readily identified using the statistical classification of economic activities in the European Community (NACE – Nomenclature statistique des activités économiques dans la Communauté européenne). It includes agriculture (NACE Division 01) and parts of the food processing sector (classified under NACE Divisions 10 and 11) but excludes forestry (NACE Division 02) and fishing (NACE Division 03) since they require a completely different set of skills to those of farming. From an occupational point of view, the focus has been on those job profiles and skills which are likely to be affected by ongoing and future technological change. The overall aim of the study has been to identify as far as possible the sector's emerging skills needs.

Agriculture in Morocco has accounted for around 12% of gross domestic product (GDP) over the past five years and around 33% of employment. Low productivity and low incomes drive people out of agriculture, leading to falling employment in the sector. Employment fell from 45% of total employment in 2006 to 38% in 2019 but remains much higher than the share of value added it produces. Agri-food as a whole is particularly important in rural areas. It is estimated that currently around 4 million rural inhabitants are employed in agriculture. On the other hand, the food processing industry has a more limited but increasing workforce, as around 141 000 people work in the sector at the national level. The agri-food sector accounts for around 21% of total exports. The sector plays a key role in rural development and food security in Morocco. It is also a sector which faces major challenges, not least soil erosion and degradation and drought which blight agriculture. There are also large disparities in the performance of large farms compared with their smaller counterparts.

Given its economic importance and the nature of the challenges it faces, the agricultural sector has been subject, over the last decade, to policy making which has addressed productivity, employment, and the climate change/green agenda. One of the most important public policy interventions has been the Green Morocco Plan (Plan Maroc Vert) 2008–2020. Launched in 2008, it was designed to support the development of the agricultural sector by fostering closer links between farms and industry, and stimulating the formation of cooperatives between farms. Given the dominance of small farms – 70% of farmers own less than five hectares – cooperatives have been regarded as an effective means of developing the technical and managerial skills the sector needs, along with improved access to finance, modern production systems, and marketing. The plan – which drew to a close in 2020 – was expected to create over one million jobs and triple the income of rural inhabitants. There are other initiatives that have focused more on the agri-food industry, such as the National Pact for Industrial Emergence (Pacte national pour l'émergence industrielle, 2009–2015) to

support sector growth by improving the agri-food infrastructure via agropoles[1]; the Industrial Acceleration Plan (2014–2020); and the Contract Programme 2017–2022 for the agri-food industry.

In spring 2020, a new strategy for agriculture – Génération Green – was launched. The new strategy, which covers the period to 2030, will build on the achievements of the Green Morocco Plan to further consolidate growth and social improvements in the sector. It focuses particularly on human capital development, increasing the revenues of farmers through investments, and widening access to social protection for workers in the sector (the Decent Work Agenda). The strategy is also intended to make the sector more attractive to young people either as an employment destination or a focus for their entrepreneurship. It also continues to support the creation of new agricultural organisations/ cooperatives and the adoption of new technologies in the production process.

Agriculture, considered part of the agri-food sector, is a sector that has relied on traditional technologies and associated skills for decades. Now, the challenges imposed by global trade and competition, climate change and sustainable farming, changing consumer behaviour and diffusion of affordable new technologies have all resulted in the sector undergoing a series of radical changes across the globe. The Moroccan agri-foods sector is no exception. The capacity of the agri-food sector to be a driver of growth is dependent on it possessing, among other things, the human capital to facilitate the shift to more effective, environmentally sustainable production systems, and improved marketing and distribution which will afford better access to international markets. This is where the current study has a role to play. It provides an assessment of current and emerging skills demands in the agri-food sector in Morocco resulting from the various changes that the sector is undergoing.

Research method

The study used a mixed methods approach, using the following:

- analysis of reports and statistics which reveal something about the evolving demand for skills in the agri-food sector in Morocco;
- big data analysis employing text mining techniques to capture data on emerging technological change (and the factors underlying that change) and associated skills needs from a variety of sources (e.g. patents, scientific papers and policy papers);
- interviews with companies from the sector, bilateral meetings, focus group and a validation workshop with key stakeholders.

The background analysis – based on a review of the literature and analysis of official statistics – provides an overview of employment, innovation and skills developments in the agri-food sector. The text mining element provides information on technological trends and associated skills needs which are not readily captured in reports, and statistics tend to focus on past rather than future trends.

The interviews with key stakeholders and companies build on the big data analysis to explore in more depth the types of technologies being introduced into the sector and the skills needs they give rise to. Importantly, the interviews also reveal much about the preparedness of the supply side to keep pace with the changing demand for skills.

[1] Agropoles offer various services to producers and are specifically designed to support the value chains in value creation and export growth.

Drivers of change

To derive a list of technologies requires an analysis of the drivers of change. Big data analysis, combined with insights from desk research and interviews, identified the following drivers of change in Morocco's agri-food sector:

- Globalisation has had a positive impact on innovation and the modernisation of production processes. But increasing international trade in agri-food products and reduced tariffs have also resulted in the abandonment of some product markets because of price competition from other countries.
- Regulation, government incentives, and taxation. National and international rules and standards affect the agri-food business, from farm production (e.g. the regulation of pesticide use) to market distribution (e.g. where goods need to be kept at a certain temperature). Additionally, government programmes, such as the Green Morocco Plan, Génération Green, and agropoles, have supported the development of the sector. Finally, taxation and trade tariffs also affect competitiveness.
- Aridity is a problem. During 2018 and 2019, Morocco has been hit by severe droughts which have affected both production quantity and quality. Related to this, climate change, which will likely worsen water scarcity, efficient water management (as a response to aridity and climate change) and environmental sustainability (e.g. issues related to energy production and waste management/reuse) are further driving change in the sector.
- Crop improvement. The development of new varieties of plants increases their resistance to water stress, disease and pest infestation. Thus, crop improvement is becoming more important in the sector.
- Technological innovation, mainly related to improving efficiency, reducing costs and raising productivity levels, has been increasing since 2008 thanks to government measures such as the Green Morocco Plan.
- Quality, identity preservation, and consumer awareness (national and international). Improving the quality of products (e.g. organic agriculture, agroecology, and preservation of food identity) and of processes (e.g. traceability), the development of new niche products, and the shift towards increased food processing is becoming increasingly important in order to compete in the international market, satisfy emerging customers' needs, and capture a relatively high-value segment of global supply chains. A related theme is that of achieving a structured value chain to improve controls and quality along the chain from production to distribution and reduce the widespread presence of the informal market.
- Change in the tastes of Moroccans. Shifts in the lifestyles and consumer preferences of Moroccans, especially new demands for quality and clean and safe products (with less or no use of chemical products), affect the agri-food sector, which potentially opens up new market opportunities. Improving sustainability requires investments and innovation in new products and associated business models.
- Impact of Covid-19. The pandemic has forced some companies to re-think their product offering as well as speed up the use of some digital technologies. Despite facing difficulties because of Covid-19, the agri-food sector has fared relatively well to date.

Emerging technologies

The various drivers of change have implications for the types of technologies used in the agri-food sector. The analysis of patent data suggests that innovations in irrigation systems, biochemistry and pesticides and fertilisers have been relatively commonplace (as indicated by the relatively large number of patents filed) and are likely to bring about future change in the agri-food sector. There are also a range of other technologies/technological processes which the text mining analysis indicates as being important to the sector in Morocco. These are:

- data acquisition and analysis
- solar thermal devices (solar collector, heating devices, heat carrier medium)
- chemical separation techniques (flash and column chromatography)
- telemetry for reducing energy consumption
- harvesting machines for precision farming
- image acquisition
- Nuclear Magnetic Resonance (NMR)
- microwave reactor
- wireless technologies
- pumps for irrigation systems
- drive mechanisms
- preventive maintenance
- sealing
- valves (isolation valve, control valve)
- material treatment
- hydraulics systems
- information technology (IT) systems development
- genetics, biochemistry, biotechnologies
- robotic arms
- automation
- automatic measurement devices for packing and transportation
- chemistry and green chemistry
- mechanical press
- raw material extrusion
- sensors (biosensors, remote sensors, microsensors)
- nanotechnologies.

These are all technologies which will become more commonplace in agri-food in the short to medium term. If these technologies are to be adopted, the workforce will need to acquire the skills to operate them.

Identifying new skills needs

The capacity of the agri-food sector to obtain maximum benefits from the new technologies listed above depends on the availability of skills to facilitate their introduction, use and maintenance. To identify the skills attached to the technologies, a further round of text mining was undertaken using two online databases which contain detailed information on occupational skills profiles: (i) the multilingual classification of European Skills, Competences, Qualifications and Occupations (ESCO) database, and (ii) the Occupational Information Network (O*NET) database from the USA. As these two databases do not contain emerging (future) jobs or new skills needs, Wikipedia was also used as it contains this information.

The results of the analysis reveal the jobs which are likely to be most affected by technological change. These are:

- technical or technology-related occupations**,** such as engineers and technicians in various technological areas, especially those related to the value chain, quality control, maintenance, and energy efficiency; data analysts and computer programmers; agriculture-related professionals such as agronomists, soil and plant scientists, irrigation specialists and food scientists; certain categories of machine operators and skilled craft workers; and agricultural and transport labourers;
- business services and related occupations**,** such as renewable energy consultants and representatives; food managers; different types of production team leaders, such as agronomic crops, horticulture and fruit; and horticulture production managers.

The analysis shows that the professional and associate professional occupations most likely to be affected by technological change are water plant technicians, biochemical engineers, sensor engineering technicians, bioengineers, water engineers, fluid power engineers and wastewater engineers and technicians. It is not just professional and technician jobs that will be affected, but also medium-skilled occupations related to day-to-day farming such as pump operators. The impact of technological change will increasingly affect people working at all levels in the sector.

The new skills needed to master the interface with new technologies will also affect the role of more traditional jobs in agri-food such as agronomists and food specialists. While the set of skills listed by ESCO for that occupation range from using pesticides to developing irrigation strategies, the information collected from the interviews with key stakeholders and employers revealed that agronomists will have to possess a wider range of knowledge than before, including, for example, precision agriculture techniques (e.g. monitoring sensors and interpreting data). Also, the skills related to the ongoing changes towards diversification, quality improvement, exports to foreign markets, and upgrading along the value chain will reshape existing profiles in a range of production, management and sales jobs.

Entirely new professions will emerge as well, typically at the boundary between disciplines. These new jobs include, for example, those related to the new niche markets that will emerge, such as environmental economist or nutritionist engineer (expert in technological processes but also in consumer preferences and habits). Other emerging specialisations are those related to the improvement and control of quality and processes such as metrologist or manufacturing and packaging managers.

Data mining analysis and company interviews reveal that even if digitalisation is disruptive, resulting in some roles being substituted by automation, there is the potential to upskill those workers who may be at risk from this development. In this way, the jobs of existing workers can be retained.

To sum up, the evidence indicates that the majority of workers will need to possess a wider range of skills than in the past as a consequence of the technological changes which are already coming on stream and which are likely to be more commonplace in the future. In particular, the interviews with companies pointed to high-level skills needs encompassing multidisciplinary competences, and the ability to interact with people from different disciplinary or professional backgrounds. This potentially poses a number of challenges for those responsible for developing the agri-food sector's future supply of skills.

Responding to change: the views of stakeholders

Desk research (review of various policy reports, collation of official statistics, and big data analysis) was the first step in looking at the demand for skills. Interviews with key stakeholders and companies on their experiences of technological change and the emerging skills needs were used as the second step to assess how the new skills are obtained by companies. The results from the interviews with key agri-food stakeholders revealed the following findings.

- All the sector representatives confirmed that the sector is undergoing a period of advanced technological change as outlined by the big data analysis.
- There are various factors which may constrain growth in the agri-food sector, from the high capital investments needed to acquire new technologies – which are out of reach for smaller companies/farms – to the shortage of skills needed to manage ongoing changes.
- Recruiting people with the skills needed to adapt to technological change can prove difficult for four reasons: the relatively low attractiveness of the sector compared with positions in the public sector that require similar levels of skill; many highly skilled workers (including engineers) leave the country to work abroad; in some regions, agri-food establishments are located far from population centres; and there is a varying level of supply coming from the local education and training system.
- Strategies to recruit people with the right skills range from recruiting new graduates from universities after an internship period, to recruitment through head-hunters and also using job advertisements. For smaller businesses, word of mouth is also a solution.
- Many companies are training their workforces (upskilling and reskilling) so that future skills needs will be met. This is an investment for both companies and society but the cost of which is carried mainly by the employers.
- More training/education centres dedicated to agri-food are needed if future skills needs are to be met. At the moment, individual businesses need to develop the skills they need in-house.

Improving skills anticipation

The use of a mixed methods approach – combining desk research with data mining techniques and interviews with stakeholders and companies – has provided more nuanced information on emerging skills needs. It has identified the key technologies that will drive skills demand over the short to medium term, and the variety of skills which will be increasingly in demand. The results can guide future training provision so that skills shortages which might constrain growth can be avoided.

This is not the end of the process. The report raises questions for further research, such as information on the supply of skills (its quality and volume) and the scale of demand, whether that demand is likely to be met, and the impact of unmet skills on the sector and the economy. By identifying the specific skills which will affect a variety of jobs in the future, it is now possible to feed this information into skills forecasting and skills foresight exercises, and into the design of employer skills surveys. The latter can help identify the volume of demand for specific occupations/jobs/skills, and the actual combinations of skills which are required within those jobs. It can also provide an indication of whether supply is keeping pace with demand.

Given the high speed of technological advances in some sectors such as agri-food, it is necessary to periodically repeat the analysis carried out in this study so that an updated list of specific skills needs is available.

Final conclusions

Based on the analysis contained in the report, the following policy conclusions emerged.

1. There is a need to adopt an integrated vision and push for greater convergence between agriculture (upstream) and food processing (downstream). They are managed by different institutions at a national level, but if a vision for the agri-food sector is to be fully developed and realised, there will need to be much more convergence/integration between those authorities responsible for the constituent parts of the agri-food sector.
2. The major challenges facing the agri-food sector are clear enough in the report: manage climate change, increase productivity, capture high value added segments of global markets, and increase the supply of skills the sector needs to name but a few. Meeting these challenges will require increased investments in research and development.
3. There is a need to support the transfer of new technologies to farms of all sizes through sectoral associations, cooperatives, and/or public institutions such as the Office National du Conseil Agricole. It will be important to demonstrate the benefits of investing in new technologies such as clearly signalling the economic benefits to be gained from, for example, using solar power to dry food. In some respects, what is important here is changing mindsets, i.e. persuading producers to be more open to innovations of one kind or another, given that the failure to change may ultimately threaten the viability of their current businesses.
4. The aggregation of small farmers was one of the key elements of the Green Morocco Plan. This direction should be pursued even further to promote different types of collective organisations. For example, the economic interest group (groupement d'intérêt économique) can play a substantial role in regional development, as they put together traditional units that otherwise would not be able to ensure quality. However, they should be provided with more capacity in terms of number of experts, and with incentives to compensate for higher costs than in the informal market.
5. Human capital development needs to take place simultaneously with technological change as the two elements are inter-dependent. Accordingly, there is a need for improved information about and diagnosis of skills and training needs. The current study has made an important step here in demonstrating the information which can be used to undertake such a diagnosis. This type of skills intelligence needs to be converted into a process for identifying training needs.
6. In considering how training and education needs relevant to the sector can be satisfied, there is a need to think about innovative, efficient and effective means of delivery. Online delivery tools are important here. More practical (e.g. laboratory) activities are also relevant, especially to complement higher education curricula. But it is not just about the means of delivery. There is content to think of as well. For instance, Morocco wants to increase the volume of its exports which, in turn, points to training and skills needs related to international cooperation.
7. Interviews pointed out that the main gap in human resources is not at university level, but is linked to vocational education and training (VET) graduates, due to a limited capacity of the education system to provide enough technicians with the appropriate competences coupled with practical training. The ability to attract and retain young graduates is another key issue.
8. To overcome the shortage of skilled professionals, a good practice that could be further explored and possibly mainstreamed is that of sectoral federations creating specialised institutions for continuing training. An example of this is the agreement between the Fédération nationale de la minoterie and the Office de la formation professionnelle et de la promotion du travail that enabled the Institut de formation de l'industrie meunière to train more than 400 technicians

specialised in milling activities. The advantage is in-depth knowledge of the sector and its specific needs.

9. Green technologies, biological or organic farming, agroecology, and sustainable development are new models for agri-food which can become profitable niches for Morocco, with benefits for both the market proposition and job creation. For example, renewable energy has been indicated alongside irrigation of wider portions of land as two main sources of new employment in the country. The Department of Agriculture of the Ministry of Agriculture and Fisheries could revise education programmes to adapt to these emerging niches.
10. One of the main challenges for the future is to enhance and diversify local products and, at the same time, improve the quality of production to attract more customers, at national and international levels. Acting at the value chain level seems an efficient way to increase employment both in the agricultural sector and in all the other economic sectors that interact with it: industry, energy, craft, design and marketing. However, at present, not all value chains are well organised; in these cases, issues should be tackled to address the lack of organisation so that large companies, cooperatives and institutions can support the aggregation of small players and transfer know-how, fostering the adoption of technologies, new management models, access to funding, and quality control and certification. A related issue is that the informal market impacts negatively on the more innovative enterprises, pushing for lower prices and lower quality.
11. New vocational schools dedicated to specific value chains could be developed to train professionals in specific competences, especially those related to higher value added products, or to promote research and development activities.
12. Last but not least, enhancing continuing training, reskilling and upskilling helps adaptability of workers to rapidly change skills and to give them tools to transit to new job opportunities. In this, cooperation with the private sector (with the establishment of specific public–private partnerships, as is already happening in some sectors) is key, together with the reinforcement of work-based learning practices and internships.

1. INTRODUCTION

The pace of technological advance in the world today often appears daunting. Speculative predictions point to huge swathes of jobs being replaced by automation in the guise of robots, artificial intelligence routines, and so on. In reality, the impact of technological change on employment is often much less sensational. Some jobs will be lost as a consequence of technological change – this has always been the case – but other new jobs will be created too. These new jobs may, as yet, be unknown to us. Thirty years ago, many of the jobs available today would have been beyond people's imagination at the time. But if advantage is to be taken of technological change, then an indication is required of types of jobs and the skills they will give rise to in the future. Technological change will only take root in a country if the skills are in place that will lead to its introduction in the first instance, and then for it to be used as effectively and efficiently as possible so that its value to the economy is optimised. The danger of not introducing new technologies is that an economy, or sector, will fall behind that in competitor countries.

Anticipating the skills needs associated with technological change faces two key challenges. First, the pace of technological change is such that predicting its future trajectory poses a number of problems. Second, if there is uncertainty about technological change, this makes it even more difficult to identify emerging skills needs. It is worth mentioning at this point that the pace of technological change in practice is often slower than some commentators would have one believe. It typically requires relatively large-scale investments by companies who, understandably, are often cautious with regard to the likely returns. This tends to slow the pace of diffusion. Nevertheless, official statistics and surveys which capture information on fixed capital investments by companies and the skills needs resulting from technological change are sometimes dated by the time they are published. Often, they provide information on what the situation was a few years ago. Policy-makers ideally want much more up-to-date information. Even if the pace of technological change is slower than sometimes predicted, current information is still a necessity for the policy-maker. This is where the approach adopted in the current study pays dividends. It makes the most of the historical data, which provides robust estimates of, for instance, changes in the occupational and job structure of employment, but marries it with more up-to-date information obtained from the use of text mining techniques which gather almost real-time data on technological change and associated emerging skills needs.

Technological change is pervasive. It has the capacity to affect all sectors and all jobs in one way or another. It has the capacity to be disruptive even in those sectors which are relatively labour-intensive. This is why the agri-food sector is of interest. It is a sector which is relatively labour-intensive but subject to major technological changes designed to address key challenges such as the need to increase crop resilience and better manage water resources. It is also a sector which accounts for a relatively large share of employment in countries such as Morocco. With this in mind, the current study addresses, among other things, the following:

- the drivers of technological change in agri-food, and an assessment of the technologies which are currently being introduced or which are likely to be increasingly introduced in the years ahead;
- the impact of non-technological drivers of change – e.g. the need for sustainability, regulation, global trade patterns, and changing consumer habits – which are also likely to have some bearing on the future demand for skills;

- the skills demand which will result from the increased take-up of various forms of technological change;
- the supply side's capacity to keep pace with the skills needs associated with technological change (i.e. the extent to which the education and training system will be able to meet emerging skills needs).

The report is organised as follows: Chapter 2 sets out the study's analytical framework and methodological approach. A more detailed explanation of the methodology has been published separately by the ETF. In Chapter 3, an overview of the agri-food sector in Morocco is provided based on a literature review and secondary analysis of official employment statistics. It provides the contextual background relating to the sector and also operation of the labour market in Morocco. Based on the text mining exercise, Chapter 4 analyses the main drivers of change in agri-food in Morocco and the technological changes which are beginning to take root. It further explores how these are likely to influence future skills needs. Using data derived from the text mining, combined with information obtained from the in-depth interviews with key stakeholders and selected innovative companies, Chapter 5 provides information on emerging skills needs and their impact on occupational job profiles. Chapter 6 outlines how the companies have responded to observed changes to meet their emerging skills needs, including their strategies involving education and training providers and research centres. The chapter finishes with a final word on the findings.

The report also includes a list of key stakeholder institutions in Morocco who were consulted at various stages (see Annex), a glossary of various terms and concepts used throughout the report, and a list of references.

2. METHODOLOGICAL APPROACH

The purpose of this study is to understand the drivers of change affecting the agri-food sector in Morocco, ascertain the technological changes which are either taking place or about to take place, and identify the resulting skills needs. The study is about understanding the links between technological change and skills demand so that policy-makers can better respond to emerging skills needs. The initial research questions that provided the framework of the study are shown in Box 2.1.

BOX 2.1 SPECIFIC RESEARCH QUESTIONS

Questions about the state of development in the analysed sector

1. What is the relationship of the selected subsector to the whole sector and the broader economy, e.g. production, employment and export?
2. What are the main drivers of change currently shaping the sector, e.g. trade, global value chains, new technologies, digital tools greening of the economy and climate change?
3. What has driven/generated innovation in this part of the sector and does it have the potential to become an influence on the rest of the sector?

Questions about the empirical evidence on the changes occurring in the sector

4. What are the ongoing changes observed in the sector in terms of production, storage, marketing, business practices, labour and skills utilisation?
5. What are the main occupational profiles used in the sector? Has the content of some occupations evolved as a result of the above changes in the sector, and if so, how?
6. Which new tasks and functions have emerged in the jobs and/or occupations in this sector? Which old ones have disappeared?
7. What are the differences in the job profiles of this innovative sector? What changes are observed in the profiles of new recruitments and job vacancies published?
8. What is the impact of these changes on labour and skills demands in the sector? Do changes require higher levels of the same skills or completely new sets of skills from workers?
9. How do these changes affect 'skills utilisation' and working conditions in the sector, e.g. salary, contracts, working hours and formality?
10. How do businesses meet their new skills needs (new hiring, retraining, etc.)? Are there initiatives for cooperation of companies with education and training providers?

Questions about policy implications

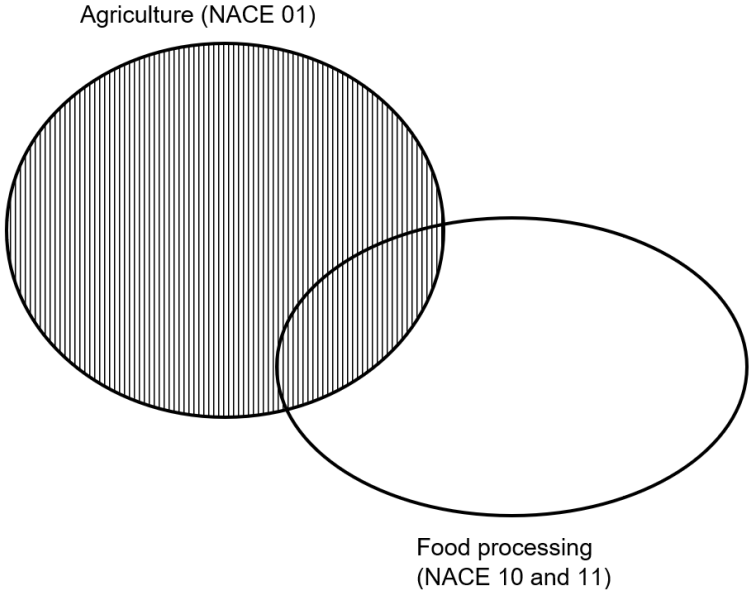
11. Do technology, innovation and other changes push countries towards a higher added value and integration in the global value chain? Are skills contributing to this shift? If so, how? Are there skills gaps that impede developments?
12. Are there any spill over effects from the changes in the broader sector overall? What context-specific and general lessons can be derived from these studies?
13. Are changes and innovation in the sector causing education and training to respond and adapt to industry needs?

2.1 Defining the agri-food sector

Activities that take place in the agri-food sector in Morocco are those which involve farming and the sale of products from Moroccan farms to final consumers. As such, it involves the processing of produce from Moroccan farms into food for sale. This will include, for example, the processing of Moroccan-grown sugar beet into sugar, the production of orange juice from oranges, and the pressing of olives to make olive oil. It forms an ecosystem whereby agricultural producers are interlinked with food processing. The agri-food sector is not readily identified using NACE (the statistical classification of economic activities in the European Community – see Glossary for more details). It includes agriculture (NACE Division 01) and parts of the food processing sector (NACE Divisions 10 and 11).

The Venn diagram in Figure 2.1 shows the interlinkages between the agriculture and food processing sectors with the shaded areas depicting the agri-food sector.

FIGURE 2.1 VISUALISATION OF THE MOROCCAN AGRI-FOOD SECTOR



The present study encompasses all food types coming from farming activities, from cereals and fruit and vegetables, to meat and dairy products, and all company types, including small, traditional, family-run activities, large and often highly mechanised farms, and cooperatives. The study does not include subsistence agriculture as it is used to satisfy the need of producers and therefore not destined for commercialisation. It also does not include fishing, because although it is related to human nutrition, its workers must possess a different and distinctive set of skills.

It is important to note that a substantial part of the strategies to develop the sectors are related to the logic of creating a business ecosystem. The Green Morocco Plan 2008–2020 has certainly boosted the agri-food sector, mostly on the production (agricultural) side, while Génération Green will focus on enhancing the value of production. Moreover, the creation of agropoles[2] has built a bridge

[2] Agropoles offer various services to producers and are specifically designed to support the value chains in value creation and export growth.

between agriculture and the food processing industry, fostering a more integrated approach linking the upstream and downstream processes in agri-food.

2.2 Step-by-step approach to data collection and processing

Given the need for the study to be forward-looking, a mixed methods approach has been used, combining desk research and data analysis with data mining techniques and interviews with stakeholders and companies (Box 2.2).

BOX 2.2 STEPS FOLLOWED IN THE STUDY'S MIXED METHODS APPROACH

1. Use of well-established methodologies derived from social science, including:
   - a literature review of the agri-food sector in Morocco, and
   - secondary analysis of employment and skills data, in particular in the sector.
2. Big data analysis in relation to the agri-food sector in Morocco:
   - text mining applied to a large volume of documents such as patents or scientific papers connected to agri-food to identify the upcoming technologies and other drivers of change, and
   - comparing and matching the list of relevant technologies extracted from text mining to the related occupations and skills listed by the occupational databases of ESCO* and O*NET*, by using semantic matching algorithms.
3. In-depth interviews with companies and key stakeholders in the agri-food sector and focus groups to verify and refine the results of the two previous steps.

* See Glossary for more details.

