NIHERST

International
Labour
Organization

Assessment of 21st Century Skills Across Emerging Sectors

Agro-processing Industry

Volume 4

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The Institute also expresses its sincere appreciation to the 159 employers from the five emerging industries who participated in the survey, providing essential data and insights that underpin this report.

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6. The University of the West Indies (UWI);
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9. National Training Agency of Trinidad and Tobago (NTA);
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11. Employers' Consultative Association of Trinidad and Tobago (ECA);
12. Public Services Association (PSA); and
13. Trinidad and Tobago Manufacturers' Association (TTMA).

Finally, we extend our heartfelt thanks to the dedicated staff at NIHERST, particularly those in the Science and Technology Statistics Department, for their tireless efforts and commitment in producing this report.

Foreword

In an era defined by rapid technological advancement, global interconnectivity and evolving workforce demands, the cultivation of 21st century skills has become essential to national development. These skills – ranging from critical thinking and creativity to digital literacy and collaboration – are the foundation upon which resilient, innovative and future-ready societies are built.

This report presents a timely and in-depth assessment of 21st century skills within the context of the agro-processing industry, a sector that holds significant promise for economic diversification and sustainable growth in Trinidad and Tobago. By examining the alignment between workforce capabilities and industry needs, the study offers valuable insights to inform education, training, and policy interventions.

As the Acting President of NIHERST, I am proud to present this document as a testament to NIHERST's ongoing commitment to conducting research in high potential sectors that support the sustainable diversification of Trinidad and Tobago's economy. Through this work, we reaffirm our dedication to fostering a knowledge-based society where science, technology and innovation are central to progress.

I wish to extend sincere thanks to our institutional partner, the International Labour Organization (ILO) for their unwavering support in enabling this series of research studies and in particular this fourth series which offers a comprehensive study of the agro-processing industry in Trinidad and Tobago.

A vote of thanks also to all contributors – researchers (inclusive of staff of the Science and Technology Statistics Department at NIHERST) and industry stakeholders whose expertise and collaboration have shaped this important study. Let this report serve not only as a benchmark of where we are, but as a blueprint for where we must go to equip our people for the future.

Ms. Julie David
President (Ag.)
NIHERST

Partner Message

The International Labour Organization (ILO) Decent Work Team and Office for the Caribbean is proud to be part of this publication to support Trinidad and Tobago's efforts to transition towards a more diversified workforce.

This report focuses on the Agro-processing Sector and is part of an impressive wider strategy by the National Institute of Higher Education, Research, Science and Technology (NIHERST) to identify needs and actions for effective skills development in emerging sectors. It offers a timely and insightful assessment of the 21st century skills and STEM competencies shaping the future of this industry.

It would be remiss of me not to highlight that the results presented in this report are based on a NIHERST survey launched with guidance from the ILO Global framework on core skills for life and work in the 21st century and technical advice from Ms. Ilca Webster, Lifelong Learning Specialist at the ILO Caribbean Office.

The ILO commends NIHERST for its targeted approach to enhancing skills anticipation and closing skills gaps for this sector. The agro-processing sector stands as a cornerstone of innovation and economic growth. Recruiting talent equipped not only with technical expertise but also with the soft and cognitive skills that are often underdeveloped in recent graduates is key to unlocking the full potential of this sector.

This report is more than a snapshot of current challenges; it is a call to action. By embracing its insights and recommendations, stakeholders across government, academia, and industry can work collaboratively to ensure that Trinidad and Tobago not only keeps pace with global trends but leads in shaping a digitally empowered future.

Dr. Joni Musabayana
Director
ILO Caribbean Decent Work Team and Office for the Caribbean

Executive Summary

The rapid advancement of technology is reshaping the world of work in the agro-processing industry, demanding that individuals continuously update their knowledge and skills to remain competitive. As automation, digital tools, and data-driven processes become more integrated into agro-processing, the need for a workforce equipped with both technical expertise and adaptable future-ready skills is growing. International organisations such as the World Bank and the OECD (Organisation for Economic Co-operation and Development) have underscored the importance of STEM (Science, Technology, Engineering, and Mathematics) education in preparing individuals to meet these evolving demands.

STEM education not only builds foundational knowledge on critical disciplines but also cultivates 21st Century Skills - such as problem-solving, critical thinking, collaboration and digital literacy - that are essential for navigating today's innovation-driven economy. These competencies are particularly relevant in agro-processing, where technological integration is transforming traditional practices and creating new opportunities for value addition and efficiency.