The first step of the study involved reviewing the literature on the innovation, employment and skills pool in Morocco. This was followed by a description of the agri-food sector. This contextual analysis demonstrates that the capacity of the sector to introduce the latest technologies does not rest only with skills policies, but also with obtaining investment capital, having links with research institutes, and offering relatively good jobs to attract those with the necessary skills.

The second step is that of text mining, a technique that allows computers to extract, discover or organise relevant information from large collections of different written resources. The textual documentation produced by industries, institutions, research centres and the like offers a vast amount of information which is often scattered across many sources, the sheer volume of which makes it impossible to collate and analyse through manual searches. Even if manual searches could be undertaken, it is likely that some data would be missed. For this study, a proprietary text mining tool was used to scan the largest possible corpus of data in English. Algorithms using natural language processing, among other techniques, were able to extract and record the number of incidences where a technology (or other relevant entities such as occupations and country names) was mentioned and keep track of all the inter-relationships between key terms.

Key sources used for the text mining analysis were patents and scientific papers in English. They comprise a large and accessible corpus of structured data which is extremely important for the reliability and completeness of results. Patents are widely considered a good proxy for measuring innovation and anticipating technological changes, while papers and conference proceedings allow the researchers to additionally capture information on social and economic factors. For patents, data

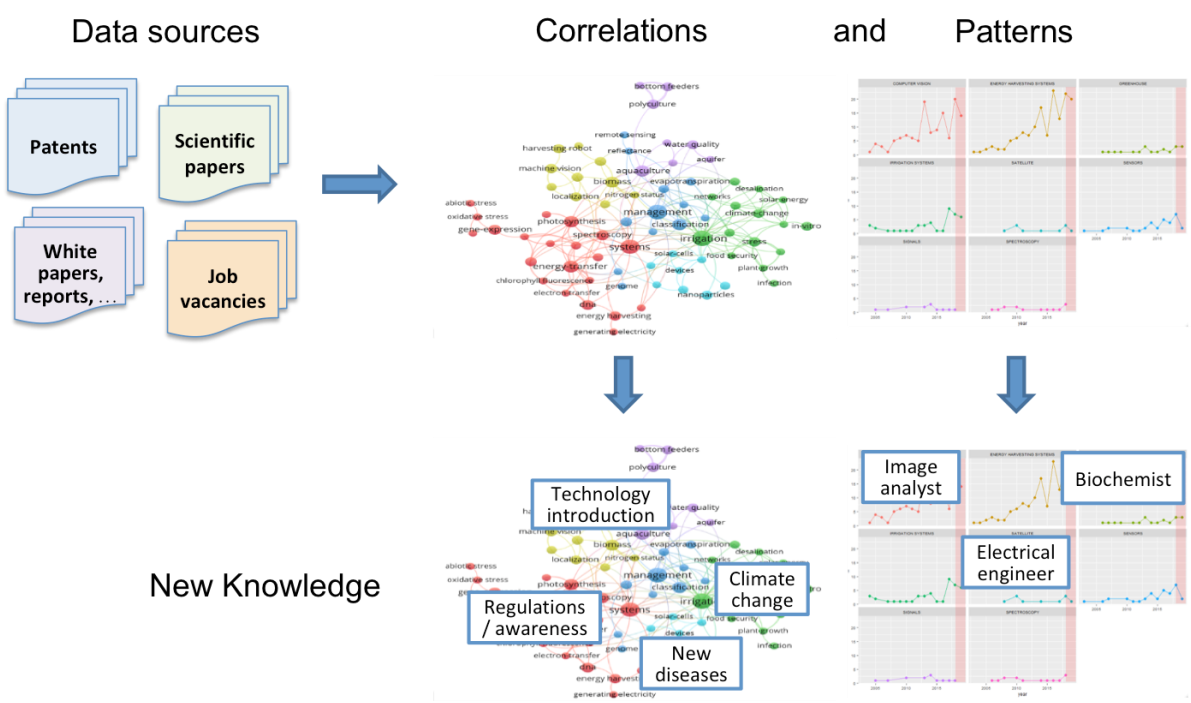
was taken from Espacenet, the official database of the European Patent Office, regarded by many as the most authoritative source of patent information, containing over 120 million documents from around the world and updated daily. For scientific papers, both Scopus (by Elsevier) and Web of Science (by Clarivate) were used, the two largest databases of peer-reviewed papers, where an equivalent study was performed on around 70 million scientific papers. In addition, white papers, policy papers, project reports and foresight papers from Moroccan and international institutions were searched using standard queries and downloaded to be analysed. But there were fewer of the latter documents and they were also unstructured, so were not as relevant as patents and papers.

The data was processed with proprietary algorithms to harmonise names of inventors, authors, companies and universities, and to consolidate the geo-localisation of parties according to the nomenclature of territorial units for statistics (NUTS) codes. The latter is clearly relevant for country-specific studies. To maintain the focus on Morocco, two types of patents were selected: those issued directly by the Moroccan Office of Industrial and Commercial Property, and international ones for which at least one of the assignees was located in the country. Papers were selected if Morocco was cited among the countries of interest for the study. Semantic algorithms were able to recognise functional concepts rather than simple keywords, so they were used to scan the full text of each document to identify those with a main focus on agri-food. Documents from as far back as 1948 were retrieved, but for many analyses, data from only the last 10 or 15 years was used. This is a good time window given the rather long cycles of agriculture, and restricting to even more recent periods would have obscured most temporal trends.

The first phase of this text mining identified two main categories of relevant information: (i) technical and societal drivers of change; and (ii) technologies introduced into the sector and their diffusion over time. In the second phase of text mining, the information identified was compared and matched to the associated occupations and skills listed in ESCO and O*NET by using semantic matching algorithms (i.e. algorithms able to find semantic connections between different concepts based on contextual information). For example, each occupation in the ESCO database included a description and a list of competences, skills and knowledge considered relevant (either essential or optional) for that occupation. The semantic algorithm looked for matches of each technology with all the concepts associated with that occupation. When a match was found, the occupation was considered associated with the technology. The entire procedure was automated using ESCO's Application Programming Interface (API), which allowed occupational data to be downloaded. If an occupation was impacted upon by a technology at any level, then the text mining found it. If no match was found in ESCO or O*NET due to emerging (future) jobs or new skills needs, other approaches – e.g. connecting the new competences through Wikipedia – were used to try to identify them.

The main advantage of text mining is the ability to search a very large number of documents quickly. In particular, patents and scientific papers are easy to access and structured (compared to social media), so information extraction is facilitated. Although information may be scattered over many different documents, algorithms are able to discover hidden patterns and emerging phenomena which might not be detected by manual search techniques. By correlating concepts and extracting trends, it allows weak signals to be detected and emerging trends to be spotted (see Figure 2.2). This gives a future-oriented perspective and hints at what is not already known from the past. Anticipating the future from the extrapolation of past trends, even with the most sophisticated forecasting models, is likely to fail if the phenomenon of interest is subject to rapid and disruptive change. Text mining at least provides a basis for identifying the variety of disruptive factors which can then be explored with key stakeholders. This is particularly important when thinking about the skills implications of technological change because there is an element of entering the unknown.

FIGURE 2.2 TEXT MINING EXTRACTS: CORRELATIONS AND TRENDS FROM THE DATA THAT CAN BE TURNED INTO KNOWLEDGE ABOUT THE FUTURE OF SKILLS AND JOB PROFILES



The third step was complementary qualitative research to obtain information from key stakeholders and companies about their experience of technological change and other change drivers in the sector and the new skills needs. Due to the Covid-19 pandemic, focus group discussions were convened online in June 2020 involving relevant stakeholders from the agri-food sector and the education and training system. Around 60 representatives from government institutions, academia and research, as well as public and private associations and organisations, attended the focus group discussions. The purpose was to reflect on the results from the previous steps. After the focus group, face-to-face in-depth interviews were conducted between June 2020 and November 2020. A semi-structured interview technique was used to guide the discussions. A final validation event with main stakeholders was organised in November 2020.

2.3 Qualitative data collection

The first set of interviews was undertaken with key stakeholders in the agri-food sector. More than 20 stakeholders were identified during the planning of the fieldwork; the stakeholders represent a broad base, including sector representatives (e.g. social partners and professional associations), policy-makers, government organisations, education and training providers, universities, members of the research community, intermediaries and entrepreneurs. Ten face-to-face stakeholder interviews were conducted to gain insight into how they perceive and manage the process of technological change and how they acquire the skills they need, but also what incentives there are for skills development. A full list of these key stakeholders (as institutions, not individuals) is provided in Annex. The names of individuals from these institutions are not included for data privacy reasons.

The second target group was the selected innovative companies in the sector, to understand their perception and actions in managing the technological change process in the companies and ways of finding the skills they need. The text mining from patents enabled identification of the top five

innovative companies (as measured by the most patent filing in recent years) for each technological cluster or subsector during the analysis. This led to around 40 Moroccan companies being selected. The list was manually revised to check for duplicates or for mergers and acquisitions and to ensure variety across subsectors. Finally, the national expert integrated the list with other candidates, and the resulting companies were contacted.

In total, 13 companies were interviewed from the sector, covering the widest possible spectrum of agri-food activities and including enterprises of different sizes and types. The questions focused on how companies deal with the process of technological change (including barriers to its implementation such as shortages of capital and skills), and the impact on the content of jobs and the related skills needs emerging from these changes. The names of the interviewed companies as well as the individual names are kept confidential for data privacy reasons.

Collecting the views of key stakeholders and interviewing the most innovative companies was an important step since new skills demands can be revealed only by understanding the responses of companies to the signals about emerging technologies. Arguably, by interviewing the most innovative companies, one may not provide a fully balanced picture, but the study wanted to collect evidence on how technological changes, if implemented, affect employment and skills. The research therefore needed to interview companies in the vanguard of technological change, so to speak, so that the impact on skills demand could be identified.

2.4 Use of mixed methods in practice

In general, there was no contradiction between the results from the text mining and interviews. Combining different research methods brought some advantages, as no single methodology can identify all the emerging skills needs in the agri-food sector. Different techniques complemented one another, each compensating for the potential shortcomings of the other. The results from different research tools were then compared and verified. For example, companies' product market and skills strategies were difficult to collate by text mining, but this could be done by reading their annual reports and interviewing key personnel. But these were not always ideal sources to find out about the technologies which are transforming or are about to transform products and processes in their sector as companies might simply be unaware of them. Here, text mining identified technologies that are likely to have a major influence on companies' strategies in the future, in addition to other advantages of text mining discussed above.

Nevertheless, there are certain limitations of this study which need to be acknowledged.

- The information provided by companies and other key stakeholders should be regarded as indicative rather than comprehensive given that only a small number of people were interviewed in the study. Future studies could include more interviews, with a more representative selection of companies and stakeholders, but this tends to be resource-intensive and costly.
- The text mining was limited to searches in English. French, for example, was not used in the searches. It is likely to be the case, however, that most of the patents and scientific papers were published in English in this period. For future analyses, there is scope to extend the text mining tool to other languages to balance this limitation.
- Despite the mixed methods approach used in the study, this report is not able to give an indication of the scale or volume of any change in jobs and employment (e.g. it is not able to estimate how many extra agronomists will be required), the relative importance of particular skills, or the extent of any skills mismatches. Other methodologies are required to address these issues.

- Patents are proxies for innovation and tend to be concerned with emerging technologies (e.g. patents are often filed to protect an innovation that is just about to come on stream). But it is possible that some innovations are not patented. Moreover, patents are mainly linked to technological innovation. Non-technological innovations are also important; the review of scientific papers and interviews with companies and stakeholders captured other drivers of change.
- The analysis of skills was limited to those associated with technologies and other trends identified by the text mining. If a certain technology was linked to occupations and skills at high or medium level in ESCO and O*NET databases, this was captured. There were several cases where this link did not exist (e.g. incomplete descriptions of skills). For example, agronomists are not yet linked to precision agriculture in the ESCO database, but the company interviews showed that agronomists that are sought after have to possess this new knowledge. It could be expected that links might be missing more frequently in the case of medium- and low-skilled occupations.
- If there are completely new (future) occupations and skills needs, they have not been found in the existing ESCO or O*NET databases. In these cases, other non-conventional data sources such as Wikipedia were used to access and identify information beyond the traditional structured ones, when considered non-exhaustive. However, it is clear that the information provided by these types of sources should be handled with care.

Despite these limitations, the data science approach brings some added value. It builds on the conventional forms of skills analyses such as undertaking skills surveys and carrying out skills forecasting. It allows identification of the skill content of jobs in the agri-tech sector and possible changes of skills with new technology. Thus, the focus is on actual jobs and how these will change over the short to medium term, rather than broad aggregations of jobs into occupations. Data is captured on specific skills in specific jobs rather than total demand for certain occupations. The approach is flexible, and the algorithms can be run and rerun in a relatively speedy manner. This means that if a sudden economic shock or a crisis of some kind emerges – such as Covid-19 – the analysis can be quickly rerun to capture the effects of these (so long as there is data that can be searched).

2.5 The impact of Covid-19 on the results of the study

The report was completed during the outbreak of the Covid-19 pandemic, which brought a high degree of uncertainty regarding the future of employment and skills demand. As the study is concerned with the long-term development of skills demand resulting from technological change, the findings are less sensitive to changes over the shorter term. The pace of change may slow down or accelerate as a result of the pandemic, but the nature of that change is likely to remain the same. The uptake of agri-food technologies (e.g. robots, drones and sensors for precision agriculture) may be accelerated in the medium term in some countries due to the Covid-19 experience of high dependency on importing essential goods from overseas (e.g. food and pharmaceuticals). Thus, the contribution of technologies could be perceived as more important (or even essential) in the plans of some countries for self-sustainable food production (i.e. not dependent on global production chains).

3. OVERVIEW OF THE AGRI-FOOD SECTOR

KEY ISSUES

- This chapter looks at recent trends in the Moroccan economy and changes in the overall demand for and supply of labour and skills.
- Employment in the Moroccan agri-food sector is also reviewed, along with drivers of skills demand in the agri-food sector.

The purpose of this chapter is scene setting. It provides an overview of recent developments in the economy of Morocco and how this has affected the overall demand for employment and skills, followed by the employment and skills developments in the Moroccan agri-food sector – both its agricultural production arm and that relating to processing, packaging, marketing and distribution. The chapter demonstrates that the agri-food sector is an important one in Morocco given the levels of output and employment it accounts for. Additionally, the chapter points to several elements affecting the performance of the economy and labour market over recent years. Key among these is the education and skills system which has struggled to provide the country – and its population – with skills that have value in the labour market. This is not to say that the education and skills system is the principal factor constraining the development of the economy or agri-food sector. Rather, this is an issue of particular importance to the study on which this report is based. As the economy adapts to technological trends and attempts to shift into higher value segments of the global economy, there is a danger that skills shortages will inhibit any such shift. This may be particularly acute in the agri-food sector given the relatively low skills levels of many of those working in the sector today.

3.1 The economy

Economic growth in Morocco has been relatively strong in recent years and was largely unaffected by the 2008 economic crisis. As shown in Figure 3.1, GDP growth from 2008 to 2018 was consistently positive unlike that of other countries in the Maghreb which were hit harder by the political turmoil of the Arab Spring and its economic consequences. In the recent past, Morocco has averaged GDP growth of around 3% a year. Before the advent of Covid-19, both the World Bank and the African Development Bank had forecast relatively strong growth for 2020 and 2021: the former forecast real growth of 3.5% in 2020 and 3.6% in 2022; and the latter forecast growth of 3.7% in 2020 and 3.9% in 2021[3].

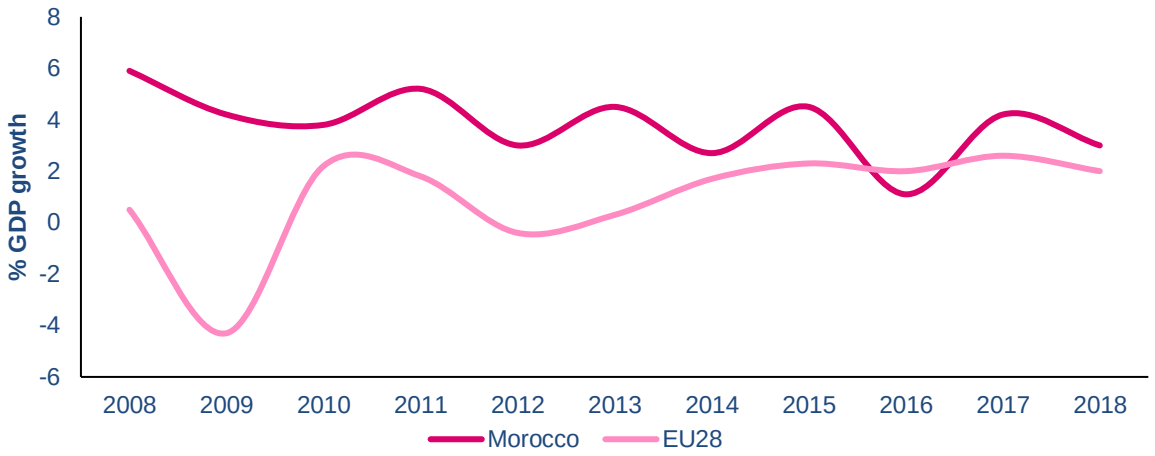
The Covid-19 crisis drastically changed the growth forecasts. In March 2020, the Centre marocain de conjoncture forecast that GDP growth would slow to 0.8% in 2020, compared with its January forecast of 3.5%. This reflected the economic impact of Covid-19 containment measures as well as the drought which adversely affected the agricultural sector[4]. In June 2020, the International

[3] These are estimates pre-coronavirus. The figures point, other things being equal, to the capacity for the economy to grow relatively strongly over the short term.

[4] http://cmconjoncture.ma/conjoncture/actualites/croissance-economique-2020-annee-blanche-selon-le-cmc

Monetary Fund revised its forecast for GDP growth in 2020 to -3.7% and in November 2020 further revised this to -7.0%[5].

FIGURE 3.1 GDP GROWTH, 2008–2018



Source: Eurostat, World Bank

Growth over recent years was driven by a number of factors, including diversification of the economy away from agriculture and into food processing, car manufacturing, aviation and electronics. The country's location and political stability means that it is an ideal hub for companies looking to operate in Africa. Additionally, the amended law on public–private partnerships and the government's regionalisation policy has increased the attractiveness of the country to national and international investors (World Bank, n.d.). But there are several structural weaknesses that are likely to constrain the economy's capacity to grow over the short to medium term, such as:

- relatively low levels of human capital development and mismatches between the outputs of the education and training system and those required in the private sector;
- rigidities in the labour market which impede job creation and are seen as a determinant of relatively high levels of youth unemployment (bearing in mind the population is a relatively young one);
- a relatively large informal sector;
- with specific reference to the agri-food sector, relatively low productivity growth over time.

Morocco is ranked 53rd out of 190 economies by the World Bank in its Doing Business 2020 report, up seven places compared with the year before (World Bank, 2019a; 2020). The country has implemented comprehensive regulatory reforms over the past couple of years, making it easier to do business. In particular, Morocco has improved dealing with construction permits, obtaining electricity supply, protecting minority investors, paying taxes, trading across borders, and enforcing contracts (World Bank, 2020). Morocco is also a relatively open economy. In 2018, it exported USD 33.7 billion of goods and services, and imported USD 48.3 billion, giving it a net trade imbalance of USD 14.6 billion. Over recent years, the value of imports has increased more slowly than that of exports: between 2013 and 2018, the value of exports increased by USD 7.2 billion, while imports increased by only USD 3.6 billion. The principal exports are cars and fertilisers, and the principal

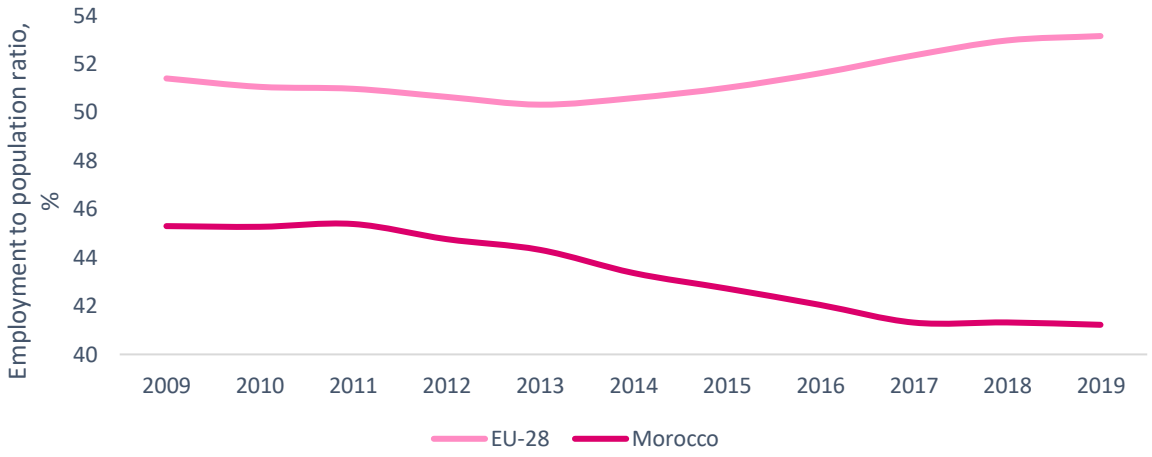
[5] www.imf.org/en/Countries/MAR

import is refined petroleum. Morocco's main trading partner is the EU, particularly Spain, France, Germany and Italy[6].

3.2 The labour market

Demographic change reduced the dependency ratio by half between 2004 and 2014, but the economy has struggled to capitalise on this, with employment growth faltering and relatively high levels of youth unemployment[7]. The employment to population ratio (15+) weakened from 2009 to 2019 (see Figure 3.2) while the unemployment rate was more or less constant at around 10%[8]. According to the World Bank (n.d. b), only 129 000 jobs are created annually, while the working-age population increases by 300 000 each year. Faltering employment growth has been explained by reference to weak economic growth in Europe on which Morocco is dependent for much of its trade (African Development Bank Group, n.d.). According to the Haut Commissariat au Plan, one in four people aged 15 to 24 in 2019 were unemployed, as were 15% of people aged 25 to 34. Moreover, the statistics point to unemployment tending to be long term, particularly in urban areas: in 2019, 71.1% of unemployed people in urban areas had been out of work for more than 12 months (68.2% at the national level)[9]. Youth unemployment is seen as a threat to social stability for most countries in north Africa, including Morocco.

FIGURE 3.2 EMPLOYMENT TO POPULATION RATIO (15+), 2009–2019



Source: World Bank

By way of summary, Table 3.1 compares key labour market statistics for Morocco with the average in the EU-28. It is immediately apparent that activity rates and employment rates are lower in Morocco, especially for women, while unemployment rates are higher. The table indicates that the situation vis-à-vis activity and employment rates in Morocco has been deteriorating over recent years whereas it has been improving in the EU-28. The ETF Torino Process report for Morocco (2017b) points to a

[6] https://oec.world/en/profile/country/mar/

[7] https://data.worldbank.org/indicator/SP.POP.GROW?locations=MA

[8] The dependency ratio is the percentage of dependent people not of working age divided by the percentage of people of working age who are economically active.

[9] Haut Commissariat au Plan, Unemployment rates (www.hcp.ma/Taux-de-chomage_r72.html) and Unemployment duration (www.hcp.ma/Duree-de-chomage_r77.html)

number of other structural weaknesses in the labour market which succinctly encapsulate the current situation.

1. Lack of inclusion: young people and women are not well integrated into the labour market. While many young people are staying in education for longer, the relatively high levels of youth unemployment point to people leaving education and training struggling to find jobs. The rate of labour force participation by women is low: 22% in 2018 compared to 71% 2018 for men[10].
2. Job creation has been insufficient to absorb the rising number of young people entering the labour market. In particular, small and medium-sized enterprises have struggled to support employment growth.
3. A large share of employment is in the informal sector which indicates that job quality and productivity are low. It is apparent that much of the growth in non-agricultural employment has been in low-skilled work (World Bank, n.d. b).
4. Graduate unemployment. Possessing a degree in Morocco does not seem to confer increased protection from becoming unemployed.

The report (ETF, 2017b) also highlights relatively low levels of educational attainment on exit from the education system which stymies the further development of human capital. As can be seen from Table 3.1, Morocco compares unfavourably with the European Union (EU) on some key measures related to human capital development. This is turned to next.

Occupation and level of educational attainment are proxy measures of skill. Figure 3.3 shows levels of educational attainment in Morocco. It shows that a large share of the active population did not complete compulsory education, accounting for around 6.48 million people in 2018. The share of people without a qualification was even higher among self-employed people, who accounted for more than 40% of employment in the agricultural sector in 2018[11].

When looking at skills demand, the occupational data for Morocco – see Figure 3.4 – shows that overall a relatively small share of the population is employed in relatively high-skilled jobs (certainly when compared to the average situation in the EU). It also reveals that a relatively high share of all employment (more than a third) is in jobs directly related to agriculture, with many of these being in relatively low-skilled jobs. This becomes particularly evident when looking at educational attainment of the workforce. According to the Haut Commissariat au Plan, among the economically active population who did not complete compulsory education (6.2 million people in 2018), almost half of them (3.1 million people in 2018) worked in agriculture, forestry and fisheries, constituting the vast majority (82.2%) of the total employment in this sector in 2018[12].

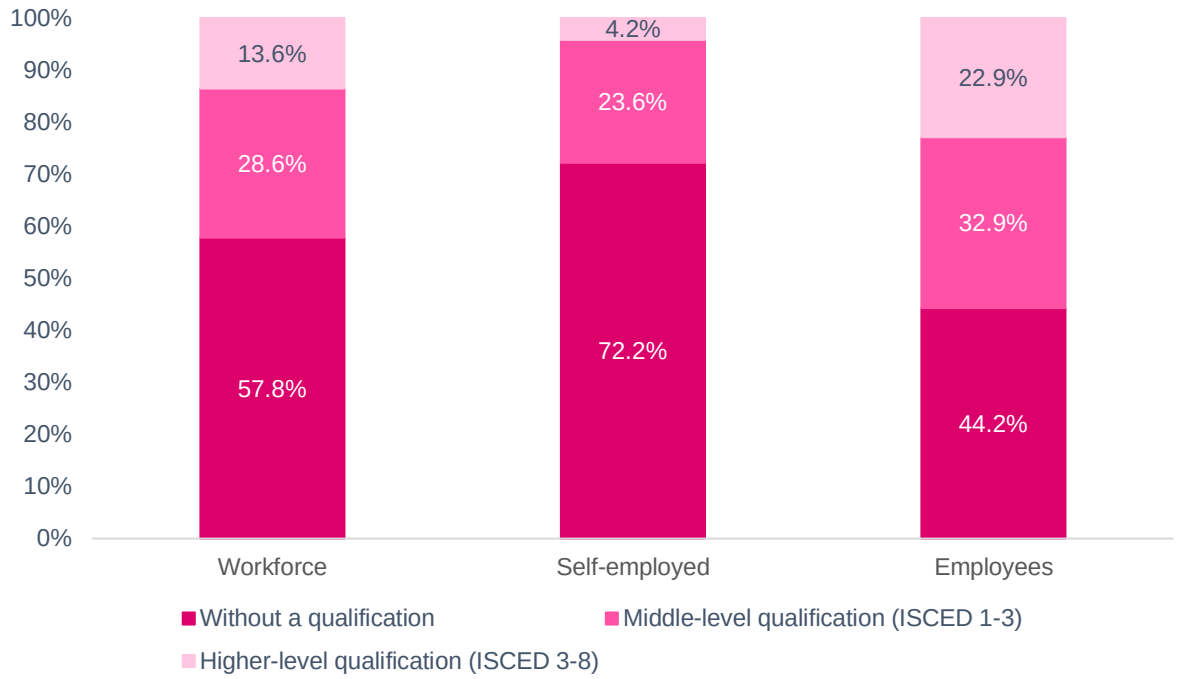
[10] Haut Commissariat au Plan, Activity rate by gender (www.hcp.ma/Taux-d-activite-selon-le-sexe_a360.html)
[11] https://lnt.ma/marche-de-travail-marocain-plus-de-59-de-salaries-contrat-selon-hcp/. Data is only available for the agricultural sector and not for the food processing industry.
[12] https://lnt.ma/marche-de-travail-marocain-plus-de-59-de-salaries-contrat-selon-hcp/

TABLE 3.1 SUMMARY STATISTICS ON EMPLOYMENT, EDUCATION AND TRAINING: MOROCCO AND THE EU COMPARED

	Morocco			EU-28		
	2010	**2019**	**Change (%)**	**2010**	**2019**	**Change (%)**
Population						
Population size (million and percentage change)	32.3	36.5	13	503.2	513.5	2
Population aged 34 years and under (%)	63.1	59.1	-4	41.2	38.8	-2.4
Labour market						
Activity rate – total (%)	49.8	45.3	-4.5	71	74	3
- Men	75.5	70.1	-5.4	77.6	79.4	1.8
- Women	25.5	21.5	-4	64.6	68.6	4
Employment rate – total (%)	45.3	41.2	-4.1	64.1	69.2	5.1
- Men	68.8	64.1	-4.7	70	74.4	4.4
- Women	23.1	19.2	-3.9	58.2	64.1	5.9
Unemployment rate – total (%)	9.1	9	-0.1	9.7	6.4	-3.3
- Men	8.9	8.6	-0.3	9.7	6.2	-3.5
- Women	9.5	10.4	0.9	9.7	6.7	-3
	2014	**2019**	**Change (%)**	**2014**	**2019**	**Change (%)**
Education and training						
Adult literacy rate (% people aged 15+)	61.4	62.5 (2016)	1.1	99.1	99.1 (2016)	0
Enrolment rates in VET (% of upper secondary enrolments)	11.6 (2012)	16	4.4	49.3	48.4	-0.9
Participation in lifelong learning (last four weeks) (% aged 25–64)	1 (2015)	1 (2016)	0	7.8	10.8	3
Young people						
Not in employment, education or training (% aged 15–24) – total	29.9 (2013)	27.5 (2016)	-2.4	12.2	10.1	-2.1
- Men	N/A	11.7 (2016)	N/A	12.1	9.8	-2.3
- Women	N/A	44 (2016)	N/A	12.3	10.4	-1.9

Source: Eurostat / ILOSTAT / ETF database / UNESCO Institute for Statistics

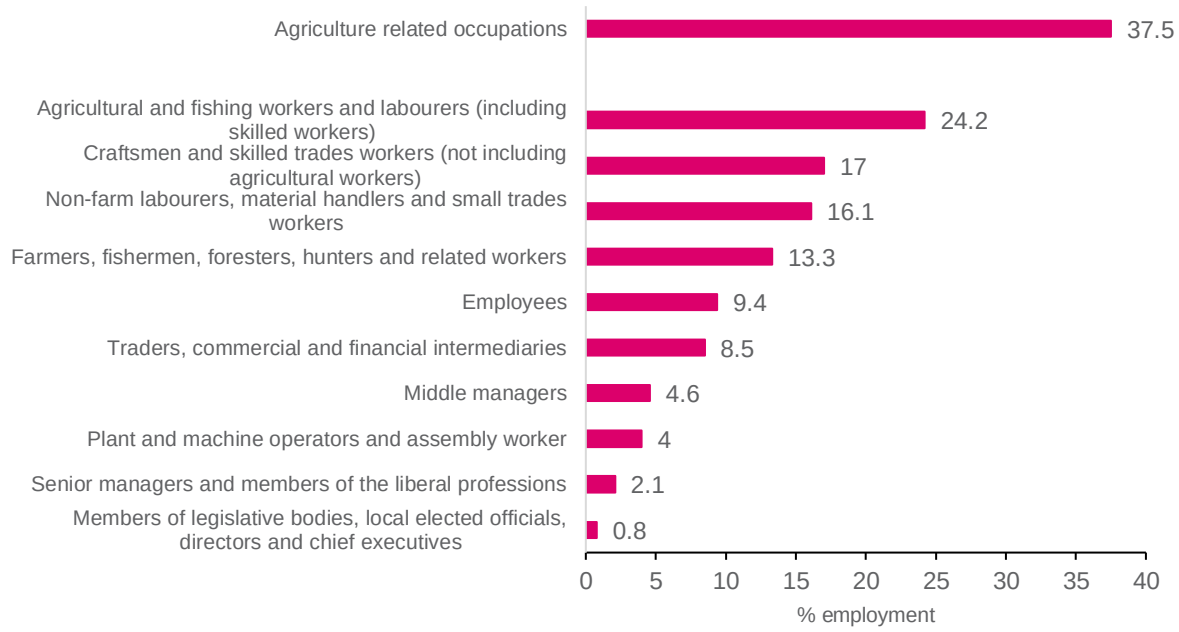
FIGURE 3.3 EDUCATIONAL ATTAINMENT OF THE WORKFORCE (TOTAL AND BY EMPLOYMENT STATUS), 2018



Note: As defined by the Haut Commissariat au Plan, middle-level qualifications include diplomas from compulsory school (International Standard Classification of Education (ISCED) 1–2) as well as ISCED 3 vocational qualifications. Higher-level qualifications include the baccalaureate (ISCED 3 general education diploma), ISCED 4 vocational qualifications and all qualifications issued at the end of ISCED 5–8 tertiary general and vocational education (Haut Commissariat au Plan, 2018; UNESCO-UNEVOC, 2019).

Source: Haut Commissariat au Plan

FIGURE 3.4 OCCUPATIONAL DISTRIBUTION OF THE WORKFORCE, 2016



Source: Haut Commissariat au Plan

3.3 Skills

A problem frequently mentioned by commentators is the relatively low level of educational attainment among the population and workforce. According to the World Bank (Chauffour, 2018), in 2018 there were approximately 600 000 Moroccans aged 20, of whom 400 000 had not passed the baccalaureate exam and were therefore low skilled, with limited prospects of finding relatively good-quality employment. Projections indicate that of the 200 000 young people with a high school diploma, only 50 000 will receive adequate training to secure a job in line with their expectations, while roughly 140 000 will acquire skills that have little value in the labour market. An estimated 10 000 young people (less than 2% of people aged 20 in 2018) will obtain degrees likely to lead to high waged employment (ibid.). These estimates – projecting the future educational outcomes of the system in place in 2018 – tend to underline how the education system is often far removed from the needs of the labour market. If left unchecked, this will potentially impose a severe constraint on the future development of the economy and labour market.

Morocco has sought to invest in education and skills. The evidence shows that Morocco invests a relatively high share of its GDP in education: in 2016, expenditure on education was 4.7% of GDP, slightly below the average of 5.1% found in Organisation for Economic Cooperation and Development (OECD) countries (ETF/Badescu, 2019)[13]. This accounted for 23.6% of total government expenditure, which is almost double the average share in the EU (12% in 2016)[14]. The majority of government expenditure on education is directed towards secondary education (42% in 2009) and primary education (38%), while tertiary education accounts for 20%. These levels of investment reflect the government's stated aims to improve the education of the population and improve their living conditions. Improvements in the quality of education and its inclusiveness are regarded as central to tackling Morocco's main social challenges, such as high youth unemployment, illiteracy, and the differences between urban and rural populations (OECD, 2018).

In 2018, 94% of Moroccan children were enrolled in their final year of primary school, compared with 82% in 2008, signalling a reduction in school dropouts[15]. Figure 3.5 reveals how enrolment rates at all levels increased from 2006 to 2018[16]. Though still far short of those in the EU at secondary and tertiary levels, they increased substantially, especially so at the tertiary level. The International Monetary Fund commented that dropout rates are still high, with 72% of all students leaving the education system without any qualifications in 2016. Furthermore, the skills students acquire in the school system appear to be insufficiently matched to the needs of the labour market and to the need to boost employment in higher value added activities (Blancher et al., 2016).

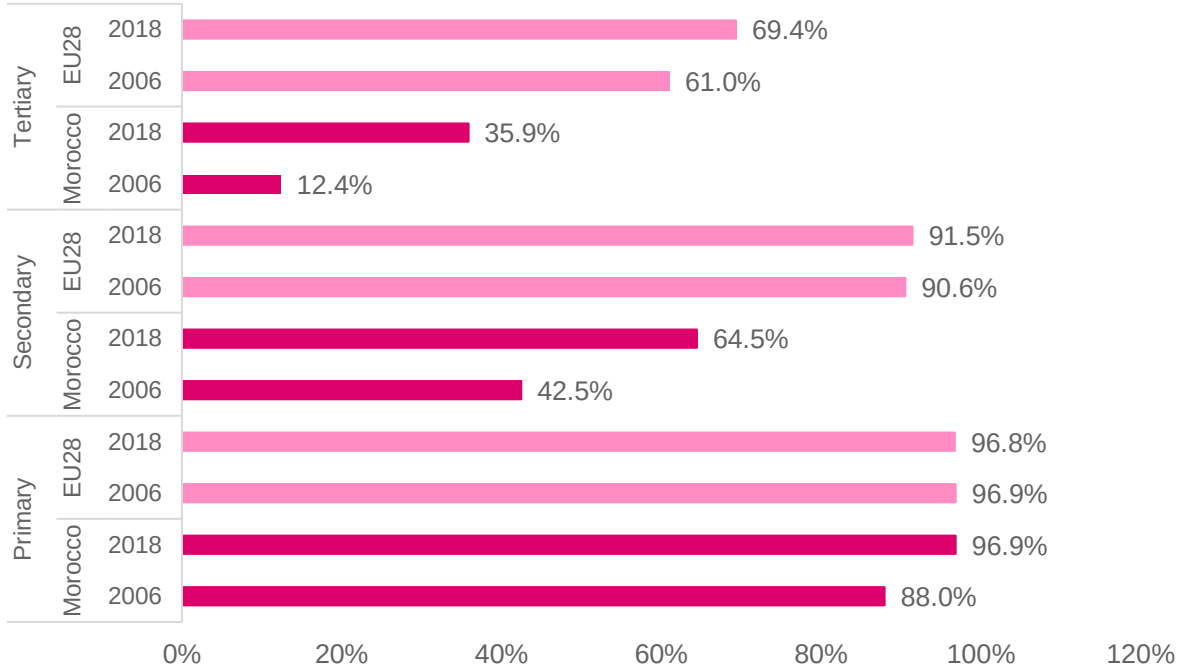
[13] https://data.worldbank.org/indicator/SE.XPD.TOTL.GD.ZS?locations=MA

[14] https://data.worldbank.org/indicator/SE.XPD.TOTL.GB.ZS?locations=MA-EU

[15] https://data.worldbank.org/indicator/SE.PRM.CMPT.ZS?locations=MA

[16] Enrolment rates are calculated by dividing the number of students of a particular age group enrolled in a given level of education by the number of people in the population in that age group.

FIGURE 3.5 SCHOOL ENROLMENT, MOROCCO COMPARED WITH THE EU-28, 2006 VS 2018



Source: World Bank

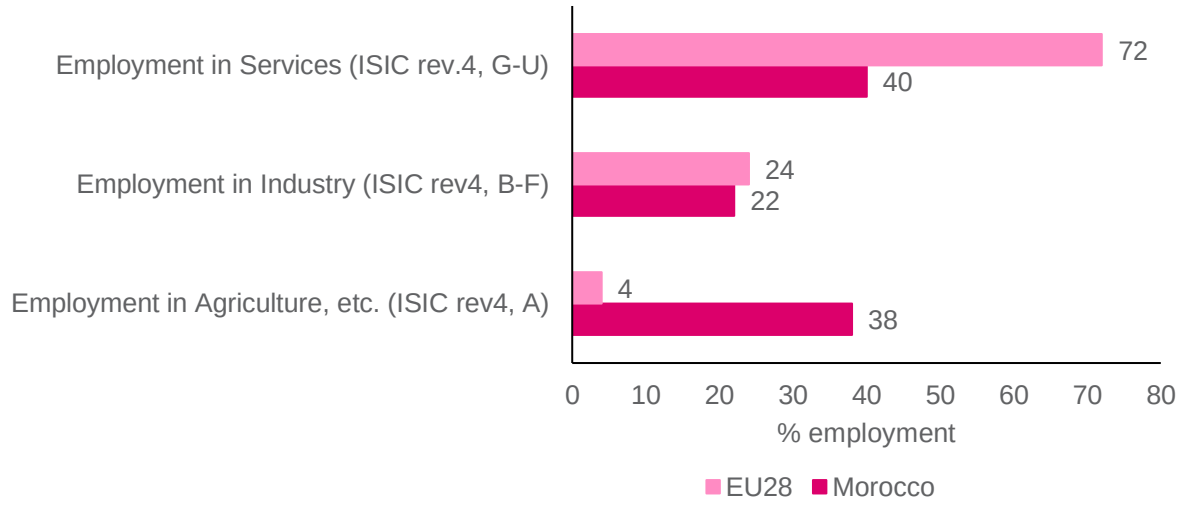
The share of secondary education accounted for by vocational education has been increasing but remained relatively low at 14% in 2017 when compared with the EU (ETF, 2019). Over half of all graduates are concentrated in management and commerce, metallurgy/mechanics, and construction, and a third of VET students become 'specialised technicians' (Ministry of Employment and Social Affairs, 2016; ETF, 2019). The budget allocated to the vocational training sector is estimated to have been around 0.2% of GDP in 2016 and has been stable over recent years. The funding of VET is particularly complex due to the multitude of stakeholders and funding sources involved. Funding comes from a variety of sources, mainly from the state (38%) but also from the VET tax (23%), households (23%) and companies (14%) (UNESCO-UNEVOC, 2019).

According to the National Strategy for Vocational Training 2021, Morocco is facing a number of challenges when it comes to its VET system. Some of them are common to the whole education system, such as the high level of student dropout rates and insufficient inclusion of certain parts of the population (e.g. people from rural areas and/or from disadvantaged families). But other challenges are specific to the VET system, such as the low level of participation (the technical VET country profile from UNESCO-UNEVOC highlights a 3.3% participation rate in technical VET for people aged 15 to 24 recorded in 2019), its lack of attractiveness to students who perform well in school, and criticisms from employers about its capacity to meet their skills needs (UNESCO-UNEVOC, 2019). There is an observed mismatch between the skills obtained in the VET system and those which employers need, despite the introduction of skills forecasting/anticipation tools that are designed to bring about better matching (ibid.). Skills mismatches are widely recognised as impediments to both improving the employment prospects of young people and shifting the economy into higher value added segments of the global economy (Blancher et al., 2016).

3.4 The agri-food sector

If one looks at the distribution of employment by sector in Morocco, it is apparent that a relatively large share – compared with the EU – is located in agriculture (see Figure 3.6). More than one-third of the workforce is found in the sector. Much of this employment is concentrated in relatively low-skill, low-value work which has proven difficult to change. But it is not only agriculture which reveals productivity levels stagnating; the same situation applies to industry which, like agriculture, has not been able to boost its share of GDP (African Development Bank, n.d.).

FIGURE 3.6 EMPLOYMENT BY SECTOR, 2018 (%)



Note: ISIC = International Standard Industrial Classification (of all economic activities)
Source: OECD, World Bank

The agri-food sector is an important part of the Moroccan economy. As noted in Chapter 2, the agri-food sector is described with reference to the agricultural sector and its intersection with the food processing industry. It therefore includes the commercial production of food by farming and technologies related to agriculture, horticulture, and food and drink processing. Besides farming and agriculture, the sector is linked to the processing, conversion, preparation, preservation, distribution, and packaging of foodstuffs. Bearing this definition in mind, a description of output, employment and skills in the agri-food sector is now provided[17].

Development of the agri-food sector

As previously mentioned, agriculture accounts for almost 40% of the total employment and 12% of the total value added in the country. The Moroccan economy is heavily influenced by agricultural production, which is in turn influenced by the availability of water for irrigation: in years of drought, GDP growth consistently shrinks. For instance, in 2016 (a dry year) GDP growth stood at 1.2%, compared with 4.5% in 2015 and 4.1% in 2017 (not dry years).

[17] For this research it was not possible to retrieve specific data on employment in the agri-food sector. By combining data from both the agricultural sector and the food processing sector, the research team estimates the agri-food sector employs around 4.5 million people in the country, which represents a little over 40% of employed people in the country.

Similarly, food processing is also an important economic activity in Morocco. In 2018 the food processing industry was Morocco's second-largest industrial subsector, accounting for 25% of the total industrial GDP with revenues over MAD 100 billion (EUR 9 billion) (EU Delegation to Morocco, 2020). In 2016, the food processing industry employed 141 000 people, organised in 2 050 establishments, representing 23% of the industrial workforce[18].

The agri-food sector plays a key role in the rural development and food security of the country, but in doing so it needs to overcome a number of challenges. These include (African Development Bank, 2019):

- soil erosion and soil degradation;
- drought, often coupled with inefficient water management systems;
- disparities between large and small farms due to parcelling of property;
- lack of sufficient sectoral investments (both from the public and private sectors);
- lack of proper diversification of crops;
- large dependence on exports towards third countries (Europe and North America especially).

In terms of international trade, agriculture accounted for approximately 20% of total imports and about 21% of the country's total exports in 2019 (ibid.). In 2018, vegetable products accounted for 9.3% (USD 3.12 billion) of all exports, followed by foodstuffs (any substance used as food or to make food) at 6.7% (USD 2.24 billion). Among foodstuffs, the most prominent products exported are processed fish and processed crustaceans, which together account for 64% of all exported foodstuffs with a total export value of USD 1.4 billion in 2018. Processed vegetables, fruits and nuts accounted for around USD 220 million, around 10% of the export value for all foodstuffs. The food processing industry has particular ties to specific Moroccan regions, with the Agadir area being particularly renowned for the presence of fish processing plants, and the Marrakech, Casablanca, Fès and Meknès areas being particularly active in the domain of processing vegetables and fruits.

Over the years the Moroccan government has put in place a range of policies to sustain the development of agriculture and food processing sectors. For instance, the country has made water resource management more transparent for users by requiring information on water resources to be made publicly available so that resources are used more efficiently (World Bank, 2019b). Moreover, as a result of efforts by authorities to diversify exports and decrease the dependence on Europe – which is the origin of and destination for three-quarters of Morocco's total trade – the agri-food sector has grown 8.2% since 2013 (African Development Bank, n.d.).

In the various policies implemented over recent years, the most important strategy by far for the agri-food sector is the Green Morocco Plan for 2008 to 2020. The plan, launched in 2008, was designed to promote the development of 1.15 million jobs by 2020 and triple the income of nearly 3 million people in rural areas[19]. The strategy was designed to support the development of agri-food by fostering closer links between producers and the processing industry (integration of upstream and downstream processes) and fostering integration/cooperation as an organisational model (i.e. bringing together producers and farmers). According to the Ministry of Agriculture, integration/ cooperation is the most appropriate solution to overcome the issue of small farms (70% of Moroccan farmers own less than five hectares), and to tackle the challenges related to the lack of technical and managerial skills and of appropriate financial means for these farmers to modernise their production

[18] Source: Haut Commissariat au Plan, http://bds.hcp.ma/data/21.4 and http://bds.hcp.ma/data/21.1
[19] www.invest.gov.ma/?Id=25&lang=en&RefCat=5&Ref=148

systems. In this way, bringing together the production and the commercialisation of agricultural products, farmers obtain the skills needed to optimise their production from partners in projects, resulting in the optimisation of the production process at all levels[20].

The Green Morocco Plan has produced positive results, though not as positive as originally planned. As an example, of the 1.15 million jobs to be created by 2020, only 342 000 additional job opportunities (less than a third) were created as of 2018. On the other hand, the plan stimulated investments in the agricultural sector (a total of MAD 104 billion between 2008 and 2018). On fostering cooperation among farmers (especially smallholders), the incentives system fostered by the state supported 63 aggregation projects (in 2018) benefitting around 55 000 farmers, 80% of whom own less than five hectares or arable land[21]. Moreover, the plan has allowed the country to increase self-sufficiency to around 98% to 100% for meat, milk, fruits and vegetables, while it is 65% for cereals and 47% for sugar. As for the long-standing issue of water management, the plan has allowed the country to save 2 billion cubic metres of water by investing in more efficient irrigation techniques. As a result, the surface area of crop fields with drip irrigation has almost quadrupled since the plan was introduced[22].

The Ministry of Agriculture has also identified some challenges and shortcomings of the plan, such as the failed modernisation of slaughterhouses and not yet having a better structure for the food distribution industry, which is believed to be of crucial importance to sustain and increase the efficiency of the Moroccan agri-food sector and enhance domestic demand. One of the main critiques of the Green Morocco Plan by commentators was the lack of coordination with other sectoral development strategies implemented over the same period of time, for instance the 'Emergence' plan for industry. Other critiques mention the 'standard' approach to agricultural development, relying on increased investments and failing to thoroughly take into account the specific features of Moroccan agriculture, especially in rural areas, where the activity is mostly run by small family businesses that lack the capacity and resources to engage in bigger projects and attract larger investments (Akesbi, 2011).

The agri-food sector faces productivity challenges. The aggregation model fostered by the Green Morocco Plan, based on cooperatives, plays a central role in sectoral improvement, being an innovative way to connect small- and large-scale producers, generating yields and ensuring agricultural production is in line with the requirements of the food industry (ibid.). It is not clear to what extent this has resulted in productivity improvements.

Other initiatives have focused particularly on agri-food, such as the National Pact for Industrial Emergence (Pacte national pour l'émergence industrielle – PNEI (2009–2015)) to support sector growth by creating agropoles; the Industrial Acceleration Plan (2014–2020); and the Contract Programme 2017–2022 for agri-food. The PNEI[23] focused on the important potential for economic growth for Moroccan agri-food, and aimed at exploiting this potential through a range of supporting measures such as a better development of agricultural resources and a diversified and competitive offer especially dedicated to exports. In order to do this, the PNEI focused on 8 to 10 value chains with particularly high potential for exports, such as argan, olive oil, spices and processed vegetables

[20] Ministry of Agriculture, Fisheries, Rural Development, Water and Forests: www.agriculture.gov.ma/en/pages/strategy
[21] www.ada.gov.ma/en/main-achievements-green-morocco-plan
[22] www.agrimaroc.ma/plan-maroc-vert-realisations/
[23] www.amith.ma/portail/PDF/PACTE_Emergence_V2010.pdf

and fruits. Among other measures, these value chains have been supported through the construction of dedicated agropoles in six regions of Morocco.

Another initiative impacting agribusiness is the Industrial Acceleration Plan (2014–2020)[24]. The plan was a successful strategy launched to boost the Moroccan industrial sector and fully exploit its potential for economic and employment growth. The plan was very successful: the target of creating 500 000 new jobs was reached or even exceeded in all targeted sectors in 2019, and overall industrial exports increased between 2014 and 2019 by more than 39%. The agri-food sector made a strong contribution to the plan's results: the sector contributed to the creation of more than 83 000 jobs between 2014 and 2019 and the sector's exports increased by more than 38%, which demonstrates the great dynamic and growth potential of this industry.

Finally, the Contract Programme 2017–2022 for agri-food is also a relevant policy for agribusiness[25]. It focuses on seven value chains considered the most important for sectoral development, due to their prominence and potential: citrus, fruits and vegetables; olive oil; dairy; meat; pastries and chocolate production; pasta; and couscous. The programme has specific targets to be reached by its conclusion and engages relevant stakeholders to achieve these targets. Relevant actors are not only the responsible ministries, but also professional associations, to make sure the effort is truly collective.

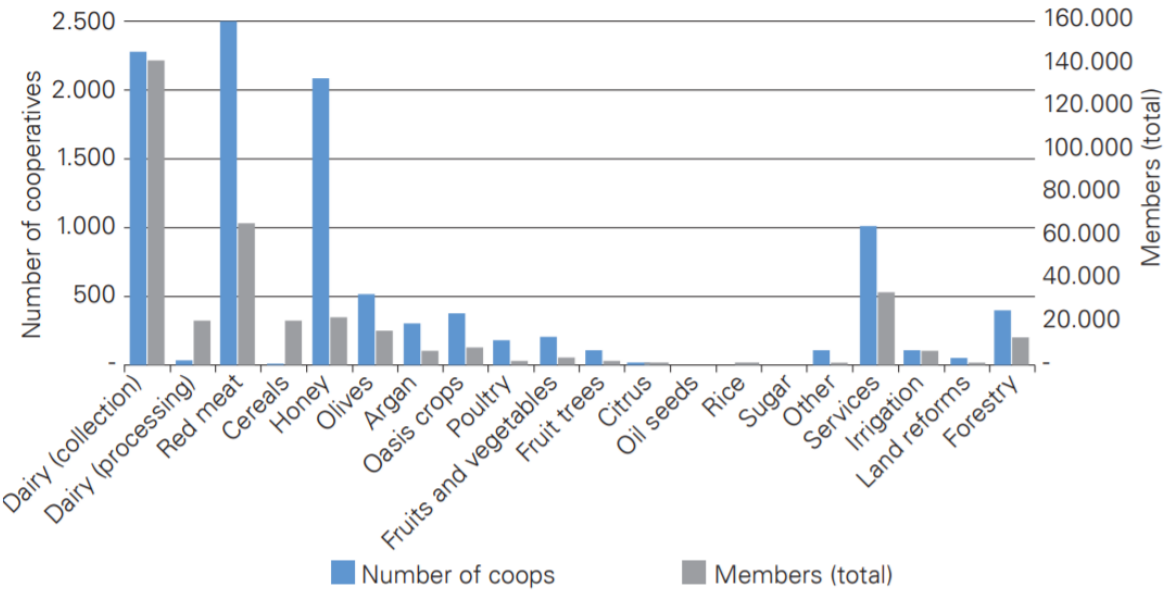
Recent policy developments

Cooperatives are defined by Moroccan law as autonomous and voluntary associations to meet their common economic, social and cultural needs through a jointly owned and democratically controlled enterprise. The Green Morocco Plan favoured the creation of cooperatives around shared projects to improve agriculture in specific regions, but also designated the state as facilitator in supporting existing cooperatives, for instance by providing financial incentives and preferential access to credit to finance relevant projects and by fostering private investments in the agri-food sector[26]. As shown in Figure 3.7, cooperatives are more numerous in the subsectors of dairy, red meat, and honey production. Cooperatives are also numerous in the agricultural services subsector.

It has been observed that the general lack of managerial and financial management capacity in agri-food cooperatives makes it difficult to ensure the sustainability and growth of operations and creates obstacles in terms of access to finance. This, in turn, generates additional problems, such as difficulties in adopting competitive industrial processes or adequate quality control systems (Pereira and Santos, 2018). Therefore, despite being the model of choice for Moroccan authorities to pursue sectoral development, research shows that the cooperative system is unlikely to perform its duties properly without an appropriate education and vocational training system that is able to address the skills needs of the agricultural workforce.

[24] www.mcinet.gov.ma/en/content/industrial-acceleration-plan-2014-2020
[25] https://ledesk.ma/2017/04/17/le-secteur-agro-industriel-dote-dun-contrat-programme-de-12-milliards-de-dirhams/
[26] www.agriculture.gov.ma/en/pages/strategy

FIGURE 3.7 MAPPING OF AGRICULTURAL COOPERATIVES AND THEIR MEMBERS PER SUBSECTOR, 2015



Source: Food and Agricultural Organisation, ODCO database (2015)

In spring 2020, a new strategy for agriculture was launched, Génération Green (2020–2030)[27]. This new strategy builds on the achievements of the Green Morocco Plan and further consolidates the growth for the sector and the subsequent social effects.