To support this transition, countries like Trinidad and Tobago must invest in education and training programmes that align with the needs of emerging sectors. The *Assessment of 21st Century Skills across Emerging Sectors* study was designed to provide insights into the current and future skills demands in five (5) key industries: Maritime, Tourism, Software Design and Applications, Agro-processing and Aviation. This report - the fourth in this research series - focuses on the agro-processing industry, offering evidence-based findings to guide policy development and workforce planning aimed at strengthening national capacity and competitiveness in this vital industry.

The agro-processing industry, a vital subset of the manufacturing sector, focuses on the transformation of raw and intermediate products derived from agriculture, forestry and fisheries.[1] By adding value to these natural resources, agro-processing plays a critical role in enhancing the productivity and sustainability of the agricultural sector. It encompasses a wide range of activities, including food and beverage processing, tobacco manufacturing, paper and wood products, and

[1] United Nations Food and Agriculture Organisation (FAO), The State of Food and Agriculture 1997

the production of textiles and apparel, among others each contributing to economic diversification and industrial development.

In Trinidad and Tobago agro-processing holds significant economic potential. Beyond its contribution to manufacturing output, the sector supports employment and rural development, particularly through the growth of small and medium-sized enterprises (SMEs). Its importance extends to broader national goals such as sustainable development, poverty reduction and food security. In 2020, processed food and agro-products accounted for 2.75% of T&T's total exports, underscoring the sector's role in trade and foreign exchange earnings.[2] With an abundance of unique natural resources, such as cocoa, hill rice, and hot peppers, the country is well positioned to meet growing local, regional and international demand for high valued agricultural based products from T&T's indigenous agricultural species. Strategic investment and policy support for the agro-processing industry can unlock new opportunities for value-added production, export expansion, and inclusive economic growth.

The *Assessment of 21st Century Skills across Emerging Sectors* study *examined* the labour needs of five (5) emerging industries including agro-processing. This report presents the key findings from data collected from twenty-six (26) of the seventy-one (71) agro-processing establishments surveyed. These businesses were primarily engaged in food processing, fruit and vegetable processing, meat processing, beverage production, and oil extraction and refining.

The report begins by outlining the characteristics of employers in the agro-processing sector. Understanding these helps contextualise the findings and provides insight into the structure and dynamics of the local industry. The majority of establishments surveyed were relatively young, with 70% operating for less than 20 years. Most were micro and small enterprises (MSEs) with 69% employing fewer than 10 people and 19% employing between 10 and 24. Food processing emerged as the dominant economic activity accounting for 38% of the establishments.

The study also explored the composition of the workforce, with a particular focus on STEM-related qualifications and occupations. This analysis is critical for identifying current capabilities and future labour needs. The data revealed that while 96% of establishments employed both male and female workers, men made up a larger share of the workforce. One-fifth (20%) of establishments had 10 or more male employees, compared to just 8% for females. Gender distribution varied across occupational groups. Males outnumbered females in five (5) of the nine (9)

[2] Trinidad & Tobago Investment Guide, InvesTT

categories including Professionals, Technicians and Associate Professionals, Skilled Agricultural, Forestry and Fishery Workers, Craft and Related Trades Workers and Elementary Occupations.[3] Conversely, females were more prevalent in roles such as Managers, Clerical Support Workers, Service and Sales Workers, and Plant and Machine Operators, and Assemblers. Given the small size of most establishments, business owners often served as managers. As a result, 96% of establishments reported having managers on staff – more than any other occupational group.

In terms of qualifications, 50% of establishments employed individuals with STEM degrees, with the highest concentration (38%) found among managers. Interestingly, a slightly higher proportion of female employees held STEM degrees compared to their male counterparts. Despite this, the overall number of employees in STEM specific occupations remained low. The highest representation was in Food and Agriculture-related roles, followed by Engineering and IT occupations. These findings highlight both the existing capabilities and the potential gaps in STEM talent within the agro-processing industry, offering valuable insights for workforce development and policy planning.

The *Assessment of 21st Century Skills across emerging Sectors* study also examined the labour market dynamics within the agro-processing industry, focusing on current and future workforce needs, particularly in relation to STEM occupations. Some of the key findings on job vacancies, recruitment challenges, core skills and the demand for STEM labour are as follows:

Job Vacancies and Recruitment Challenges

An important component of the study was identifying job vacancies and understanding recruitment challenges faced by employers**.** This data provides insights into labour market gaps – especially in STEM fields- and informs decisions on training, education, and workforce development.

At the time of the survey, job opportunities in the industry were low. Only (23%) of the establishments reported vacancies while 77% had none. A higher proportion of establishments reported vacancies in non-STEM fields (15%) compared to STEM fields (8%). STEM vacancies were concentrated in Food and Agriculture, Natural Sciences and Computer Science/IT. Over the previous 12 months of the survey,

[3] The occupational groups presented in this report are based on the ILO's International Standard Classification of Occupations (2012) and are further detailed in Appendix I.