The new strategy focuses particularly on human capital development, aiming at enhancing revenue of farmers through investments and wider access to social protection for workers in the agricultural sector. The strategy also aims to promote the sector among young people, to make working in agriculture as employees but especially as entrepreneurs more attractive to them. The strategy will make arable land available by offering funding to 180 000 young entrepreneurs to launch start-ups[28]. The strategy aims to have 350 000 new workers and entrepreneurs not only in the agricultural sector but also in all services related to it (i.e. other agri-food subsectors such as food processing, but also services such as the provision of irrigation systems or pesticides/fertilisers). Finally, the strategy aims to support the creation of new agricultural organisations and cooperatives, with the aim of having five times more of such organisations by 2030, while also providing support to the implementation of digitalisation and new technologies in all agricultural activities[29].

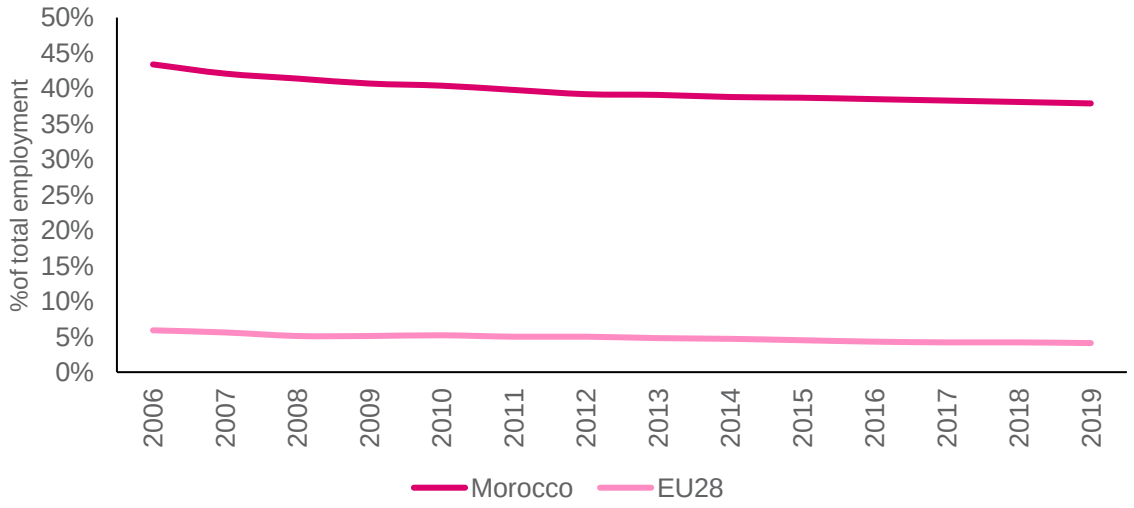
Employment

As previously mentioned, agri-food is a very important sector in Morocco. Output (value added) from the agricultural sector accounts for around 12% of total output, while the food processing industry alone accounts for 25% of the total industrial GDP for Morocco (EU Delegation to Morocco, 2020). The value added from agriculture has remained relatively stable over time. But as Figure 3.8 reveals, agriculture is a major source of employment at around 40% of total employment (compared with the

[27] www.agrimaroc.ma/generation-green-agriculture-maroc/
[28] www.forbes.fr/environnement/generation-green-le-modele-agricole-marocain-un-exemple-a-suivre/
[29] www.ecoactu.ma/48788-2/

EU-28, where agriculture accounts for only around 4% of total employment), indicating that it is a relatively low productivity sector. Even though employment in the sector has been falling, from 45% of all employment in 2006 to 38% in 2019, it remains much higher than the share of value added it produces. It needs to be noted that this underestimates the overall level of employment in the agri-food sector since it excludes those who are employed in the food processing sector (part of the manufacturing sector).

FIGURE 3.8 EMPLOYMENT IN AGRICULTURE, 2006–2019



Source: World Bank

As noted above, the agri-food sector is important for employment, especially so in rural areas. It is estimated that around 4 million rural inhabitants are employed in the agri-food industry. This estimate reveals that, particularly in rural areas, agriculture is largely dependent on a large workforce and relies very little on techniques and technologies aimed at increasing productivity[30].

Additionally, one important factor to be taken into account is the extent of subsistence agriculture, i.e. when people are registered as self-employed and work in their own family field, producing food for their own use. This could particularly be the case for women, especially in rural areas. Recent data shows that around half of employed people are self-employed (48.6% in 2019), compared to only 15.2% in the EU-27 in the same year[31]. In 2019, self-employed women constituted 57.1% of total female employment, compared to 45.9% for self-employed men[32]. In 2018, 41.5% of self-employed people worked in agriculture, forestry and fisheries; 25.9% of the total self-employed population worked in urban areas, while 35.7% worked in rural areas[33]. The high share of employment and self-employment in the agricultural sector, coupled with the prevalence of smallholders, points towards an agricultural model of production more focused on subsistence production rather than commercialisation.

[30] www.agriculture.gov.ma/en/pages/strategy
[31] https://data.worldbank.org/indicator/SL.EMP.SELF.ZS?locations=MA-EU
[32] https://data.worldbank.org/indicator/SL.EMP.SELF.MA.ZS?locations=MA-EU
[33] https://lnt.ma/marche-de-travail-marocain-plus-de-59-de-salaries-contrat-selon-hcp/

Innovation and skills

As presented in previous sections, the agri-food sector has been the target of a series of important public and private investments over the years. Investments have mainly targeted innovation in water management and irrigation techniques as well as the differentiation of crops and the enhancement of self-sufficiency for agricultural production. Some attention has also been given to innovation on a systemic level, in the way producers are interconnected among themselves and with the food processing industries. More recently, with the Green Morocco Plan and especially Génération Green, increasing importance has been given to human capital development and skills.

In line with the integration/cooperation approach that has driven investments and innovation in the sector, Moroccan authorities have been developing agricultural production sites (agropoles) in some key regions to strengthen upstream and downstream collaboration among relevant stakeholders and attract agri-food investments (as well as foreign investments). The regions of Fès-Meknès and Berkane, in northern Morocco, already have agropoles, supported by the public Caisse de dépôt et de gestion that finances territorial development activities in the whole country. Four additional sites are planned for the central regions of Tadla and El Haouz and for the coastal regions of Agadir and Gharb. Each agropole is designed to offer the following elements (Agency for Agricultural Development, 2015):

- an area of agro-industrial activities where food production companies are located;
- an area of logistics and service companies including business incubators;
- an area dedicated to distribution and trade activities;
- an element of research and development (R&D) (represented by the Institut national de la recherche agronomique (INRA)), and food quality control authorities (represented by the Office national de sécurité sanitaire des produits alimentaires (ONSSA) and Morocco FOODEX);
- a dedicated training centre;
- an area dedicated to specific tertiary activities, such as banks, insurance companies, catering and other relevant services.

Agropoles represent important elements of innovation in the way the different stakeholders in the agri-food sector can interact and foster integration between upstream and downstream processes. They also constitute an important innovative model of cooperation among these stakeholders, as well as an innovative way to attract investments (both from national and foreign investors). The implementation of agropoles is still in its infancy, with only two out of six planned sites being operational at the time of writing. If fully exploited, the potential for aggregation and integration of stakeholders in the agri-food value chain will boost the economic potential for the sector, which suffers from the presence of many smallholders and small industries.

Acknowledging the need for specific and good-quality education for this sector, the Green Morocco Plan defines a range of measures to support higher agricultural education and VET. For instance, the four public institutions providing higher agricultural education[34] were due to merge into a polytechnic, with the aim of pooling resources and coordinating actions and curricula among themselves and with other relevant stakeholders (i.e. VET providers), as well as operate with more transparency and rationality (Agency for Agricultural Development, 2015).

[34] The Hassan II Agronomy and Veterinary Institute in Rabat (IAV Hassan II) and Horticultural Complex in Agadir, the ENA of Meknès and the National School of Forestry engineers in Salé.

One constraint in the development of agri-food is the lack of enough training centres for agri-food technicians, as currently only one centre exists in Casablanca. It is worth noting that IAV Hassan II no longer provides training at the level of technicians, but public and private universities are providing technician-level and bachelor's degrees. For VET, the Green Morocco Plan distinguishes between three different providers with specific roles (ibid.):

- agricultural vocational training, aimed at improving the technical and competitive aspects of businesses and farms by meeting their employees' skills needs, through training for adults offering qualifications for qualified and specialised technicians and workers;
- technical agricultural education, a dedicated path in lower secondary education (classes in agricultural technology) and upper secondary education (baccalaureate in agricultural sciences) aiming to equip young students with the technical knowledge to pursue studies in agriculture, making the agricultural sector more attractive;
- apprenticeship training for the social and professional integration of rural youths, especially targeted at young people living in rural areas who have dropped out of education with only primary education or no qualifications.

The Moroccan government has always recognised the importance of investing in skills in the agricultural workforce to develop its potential for economic growth. On top of investments made in recent years, more investments and policy developments in terms of employment and skills are part of Génération Green, the new strategy to support the Moroccan agri-food sector. Nevertheless, implementation of the strategy itself as well as the 'normal' development of the sector have been heavily impacted by the Covid-19 crisis, and the medium-term growth outcomes are still quite uncertain due to the current economic conditions and forecasts for the future, both at the national and global level.

Commentators have noted that the efforts of the Moroccan government to increase agricultural self-sufficiency in the past two decades have been proved to be working. During spring 2020, when Covid-19 had its first impact in Morocco, the agricultural sector was able to provide the domestic market with an abundant supply of food while exports of fruits and vegetables grew 3% by mid-April compared with the same period of 2019[35]. On the other hand, a severe drought has impacted production, and this will likely lead to an increase in imports of some products such as wheat and grains (North Africa Post, 2020).

The Covid-19 pandemic has underlined the importance of digitalisation in the agri-food sector. In a statement from the Ministry of Industry, Trade and the Green and Digital Economy, digitalisation is reported as a key lever for national operators in agri-food to upgrade and enter high-value markets, increase productivity and secure new export markets by better aligning output with customers' requirements[36]. Supporting digitalisation in the agri-food sector is part of the Génération Green strategy and is complemented by the work of the Moroccan Digital Development Agency, which is a partner of the industry supporting digital education[37]. R&D is seen as critically important to the development of the agri-food sector. The roadmap for the agricultural sector mentions the potential for increases in the export of olive oil, tomatoes, preserved fruits (particularly apricots), biscuits, pastries and chocolate, and ready meals, sauces and snacks. In all these sectors, R&D is seen as

[35] www.agrimaroc.ma/covid-19-autosuffisance-alimentaire/
[36] www.agrimaroc.ma/maroc-digitalisation-agroalimentaire/
[37] Ibid.

crucial to unlocking the development potential of these goods. The roadmap draws attention to competences in R&D being in need of development[38].

The agri-food sector is supported by a number of organisations and institutions that contribute to the economic development of the sector. Some of these institutions are specific for the agricultural/agri-food sector, while others deal with labour market and training policies at the national level. These institutions often have complementary duties and work in cooperation with one another to implement major public initiatives and carry out research and sectoral studies. The main actors are listed below.

- Agence nationale de promotion de l'emploi et des compétences (Anapec) is the Moroccan public body charged with the management of active labour market policies.
- Agence pour le développement agricole (ADA) is a public institution with legal personality and financial authority. It is under the supervision of the Ministry of Agriculture, Fisheries, Rural Development, Water and Forests. It plays a key role in achieving the strategic goals set for the agricultural sector. Launching concrete projects, intermediation, implementation monitoring, and managing partnerships with institutional and social investors are the core tasks entrusted to ADA.
- Confédération générale des entreprises du Maroc is the association representing the private sector vis-à-vis the relevant public bodies in Morocco.
- Fédération nationale de l'agroalimentaire (Fenagri) is a confederation of 20 national federations with more than 100 companies directly affiliated, including some of the big players in the sector. It was created in 1996 and now is charged with the supervision of the Development Programme for Agribusiness 2017–2021.
- Groupement interprofessionnel d'aide au conseil du secteur agroalimentaire (GIAC AGRO) is a non-profit association established by eight associations of the agri-food sector, and whose general purpose is, among other things, to promote advice on training to its members. The GIAC cooperates with Fenagri in a horizontal way to respond to companies' training needs.
- INRA was created in 1914 and is the major research organisation dedicated to agricultural research and innovation.
- IAV Hassan II and the National School of Agriculture de Meknès are the major higher education organisations within the mandate of the Department of Agriculture.
- Office de la formation professionnelle et de la promotion du travail (OFPPT) is a public body charged with the management of vocational education.
- Office national du conseil agricole (ONCA) is a public body responsible for leading, coordinating and monitoring implementation of the agricultural development strategy at the national level.
- ONSSA is a public body responsible for the safety of food products and the conformity of food imported into Morocco.
- Morocco FOODEX: Food Export Control and Coordination is a public structure under the Ministry of Agriculture, Fisheries, Rural Development, Water and Forests, created in 1986. Since then, it has been dedicated to the service of the agri-food and maritime products sector, one of the levers of the country's economic growth.

The existence of specialised bodies dealing with skills, research and training needs of the agri-food sector allows for a better targeting of policies and initiatives to the needs of the sector. Nonetheless, some commentators have observed that the division of responsibilities for VET (and of sectoral policies more in general) among many actors makes coordination and integration of initiatives

[38] www.intracen.org/uploadedFiles/Feuille_de_route_secteur_agroalimentaire_final.pdf

difficult, therefore undermining the effectiveness of sectoral policies. Integration between companies, following the models of agropoles, and also more cooperation and integration on the side of specialised public bodies could be pursued to fully exploit the potential of dedicated sectoral bodies to be in close contact with companies and respond quickly to sectoral needs.

4. KEY DRIVERS OF CHANGE IN THE AGRI-FOOD SECTOR

KEY ISSUES

- Analysis of the main drivers of change currently shaping the sector, such as global value chains, new technologies, digital tools and international regulations.

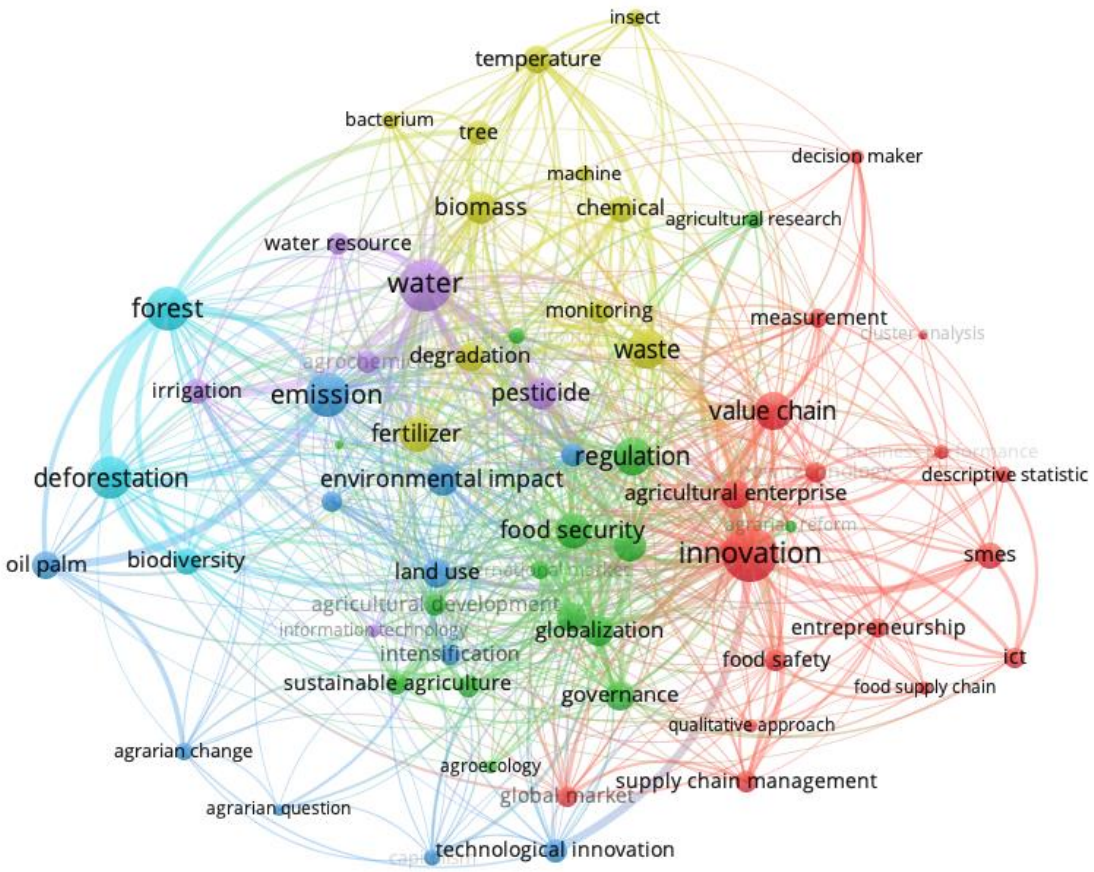
The preceding chapter outlined the broad contours of skills demand in the agri-food sector. In moving towards a more detailed analysis of skills needs – i.e. what are the actual skills people use in their jobs and how are these skills likely to change? – there is a need to understand the factors driving the change and those technologies that are associated with that change. It is not just about technological change: a need to consider a variety of non-technological factors which will shape the future is relevant as well. In the sections that follow, consideration is given to the range of technological and non-technological factors driving change in the agri-food sector in Morocco.

4.1 Identifying drivers of demand

Fast technological development is one of the major factors influencing the demand for skills. There are many other factors such as social, economic and environmental ones which also determine and shape future skills needs. In order to study all the possible drivers of change, the entire Scopus and Web of Science databases were searched to find scientific papers and conference proceedings related to the agri-food sector in Morocco. In addition, websites were scoured for direct information and links to various studies. The documents gathered were scanned using text mining tools to extract the most relevant keywords which were then clustered using network analysis.

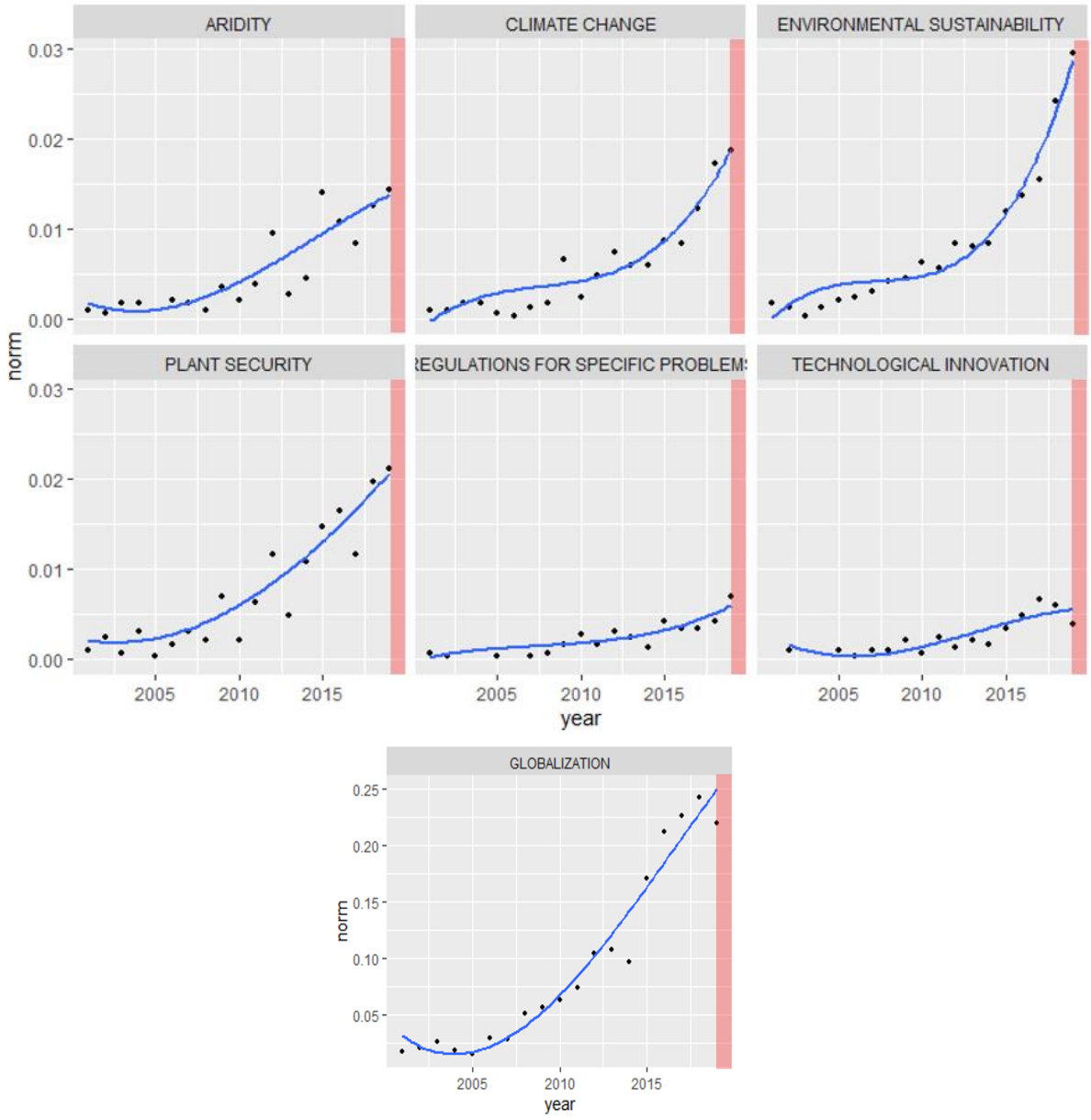
Figure 4.1 provides a snapshot of such a clustering process: for example, the red group of connected terms clearly points to the semantic area of innovation along the supply chain. Browsing the network of correlations between the topics provides an understanding of the relationships among them. For instance, the introduction of innovative solutions could lead to a reuse of agricultural waste, for the production, for example, of biomass energy, which then leads to a positive environmental impact and the reduction of deforestation (red, yellow, blue and light-blue clusters respectively). Inspection of all clusters provides the basis for identifying potential candidates for drivers of change.

FIGURE 4.1 NETWORK DIAGRAM OF KEYWORDS RELATED TO THE AGRI-FOOD SECTOR IN MOROCCO FROM THE ANALYSIS OF SCIENTIFIC PAPERS



A driver of change is considered to be a factor that strongly influences the evolution of future scenarios. By combining the clustering with an analysis of change over time (i.e. the number of scientific papers each year), it is possible to identify if one is observing phenomena that are increasing (see Figure 4.2 for examples). Compared to other drivers, globalisation has a higher number of occurrences within the considered dataset of papers. For this reason, to better appreciate the trends, two graphs are shown; the percentage value on the vertical axis shows the difference in scale.

FIGURE 4.2 DISTRIBUTION OVER THE YEARS OF KEY CONCEPTS IDENTIFIED FROM THE ANALYSIS OF SCIENTIFIC PAPERS ON AGRI-FOOD



From the above-described text mining analysis, a series of non-technological drivers of change were identified. Each of those can bring some changes to the sector and, in turn, may cause new profiles to be created for the sector.

The results obtained were validated and supplemented by the interviews with both stakeholders and companies during the field missions. This led to the identification of some additional drivers of change not captured by the text mining: productivity, quality of products and changes in Moroccan habits.

Globalisation

The relevance of globalisation seen from the data mining analysis was confirmed in the interviews, which indicated it as a main driver of change, often affecting several subsequent factors.

The increased competition that has arisen following globalisation has in some cases been a positive factor for innovation and for finding other business solutions. In other cases, it has led to the abandonment of some business lines due to their uncompetitive price point compared to foreign operators (i.e. in the case of free trade agreements).

The different starting conditions of companies within the sector have led to a series of possible scenarios. Many small-scale farmers seem to be focused on short-term issues while other companies focus on globalisation as they find the international market more profitable than the local market (e.g. companies that started as international exporters before being suppliers for the domestic market). Generally, the export of products is widespread among medium and large companies, both to North America and to Europe.

If this is true for commercialisation aspects, the same can be said for issues related to technology, skills and competitiveness. Globalisation also implies a structured value and logistics chain and a high-quality standard. Since technologies often come from foreign companies, globalisation has positively affected the sector from the point of view of modernisation of storage, production techniques, and environmental protection. Some of the conferences and fairs in which some Moroccan companies take part are also international. Attending postgraduate degrees abroad and doing internships with European universities allow Moroccan students and workers to bring new skills, knowledge and innovation to the area.

The opening of borders has certainly favoured an exchange of international collaboration and projects (such as the Millennium Challenge Corporation). An open benchmark with producers from other countries has begun, usually unfavourably because of the higher Moroccan taxation and cost of energy and smaller internal market. Very often imported goods are cheaper than locally produced ones. Moreover, many new operators have entered the sector, in particular big farms. In such a competitive environment, people have started to look for alternative and advantageous solutions. It is precisely this international competitiveness that has encouraged local producers to improve their offer by reducing costs and looking for a higher quality standard. It has also prompted the shift to different crops (e.g. olive oil, which received support from the Green Morocco Plan) or the exploration of niche markets (e.g. organic agriculture).

Government support and taxation

Agri-food is an important and strategic sector for the country. The government has implemented important measures for the economic development of the sector. The Green Morocco Plan has certainly boosted the agri-food sector on the production side while Génération Green will focus on enhancing the value of production. Moreover, the creation of agropoles has built a bridge between agriculture and agri-food. Government incentives and the presence of governmental and non-governmental bodies, such as FOODEX, Maroc PME (petites et moyennes entreprises), chambers of commerce and green industrial areas, are all important factors that support innovation.

The division of roles and tasks between the two ministries (the Ministry of Agriculture, which pursues upstream activities, and the Ministry of Industry, which focuses on downstream processes) seems in some cases to slow down the pace of improvements, since the division brings difficulties in the

governance and convergence of programmes and actions. At the same time, the excessively high costs of value added taxes, energy and product certifications seem to disadvantage local companies in international competition.

The presence of the government within the sector is strong and certainly fosters innovation and improvement of skills: through the OFPPT, the government provides paid continuing training courses that seem to be appreciated and used by companies. There is an effort from the government to cover around 80% of the expenses of the courses and it is asked to intervene, through ONSSA, to reduce the informal market in favour of higher quality of the marketed products. ADA has launched an incentive to increase competitiveness and visibility of local products both nationally and internationally.

International regulations and standards

As much as national regulations and incentives affect companies' abilities to enter and operate in the market, international regulations and standards act as a main driver for international trade and exports, and can affect businesses in different directions. For example, strict regulations introduced in various countries on pesticide remnants and other pollutants in food obliged companies exporting their products to adopt more environmentally sustainable solutions. In general, regulations introduced in export-bound countries prompt companies in Morocco to focus on compliance to ensure they are still able to export their products.

Aridity and efficient water management

In 2018 and 2019, Morocco was hit by severe droughts and variability which affected water security and hence food and energy security. Such a factor affects crops, in particular those with the highest consumption of water such as tomatoes. Other kinds of crops, such as olive tree cultivation, consume less water and, in general, are more resistant to water scarcity. From a production point of view, aridity affects both the quality and quantity of crops.

To cope with these environmental factors, local farmers have introduced some innovations: the development of new irrigation technologies that allow for more efficient use of water (drip irrigation); the construction of wells to avoid drawing water directly from the main supply; and the introduction of new varieties of plants that have higher resistance to water stress. The latter, where implemented, are largely supported and facilitated by the research work done by INRA.

Despite this progress, only a small area of the land is irrigated using drip systems (approximately 7%), as efficient irrigation techniques incur high costs. Extending the reach of water management systems to remote areas will have an immediate effect in terms of job creation, while the diffusion of technological advances will surely benefit the entire sector.

Climate change

Besides globalisation, climate change is considered the other factor that will most affect agri-food companies. It has important repercussions on production, both in terms of quality and crop productivity. It will worsen the problem of water scarcity, while higher temperatures will have devastating effects on agriculture, particularly on the cultivation of olives; also, new plant diseases could spread more easily. In recent years, Moroccan agriculture has seen important and successful advancements in terms of water management; still, given the expected worsening of climate conditions, keeping at the frontier of technological evolution in terms of irrigation systems would be

extremely helpful, as will be the study of new varieties of crops and of plant protection techniques. Numerous water policies and investments have been launched and developed over recent decades. Morocco has 145 large dams with a capacity exceeding 18.67 billion cubic metres and several thousand boreholes and wells to capture groundwater. The Green Morocco Plan and water-related policies and programmes have helped to increase the irrigated area to 1.6 million hectares (in which 610 000 hectares are equipped with drip irrigation systems). The programmes focused on efficiency and economy of water and energy by shifting from traditional irrigation schemes to drip irrigation systems. In addition to IAV Hassan II, there are two other higher education schools that have the mandate to train engineers in water sectors: École Mohammadia des ingénieurs in Rabat and École Hassania des travaux publics in Casablanca.

Energy efficiency is becoming increasingly important. Some companies are introducing improved energy efficiency systems, and the use of alternative energy sources is often considered. In the future most companies will move towards alternative technologies, considering the current high cost of energy and the absence of traditional energy sources in the country. Photovoltaic solutions will likely be adopted; unfortunately, up to now, they have not been accessible to many companies because of their price.

Environmental sustainability and greening of the economy

Some companies are starting to adopt alternative ways of producing energy in order to reduce the impact of humans on the environment, both in terms of emissions and deforestation. The energy production from biomass obtained from olive waste is an example. In general, there is increased awareness of the need to reduce waste from the production processes. Reuse of waste materials that are generated along the chain is increasingly widespread among companies. Due to the increasing importance of exports to the sector, logistics is another area where improvements in resource use, efficiency and waste management will be needed.

Organic farming, which is not yet widespread in Morocco, should contribute to the reduction of emissions, better soil and water quality, lower energy consumption and better energy efficiency. Génération Green has set the goal of having 100 000 hectares of organic farming by 2030. In addition to producing higher quality and healthier foods, biological production aims to reduce the environmental impact of crops, through the non-use of fertilisers and chemicals in the soil. Companies are gradually implementing green strategies in their businesses and they are moving towards healthier and more respectful (for the environment and for future generations) solutions. In fact, the Department of Environment has within its National Strategy for Sustainable Development launched a programme for the government to respect the environment and ensure green solutions and approaches[39].

From an international point of view, to prevent countries importing products that come from highly polluted areas, some restrictive policies have been implemented. Such restrictions certainly encourage the adoption of low-emission technologies. There would be willingness to innovate, even on the part of small-scale farmers, if incentives were sufficient to cover the costs of new technologies.

[39] www.environnement.gov.ma/fr/strategies-et-programmes/sndd

Crop improvement and new plant varieties

Crop improvement through genetics and biotechnology is developing in Morocco. This driver mainly deals with issues related to abiotic stress as well as to diseases and plant infestations while enhancing crop productivity and quality. In a country where water resources are already critical, the protection of plants from diseases is a topic of great and growing interest. More and more companies are trying to experiment with new plant varieties that are more resistant to external events. This has led to the research of new varieties of crops that are more heat tolerant and resistant to water stress. Institutions such as INRA are working on the R&D of new varieties of plants and are supporting companies. In general, by adopting a new variety of cultivation, productivity increases: it allows better water efficiency and produces more with less water. To reduce diseases, some companies also use ecological techniques such as compost and essential oils.

Technical innovation

While technology has the potential to bring radical changes to the sector, from this first analysis of data, the technological input does not seem to have achieved a breakthrough effect in the Moroccan agri-food sector yet. Interviews have confirmed this trend. In the period from 2005 to 2015, the innovations introduced were mainly aimed at coping with the climatic situation due to droughts and climate change, such as more effective irrigation systems and new plant varieties. More recently, technologies to improve production efficiency have started to be introduced, but mainly in large farms (e.g. precision agriculture) or large plants (e.g. agricultural waste reused as fuel in sugar refineries). Digitalisation was more widely adopted in e-commerce and marketing.

Productivity

One of the main goals of the measures adopted through the Green Morocco Plan was to enhance productivity. Cultivated areas have been increased, and in addition to innovations that have been introduced by the companies, training courses, events and activities to support production have been promoted nationwide. Plants for the transformation process, based on more modern production processes, have also been powered up in the period.

Quality and upgrade along the value chain

The issue of improving the quality of products and introducing structural quality control actions have been indicated during interviews as a key element for the future of the sector. While the Green Morocco Plan focused on productivity, the subsequent Génération Green's focus is on the enhancement of production, hence the quality of products. The ONSSA certification is necessary for products to be on the market while other types of certifications are still difficult to access by some companies due to the high associated costs.

The quality issue is clearly dependent on technological inputs: at the farm level, precision agriculture will help minimise the use of pesticides; in subsequent steps of the value chain, techniques for accurate tests – for traceability, proper storage and conservation – will all be necessary to guarantee quality standards to the final customer. In this sense, some regions and some value chains start with greater organisation than others; for example, citrus is an established crop with large farms that could invest in technology to guarantee international quality standards, while olive oil or red meat are newer parts of the chain, with a lower degree of organisation and varying degrees of readiness of the various companies. In the same way, government support and customer awareness are equally important. There is the need to enforce legislation on quality controls, support better management

and organisation of old-fashioned value chains, incentivise quality, and encourage consumers to move from the informal market to certified and healthier products.

A related action to upgrade the positioning of Moroccan products towards the higher price segment of the value chain is that of promoting organic farming, identity preservation of food, and the development of niche products or applications. Organic farming (i.e. certified) and its counterpart agroecology agriculture (based on agreement between small producers) are growing but need recognisable labels and more support to reduce costs and reach customers. A relevant factor highlighted during a focus group was that of preserving the identity of foods, which need traceability technologies but also skills and competences on how to protect and enhance local products. Finally, a higher selling value and better employment can be achieved through niche products, such as argan oil, avocados, or low-calorie sugar, or niche applications, such as the use of oil as an ingredient for the cosmetic industry.

Changes in consumer tastes

Companies often pointed out that changing consumer tastes led to the development of new consumption patterns and therefore a reshaping of business. Until recently, some types of food products were made at home (subsistence economy), and the most widely marketed products were fresh ones. According to the interviews, due to the development of urbanisation, women entering the labour market and more recently Covid-19, the demand for processed products has increased. Fresh products are experiencing a slowdown in consumption in favour of long-life products. This leads companies to want to satisfy the new needs of customers by offering products that are aligned with their preferences. Some sectors such as pastry and gastronomy have developed recently so there is a strong demand for new competences.

The increasing demand for healthier food is growing worldwide and this creates opportunities for exported goods; in any case, industries are obliged to adapt and introduce innovation to achieve greener and more sustainable production. In the domestic market, there is also growing interest in ethical, environmental and nutritional aspects, especially among the educated middle classes and younger generations. Yet, various companies complained about a lack of awareness in the general Moroccan population about issues such as quality (also due to the higher prices of quality local goods).

4.2 Preliminary findings on the impact of Covid-19

Covid-19 has revealed various weaknesses in the sector. Agri-food companies and farms have been hit to different degrees according to the product range of their businesses. The impact of Covid-19 on productivity is linked to a company's capacity to adapt, but it also depends on the type of production and services offered by the company. For instance, Fenagri reported a 30% fall in the number of transactions for the food processing industry in April 2020, with specific products experiencing particular contractions in demand (for instance, chocolate and drinks and beverages dropped by 65% and biscuits by 60%)[40]. On the other hand, farmers producing for the local market were allowed to continue working and have not seen a reduction in their business; certain products such as citrus and yeast have even seen increased demand during the crisis.

[40] www.agrimaroc.ma/agroalimentaire-produits-locaux-maroc/

Exports have been damaged, as have all products dependent on imported goods (e.g. cereals) or raw materials (e.g. chocolate, canned drinks). Agri-food supply chains have been adversely affected. The logistics and distribution processes have been affected the most. Major difficulties were faced by those companies engaged in international trade (both imports and exports) and by those companies which had difficulties reaching some cities due to temporary restrictions. Activities that included training services, product sales and catering directly at farms also suffered negative consequences: while in the first case the activities were suspended, as far as sales and catering were concerned, the companies re-packaged their product offer (e.g. self-service, delivery). As far as production is concerned, it never stopped completely but it has not always continued at the same output level.

The government has intervened with support to both unemployed people and companies in the sector, especially for small enterprises to help them retain employees. Although labour demand has not diminished, since the sector is strategic for food security during the crisis, in certain cases labour supply reduced due to concerns about infection from Covid-19 in crowded working places.

In some cases, new business models have been adopted by companies that work with fresh or rapidly perishable products (e.g. milk or yeast). Companies have started to increasingly sell their products in supermarkets and hypermarkets, and have shifted towards the production and marketing of longer-life products.

It is a common belief that the crisis has raised people's awareness of health-related issues. Customers are shifting to healthier and organic food more than before. The Covid-19 pandemic has also boosted the use of digital technologies in the sector. Digital solutions have been adopted for training purposes such as distance training and e-learning activities, and to create a digital platform where farmers can sell products online to reach new customers. Many interviewees believe that Covid-19 has accelerated the adoption and introduction of digital technologies and that this, in the long term, will benefit the entire sector.

4.3 The role of innovation

The following discussion is about technology as a driver of change. It is important to note that the focus is not about technology per se but about its potential to influence, through its adoption, the demand for employment and skills. From a methodological point of view, the interest is in the functional use of technology rather than on its performance or actual content. All technology exists to fulfil a purpose for the user, to solve a real-life problem, or provide an advantage. In the theory of engineering design, the purpose is referred to as the function of the technology.

The current literature on the future of work and skills focuses more on the potential of new technologies, but existing empirical evidence is limited on the actual impact of technology use in companies. By looking at the functional use of technology – i.e. the actual problem it solves or the actual beneficial uses it enables – it is possible to study its real impact in the real world. Moreover, even if a specific technology is not eventually adopted, if the need expressed by its functional use is real, in the long term another substitute technology will appear. In this sense, the functional approach allows for an understanding of the obsolescence and/or resilience of certain jobs or occupations and forecasting or even designing the shifts occurring between jobs, and the trajectory of skills from one job to another.

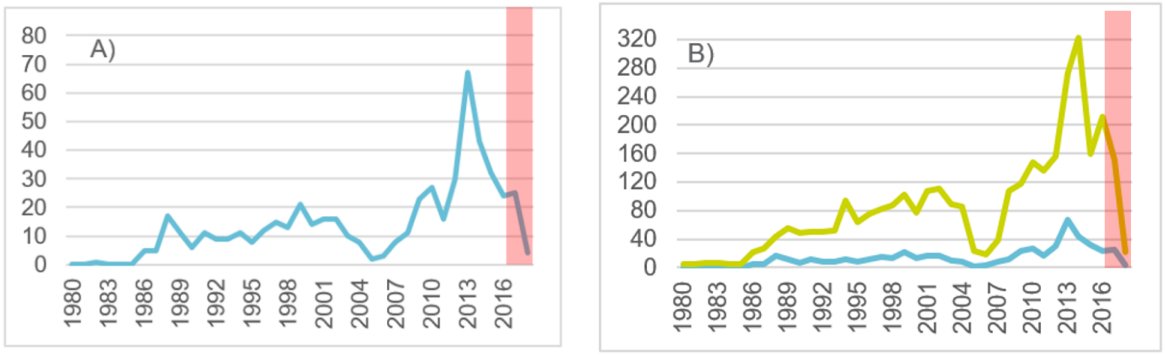
The first analysis is a general one and concerns the competitive potential provided by technological development. One indicator of the innovative capacity of a country is given by its capability to invent, expressed by the patents filed by companies and research centres. Of course, this applies not only in

quantity but also in quality, but even the sheer number of patents provides a useful measure of innovation.

Figure 4.3A shows the patents filed over the years in the agri-food sector in Morocco, whereas Figure 4.3B compares that data with the total number of filed patents in Morocco. Figure 4.4 compares the number of agri-food patents filed in Morocco with the total number of patents worldwide related to the agri-food sector, expressed as a percentage.

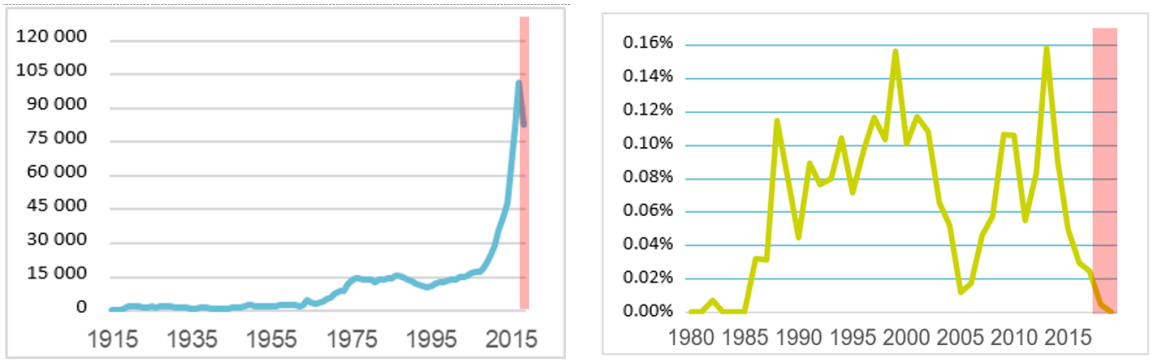
Note: the red shading covers the last year and a half of each graph, since the number of filed patents cannot be considered final, due to the 18-month period of secrecy occurring before a patent application is published. Considering the last two years in the analysis without keeping this in mind would lead to wrong and distorted interpretations.

FIGURE 4.3A MOROCCAN AGRI-FOOD PATENTS OVER THE YEARS (BLUE LINE); 4.3B COMPARISON WITH ALL MOROCCAN PATENTS (GREEN LINE)



As can be seen from Figure 4.3B, except for the period 2002 to 2006 (due to the economic crisis), innovation has been growing in the country. With reference to the period 2007 to 2014, patent filing increased substantially. Specifically related to the agri-food industry, the trend in filed patents follows the general one. The year 2013 saw a peak in agri-food sector patents, with it accounting for 24.6% of the country's total filed patents. As the desk research reveals, the positive (or negative) trends are also the result of actions from the government, e.g. the Green Morocco Plan. The decrease from 2014 onwards is likely to be related to a period of economic instability.

FIGURE 4.4 WORLDWIDE AGRI-FOOD FILED PATENTS (LEFT PLOT) AGAINST MOROCCO'S AGRI-FOOD PATENTS (RIGHT PLOT – EXPRESSED AS A PERCENTAGE OF THE TOTAL NUMBER OF AGRI-FOOD PATENTS WORLDWIDE)



The number of patents filed worldwide has been growing exponentially over the past 15 years; the benchmark for the country, expressed as the percentage of Moroccan patents compared with all worldwide, shows that Morocco has usually been able to keep pace with worldwide innovation since the 1990s, except during two periods of economic instability which led to a drop in inventive activity. Thus, the issue is not the country's capacity to innovate, but rather in sustaining it consistently over time.

4.4 Evolution of the technology landscape

Identifying new technologies

Various data sources were analysed through text mining techniques, providing insights into the ongoing changes in the technology landscape of the Moroccan agri-food sector. First of all, the vast majority of innovation is occurring in the subsectors listed in Table 4.1, where it is reasonable to expect, in the near future, a change in the demand for both new jobs and new skills.

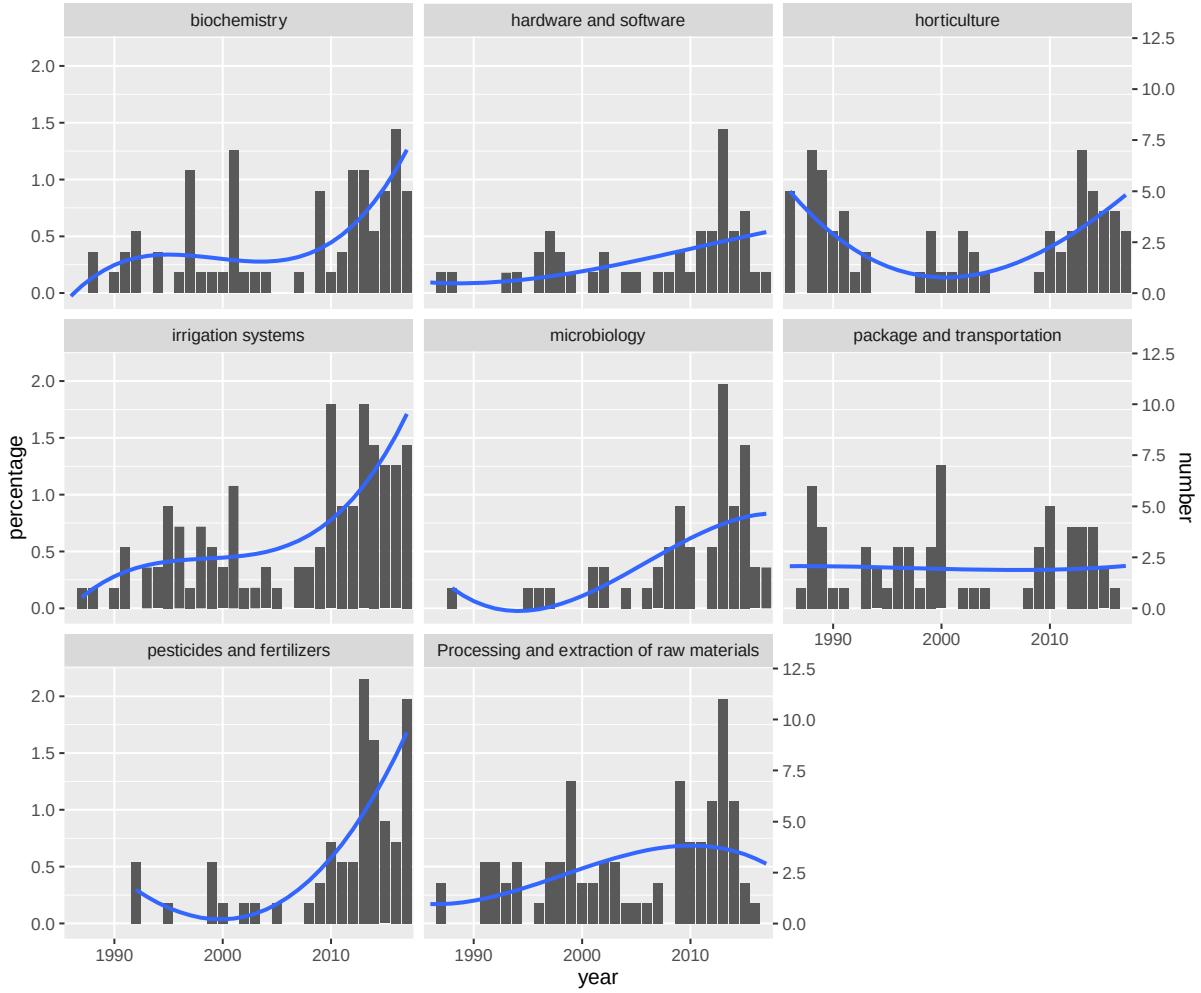
TABLE 4.1 FAMILIES (CLUSTERS) OF MOROCCAN AGRI-FOOD PATENTS (RANKED FROM HIGHEST TO LOWEST NUMBER OF PATENTS), 1990–2020

Number of patents	Cluster
151	Irrigation system
148	Biochemistry
121	Pesticides and fertilisers
121	Processing and extraction of raw materials
113	Packaging and transportation
105	Horticulture
69	Microbiology
63	Hardware and software

Out of the eight patent families listed in the table, the first three represent 75% of the total number of Morocco's filed patents in the sector. Clusters are consistent with the analysis of the drivers of change in Section 4.1, as well as with the idea of the functional use of technology. For example, the irrigation system cluster is linked to those drivers of change that are related to aridity, climate change and environmental sustainability of the sector. Clusters such as biochemistry, fertilisers and pesticides may reveal the development of products specifically related to biological agriculture, while the packaging and transport cluster is linked to globalisation and downstream activities, such as the distribution and commercialisation of products.

Regarding the number of filed patents over the years, it is also possible to create temporal trends for each cluster, as shown in Figure 4.5. Compared with Table 4.1, the representation of trend clusters provides a more dynamic view. Furthermore, when addressing changes occurring in the sector, trends are the key variable to analyse since they resemble the evolution of a specific concept.

FIGURE 4.5 TRENDS FOR SPECIFIC TECHNOLOGIES (BARS INDICATE RAW DATA, BLUE LINE THE INTERPOLATION CURVE)



At first sight, the trends for each cluster seem to confirm the overall trends depicted in Figure 4.5: a first period of patent submission activity during the 1990s, when particular clusters such as biochemistry and packaging and transportation had a greater relevance in terms of filed patents, and a second phase of growth when filed patents reached values even higher than those of the first phase. In fact, even if this second period is characterised by an overall fluctuating trend, the majority of clusters present a positive growth since 2010.

Moreover, Figure 4.5 confirms that the clusters at the top of the list, from irrigation systems to pesticides and fertilisers, have been growing faster than the others in recent years. It is also interesting to note that the trends for the hardware and software and microbiology clusters, although in the bottom two positions in terms of absolute numbers, have been steadily growing over time.

As for the actual technologies that have been or are being introduced, the following list contains all the most recent and most active ones within each of the above clusters, as determined from the text mining analysis (please note that the same technology can appear in more clusters which will increase its significance):

- solar thermal devices (solar collector, heating devices, heat carrier medium),
- chemical separation techniques (flash and column chromatography),

- telemetry for reducing energy consumption,
- harvesting machine for precision farming,
- image acquisition,
- nuclear magnetic resonance (NMR),
- microwave reactor,
- wireless technologies,
- pumps for irrigation systems,
- drive mechanism,
- preventive maintenance,
- technologies for sealing (related to irrigation systems and to processes of extraction of liquids),
- valve (isolation valve, control valve),
- material treatment,
- hydraulics systems,
- information technology (IT) systems development,
- genetics and biochemistry,
- robotic arms,
- automation,
- automatic measurement devices for packing and transportation,
- chemistry and green chemistry,
- mechanical press,
- technologies for the extrusion[41] of raw materials (for example to produce packaging),
- sensors (biosensor, remote sensor, microsensor),
- nanotechnologies.

Among the group of new technologies (at least new for the agri-food sector in Morocco) are all those linked to irrigation technologies in actual fields and more efficient management of water: pumps for irrigation systems, various types of valves, sealing solutions, and hydraulic systems. A second group is related to the production side of the chain and issues related to automation technologies and predictive maintenance. A third group relates to new varieties, such as genetics and biochemistry, green chemistry and chemical separation techniques such as the various solutions regarding chromatography techniques.

Other technologies relate to the tracking and integration of the supply chain: image acquisition, various types of sensors, and automatic measurement devices for packaging and transportation.

Interest in greener energy has led to research on technologies such as solar thermal devices, including solar collectors, heating devices, heat carrier mediums and the introduction of telemetry to improve energy efficiency in factories and offices.

Finally, some technologies are related to automation at the transformation level of the chain. These include robotic arms, solutions for production line automation, wireless technologies, preventive maintenance and information systems development.

[41] Extrusion is the process of forcing soft mixed ingredients through an opening in a perforated plate or die designed to produce the required shape.

On the potential impact of technologies

The interviews with key stakeholders and companies confirmed the relevance of all the technologies presented in the previous section. The discussions also highlighted which technologies are more likely to come on stream in the foreseeable future and transform elements of the agri-food sector. Even though there is awareness that the introduction of new technologies can improve competitiveness and productivity at all stages of the value chain (e.g. yield, durability, system irrigation, fertilisation processes and soil conservation), these technologies, except in large enterprises, have rarely been adopted to date.

The sector is moving at two different speeds: the first group of farms (the minority) is modern and evolving by adopting digital and mechanical technologies, sometimes imported from other countries; the second group (the majority) is composed of farms that are smaller in dimension, still work with traditional methods, and are facing multiple challenges with respect to new technologies. As a result, and despite incentives from the government, precision agriculture solutions or even drip irrigation systems are not common. The high cost of the technologies means they are out of reach of many players in the sector, but it is also the case that some in the sector are wedded to more traditional systems of production.

To support the transition, cooperatives and institutions like ONCA are the bridge between INRA and small farmers and are responsible for transferring technologies and competences. While INRA carries out research, ONCA directly interacts with farmers. Also thanks to this support, those value chains that have started to invest in processing have reached high levels of technological development.

New technologies can bring enhancements at all stages of the value chain, from production in the field to market distribution. Many of the new technologies and approaches most commonly mentioned in the interviews have the potential to change the sector if adopted. The key ones are listed below.

- Introduce drip irrigation and sensor-based irrigation to counter water scarcity and improve production. Parts of the country are not irrigated and reaching remote regions even with standard irrigation techniques will have a profound impact on production and job creation.
- Look to make use of the ‘smartification’ of production by adopting forecasting, modelling and simulation technologies alongside precision agriculture solutions.
- Invest in more specific machines (e.g. harvesters) for farms to increase yields and reduce labour-intensive work by farmers.
- Adopt production methodologies derived from best practices developed for industrial processes to increase efficiency and yield.
- Construct more greenhouses run with energy efficient systems.
- Use technologies for the transformation processes and quality enhancement of production, for example with solar dryers for dates and apricots, pasteurisation machines for milk, or selection of input seeds for cereals.
- Use technologies to test, diagnose and profile products, at all steps along the value chain, to ensure traceability and quality of food up to the final distribution stage. Certifications and labels to recognise/confirm the product’s identity would also support sales and increase consumer loyalty.
- Reintroduce/reuse production waste within the production cycle to improve revenue for farmers and reduce environmental impact (e.g. reuse of agricultural waste for heating).

- Introduce more efficient technologies for energy production in order to be more environmentally friendly and reduce costs.
- Digitalise production with digital communications and IT solutions, both hardware and software, and sensors.
- Digitalise sales with e-commerce but also social media activity for marketing.

Improvements in production processes and the push to higher quality and food safety standards are largely dependent on investments in new technologies. Agropoles play an important role in the frame of the partnership with universities for transferring technologies. For the future, it is expected that ONCA will have significantly more resources for transferring technologies through Génération Green. Moreover, the next generation of smart young farmers are eager to increase the use of new technologies in the sector.

4.5 Main findings

- Many factors have influenced the evolution of the sector, from greater integration into a more globalised market to customers' changing tastes, to the increased interest in the green economy and sustainability. The complex interplay of factors shaping the sector calls for long-term strategies.
- Numerous technologies are coming on stream which are likely to transform the agri-food sector. Many technologies show a positive adoption trend with implications for related jobs profiles.
- According to interviewees, certain technologies have the potential to completely disrupt and reshape production and value chains. Economic support and changes in the mindsets of producers are needed to boost wider adoption, especially in smaller enterprises.
- The following factors all have the potential to create new jobs in the sector: growing trend of innovation, increasing quality of production, the creation of niche products or markets with higher value added, the greening of production, and the high volumes of exports.