54% of the employers had filled at least one vacancy, with non-STEM roles (35%) more frequently filled than STEM roles (23%). Employers reported greater difficulty filling STEM positions particularly in professional roles (67%). Among STEM occupations, Natural Sciences roles were the most difficult to fill (50%) with Food Scientist positions being the most challenging (40%). The main barriers to filling STEM vacancies included a lack of applicants with the right attitude, motivation or personality (63%) and a general unwillingness to take on certain types of jobs (54%). The main recommendation from employers on how to overcome problems experienced while filling STEM vacancies was to regularise the industry by standardising job roles, issuing formal contracts, adhering to labour laws and providing benefits and job security for employees (30%).

Core Skills and Skills Mismatches

The study also assessed the cores skills of the workforce to identify mismatches between employer expectations and employee capabilities. Skills mismatch can hinder productivity, limit career advancement and reduce firm competitiveness. Skills mismatch represents the discrepancy between the skills demanded by employers and the skills workers possessed.[4] The skills examined in this study are based on nineteen (19) core skills that are described in Appendix III. These skills were identified by the ILO as core skills that were important building blocks to lifelong learning and adapting to changes in the labour market. Identifying the essential skills required to achieve business goals and matching them with the skills of potential and existing employees can assist in understanding the size and nature of the skills mismatch in the industry. Employers were asked to assess 19 core skills identified by the ILO as essential for lifelong learning and adaptability. At least 50% of employers rated all 19 skills as important, with Communication (Collaboration and Teamwork Self-reflection and Learning to Learn Energy and Water efficiency (95%) and Waste reduction and management rated highest. Internally, people (73%) and profit (62%) were the main drivers of change with Communication (33%) identified as the most critical skills to address these changes. Externally, competition (63%_ and climate change (37%) and technology (32%) were the top drivers of change. The most relevant skills to address these external changes were IT (19%) and Creativity and Innovation (16%).

[4] Productivity is defined as a ratio between the volume of output and the volume of inputs. It measures how efficiently production inputs, such as labour and capital, are being used in an economy to produce a given level of output (OECD 2024)

A half (50%) or more of the employers rated the level of skill among recent university graduates employed in their establishment as high or medium in 18 of the 19 core skills. These employees were rated the highest for Basic skills for green jobs followed by Basic digital skills. In contrast, existing employees were more often rated as having medium or low proficiency across all 19 skills. The highest ratings were for Collaboration and Teamwork (48%) and Problem solving and Decision making (48%). The largest skill gaps were observed in Self-reflection and Learning to Learn (73%), Conflict Resolution and Negotiation (62%) and Communication (61%). The smallest gap was in basic digital skills. Despite these gaps, over half of the employers reported no difficulty finding key skills such as – Creativity, Critical thinking, Collaboration, Communication, IT, Decision-making and Problem solving - among recent job applicants. However, some skills remained difficult to source from graduates, particularly Emotional intelligence (63%), Communication (50%), and Self-Reflection and Learning to Learn (50%). Most employers (80%) felt that recent graduates were somewhat prepared for the workforce, while 10% believed they were very well prepared and another 10% said they were well prepared. Notably, three-quarters (75%) of the respondents indicated that skill deficiencies among workers did not negatively impact their operations, while 25% disagreed.

Demand for STEM Labour

The study also explored the current and projected demand for STEM labour in the agro-processing industry, recognizing that technological innovation is reshaping workforce requirements. During the survey period, overall demand for STEM occupations was low among participating establishments. The highest demand was for Food and Agriculture related occupations while the lowest was in Medical and Health fields. The top STEM job currently demanded was Food Scientists (19%), followed by Web and Digital Interface Designers (10%), Mechanical Engineers (10%) and HSE Officers (10%). The study also explored employers' projections for future workforce needs. Based on strategic direction of their businesses, the three (3) most important STEM occupations employers forecasted over the next five (5) years were Food Scientists (35%), Agricultural Technicians (22%) and Environmental Scientists (17%). These roles reflect the sector's growing emphasis on innovation, sustainability, and food security.

TVET Labour Needs

In addition to STEM, the assessment examined labour needs related to Technical and Vocational Education and Training (TVET). However, the response rate for the TVET section was notably low. It is recommended that assessments focusing mainly on TVET be undertaken to better understand the sector's vocational training requirements.