5. ONGOING CHANGES IN JOBS AND SKILLS DEMAND

KEY ISSUES

- An analysis of the main occupational profiles used in the sector and of the evolution of the skill content of selected occupations as a result of the changes occurring in the sector.
- An analysis of new tasks and functions which have emerged in the jobs and/or occupations in this sector, as well as of the ones that have disappeared (or are likely to disappear).
- The impact of the drivers of change on labour and skills demand in the sector, and whether such changes require higher levels of the same skills or completely new sets of skills.

While the previous chapter looked at the drivers of change in the agri-food sector and the associated technological changes, this chapter focuses on the implications of these changes. From both the data mining and the interviews, two groups of occupations emerged as likely to be increasingly sought in relation to the technological changes being introduced into agri-food: (i) technical or technology-related occupations (see Section 5.1); and (ii) business services and related occupations (see Section 5.2). Section 5.3 describes new skills needs. In addition, attention is given to those jobs which may become obsolescent. Overall, the analysis reveals that significant changes are taking place, and will continue to take place, in job profiles resulting from the technological changes described in the previous chapter.

5.1 Technology-related occupations

Identifying emerging jobs and skills needs

The incumbents of technology-related occupations comprise those who manage and use a given technology. The key assumption is that the growing interest in a certain technology (as expressed by patents filed, discussion in scientific papers, and so on) is associated with a growing need for skills associated with the use of that technology. The scale of skills demand will depend on the adoption or diffusion of the technology, which may vary for a number of reasons (e.g. capital constraints), and the strategic decisions companies make regarding the organisation of work.

There are various possible ways to link the information on technologies derived from text mining to the possible future skills needs. The following procedure was used. The relevant technologies extracted from the literature (see Section 4.3) were compared, using semantic matching algorithms (i.e. algorithms able to find semantic connections between different concepts based on contextual information), to the occupations listed by the European classification system ESCO.

Each occupation in the ESCO database includes a description and a list of competences, skills and knowledge considered relevant (either essential or optional) for that occupation. The semantic algorithm looks for matches of each technology with all the concepts associated with an occupation. When a match is found, the occupation is considered associated with the technology. The entire

procedure is automated by using ESCO's API, which allows occupational data to be downloaded. Table 5.1 provides a few examples of the matching process.

TABLE 5.1 EXAMPLES OF THE MATCHING PROCESS FROM PATENT TOPICS TO ESCO'S SKILLS AND OCCUPATIONS

Topic from patents	Matched ESCO skill	Related ESCO occupation
Harvesting + machine	Harvest crop	Horticulture worker
	Harvest aquatic resources	Aquaculture harvesting technician
	Operate hydraulic pumps	Pump operator
Pumps	Operate pumping systems	Mechanical engineer
	Set up water pump	Irrigation system installer
		Water conservation technician
	Geographic information systems	Hydrographic surveyor
Information + systems	Geographic information systems	Remote sensing technician
		Geological engineer
Sealing	Instrumentation equipment	Industrial engineer
Valve	Instrumentation equipment	Electrical engineer
	Maintain specified water characteristics	Wastewater treatment operator
		Water plant technician
	Hydraulic fluid	Mechanical engineer
Hydraulics	Hydraulic fluid	Fluid power engineer
	Operate hydraulic machinery controls	Energy engineer
		Pump operator
		Water plant technician
	Genetics	Bioengineer
Sensor	Digital camera sensors	Sensor engineering technician
		Electrical engineer
		Optical engineer
	Microsensors	Sensor engineer
	Harvest crop	Fruit and vegetable picker

Instead of starting from technologies (as extracted from patents) and then matching these with job profiles, an alternative methodology consists of extracting profiles directly from papers about Morocco's agri-food sector. In detail, the way this can be achieved is by using a list of skills, tools and technologies which can be found in the O*NET classification (this information can be easily downloaded from the online database) and then each one is searched for in the text of scientific papers. Once skills, tools and technologies have been extracted from the latter, it is then possible to refer to the O*NET occupations.

The following lists the technical professional and associate professional jobs which comprise ISCO (International Standard Classification of Occupations) occupation groups 21 – science and engineering professionals, and 31 – science and engineering associate professionals. The list emerged from the data mining (merging matches from both ESCO and O*NET). Please note that the list does not imply a ranking of relevance or intensity.

- Agronomist
- Biochemical engineer
- Sensor engineering technician
- Bioengineer
- Wastewater engineer
- Fluid power engineer
- Water engineer
- Hydroelectric operator
- Geneticist
- Biochemist
- Biochemistry technician
- Microbiologist
- Mechanical engineer
- Electrical engineer
- Solar energy engineer
- Renewable energy engineer
- Energy engineer
- Sensor engineer
- Energy assessor
- Water engineering technician
- Wastewater treatment technician
- Water plant technician
- Thermal engineer
- Drainage engineer
- Photonics engineering technician
- Optoelectronic engineer
- Optical engineer
- Optoelectronic engineering technician
- Water treatment systems operator
- Wastewater treatment operator
- Microelectronics engineering technician
- Energy systems engineer
- Industrial pharmacist
- Chromatographer
- Chemistry technician
- Instrumentation engineer
- Instrumentation engineering technician
- Chemical engineer

The occupations listed above can be grouped according to two main branches of the occupational classification:

- science and engineering professionals divided in two main groups: life science professionals such as geneticists, biochemists, microbiologists and agronomists; and engineering professionals such as mechanical engineers, fluid power engineers, and solar and renewable energy engineers;
- associate professionals such as physical and engineering science technicians (e.g. sensor and water engineering technician, chromatographers and microelectronics engineering technician), process control technicians (e.g. water plant technician and wastewater treatment technician) and life science technicians (e.g. biochemistry technician).

The role of agronomist has always been associated with agri-food and it implies that even the introduction of new technologies will not diminish the need for this profession on which the sector has been historically dependent. The presence of mechanical engineers and electrical engineers shows, in the former, that there is still the traditional link with mechanical tools both in agricultural and industrial fields, while the latter may indicate a shift towards the adoption of electrical solutions in production processes. The largest group of professions is related to the topic of water management. Besides the more generic engineering professions, there are specific profiles for wastewater management and for the use of water as an energy source. In this regard, some professions on the list are related to the management of energy, i.e. those that explicitly refer to renewable energy and solar energy. Professions related to the introduction of sensors also emerge which, although no longer pioneering, can still be relatively new and confirm a possible development for the sector. In

this sense, these should also be considered profiles for the adoption of optical solutions in the food industry sector.

As well as looking at professional and associate professional occupations, i.e. highly skilled workers, it is also possible to look at lower-skilled occupations, in particular service workers (ISCO 5 – service and sales workers), skilled trades workers (ISCO 7 – craft and related trades workers), machine operators (ISCO 8 – plant and machine operators and assemblers), and agricultural and transport labourers (ISCO 9 – elementary occupations). The following occupations emerged as being related to technological change in agri-food:

- Pump operator
- Heat sealing machine operator
- Concrete pump operator
- Fluid power technician
- Water network operative
- Irrigation system installer
- Fruit and vegetable picker
- Pipeline pump operator
- Land-based machinery operator
- Waterway construction labourer
- Tower operator
- Pipe welder
- Crop production worker
- Solar energy technician
- Precision mechanic
- Machinery assembler
- Machinery mechanic
- Drainage worker
- Forestry equipment operator
- Precision instrument assembler

As with the highly skilled professional group, it is possible to notice a similar distribution at the lower-skilled levels. In fact, there are profiles related to the mechanical, hydraulic and energy fields. However, low-skilled profiles do not mention electrical professions or those in the field of scientific research. It is also interesting to note the presence of elementary professions within the sector: fruit and vegetable picker, waterway construction labourer, crop production worker, drainage worker and aquaculture harvesting worker.

Skills required by technological professions

As well as looking at the occupations associated with technological change, there is a need to know which skills within those occupations are likely to be in demand. One can achieve this by looking at the skills listed for each occupation in ESCO. This is a straightforward exercise (for example, a sensor engineering technician must know how to *assemble sensors, test sensors etc.*). The process is illustrated in Table 5.2.

TABLE 5.2 OCCUPATIONAL SKILLS NEEDS RELATED TO A TECHNOLOGY: THE EXAMPLE OF SENSOR TECHNOLOGY

Starting technologies	Related occupations (ESCO match)	Related skills (ESCO match)
Sensors	Sensor engineering technician	Assemble sensors
		Assist scientific research
		Fasten components
		Inspect quality of products
		Liaise with engineers
		Meet deadlines
		Operate scientific measuring equipment
		Prepare production prototypes
		Read engineering drawings
		Record test data
		Solder electronics
		Test sensors

Source: ESCO

There are limitations to using ESCO. In many cases, it lists general skills (e.g. test sensors), while specific competences (e.g. knowledge of different types of sensor devices), which effectively allow deeper detail, are less well covered. Additionally, the competence level required (e.g. how much knowledge/ability in a sensor device is required for each of the various occupations it appears in) is another critical factor which is not specified in existing classification systems such as ESCO. In addition to this, the technologies likely to be increasingly adopted in agri-food may result in demand for people to work in jobs or occupations which are new and not classified in ESCO, ISCO or other job classifications.

To address the limitation described above and obtain a more complete picture of the knowledge needed to master a given technology, additional information was obtained from Wikipedia (chosen for its accessibility, the comprehensive amount of information it contains, and the structured way it presents information). More precisely, for every topic (most recurrent terms found in patents) the corresponding Wikipedia page was downloaded using web scraping. The content of the pages and of its associated content tree was then semantically matched with the various related occupations in order to find those technical concepts that seemed to correlate with each one of them. It is thus possible to provide a more in-depth analysis of the specific skills that will be required in various technical jobs (as shown in Table 5.3). As in the previous example, the sensor technology has been matched to the occupation of sensor engineering technician and its associated skills (according to ESCO), but here the occupation has been further linked to more detailed information about the skills required to master the use of sensors.

TABLE 5.3 EXPANDING OCCUPATIONAL SKILLS DATA PROVIDED IN ESCO: THE EXAMPLE OF SENSOR TECHNOLOGY

Starting ESCO occupation	Examples of associated skills from ESCO	Examples of required knowledge inferred from
Sensor engineering technician	Assemble sensors	Chemical sensors
	Fasten components	Pressure sensors
	Inspect quality of products	Metal-Oxyde-Semiconductor
	Solder electronics	Temperature sensors
	Test sensors	Image sensors

It is important to note that not all topics/technologies which emerged from the patent analysis were matched to ESCO competences and occupations. For example, the technology *chromatography* did not find a direct match. It is another indication that existing classifications may not yet encompass references to all new technologies.

That said, to complement the above analyses, job profiles related to technologies can be extracted from online job postings in an automated way, i.e. through web scraping. More specifically, it is possible to search for all job offers (for this task the global employment website Monster.com was used) which mention, for example, chromatography, and extract details of the occupations where this technology is mentioned. Since this approach leads to results which are not readily cross-classified with standard occupational classifications (e.g. ESCO or ISCO), it was not pursued further in this study, but Table 5.4 illustrates the possible outcomes using the example of chromatography.

TABLE 5.4 SELECTION OF JOB PROFILES EXTRACTED FROM ONLINE JOB POSTINGS RELATED TO CHARGING STATIONS FOR CHROMATOGRAPHY (WEB SCRAPING FROM MONSTER.COM, TECHNOLOGIES FROM PATENT ANALYSIS)

Technology not matched in ESCO	Matched occupational profiles in job postings
Chromatography	Chromatography scientist
	Chromatography technical sales manager
	Senior product manager bio high performance liquid chromatography (HPLC)
	Scientist – analytical chemistry
	Assistant/associate scientist (chromatography, filtration, AKTA™ fast protein liquid chromatography systems)
	Downstream R&D scientist
	High performance liquid chromatography (HPLC) scientist
	Chemistry research associate
	Analytical chemist

Ranking occupations according to potential demand

In the case of technology-related occupations or jobs, it is possible to use data mining results not just to list occupations but also to estimate their relative relevance in the future labour market based on technological trends. To do this, an assumption is made about the relevance of an occupation depending on:

- the technological transversality of the occupation, i.e. its importance grows if it has skills related to more than one technology or topic;
- if the associated skills are essential or optional (as defined in the ESCO classification);
- the weight of the technologies to which it has been matched, in terms of potential future use, as expressed by the normalised number of patents it appears in.

To assign an importance value to each job profile, the three conditions must be intersected as shown by the following formula:

$$\text{Importance of Job profile } j\ (y_j) = \sum_{i=1}^{m} T_{ij}\, E_{ij}\, W_i$$

Where:

$$T_{ij} = \begin{cases} 1 & \text{If technology/topic } i \text{ is linked to job profile } j \\ 0 & \text{otherwise} \end{cases}$$

$$E_{ij} = \begin{cases} 1 & \text{If technology/topic } i \text{ is essential to job profile } j \\ 0.5 & \text{otherwise} \end{cases}$$

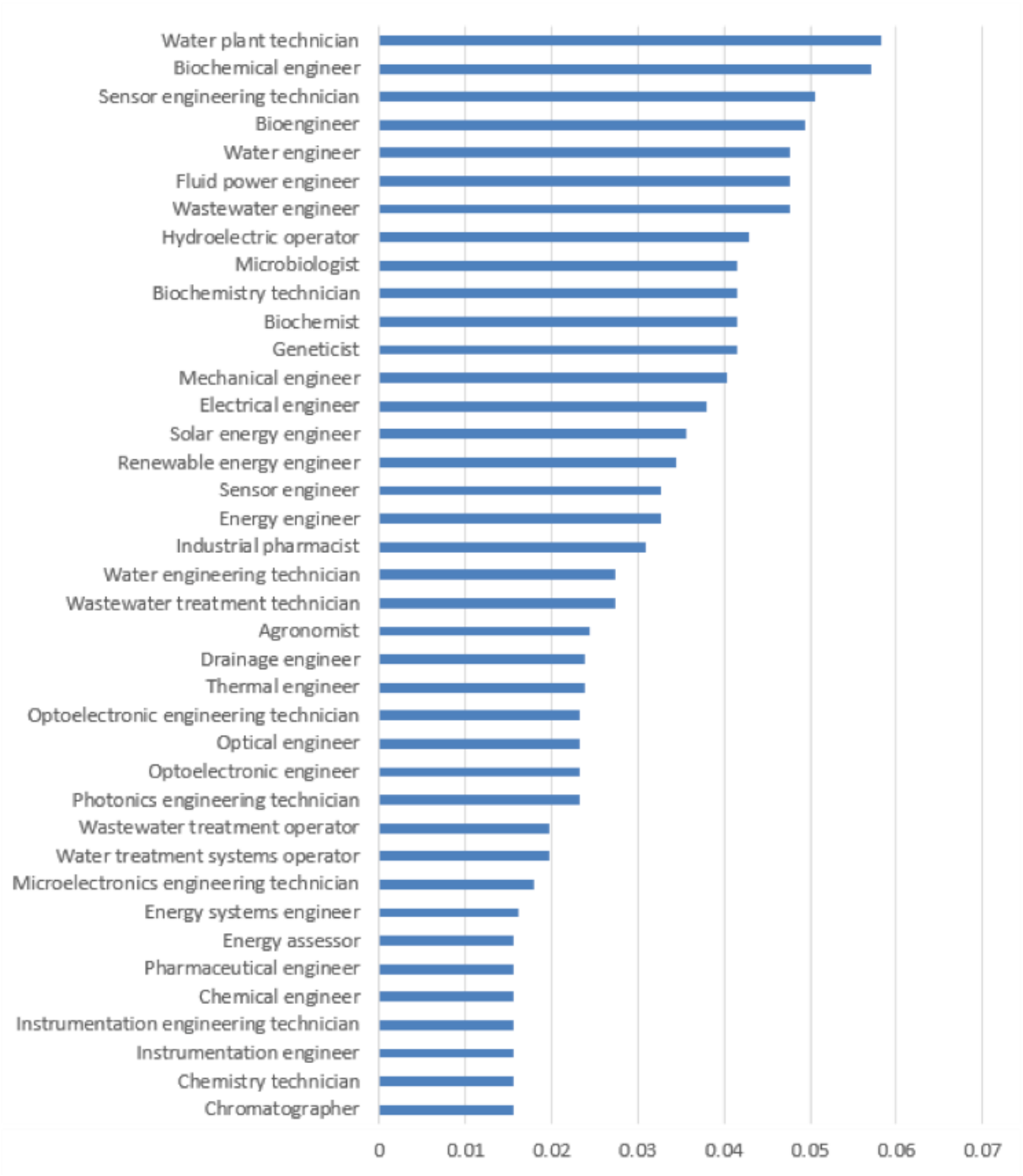
$$W_i = \text{Importance of the technology/topic } i$$

The values of T_{ij} are based on the analysis an extract of which is shown in Table 5.1, the values of E_{ij} are based on a sensitivity analysis[42], and the values for W_i are derived from the intensity of the signal for the given technology derived from the patent analysis (see Section 4.3 and Figure 4.3). Once the scores have been calculated for all occupations, a bar plot can provide a visual understanding of the most relevant occupations in the agri-food sector.

The output is shown in Figure 5.1 (relevance scores are normalised and cut above 0.15). The ranking is indicative of which job profiles are of potential interest but not for the exact order or score. A full-scale analysis of the demand for jobs would require a deeper investigation and a range of different approaches, and is beyond the scope of the present study. Yet it provides interesting insights: from the plot it is clear that there will be a high demand for water plant technicians, biochemical engineers, sensor engineering technicians, bioengineers and wastewater engineers, among others. Occupations such as energy assessor will still be needed in the future but less so than the above-mentioned occupations.

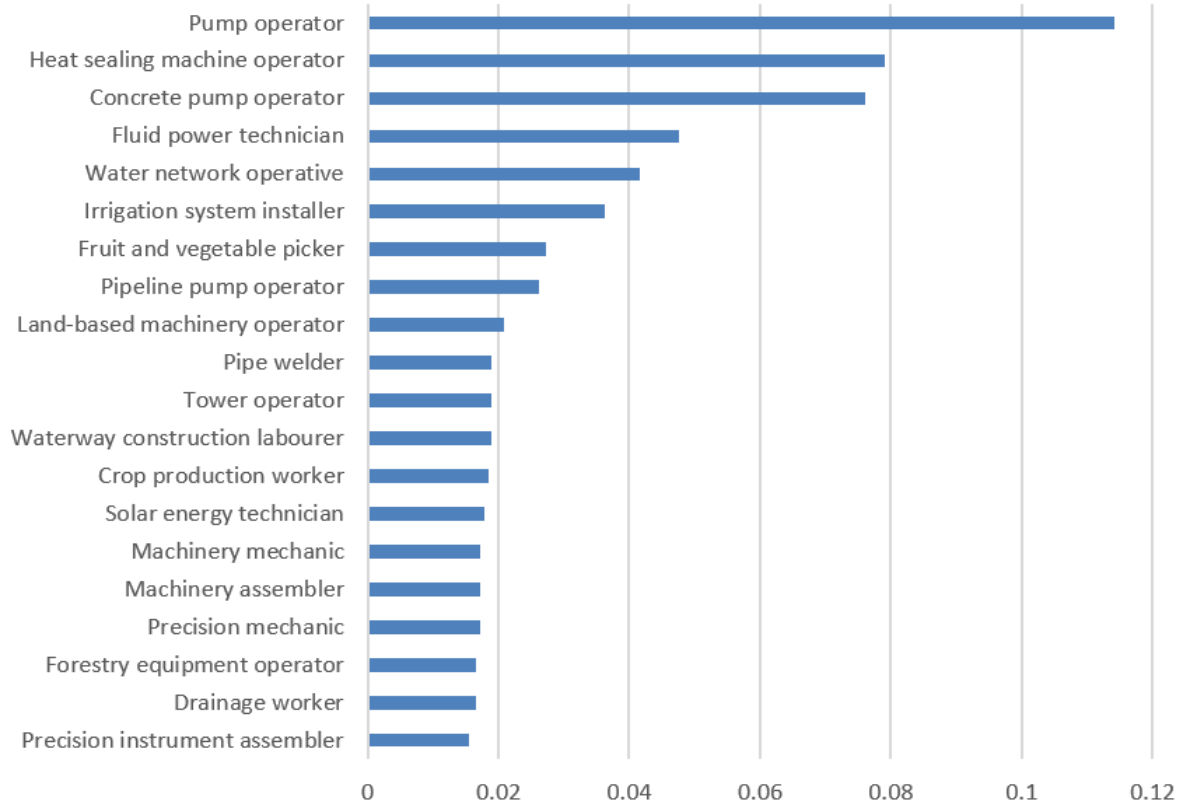
[42] Sensitivity analysis is an iterative procedure for defining the 'strength' of the link between technology/topic and job profile. In comparing the ranks obtained from the iterations, the lower value is set to 0.5 in order to generate a rank that is consistent with the association between job profiles and technologies.

FIGURE 5.1 RANKING OF RELEVANCE FOR PROFESSIONAL AND ASSOCIATE PROFESSIONAL OCCUPATIONS FROM ESCO (ON THE BASIS OF THE TECHNOLOGIES THEY CORRELATE WITH)



A similar analysis can be repeated for trade workers and machine operators, with the same remarks about the meaning and the limitations of the ranking. The output is shown in Figure 5.2 (relevance scores are normalised and cut above 0.15). It is worth noting that if generally low-skilled occupations receive a lower score compared to professional occupations, in this case some of them have a higher relevance: pump operator, heat sealing machine operator and concrete pump operator seem to receive a higher ranking than, for example, water plant technician and biochemical engineer.

FIGURE 5.2 RANKING OF RELEVANCE FOR MEDIUM-, LOW- AND VERY LOW-SKILLED OCCUPATIONS FROM ESCO (ON THE BASIS OF THE TECHNOLOGIES THEY CORRELATE WITH)



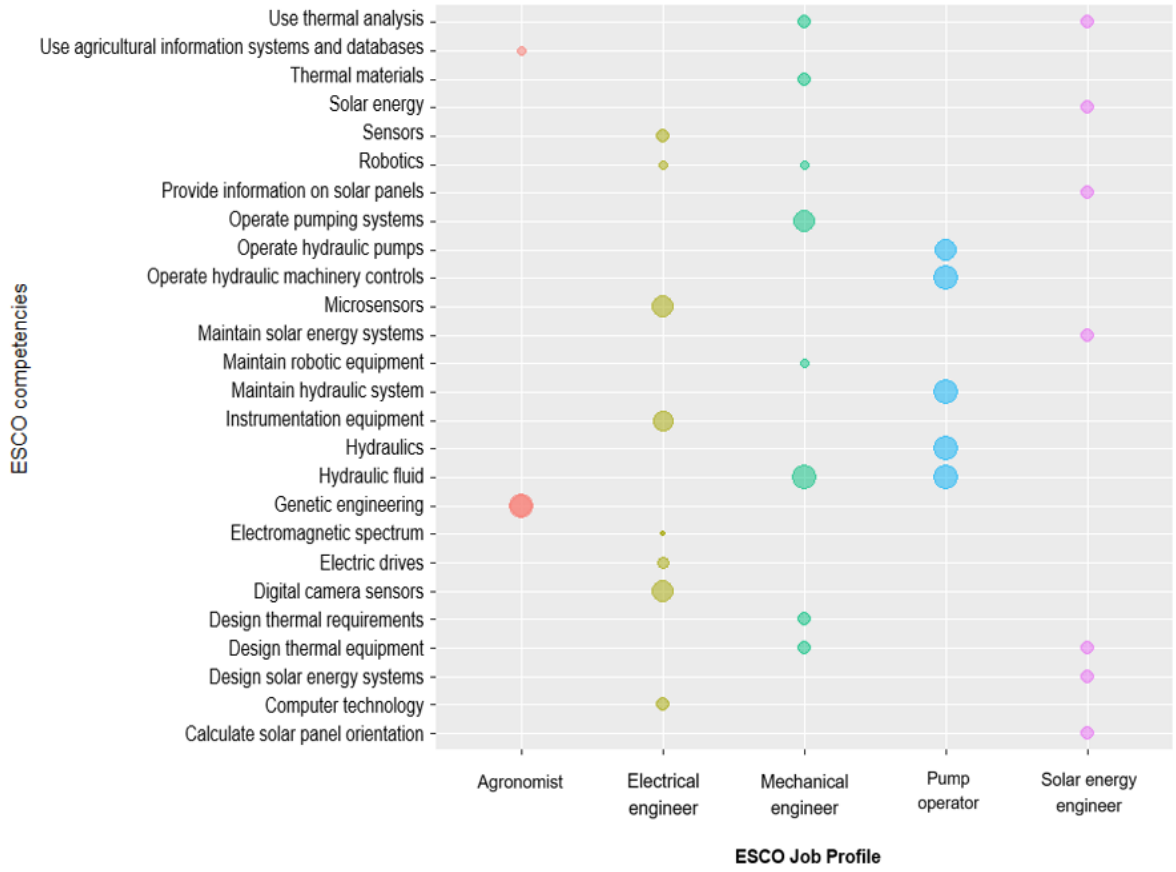
In addition, it is also possible to have a more detailed look at each occupation by analysing how they differ from one another based on which ESCO competence they are connected to. For instance, taking the agronomist, electrical engineer, mechanical engineer, pump operator and solar energy engineer, a bubble chart can be used to visualise which skills or sets of knowledge are associated with the occupations, and how important these are based on the technology/topic to which they are connected (see Figure 5.3). In the figure, the horizontal axis lists the five ESCO occupations which are matched on the vertical axis with the competences ESCO associates with them. Each competence is associated with a technology according to the procedure described at the beginning of the section, and the size of the bubble at the intersection indicates the relevance of the technology as determined by its occurrence in patents.

Figure 5.3 shows the distribution of competences across occupations. For example, it reveals that to work in the agri-food sector, the electrical engineer needs to have skills related to sensors, digital camera sensors and microsensors, robotics, instrumentation equipment, electric drivers and computer technology. On the other hand, the mechanical engineer needs to have competences that are mostly linked to the use of thermal and hydraulic systems.

It is also interesting to note that the agronomist, according to ESCO at least, seems to be a profession with a rather small set of competences. However, the increasing relevance of techniques such as precision agriculture for agronomic production hints at the fact that ESCO classification is not sufficient to define the skills range of future agronomists: it is very likely (and trends in other countries

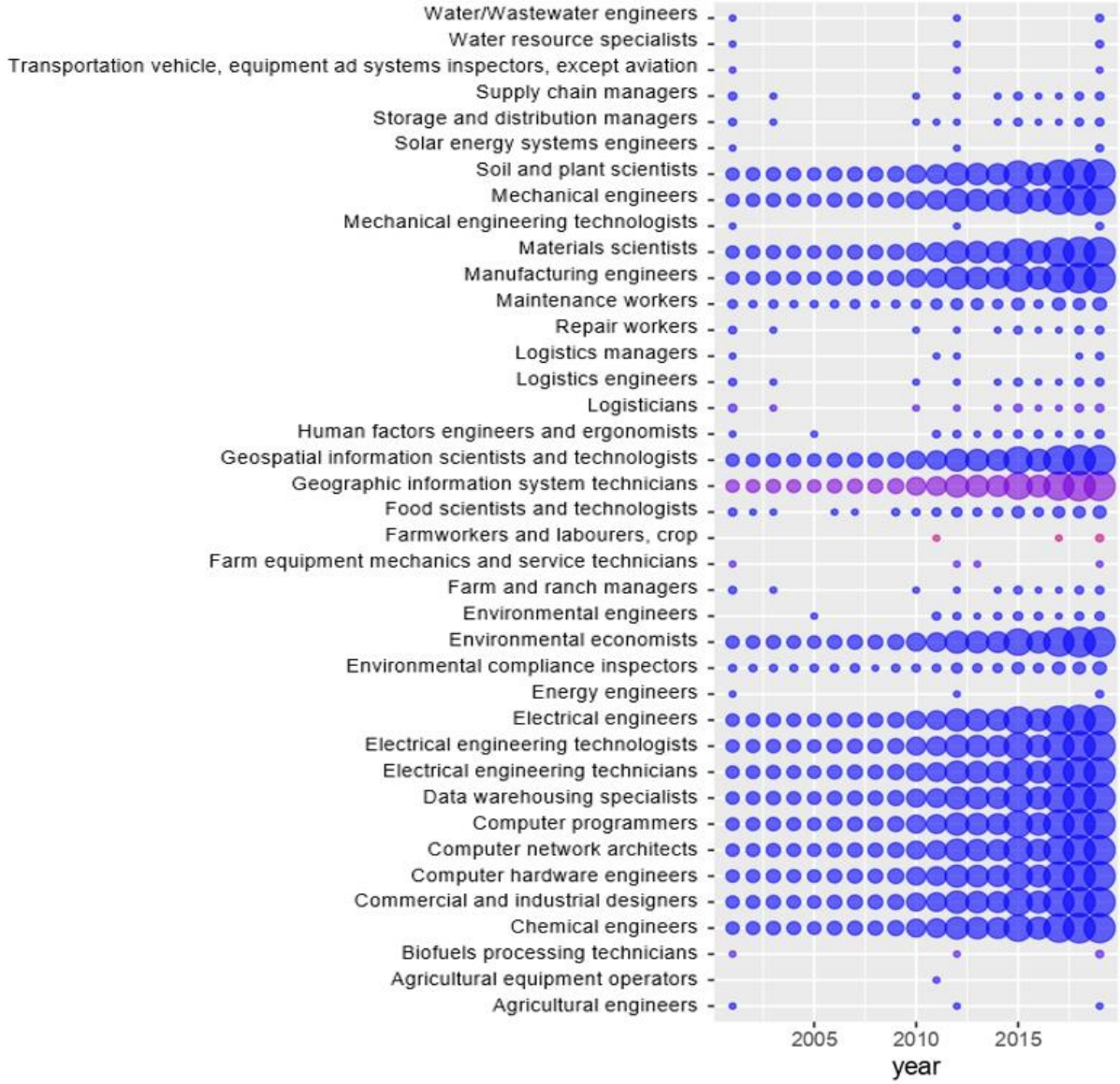
confirm this assumption) that this occupation will become more complex and will need to possess a wider range of competences, from knowledge of sensors to the basics of data science.

FIGURE 5.3 COMPARING FIVE JOB PROFILES IN TERMS OF THEIR SKILLS (ACCORDING TO ESCO CLASSIFICATION OF OCCUPATIONS AND RELATED COMPETENCES), AND WHICH COMPETENCES ARE THE MOST RELEVANT FOR EACH OCCUPATION (BASED ON THE ASSOCIATION WITH TECHNOLOGIES PROVIDED BY PATENT ANALYSIS)



Finally, the ranking procedure applied to patents and ESCO occupations (shown in Figures 5.1 and 5.2) can also be applied to scientific papers and O*NET to obtain the results shown in Figure 5.4. This chart has a similar purpose to Figures 5.1 and 5.2, but instead of aggregating all contributions to create an overall ranking, an alternative visualisation has been chosen, showing the time trend of the references to each occupation. The size of each dot in the chart is proportional to the strength of the signal associated with a given occupation in a given year.

FIGURE 5.4 O*NET OCCUPATIONS AND THEIR GROWTH OVER THE YEARS IN THE MOROCCAN AGRI-FOOD SECTOR (AS EXPRESSED BY THEIR OCCURRENCE IN SCIENTIFIC PAPERS)



The information presented in Figure 5.4 summarises what emerged from previous analyses. Information system technology had already emerged as one of the most recurring topics in Table 5.1. Figure 5.4 seems to confirm this conclusion, since profiles related to geospatial information scientists and technologists and geographic information system technicians seem to be growing in importance.

The fact that the number of soil and plant scientists and chemical engineers is also increasing can be a reasonable and expected result, since we have seen that papers and websites often relate to aridity, fertilisers, pesticides, biochemistry, microbiology, genetics, chemistry and crop improvement. The growing trend of the profiles such as environmental economists, environmental compliance inspectors and environmental engineers is linked to the climate change and environmental sustainability drivers found in the paper analysis.

Other occupations which emerged through this last analysis are: computer technology profiles (such as computer programmers, computer network architects and computer hardware engineers) and data warehouse specialist (connected with data acquisition and analysis and digital communication found in paper analysis); supply chain managers, storage and distribution managers and all logistics-related profiles (globalisation driver emerged during previous paper analysis); and food scientists and technologists. Some occupations do not seem to have well-defined trends and only appear in recent years and in very low numbers, but this does not mean that they are not gaining importance. For example, solar energy system engineers, energy engineers, water/wastewater engineers and water resource specialists are all profiles related to topics that emerged both from papers and patents.

The above discussion highlights which job profiles are often in demand and thus resilient to change or even favoured by such change, and which job profiles are currently in lower demand but are emerging as likely to be more and more relevant. At the same time, the blue dots in Figure 5.4 depict those profiles with no propensity to being substituted by automation, while red dots show those profiles with a higher propensity for substitution (purple indicates profiles in between). In this regard, it is possible to see how the profiles belonging to farmworkers and labourers (i.e. elementary professions according to ISCO classification) have a high risk of being substituted by machines in the near future and the number of such workers will likely decrease, although it is difficult to quantify by how much.

Summing up trends for technology-related occupations

To sum up, as already stated, data for Figures 5.1, 5.2 and 5.4 is indicative of those job profiles which are likely to be associated with technological change in the future in agri-food. According to both the data analysis and the interviews with stakeholders and companies, the technology-related job profiles most sought after at present are as follows, grouped by similar types:

- data analysts[43], computer programmers, computer network architects, computer hardware engineers and data warehousing specialists;
- agronomist, soil and plant scientists, and agricultural engineers;
- geospatial information scientist and technologists, and geographic information system technicians;
- quality control engineers, food scientists and technologists, engineers in food management and food science;
- chemical engineers, biofuel processing technicians, biochemical engineers, bioengineers, microbiologists, biochemistry technicians, geneticists and pharmacists;
- various other branches of engineering: mechanical engineers, electrical engineers, sensor engineers and optoelectronic engineers;
- various types of blue-collar or specialised workers: farm equipment mechanics and service technicians, pump (and other irrigation systems) operators, agricultural equipment operators (in particular special drivers for agricultural machines such as tractors or harvesters), fruit and vegetable pickers, and crop production workers.

The variety of job profiles listed above – including many professions which can be considered traditional to the agricultural sector, such as agronomists, food specialists and soil and plant scientists – prove that technology is reshaping all activities and processes. It was noted during

[43] The data analyst profile in particular is not only related to the ongoing digitalisation process but also to the need to use specific information from data to support strategic decisions.

the interviews that certain agricultural job profiles, although traditional, are nevertheless hard to find, such as horticultural experts, as are skills in specific tasks such as branching and harvesting.

Profiles that represent a bridge between different fields are important in the agri-food sector. For example, an agronomist has competences in upstream activities, since they have a basis in agriculture, and understand the downstream processes of transformation.

The analysis (both from data and from interviews) also projected into the near future: due to the climatic condition of the country and the worldwide movement on reducing emissions, and to the need to increase competitiveness, the following professions are expected to be even more sought after:

- environmental economists, environmental compliance inspectors, environmental engineers, solar and renewable energy engineers, thermal engineers, energy systems engineers, energy assessors and experts in energy efficiency;
- water/wastewater engineers, water resource specialists, water plant technicians, fluid power engineers, pump operators, fluid power technicians, water network operatives, irrigation system installers and pipeline pump operators;
- metrologists and other associated professions (experts in metrology are considered by many a necessary addition to keep pursuing more demanding quality control and enforcement);
- manufacturing and packaging managers;
- research laboratory officers: these are required in the R&D departments of companies to ensure a connection between research and production and increase the innovativeness of the sector;
- nutritionist engineers, who work on the technological processes and at the same time have competences in commercial aspects, knowing food habits, consumer preferences and market trends. This is a new profile that still does not exist in Morocco. They will also be needed to develop more value added products.

The data analysis also detected some job profiles which might currently only employ relatively few people but are mentioned with increasing frequency over time. These include:

- supply chain managers, storage and distribution managers, logisticians, logistic managers, logistics engineers, transportation vehicle, equipment and system inspectors, and commercial, industrial and manufacturing engineers/designers.

Finally, there are those job profiles where demand may be diminishing because their tasks can be easily automated. These include:

- farmworkers and labourers, and geographic information system technicians.

The findings provided indicate how technology will shape the competences of jobs. It is this degree of detail which is important to those who are responsible for anticipating future skills demand and designing training programmes. But it is not just the more technical jobs which need to be considered. As the next section reveals, the jobs of those involved in a range of business services will also be affected in the agri-business sector.

5.2 Business services and related occupations

The analysis also identified a second category of profiles: non-technological jobs more related to business aspects such as management, marketing and sales, and export and trade. Such professions, which are related to particular agri-food subsectors rather than technologies, are relevant to the business models that companies adopt and the way they organise production. These professions affect the adoption and use of technology in agriculture.

The same data mining analysis used to identify technology-related jobs was used to identify the following business service occupations (from both ESCO and O*NET):

- renewable energy consultant,
- renewable energy sales representative,
- agronomic crop production team leader,
- horticulture production team leader,
- fruit production team leader,
- horticulture production manager.

In the above list, given the lower number of entries, high- and medium-skilled occupations have been grouped together. The list spans from business professionals and associated professionals (ISCO Group 24 – business and administration professionals and ISCO Group 33 – business and administration associate professionals) to highly skilled profiles and team leaders (ISCO Group 61 – market-oriented skilled agricultural workers, limited to organisational and planning roles) to medium-skilled ones.

From the point of view of functions performed, two main distinct groups can be identified:

- business and administration professionals and sales and purchasing agents; these are directly related in the renewable energy sector;
- market-oriented skilled agricultural workers such as team leaders dedicated to the organisation and planning of scheduled production.

The relatively low numbers of business roles highlighted during the data analysis is an indication that many occupations in management and sales will not feel the impact of new technologies. Rather, they will be affected by other types of drivers of change, as indeed the interviews suggested.

Trends in skills levels and specialisation and the expected impact on employment

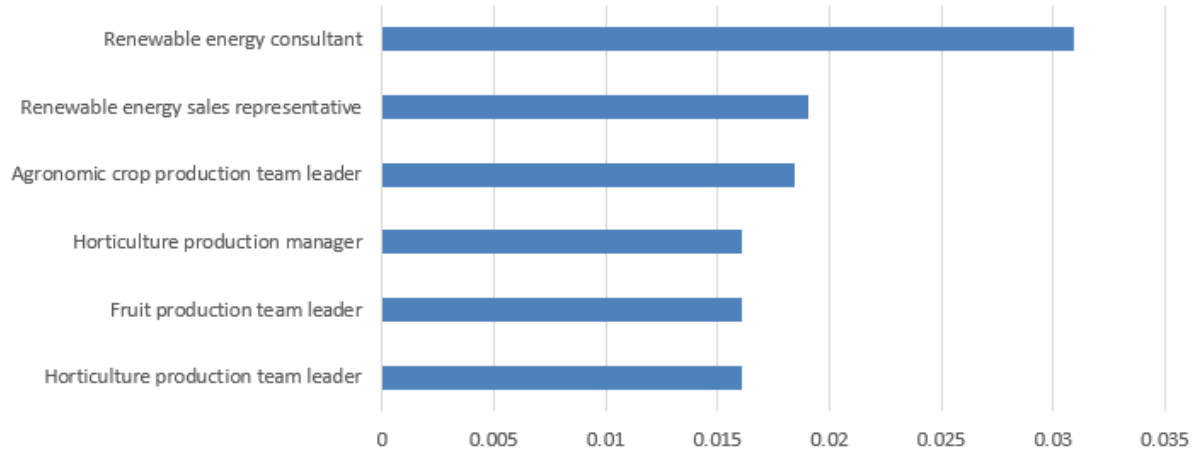
There are a wide variety of skills attached to the business service roles and even more than for technological occupations. For instance, management roles tend to require relatively high-level skills, while for salespeople, the skills requirements tend to be lower.

Given the relational nature of business occupations, there is a lower risk of a decrease in employment due to automation. More likely, the technological input on the sales and management processes will reshape tasks and competences but not replace the human factor. It may, however, result in jobs becoming broader – i.e. covering a wider range of tasks – because technologies may merely assist with tasks. Even though they are necessities, managerial and business development roles tend to be less required in comparison with roles more closely linked to production. This trend will likely increase as organisations become more structured. Access to international markets will also require properly trained managers, as well as marketing and salespeople.

Attempts to rank occupations according to possible demand

The ranking of relevance – as provided by the correlation with technologies, according to the formula reported in Section 5.1 – can be applied here to show which business professions are more likely to be affected as a result of technology (Figure 5.5).

FIGURE 5.5 RANKING OF RELEVANCE FOR MANAGERS, SALESPEOPLE AND SERVICES WORKERS FROM ESCO (ON THE BASIS OF THE TECHNOLOGIES THEY CORRELATE TO)



The ranking is indicative of which occupations or jobs are likely to be related to the technological changes expected over the coming years, with profiles related to renewable energy more relevant than the various team leader ones.

By considering the information provided in Figure 5.5 in the light of the information collected during the interviews with key stakeholders and employers, the business occupations most likely to be in demand are listed below.

- Marketing, communication and commerce: Marketing activities have been indicated as insufficiently covered by the existing workforce. Consumer demand and competition are pushing companies towards new markets such as the African market, requiring marketing and communication profiles that could deal with the changing scenario. At the same time, digital marketing and e-commerce will be more relevant for business in the near future and experts able to take advantage of such tools will be required in relevant numbers.
- Project managers, operation managers and production team leaders: These types of roles are connected on the one hand to the increasing need to adopt efficient processes, imported from the industrial world, and on the other hand to the increasing relevance of logistics and management of the supply chain.

Business and management roles are important in a sector such as agri-food where the integration along the supply chain (horizontal integration) and within the same company (vertical integration) characterises its complexity. The demand for marketing and sales-oriented profiles demonstrates the need for companies operating in the sector to increase their visibility on sales channels (both physical and virtual) in order to maximise the value of their products.

5.3 Emerging skills needs and skills obsolescence

New skills for existing jobs and new emerging professions

New competences are at the basis of the introduction of new technologies; in many cases, people in existing occupations need to reshape their skill sets so they are able to deal with the challenges ahead.

A clear example is given by commercial roles. Many interviewees pointed out that there is a general need for experts in communication, marketing and negotiations in order to promote national products in the global market. Nowadays, this implies more expertise in digital techniques, such as for social media marketing and e-commerce, and thus new profiles for such occupations will emerge in the country. Some value chains are already trying to digitalise their marketing and creating a unique digital platform for the business-to-consumer market. It is important to fill this competences gap: the digital divide may hamper the success of many small companies, which may not be able to take full advantage of the new opportunities and the incentives and tools provided by institutions and associations.

In a similar way, the need to improve quality standards and introduce more sophisticated quality controls often requires the employment of dedicated professionals, such as quality engineers; regardless of this, existing production engineers and technicians need to learn about metrology techniques, food management, quality control management and safety issues. Farmers will have to learn how to grow and test their products to ensure quality and health standards.

Finally, some large enterprises have introduced digitalisation and mechanisation in their processes. In these cases, they have started to look for new competences: new kinds of roles have been created, such as qualified technicians that have some specialisation in automation and sensors.

Other professions are instead totally new, at least for Morocco. For example, the increasing demand for processed foods creates new subsectors, such as pastry, gastronomy and cheese, which in turn create a demand for new competences and job roles.

The need to enhance local products and preserve the identity of food requires expertise in testing and traceability technologies, but also competences in intellectual property to protect such products, both of which are new to the sector in Morocco. In the same way, experts in international certification will be required to verify that production meets relevant criteria to be able to refer to something as organic.

The trend towards a higher value added value chain creates the need for new professions. An example of an emerging occupation is a nutritionist engineer, a new profile which creates a bridge between the production processes and the market, having a knowledge both of technical aspects and of consumer habits and preferences. Another case is that of the various experts needed to create market niches, such as the use of olive oil in the cosmetic or pharmaceutical industry, or of its waste products to produce energy. Other professions that will likely emerge in the future are the profiles related to renewable energies, in particular solar energy.

Skills obsolescence

Skills can become obsolete due to technological changes, such as the introduction of automation in processes. The introduction of new technologies can therefore lead to a reduction in the number of people working in the sector. This does not seem to be happening yet, and is not expected in the

short term, in the agri-food sector in Morocco. The feedback received from the interviews with companies is that no job profiles are expected to disappear in the near future. Even if the introduction of automation in their field of activity takes place, manual activities will continue to be necessary. It may be that some specific activities related to elementary professions (such as farmworkers and labourers) will disappear, but employers reported that people will be relocated to different activities and will not be replaced; this is in line with the data shown in Figure 5.4.

So far, the limited digitalisation in the sector has not affected manual work and has not replaced people with automation; it has mainly positively affected some technical aspects that concern measurements and in some cases data acquisition. At the same time, the introduction of technologies helps improve working conditions: at the field level, many activities are still tiring, heavy, and energy-consuming for manual operators, and technological solutions will reduce effort and thereby safeguard the workers' health.

At the field level, traditions and knowledge of a certain vintage are still considered important for farming. The combination of traditional knowledge with a modern research approach may provide several competitive advantages.

5.4 Main findings

- The two main categories of job profiles with growing demand are technology-related occupations and business services-related occupations (from sales to management). Both are impacted by new technologies; for example, digital skills will be required for technical roles on the production side, but also for marketing and sales profiles on the business side. All skills levels within technology-related occupations will be affected (from high-level skills to elementary skills), while business-related roles sensitive to the adoption of new technologies usually require a medium level of skill.
- New jobs and competences are emerging; some of them are new for the country, while others are not found in occupation and skills classifications such as ESCO. In both cases, specific competences need to be acquired by the workforce.
- Some occupations show signs of obsolescence, such as manual or low-skilled occupations with a relatively high level of specialisation amenable to automation. However, most of the companies believe that the overall level of employment in agri-food will not decrease as a consequence of the introduction of new technologies. Instead, the decline in labour-intensive occupations will be compensated by the increase in productivity and the shift of workers to more value added tasks.
- Companies and stakeholders value soft skills. Thus, the debate on future skills needs is not just about technical skills but also the mix of technical and soft skills.
- The interviews with companies pointed to the increasing relevance for high-skilled profiles comprising multidisciplinary competences and the ability to interact with people from different disciplinary or professional backgrounds.

6. MEETING THE CHANGES IN SKILLS DEMAND

KEY ISSUES

- How the changes due to the introduction of new technologies affect skills utilisation and working conditions in the sector.
- How businesses meet their new skills needs (e.g. via recruitment or retraining existing workers), and the relationships they have with education and training providers.
- Whether the education and training system is adapting sufficiently to changing skills needs resulting from technological and other changes to meet the agri-food's skills needs in Morocco.

This chapter focuses on company strategies to meet their emerging skills needs. Please note that all findings presented in this chapter are from the focus group discussion and the in-depth interviews conducted with companies and key stakeholders (from both education and employment sides).

6.1 Constraints on technological change

Companies were asked which factors have limited the adoption of new technologies and the development of their business. Answers were divided into two main groups: economic aspects and the supply of skills.

For many interviewees, the main limiting factor is the high cost of new technologies and the related insufficient investments to support technology adoption. Modern irrigation techniques, photovoltaic solutions, greenhouses, solar dryers and precision agriculture are all technologies that many farmers would like to introduce but lack the funds to do so. This varies to some degree according to their position in the value chain. Employers are different from one another in their capacity to invest, with large companies being much better placed to introduce innovations than smaller ones.

A related aspect is the role of incentives to promote the introduction of new technologies. Government agencies have promoted the development of the agri-food sector. It was reported that there is a division of competences between the Ministry of Agriculture (concerned with upstream activities) and the Ministry of Industry (with downstream processes). Improved integration would be beneficial. For agri-food companies, there are two funds which they can draw on to assist with their development: a fund for industrial development and a fund for agricultural development. Both provide opportunities, but for small-scale farmers it is practically difficult to obtain access to them. Concerns were also reported about the funding of research centres and companies to jointly develop programmes. According to some interviewees, agricultural research in Morocco tends to be underfunded and lacks continuity of development.

Companies also pointed out that high-quality Moroccan products are usually less price competitive than both those imported from abroad (e.g. Turkey and Egypt) and those found in the informal market. Indeed, imported products are usually cheaper because the larger size of foreign companies and markets allow for more economies of scale; there used to be high import duties protecting small Moroccan producers, but with recent free trade agreements, local farmers have become less

competitive while at the same time the price for raw materials has increased. Regarding competition from the informal market, the agricultural sector is defiscalised, while the agri-food sector, i.e. more structured companies, pays taxes and value added tax (20%). Traditional producers on the informal market that do not offer quality standards can keep prices much lower than their formal counterparts. Furthermore, the high price of quality certifications discourages the creation of structured, controlled and well-organised value chains.

A further factor affecting the competitiveness of the sector is its capacity to pay the wages to attract the skills it needs. Graduate engineers, for instance, can easily find a job in Morocco but many of them (about 25% of the total) decide to go abroad for work because the salaries are higher. And if skilled people choose not to move abroad, they prefer to work in the public sector. Moreover, young engineering graduates also prefer to work and live in the cities. In the rural areas where much of the agri-food sector is located, and where there is much growth because of the Green Morocco Plan, it is becoming difficult to find enough qualified engineers.

A second line of thought identifies the lack of competences and the shortage of qualified workers as a factor hindering the diffusion of innovation and the development of the sector. Employers reported that many competences discussed in the previous chapter are in short supply. Indeed, apart from migration and salary issues, there is the issue of capacity of the education and training system: for example, IAV Hassan II is only able to train a limited number of engineers each year, as they do not have capacity and teachers to do more, while an existing VET track was cancelled due to lack of resources. In general, even if there is a lack of higher education graduates, most of the problem is linked to VET graduates, due to the limited capacity of the education systems, but also to very limited use of laboratories and practical activities to provide the right set of skills needed by companies. R&D capability has also been reported as a key missing aspect by various interviewees.

The gap in competences has negative consequences: farmers are unable to take advantage of the many incentives provided by institutions and associations. For example, Fenagri developed a free-of-charge digital platform for e-commerce, but some cooperatives were not able to access it because of the low level of digital skills in their workforces.

It is also a matter of mindset. Because many agri-food enterprises are small (essentially smallholdings), the approach to business is a traditional one which is not oriented or open to innovation. It is focused on meeting short-term goals with little interest in the global market (or how the global market might eventually affect the demand for what they produce). According to some interviewees, even when competences are widely available and access to technology is subsidised, change still fails to take place. For example, some farmers will not accept the introduction of new varieties of plants because it goes against what they have been doing for years. Courses for enhancing and updating many competences are available and the government covers around 80% of their costs, but available technicians with diplomas in digital skills still face difficulties finding employment.

According to some interviews, it is not so much the lack of an innovation-oriented mindset that is the problem, but the organisation of the value chain. At present there is no clear guidance on how to raise quality and productivity. This is required to lead small-scale farmers to use technologies that are developed by INRA or other institutes. Small-scale farmers should be better organised. Larger companies and cooperatives could contribute here. For example, with guidance linked to funding, the sector would be better incentivised to take up organic farming, renewable energy, climate-smart agriculture and environmentally friendly technologies.

Innovation is not restricted to technological advancements. Non-technical but systemic innovation that the sector needs includes wider application of new technologies, training at all skills levels, aggregation to increase productivity of smaller farms, and improved role of sectoral associations to support small producers. In particular, this calls for special support for cooperatives to widen their distribution.

Another factor that has emerged from the interviews is the lack of awareness of the Moroccan population about healthy eating and environmental sustainability (despite a growing consciousness in specific groups). The other side of the coin is that organic food costs more and is less affordable than conventional foodstuffs.

6.2 Finding the required skills – recruitment

Recruitment strategies vary according to the level of the profile that is required and it seems that there is no single strategy. Some businesses rely exclusively on head-hunters, while others (usually small-scale farmers) mainly adopt word-of-mouth solutions. Other companies prefer to hire people who work for competitors so that no training is needed as skills have already been acquired. This 'poaching externality', as it is sometimes referred to, is a disincentive for employers to train people. In general, for recruitment, companies use advertisements and some employment agencies (Anapec).

The availability of skills varies by geographical area. In some regions there is an excess supply of skills, while the opposite is true in more remote regions. In general, there are four major issues when recruiting people with the skills required: (i) the relatively low attractiveness of the sector compared with positions in the public sector; (ii) many highly skilled workers (including engineers) leave the country to work abroad; (iii) in some regions, it is difficult to reach the enterprises and there is a general preference to live and work in cities; and (iv) there is a varying level of supply coming from the local education and training system.

Among larger enterprises, internship programmes are commonly used. Every year, students from the more prestigious universities are sent to companies on internships: each student has a subject on which they work during the two months they spend at the enterprise. This provides a pool from which agri-food enterprises recruit people. In the last three years, offers to new engineering graduates have quadrupled even if, in some cases, their skills still need to be improved.

6.3 Training strategies and opportunities

Many public institutes are present at the national level to support the strategy of the Ministry of Agriculture; many incentives are also provided for the training of employees. Training programmes are usually project-oriented and INRA and ONCA collaborate in developing programmes together. GIAC helps companies define strategies for skills and competences development, while INRA provides consultancy regarding quality issues. The government covers around 80% of the expenses of the courses and there are several establishments which provide professional training.

Various public and private universities and engineering schools in the country offer degrees in agro-industry engineering and technology, such as IAV Hassan II or the National School of Agriculture (École nationale d'agriculture – ENA) in Meknès. The OFPPT offers technician-level education in various disciplines and supports companies in reducing gaps in capacity development. Within the Ministry of Agriculture and under the management of the Department of Education, Training and Research (Direction de l'enseignement, de la formation et de la recherche), there are several technician-level institutions across the country. Some of them also offer short courses to company

personnel for both initial education and continuing training. However, companies point out that the curricula are sometimes too theoretical, such that new graduates have good theoretical knowledge but less developed practical competences.

To address the skills gap, companies use a mix of strategies. Specific training can be carried out internally in the company while continuing learning programmes are usually provided through government support (mainly through arranged agreement with the OFPPT). In the last five years (2015-2020), the demand from companies for continuing training has doubled, and it is increasing every year. On the basis of annual training plans, the first set of training is usually carried out by internal experts; for the second set, companies usually have agreements with the OFPPT so the training is subsidised by the state. In a few cases, companies have set up internal training academies that provide apprenticeship programmes coupling practical experience with theory. There are also some events (such as the Cité des métiers in Agadir) or training programmes provided by ONCA (for agriculture) and ONSSA (for industry). Some companies have internship programmes with universities abroad (e.g. France and Spain), while others have internship programmes with schools in Morocco; every year, some technicians are sent to engineering schools in Morocco for specific training.

In any case, the need for training is widely acknowledged in the sector, especially for new graduates. The common perception is that knowledge of the needs of the market, the processes and the competitors has to be learned in the field. Thus, a period of internal apprenticeship is essential for every new recruit, and it is carried out by people in the industry who have a deep knowledge of the trade: ‘The problem with innovation is that it begins with the mastery of the profession’.