Technological Advancements in Agro-Processing

A key element of this publication is the assessment of technological advancements in agro-processing. Technologies such as Artificial Intelligence (AI), Blockchain, Robotics and Biotechnology are transforming the industry by enhancing productivity, efficiency and product quality. For local businesses to remain competitive, they must embrace these innovations and integrate them into their operations. The adoption of such technologies not only strengthens business performance but also expands opportunities for of STEM careers within the sector.

Policy Relevance and Recommendations

This study serves as a critical resource for shaping national skills policy and supporting the development of a future-ready workforce aligned with Trinidad and Tobago's economic diversification agenda. This publication also captures employers' recommendations on how government, industry and tertiary institutions can work together to strengthen STEM education and the STEM labour force.

Some of the key recommendations from employers include: introduce more internship and apprenticeship programmes to provide hands-on experience; align tertiary education programmes more closely with industry needs; foster greater collaboration among stakeholders in education, government and industry; provide incentives for businesses operating in STEM-related industries; increase public awareness of STEM careers and their importance; and regularise the industry and improve job security and benefits to attract and retain talented employees.

In addition to these employer-driven suggestions, the report outlines broader recommendations based on the study's findings. These include: enhancing STEM education at all levels, expanding training opportunities, integrating STEM in classroom learning, promoting STEM careers through targeted outreach and communication, improving data collection and analysis on the labour market and strengthening linkages between stakeholders to ensure a coordinated approach to workforce development.

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Abbreviations and Acronyms

AI	Artificial Intelligence
AR	Augmented Reality
CBTT	Central Bank of Trinidad and Tobago
COSTAATT	College of Science, Technology and Applied Arts of Trinidad and Tobago
CSO	Central Statistical Office
GDP	Gross Domestic Product
GORTT	Government of the Republic of Trinidad and Tobago
ICT	Information and Communication Technology
IT	Information Technology
ILO	International Labour Organization
ISCO	International Standard Classification of Occupations
MoE	Ministry of Education
MSEs	Micro and Small Enterprises
MSMEs	Micro, Small and Medium Enterprises
NAMDEVCO	The National Agricultural Marketing and Development Corporation
NIHERST	National Institute of Higher Education, Research, Science and Technology
NTA	National Training Agency
OECD	Organisation for Economic Co-operation and Development
OJT	On-the-Job Training
SMEs	Small and Medium Sized Enterprises
STEM	Science, Technology, Engineering and Mathematics
S&T	Science and Technology
SDG	Sustainable Development Goal

T&T	Trinidad and Tobago
TVET	Technical and Vocational Education and Training
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UTT	University of Trinidad and Tobago
UWI	The University of the West Indies
VR	Virtual Reality
WEF	World Economic Forum

Introduction

Agro-processing can be the game-changer that transforms Trinidad and Tobago's agricultural sector into a globally competitive, tech-driven industry. With its vast potential to add value to indigenous crops like cocoa, hot peppers, and cassava, the agro-processing industry stands at the crossroads of innovation, sustainability, and national development. As the country seeks to diversify its economy and strengthen food security, agro-processing offers a promising frontier, one where traditional practices meet the tools and talents of the Fourth Industrial Revolution.

The Assessment of 21st Century Skills in Emerging Sectors project is both timely and strategically significant, aligning closely with the Government of Trinidad and Tobago's 2025 policy priorities. It serves as a critical mechanism for building a future-ready, STEM-empowered workforce, catalyzing economic transformation, and advancing inclusive national development in accordance with the Government's vision for a prosperous and modern Trinidad and Tobago. Grounded in the Government's Youth Development Policy which emphasizes the empowerment of a future-fit generation through skills, purpose, and opportunity, this initiative reflects a firm commitment to equipping the nation's youth for the demands of the Fourth Industrial Revolution.

NIHERST, in collaboration with the International Labour Organization (ILO), undertook the Assessment of 21st Century Skills Across Emerging Sectors study from February 2023 to July 2025. The overarching objective of this study is to provide timely and reliable data on STEM labour needs in strategic sectors to empower policymakers to design more robust education and training, and labour force policies in an era of disruptive technologies. This report will focus on the research findings of the agro-processing sector. The Government aims to transform the agricultural sector into a high-value, tech-driven, and export-oriented industry.[5] This transformation is expected to contribute significantly to food security, foreign exchange earnings, sustainable employment, and environmental sustainability. This report will serve as a key document in support of this national priority, which also includes strengthening agro-processing as a critical component of agricultural transformation.

As the adoption of advanced technologies such as AI and Robotics and Automation becomes more widespread in the workplace, the demand for highly skilled workers will continue to grow. According to the World Economic Forum's (WEF) Future of

[5] Government Manifesto on Agriculture and Food Security, 2025. https://uncmanifesto.com/

Jobs Report 2025, employers predicted that 39% of workers' core skills will need to change by 2030. Additionally, based on the feedback from employers, technological skills were forecasted to grow in importance more rapidly than any other type of skills with AI and big data leading the way, followed by networks and cybersecurity, and technological literacy. Technological advancements are reshaping the workforce across sectors and agro-processing is no exception. The agro-processing industry is transitioning from manual labour and traditional machine operation to automated processes using technologies such as AI, robotics, and data analytics. As technology advances in the sector, the demand for new and more advanced skills, especially those grounded in STEM disciplines, will become increasingly important.

Developing STEM competences within the workforce will be essential for employees to operate successfully in a technology driven environment. STEM competences refer to an individual's ability to apply STEM knowledge, skills and attitude appropriately in his or her everyday life, workplace or educational context.[6] It is widely agreed that STEM competencies are essential for driving innovation, competitiveness and economic growth. STEM workers play a crucial role in innovation, creation and implementation of new technologies, leading to increased productivity, efficiency and sustainability across all sectors. They are needed to help develop solutions to address global issues such as climate change, healthcare and food security. Investing in the necessary skills and training for current and future employees, will help them to reach their full potential and contribute more effectively to economic growth, prosperity and sustainability. Countries that invest in STEM education and careers are better able to capitalise on technological advancements and innovations and secure a better future for their citizens.

This research was conducted to gather data on the current and future demand for STEM-related skills and labour in the agro-processing industry of Trinidad and Tobago. The research explored key characteristics of both employers and employees of the agro-processing industry. Additionally, the study examined vacancies and recruitment issues such as the trends in employment and the level of difficulty employers encountered in filling STEM vacancies. This undertaking also included a comprehensive analysis of the skills characteristics of recent job applicants and existing employees and the skills demanded by employers. Furthermore, the skills mismatch in the industry was assessed based on the skills required by employers and the skills employees possessed. In addition, the enquiry

[6] UNESCO International Bureau of Education, Exploring STEM Competences for the 21st Century, 2019

focused on the current and future demand for STEM labour. It also investigated the types of innovations adopted in the global agro-processing market along with the associated careers and benefits. Drawing from the research findings, a series of evidence-based recommendations were developed.

This report is organised into the following sections:

Section 1 describes key aspects of the survey methodology employed for the study. The following aspects are discussed in this chapter the objectives of the study, research methods, questionnaire design, sample design, data collection, and data processing and presentation.

Section 2 focuses on the characteristics of establishments that participated in this study, including length of time in operation and employment size by gender, occupational group and main economic activity performed by businesses.

Section 3 presents data on the characteristics of the workforce. This section provides data on employees by gender, occupational group, STEM qualifications and STEM occupations.

Section 4 introduces the recruitment issues reported by employers in the agro-processing sector. This section offers data on the number of establishments with current vacancies, difficulty employers experienced when filling vacancies, and the number of vacancies filled in the last twelve (12) months of the survey period. In addition, the section features a comparison of vacancies and recruitment issues by STEM and non-STEM fields. It also provides recommendations from employers on how to overcome difficulties faced during recruitment.

Section 5 presents an assessment of the skills mismatches in the agro-processing sector. The chapter examines the skills employers identified as important for employees to possess in order to meet organisational goals and the skills set of job seekers, recent university graduates employed and existing employees is depicted in this section. Section 5 also provides data on the perception of employers on the preparedness of recent university graduates transitioning to work.

Section 6 examines the demand for STEM workers, including current and future demands. The top STEM occupations demanded by the industry based on their strategic plan are also identified in this section.

Section 7 identifies the Technical and Vocational Education and Training (TVET) needs in the agro-processing sector.

Section 8 offers recommendations provided by employers on how the tertiary education, government and business sectors can help improve STEM competencies.

Section 9 examines significant technological advancements in global agro-processing along with key STEM careers associated with these innovations. It also explores the ease and advantages of integrating these technologies into local operations. additionally, the section showcases the Netherlands experience in advancing technological innovations in agro-processing.

Section 10 offers general recommendations based on the research undertaken, stakeholder consultations and the results of the industry survey.

Section 11 is the conclusion that reiterates salient points made throughout this publication.

1. Research Design

This section describes key aspects of the survey methodology employed for the Assessment of 21st Century Skills Across Emerging Sectors. The methodology for this study was guided by the European Training Foundation/European Centre for the Development of Vocational Training/ILO guide to developing and running an establishment skills survey.[7] This section begins by identifying the objectives of the study. The next aspect discussed is the research method employed for the study. The section also includes a description of the design of the survey questionnaire, presenting several key documents that guided the development of the questionnaire. Additionally, the section summarises the sample design and response rate for the survey. The final aspects discussed under this section are data collection, survey limitations, and data processing and presentation.