Many companies point out the imbalance between the training of engineers and that of technicians. While for the former, university and training institutions are of a high level, the quality of teachers is considered much lower when it comes to technical schools. Particularly on quality control management and safety issues, there are several postgraduate programmes for engineers organised by universities, but for technicians and other medium-skilled workers, major gaps in equivalent provision remain. Various institutes have started working on the issue but the demand for intermediate professionals is growing so fast that the training deficit persists.

Many companies organise training on quality aspects, but this needs to be followed up by continuing training for managing and maintaining the quality control system. There are also training courses on hygiene and quality, and technical training for different processes and logistics.

In general, companies require courses to be updated; this relates to the curricula and in increasing the hours in the laboratory (the practical part) and time for theoretical learning.

Covid-19 has boosted the use of digital solutions for distance learning. The OFPPT recommended a model of hybrid education, where the theoretical part is carried out online and the practical part (up to 30% of the students’ time) is undertaken in person. For the next semester, IAV Hassan II is preparing a platform for providing the courses entirely online.

In some cases, companies state that there is a lack of schools related to specific value chains, as is the case for example for olive oil and milk. Moreover, depending on the subject area, there are no specific schools or universities for developing marketing and sales competences with specific reference to the agri-food sector, and there is no background training that can be found in Morocco specifically for R&D. However, it is worth underlining that such very specific competences could also be developed through continuing training, work-based learning and internships as a way to adapt and upskill workers on the sector needs and specificities.

6.4 A final word on the findings

Various good practices are being implemented in the country. The introduction of coordinated strategies, such as the Green Morocco Plan, has helped Morocco reduce productivity gaps with other countries. The creation of multidisciplinary agropoles, where the main institutions of the sectors are clustered, has contributed to reducing the problem of access to international research and markets. The new strategic plan (Génération Green) is expected to bring even more advances to the sector. The aggregation of smaller players promoted by the Green Morocco Plan has resulted in positive impacts on both productivity and revenues.

However, agri-food in Morocco is still structured in two segments that seem to proceed at two different speeds: on one side a minor set of companies, mainly large ones, that produce using modern techniques, and on the other side, the majority of small farmers still produce using traditional means. There is also great heterogeneity, with many subsectors (some important economically, others important from a social point of view, for instance argan production). The vision of stakeholders is that all groups and sectors need to be supported.

A first important aspect is related to the transfer of technologies to farmers. The adoption of solutions such as precision agriculture, modern irrigation techniques and renewable energy is definitely one of the main drivers of development for the sector. Several incentives are available for investing in new technologies, but their limited diffusion hints at the fact that many farmers are still not able to access such incentives; moreover, in many cases the attitude towards innovation should change. Farmers should be helped to raise their skills level so that they can really take advantage of new technologies. An increased technological input would also increase the attractiveness of the sector (especially for younger generations) and support new start-ups (as suggested in Génération Green).

A way to achieve the transfer of new technologies to farms of all sizes could be through the aggregation model, or with cooperatives, and through the mediation of sectoral associations and public institutions. In particular ONCA can play a relevant role, connecting with farmers and training them on the use of new technologies. Important here will be demonstrating the benefits of investing in new technologies such as clearly signalling the economic benefits which can be gained from, for example, using solar power to dry food. In other words, it is about persuading producers to be more open to innovations of one kind or another, given that the failure to change may ultimately threaten the viability of their current businesses.

The aggregation of small farmers has been one of the key elements of the Green Morocco Plan, and itself is an innovation. This direction should be pursued even further to promote different types of collective organisations. For example, the economic interest group (groupement d'intérêt économique) can play a substantial role in regional development, as they put together traditional units that otherwise would not be able to ensure quality; however, they should be provided with more capacity in terms of number of experts, and with incentives to compensate for higher costs than in the informal market.

Another important direction of action relates to planning according to value chains. One of the main challenges for the future is to enhance and diversify local products at the same time as improving the quality of production in order to attract even more customers, at national and international levels. More structured value chains and a better link between industry and related services and professions will increase employment both in the agricultural sector proper and in all the other economic sectors that interact with it: industry, energy, craft, design and marketing. In this sense, the agri-food sector can be an important job creator since it requires different kinds of job roles, and a lot of opportunities

are present both at national and international level. For value chains that are not organised yet, there is a need to tackle the issues behind the lack of organisation in order to create new employment. Also, the shift towards market niches and higher value added crops or applications has the potential to create additional jobs but needs to be supported with adequate measures and training. It is not only technical skills that need to be acquired or developed, but also skills in quality management, managerial capability and business activities. Support is also needed in terms of incentives to boost cooperation and to develop bankable business plans.

Another area that could bring improvement to the sector is that of certification. Currently a quality certification is issued by ONSSA and it is expected that all companies will have it by the end of 2021. However, some constraints need to be removed. Presently, production is very heterogeneous in terms of quality; moreover, consumers still look at the price more than the quality of the products, and thus the informal market is a great obstacle for the development of the agri-food sector. An awareness campaign on the healthier aspects of quality products would support the sector. Consumers should be encouraged to buy quality products and avoid uncertified food.

Moreover, despite the general public largely being unaware of health and security concerns related to food and food production, it is worth underlining that due to Covid-19, customers have become and are becoming more aware of the health aspects related to food consumption. The change in awareness of consumers means quality certifications, new technologies, and organic farming are expected to grow even more. For organic farming, the sector needs to develop more competences in view of its likely future growth. ONCA is responsible for transferring technologies and competences and with the local associations must manage the transition and skills requirements.

Last but not least, green technologies, biological agriculture, agroecology agriculture and sustainable development are new models for agribusiness that can become profitable niches for Morocco, with benefits for both market proposition and job creation (renewable energy has been indicated alongside irrigation of wider portions of the land as two main sources of new employment in the country). The Ministry of Agriculture could revise education programmes to adapt to these emerging niches, together with the OFPPT and the VET department of the Ministry of Education, in relation to apprenticeships and private schools.

In the above-mentioned aspects too, the sector is moving at two different speeds: some farms are evolving by adopting digital and mechanical technologies, and producing organic products, while some other farms are smaller and still work with traditional methods. The latter have no ability to obtain a quality certification without the support of engineers or technicians. In this sense, bigger industries and cooperatives should help small companies in training and technology development.

Génération Green also focuses on the creation of communities inside rural areas. Future investments could make the sector more attractive for young people, create a community of smart young farmers that will boost the adoption of new technologies, and help the sector move towards more efficient and productive solutions. According to the interviews, in part this is already happening in some areas of the country.

It is hoped that these findings will raise awareness of policy-makers and practitioners about the changing skills needs in the agri-food sector and provide food for thought especially in relation to the ability of the education and training system to address these changes and to prepare workers to be fit for the new jobs and occupations.

Possible specific actions could include the following.

- adopt an integrated vision and push for greater convergence between agriculture (upstream) and food processing (downstream), and integration between the authorities responsible for the constituent parts of the agri-food sector;
- make greater investments in R&D to address the forthcoming challenges such as climate change and capture high value added segments of the market;
- structure interventions at the value chain level, and remove factors behind the lack of organisation in certain value chains, in order to create new employment. Large companies, cooperatives and institutions can support the small players and transfer know-how on the basis of the specific needs of the chain, fostering the adoption of technologies, new management models, access to funding, and quality control and certification;
- create collective organisations (or boost existing ones) that are able to aggregate or involve the largest possible number of small farms and guide them towards a path of improvement in terms of enhancing the value of production; favouring a change of mindset about innovation and the need to be competitive in order to survive and thrive; and adopting new technologies and business models, also through technology transfer. Cooperatives could be one possible model to be scaled up, assuming that training is granted at all skills levels, as aggregation aims to increase productivity and quality, and aims to establish more structured value chains. Sectoral associations should be equipped to support small producers and special support should be granted to cooperatives to expand distribution;
- improve the organisation and control of value chains to reduce the use of the informal market;
- incentivise the formal market through ad-hoc policies to raise consumers' awareness about higher quality and healthier products;
- enable a better understanding of companies' needs through more specific diagnostic studies with indications of specific occupational profiles required and additional training. This would have implications on occupational standards in the country, with the need to revise documents that describe tasks and activities and specify performance requirements to attain competence in the different occupations. Social partners, ministries, experts, providers and other interested stakeholders would need to review them, looking at implications for existing related qualifications and/or the need to identify new ones;
- enhance the training curricula, especially in VET schools, with more laboratories for practical activities and at the same time more digital tools for more efficient content delivery. There is also the need to expand the competences on internationalisation (e.g. laws and regulations, trade agreements, quality requirements, digital and traditional marketing techniques), given the growing focus on exports;
- revise education programmes to adapt to new emerging niches and in particular to those related to green and sustainable economy such as agroecology or renewable energies;
- create new, dedicated vocational schools to develop specific value chains, intermediate professional figures on specific competences, and agricultural R&D activities. Possible best practices to explore and expand on are the training institutes set up by sectoral federations in collaboration with international and national counterparts; for example, the Institut de formation de l'industrie meunière has trained more than 400 technicians specialised in milling activities;
- enhance continuing training and reskilling and upskilling as a way to ensure workers are adaptable to rapidly changing skills needs in their jobs and to give them tools to transit to new job opportunities. In this, cooperation with the private sector (with the establishment of specific public–private partnerships, as is already happening in some sectors) is key, together with the reinforcement of work-based learning practices and internships.

6.5 Main findings

- There are various factors which may constrain growth in the agri-food sector, from those related to the cost of introducing new technologies (and the estimated returns), to those related to the availability of skills needed to use new technologies.
- The mindset in some of the more traditional agri-food enterprises (small-scale farms, often not part of existing cooperatives or other aggregation mechanisms) is such that they are largely unaware of the need to introduce new technologies.
- Recruiting people with the skills needed to adapt to technological change can prove difficult for the following reasons: (a) the relatively low attractiveness of the sector compared with positions in the public sector; (b) many highly skilled workers (including engineers) leave the country to work abroad; (c) in some regions, it is hard to reach the agri-food enterprises and there is a general preference for living and working in cities; and (d) there is a varying level of supply coming from the local education and training system.
- Companies follow various strategies to find the skills they need, ranging from recruiting new graduates from universities after an internship, to recruitment through head-hunters and also using job advertisement campaigns. For smaller enterprises, word of mouth is also a solution.
- The subsectors do have links with the education and training system, but employers report that schools are not able to provide all the competences required by the industry.
- Companies try to compensate for skills gaps in their workforces by widening their training strategies, e.g. by providing in-house learning, mentoring and on-the-job training, or using external organisations to secure training, or even setting up their own internal academies and training centres.
- Private actors in the sector pointed out that to allow the entire sector to grow, more specific professional schools (from the value chain of oil to that of milk production) are needed. In parallel, the enhancement of continuing training and reskilling and upskilling is essential to ensure sector-specific skills and make workers adaptable to new emerging needs.

ANNEX: KEY STAKEHOLDERS CONSULTED

The following table lists all the stakeholders and companies which were met during the project, either during the focus group discussions or bilateral online interviews with Moroccan representatives.

No	Organisation (alphabetical order)
1	ADA – Agence pour le développement agricole
2	Agrinova
3	Agro-Pôle Olivier Meknès
4	AGRIVAL – Comptoir agricole de Souss
5	Aïcha Conserves de Meknès
6	Anouar Invest
7	Cafés Carrion
8	COMADER – Confédération marocaine de l'agriculture et du développement rural
9	COSUMAR
10	Delassus Group
11	Direction régionale de l'agriculture Fès-Meknès
12	ENA Meknès – École nationale d'agriculture de Meknès
13	FAO – Food and Agriculture Organisation
14	Fenagri – Fédération nationale de l'agroalimentaire
15	Ferme Bio Settat
16	GIAC AGRO
17	HCP – Haut Commissariat au Plan
18	Huiles de Saiss
19	IAV Hassan II – Institut agronomique et vétérinaire Hassan II
20	IFIM – Institut de formation de l'industrie meunière
21	INRA – Institut national de la recherche agronomique
22	ISIAOM – Institut spécialisé en industrie agro-alimentaire et oléiculture – Meknès
23	Lesaffre Maroc
24	Lesieur Cristal
25	Millennium Challenge Account Morocco Agency
26	Ministère de l'Agriculture
27	Ministère du Travail et de l'Insertion professionnelle
28	Nestlé
29	Observatoire des métiers et des compétences des branches professionnelles
30	OFPPT – Office de la formation professionnelle et de la promotion du travail

No	Organisation (alphabetical order)
31	RIAM – Réseau des initiatives pour l'agroécologie au Maroc
32	Saytlia Agrobio
33	The Euromed University of Fez
34	UCAM – Université Cadi Ayyad
35	UEMF – Université euro-méditerranéenne de Fès
36	Unimer SA
37	Ibn Tofail Université
38	Zouyout AIT ATTAB

GLOSSARY

Artificial intelligence (AI) is a general term used to describe a variety of technologies and approaches that allow computers to solve complex tasks (usually associated with higher cognitive levels), for example: recognition of objects or patterns; classification of entities; simulation and modelling of situations; predictions of future behaviours; and generation of constructs similar to existing ones.

Cognitive bias is a systematic pattern of deviation from the norm or rationality in judgement. Cognitive biases are considered by many authors as linked to the normal functioning of the human brain and thus can arise in any activity involving human judgement.

Competence means 'the proven ability to use knowledge, **skills** and personal, social and/or methodological abilities, in work or study situations and in professional and personal development' (European Qualifications Framework). While sometimes used as synonyms, the terms skill and competence can be distinguished according to their scope. The term skill refers typically to the use of methods or instruments in a particular setting and in relation to defined tasks. The term competence is broader and refers typically to the ability of a person – facing new situations and unforeseen challenges – to use and apply knowledge and skills in an independent and self-directed way.

Cross-sector knowledge, skills or competences is one of the four levels of **skills** reusability identified by the **ESCO** initiative, whereby reusability means how widely a knowledge, skills or competence concept can be applied in different working contexts. Cross-sector knowledge is relevant to occupations across several economic sectors, whereas sector-specific or occupation-specific knowledge is restricted to one specific sector or **occupation**. See also **transversal knowledge**.

Cross-sector technology – adopting the **cross-sector** concept from **ESCO**'s **skills** reusability levels, the term indicates a technology that finds application in many different economic sectors (e.g. control units or sensors).

ESCO is the multilingual classification of European Skills, Competences, Qualifications and Occupations. ESCO works as a dictionary, describing, identifying and classifying professional **occupations**, **skills** and qualifications relevant for the EU labour market and education and training, in a format that can be understood by electronic systems. It lists over 3 000 occupations and 13 000 skills and competences. For more info, see https://ec.europa.eu/esco/portal/home.

ISCO stands for International Standard Classification of Occupations and is an International Labour Organisation classification structure for organising information on labour and jobs. It is part of the international family of economic and social classifications of the United Nations. It contains around 7 000 detailed jobs, organised in a four-level hierarchy that allows all jobs in the world to be classified into groups, from 436 lower-level groups up to 10 major groups.

Job is a set of tasks and duties performed, or meant to be performed, by one person (ISCO-08).

Job profile is the description of a particular work function, developed by the employer or by the human resources department of a company, that includes all the elements deemed necessary to perform the corresponding **job**. In particular, it includes general tasks, duties and responsibilities, and required **qualifications**, **competences** and **skills** needed by the person in the job.

Job title is the identifying label given by the employer to a specific job, usually when looking for new candidates to the position. In the absence of standardised nomenclature, it can coincide with either a description of the **job** or the **occupation** group the job belongs to.

NACE (Nomenclature statistique des activités économiques dans la Communauté européenne [Statistical classification of economic activities in the European Community]) is a four-digit classification providing the framework for collecting and presenting a large range of statistical data according to economic activity in the fields of economic statistics, provided by Eurostat. Economic activities are divided into 10 or 11 categories at high-level aggregation, while they are divided into 38 categories at intermediate aggregation.

Natural language processing (NLP) is an interdisciplinary field at the intersection of linguistics, computer science and information engineering. NLP deals with the interactions between computers and human (natural) languages, in particular how to program computers to process and analyse large amounts of natural language data, starting from the identification of the grammatical and logical parts of speech within a sentence, up to the complex representation of semantic relationships between words.

O*NET stands for Occupational Information Network, a free online database of occupational requirements and worker attributes. At the time of writing, the online database contains 1 016 occupational titles, each with standardised and occupation-specific descriptors, covering the entire US economy. It describes occupations in terms of the skills and knowledge required, how the work is performed, and typical work settings. It can be used by businesses, educators, jobseekers and human resources professionals. It is a program to facilitate the development and maintenance of a skilled workforce, developed under the sponsorship of the US Department of Labour/Employment and Training Administration (USDOL/ETA). For more info, see www.onetcenter.org/ and www.onetonline.org/.

Occupation – according to **ESCO**, an occupation is 'a grouping of jobs involving similar tasks, and which require a similar **skill** set'. Occupations should not be confused with **jobs** or **job titles**. While a job is bound to a specific work context and executed by one person, occupations group jobs by common characteristics (for example, being the 'project manager for the development of the ventilation system of the Superfly 900 aircraft' is a job; 'project manager', 'aircraft engine specialist' or 'heating, ventilation, air conditioning engineer' could be occupations, i.e. groups of jobs, to which this job belongs).

Occupational profile is an explanation of the **occupation** in the form of description, scope, definition, and list of the knowledge, **skills** and **competences** considered relevant for it. Each occupation in the **ESCO** database also comes with an occupational profile that further distinguishes between essential and optional knowledge, skills and competences.

Profession – an **occupation** requiring a set of specific **skills** and dedicated training.

Qualification is the 'formal outcome of an assessment and validation process which is obtained when a competent body determines that an individual has achieved learning outcomes to given standards' (European Qualifications Framework).

Regulated profession – a profession is called regulated if its access, scope of practice, or title is regulated by law.

Semantic matching is a technique used in computer science to identify information which is semantically related.

Skill means 'the ability to apply knowledge and use know-how to complete tasks and solve problems' (European Qualifications Framework). Skills can be described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments). While sometimes used as synonyms, the terms skill and **competence** can be distinguished according to their scope. See **competence** for more details.

Soft skills are usually associated with **transversal skills** and are considered the cornerstone for personal development, also within the context of labour and employment. To distinguish them from other knowledge-based basic skills, they are often referred to as social or emotional skills. They can be further classified into personal skills (e.g. problem-solving and adaptability) or interpersonal ones (e.g. teamwork and leadership).

Text mining is a general term indicating a variety of techniques that allow computers to extract, discover or organise relevant information from large collections of different written resources, such as websites, books and articles. The first part of any text mining process implies the transformation of texts in structured representations useful for subsequent analysis through the use of **NLP** tools. Sometimes **AI** techniques are used to perform text mining tasks more effectively.

Transversal knowledge, skills or competences is the highest of the four levels of **skills** reusability identified by the **ESCO** initiative. Transversal skills are relevant to a broad range of **occupations** and sectors. They are often referred to as core skills, basic skills or soft skills, the cornerstone for the personal development of a person. Transversal knowledge, skills and competences are the building blocks for the development of the 'hard' skills and competences required to succeed in the labour market.

Transversal technology, adopting the **transversal** concept from **ESCO**'s **skills** reusability levels, is relevant to a broad range of **occupations** and sectors and is a building block for more specific technologies (e.g. computerised image analysis).

ABBREVIATIONS AND ACRONYMS

ADA	Agence pour le développement agricole (Agency for Agricultural Development)
Anapec	Agence nationale de promotion de l'emploi et des compétences
ENA	École nationale d'agriculture de Meknès (National School of Agriculture of Meknès)
ESCO	European Skills, Competences, Qualifications and Occupations
ETF	European Training Foundation
EU	European Union
EUR	Euro (currency)
Fenagri	Fédération nationale de l'agroalimentaire (National Federation of Agri-Food)
GDP	Gross domestic product
IAV Hassan	Hassan II Agronomy and Veterinary Institute
INRA	Institut national de la recherche agronomique
ISCO	International Standard Classification of Occupations
IT	Information technology
MAD	Moroccan dirham (currency)
NACE	Nomenclature statistique des activités économiques dans la Communauté européenne (Statistical classification of economic activities in the European Community) – see Glossary
NLP	Natural language processing
OECD	Organisation for Economic Cooperation and Development
OFPPT	Office de la formation professionnelle et de la promotion du travail (Office for Vocational Training and Work Promotion)
ONCA	Office national du conseil agricole
O*NET	Occupational Information Network
ONSSA	Office national de sécurité sanitaire des produits alimentaires
PNEI	Pacte national pour l'émergence industrielle (National Pact for Industrial Emergence)
R&D	Research and development
USD	United States dollar (currency)
VET	Vocational education and training

REFERENCES

URLs last accessed March 2021

African Development Bank Group, *Country results brief 2019: Morocco*, 2019. www.afdb.org/sites/default/files/2019/10/15/crb_morocco_en.pdf

African Development Bank Group, *Morocco economic outlook*, [online], n.d. www.afdb.org/en/countries/north-africa/morocco/morocco-economic-outlook

Agency for Agricultural Development, *Investor's guide in the agricultural sector in Morocco*, 2015. www.agriculture.gov.ma/sites/default/files/investors_guide_in_the_agricultural_sector_in_morocco.pdf

Akesbi, N., 'Le Plan Maroc Vert: Une analyse critique', *Questions d'économie marocaine 2011*, Presses universitaires du Maroc, 2011, pp. 9–48. www.amse.ma/doc/Questions%20d'e%CC%81conomie%202011.pdf#page=9

Blancher, N., Fayad, D. and Auclair, G., *Education: Investing in Morocco's future*, IMF, 4 May 2016. www.imf.org/external/np/blog/nafida/050416.pdf

Chauffour, J.-P., *Morocco 2040: Emerging by investing in intangible capital. Directions in development*, World Bank, Washington, DC, 2018. https://doi.org/10.1596/978-1-4648-1066-4

ETF (European Training Foundation), *Morocco: Education, training and employment developments 2016*, ETF, Turin, 2017a. www.etf.europa.eu/sites/default/files/m/219F2D787DF91A26C12580E60051181C_Morocco%202016.pdf

ETF (European Training Foundation), *Torino Process 2016–17: Morocco – executive summary*, ETF, Turin, 2017b. www.etf.europa.eu/en/publications-and-resources/publications/torino-process-2016-17-morocco-executive-summary

ETF (European Training Foundation), *Morocco: Education, training and employment developments 2019*, ETF, Turin, 2019. www.etf.europa.eu/sites/default/files/document/Country%20fiche%20Morocco%202019.pdf

ETF (European Training Foundation), Badescu, M., *Key indicators on education, skills and employment 2019*, ETF, Turin, 2019. www.etf.europa.eu/sites/default/files/2019-12/kiese_2019.pdf

EU Delegation to Morocco, *Note sur les impacts économiques du Covid-19 au Maroc au 26 mars 2020* [Note on the economic impact of Covid-19 in Morocco on 26 March 2020]. www.awex-export.be/fr/medias/note-sur-les-impacts-economiques-du-covid-19-au-maroc

Harbouze, R., Pellissier, J.-P., Rolland, J.-P. and Khechimi, W., *Rapport de synthèse sur l'agriculture au Maroc*, Rapport de recherche CIHEAM-IAMM, 2019.

Haut Commissariat au Plan, Activité, emploi et chômage 2018 [Labour force participation levels, employment and unemployment], 2018. www.hcp.ma/downloads/Activite-emploi-et-chomage-trimestriel_t13038.html

Mabaya, E., Christy, R.D. and Bandama, M., 'The current state of agribusiness education and training in Africa', paper presented at the Joint 3rd African Association of Agricultural Economists and 48th Agricultural Economists Association of South Africa Conference, Cape Town, 19–23 September 2010.

Ministry of Employment and Social Affairs, *Bilan social 2015*, 2016.

Ministry of National Education and Vocational Training, *Stratégie nationale de la formation professionnelle*, 2021.

North Africa Post, *Morocco's food self-sufficiency, a boon to counter coronavirus consequences*, [online], 20 April 2020. https://northafricapost.com/40140-moroccos-food-self-sufficiency-a-boon-to-counter-coronavirus-consequences.html

OECD (Organisation for Economic Cooperation and Development), 'Éducation au Maroc' [Education in Morocco], *Examens de l'OCDE du cadre d'évaluation de l'éducation: Maroc*, OECD Publishing, Paris, 2018. https://doi.org/10.1787/9789264301832-5-fr

OECD (Organisation for Economic Cooperation and Development), *Programme for International Student Assessment (PISA): Results from PISA 2018 – Morocco country note*, 2019. www.oecd.org/pisa/publications/PISA2018_CN_MAR.pdf

Oxford Business Group, 'Morocco invests in agribusiness and improves agricultural efficiency', [online], *The report: Morocco 2015*, 2015. https://oxfordbusinessgroup.com/analysis/morocco-invests-agribusiness-and-improves-agricultural-efficiency

Pereira, L.D. and Santos, N., *Morocco – Investing in collective action: Opportunities in agrifood cooperatives*, Food and Agriculture Organisation of the United Nations, Rome, 2018. www.fao.org/3/CA1198EN/ca1198en.pdf

UNEVOC-UNESCO, *TVET country profile: Morocco*, 2019. https://unevoc.unesco.org/pub/tvet_country_profile_-_morocco.pdf

World Bank, *Cultivating knowledge and skills to grow African agriculture: A synthesis of an institutional, regional, and international review*, World Bank, Washington, DC, 2007.

World Bank, *Jobs for shared prosperity: Time for action in the Middle East and North Africa*, Working Paper 72469, World Bank, Washington, DC, 2013a.

World Bank, *Growing Africa: Unlocking the potential of agribusiness*, World Bank, Washington, DC, 2013b. http://documents.worldbank.org/curated/en/327811467990084951/pdf/756630v10REPLA0frica0pub03011013web.pdf

World Bank, *Doing business 2019: Training for reform*, World Bank, Washington, DC, 2019a. www.doingbusiness.org/content/dam/doingBusiness/media/Annual-Reports/English/DB2019-report_print-version.pdf#page=13

World Bank, *Enabling the business of agriculture 2019*, World Bank, Washington, DC, 2019b. https://doi.org/10.1596/978-1-4648-1387-0

World Bank, *Doing business 2020: Comparing business regulation in 190 economies*, World Bank, Washington, DC, 2020. https://doi.org/10.1596/978-1-4648-1440-2

World Bank, *The World Bank in Morocco*, [online], World Bank, Washington, DC, n.d. a. www.worldbank.org/en/country/morocco/overview

World Bank, *Labor market in Morocco: Challenges and opportunities*, World Bank, Washington, DC, n.d. b. http://documents1.worldbank.org/curated/en/477441523251051211/pdf/125041-WP-ENGLISH-PUBLIC-Summary-labor-market-note.pdf

Useful websites

Ministry of Agriculture, Fisheries, Rural Development, Water and Forests: www.agriculture.gov.ma/en/pages/strategy

Investing in Morocco: www.invest.gov.ma/

Observatory of Economic Complexity: https://oec.world/en/profile/country/mar/

Where to find out more

Website
www.etf.europa.eu

ETF Open Space
https://openspace.etf.europa.eu

Twitter
@etfeuropa

Facebook
facebook.com/etfeuropa

YouTube
www.youtube.com/user/etfeuropa

Instagram
instagram.com/etfeuropa/

LinkedIn
linkedin.com/company/european-training-foundation

E-mail
info@etf.europa.eu

ETF Working together Learning for life
European Training Foundation

THE EU AGENCY SUPPORTING COUNTRIES TO DEVELOP THROUGH LEARNING