1.1 Objectives of the Study

The objectives of the study are to:

- Provide data on the demand of STEM graduates in emerging sectors
- Provide data on the skills mismatches in emerging sectors
- Provide information to improve the alignment between education and labour market demand
- Provide data to inform policymakers, education specialists, industry and all stakeholders in creating policies to develop the STEM workforce of the country
- Provide data on key areas where scholarships/incentives are needed to encourage students to pursue degrees in these fields
- Collaborate with the public universities to align their programmes to the key STEM areas and to introduce new programmes where necessary
- Provide information to introduce students to relevant STEM careers necessary for growth and development of critical sectors of the economy

[7] Developing and Running an Establishment Skills Survey: Guide to Anticipating and Matching Skills and Jobs Volume 5 - European Training Foundation/European Centre for the Development of Vocational Training/ILO

1.2 Research Method

The survey employed a mixed methods approach. A questionnaire was designed to collect both quantitative and qualitative data.

1.3 Questionnaire Design

The questionnaire was developed based on the objectives of the study and was designed to generate the key information necessary to achieve the objectives. The questionnaire design was guided by existing labour force studies and guides, mainly the ILO's Global Framework on Core Skills for Life and Work in the 21st Century and STEM in TVET Curriculum Guide.

1. The ILO's Global Framework on Core Skills for Life and Work in the 21st Century was utilised to capture data on the skills characteristics of the workforce. Recognising the importance of core skills for enabling workers to attain decent work and improving living standards, the ILO developed the Global Framework on Core Skills for Life and Work in the 21st Century. The framework was developed after a comprehensive literature review of international and national core skills frameworks and an analysis of the impact of the global drivers of transformative changes on the world of work was undertaken to extract the most important skills necessary to adapt to the future of work. Additionally, several consultations were undertaken to revise these skills into 19 core skills considered essential for both work and life. The Framework identified 19 core skills that were grouped into the four categories shown in Table 1. These skills are further defined in Appendix III.

Table 1: Core skills for life and work in the 21st century

Core skills for life and work in the 21st century			
Social and emotional skills: • Communication • Collaboration and teamwork • Conflict resolution and negotiation • Emotional intelligence	**Cognitive and metacognitive skills:** • Foundational literacies • Analytical and critical thinking • Creative and innovative thinking • Strategic thinking • Problem-solving and decision-making • Self-reflection and learning to learn • Collect, organise and analyse information • Planning and organising • Career management	**Basic digital skills**: • Use basic hardware • Use basic software • Operate safely in an online environment	**Basic skills for green jobs:** • Environmental awareness • Waste reduction and waste management • Energy and water efficiency

2. The survey utilised the STEM in TVET Curriculum Guide, ILO Women in STEM for Workforce Readiness and Development Programme to gather data on STEM skills in TVET workers. The STEM in TVET Curriculum Guide identified four major domains of STEM competencies that support TVET including STEM knowledge, thinking skills, multiliteracies and socio-emotional intelligence. These skills are described further in Appendix IV.

1.4 Sample Design

A sample of 71 businesses from the agro-processing sector was contacted to participate in the survey. The survey frame was created using several data sources including business listings from the Central Statistical Office (CSO), The National Agricultural Marketing and Development Corporation (NAMDEVCO) and the National Training Agency (NTA). A sample was generated using systematic random sampling. Of the 71 businesses contacted, 26 responded, representing a response rate of 37%.

1.5 Data Collection

1.5.1 Interviewers

Field interviewers were recruited to conduct interviews with employers. These interviewers already had considerable training and experience in conducting labour surveys. They were further trained on the survey objectives and questionnaire. Data collection was undertaken during the period of October to November 2023.

1.5.2 Pilot Study

A pilot study was undertaken using a sample of twenty-four (24) businesses to pre-test the survey instrument to ensure that respondents understood the questions correctly and were able to provide accurate answers. The feedback from the pilot study was used to improve the questionnaire for greater accuracy in responses.

1.6 Limitations of the study

There were several challenges encountered whilst undertaking this study. These include:

i. Business listing was outdated - The CSO listing was outdated and had to be updated by the project team. An updated businesses listing is important for future studies. This would save time and ensure greater accuracy of the sampling frame.
ii. No business listing was available for some sectors categorised as emerging – some emerging sectors, such as software design and applications, are part of a broader sector, as a result the team had to extract these companies from the overall list. In certain cases, alternative sources were used to compile a list of businesses within these specific sectors. There is a need for up-to-date listings of sectors identified for expansion. This would not only support future research but also enable the accurate measurement of growth within these industries.
iii. Low response from industry – A substantial percentage of employers declined to complete the survey, citing several reasons, mainly time constraints. This lack of participation highlights the need to increase the promotion of STEM skills and the importance of STEM workers in driving competitiveness, growth, and sustainability within businesses. It also

emphasizes the importance of data collection to guide policies that support workforce development, ensuring businesses can meet both their current and future workforce needs.

iv. The response rate to the TVET section was low across all surveyed sectors. Some respondents felt that the survey was too lengthy, which led to incomplete responses to TVET questions, which was the last section while others chose not to participate at all.

1.7 Data processing analysis and presentation

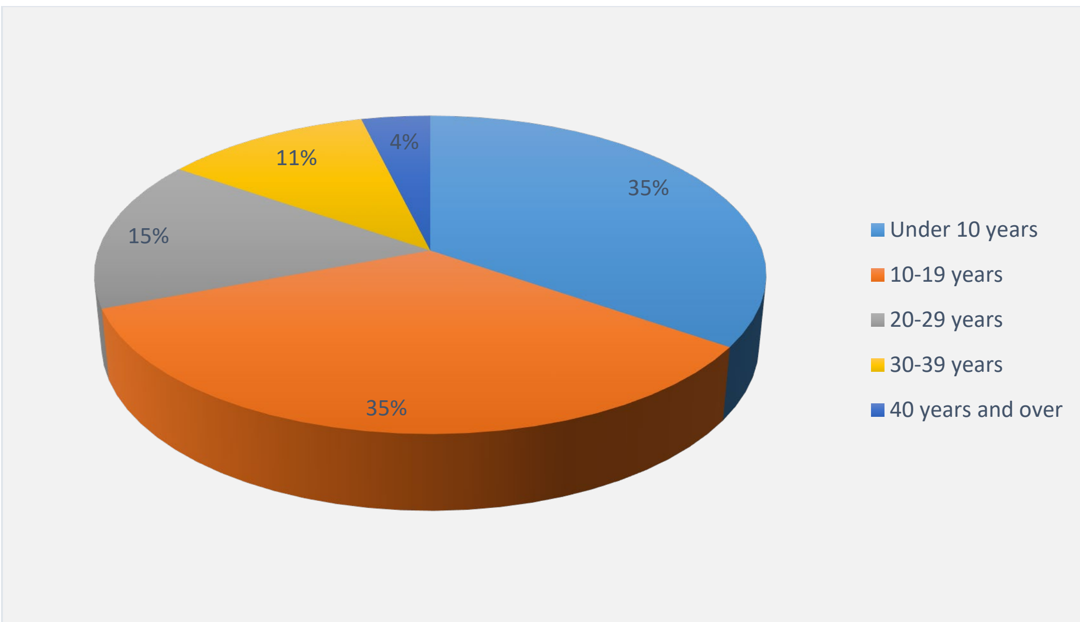
The quality of the data was checked for accuracy. Where there were discrepancies, the field interviewer or office staff contacted the respondents for verification. Quantitative and qualitative data was coded and processed on SPSS and Excel. The results of the study are presented in the sections that follow.

2. Characteristics of Employers

This section outlines key attributes of employers in the agro-processing industry of Trinidad and Tobago who participated in the study. Gathering information on employer characteristics helps to provide context to the report's findings and facilitate a better understanding of the survey participants. This study analysed employers based on their length of time in operation, employment size and main economic activity.

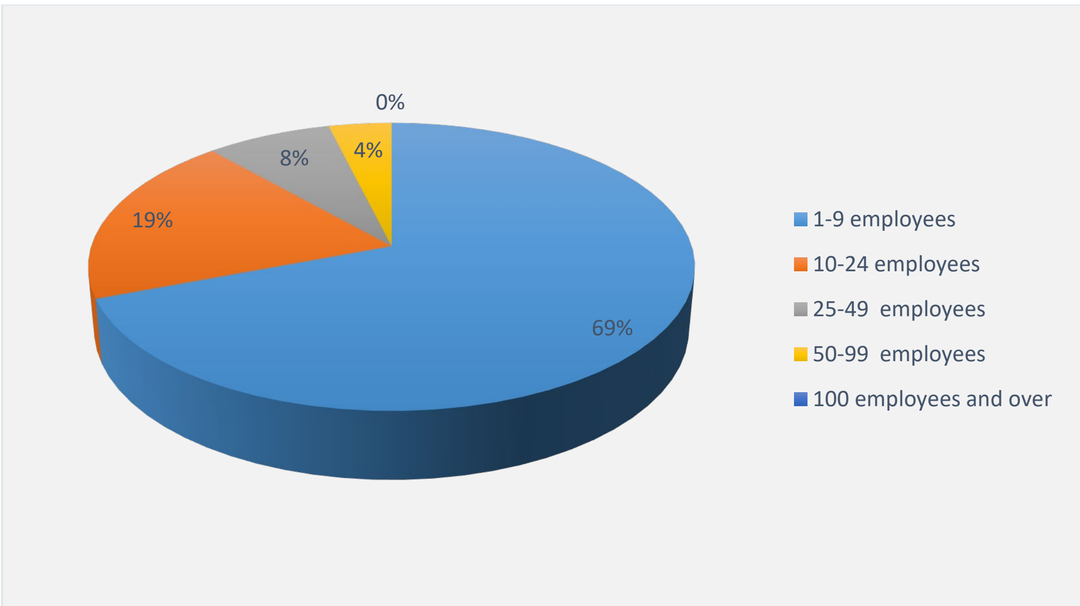
The first characteristics of employers presented in this section is the length of time in operation. Figure 1 presents the percentage of businesses in the agro-processing sector by the length of time in operation. The data shows that the majority of establishments were relatively young, with 70% in operation for less than 20 years. Only 4% of the establishments that responded to the survey were in operation 40 years or over.

Figure 1: Percentage of establishments by length of time in operation



Regarding employment size, the results show that the sector was predominantly made up of Micro and Small Enterprises (MSEs). Figure 2 shows that three-quarters (75%) of the establishments that participated in the survey had less than 10 employees and 21% had between 10 and 24 employees. At the national level, it is estimated that 95% of the businesses in Trinidad and Tobago were Micro, Small and Medium-sized Enterprises (MSMEs), with the vast majority being micro and small.[8]

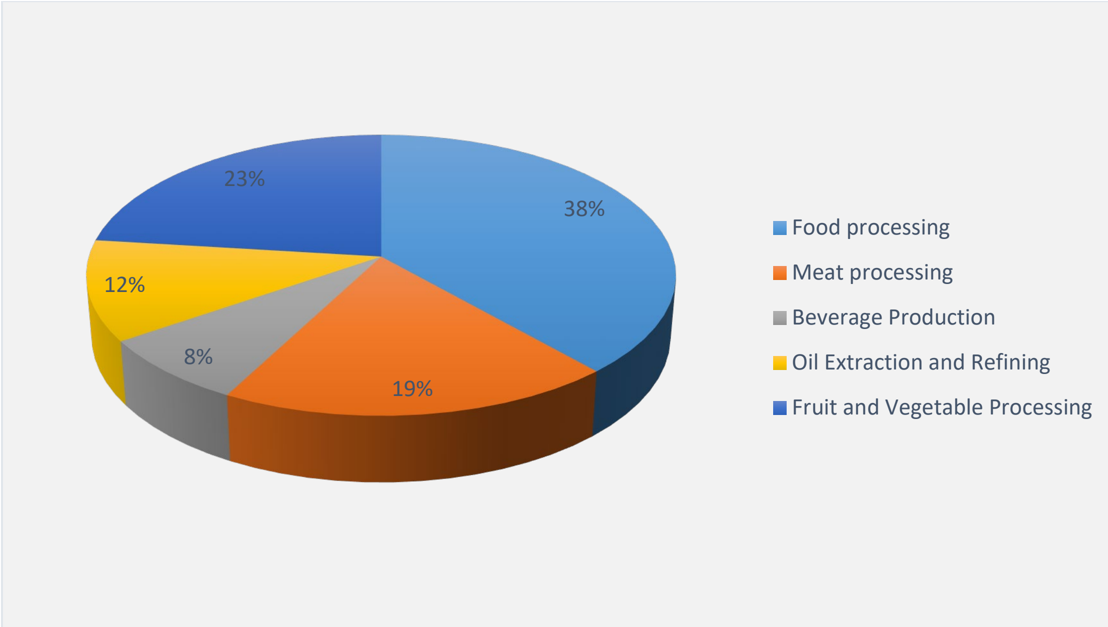
Figure 2: Percentage of establishments by employment size



Another characteristic of employers featured in this section is the main economic activity they performed. The main activity in the local agro-processing industry was food processing (38%), followed by fruit and vegetable processing (23%) and meat processing (19%) (Figure 3).

[8] Central Bank of Trinidad and Tobago, Research Papers Vol. 3 No. 2 September 2023

Figure 3: Percentage of establishments by main economic activity

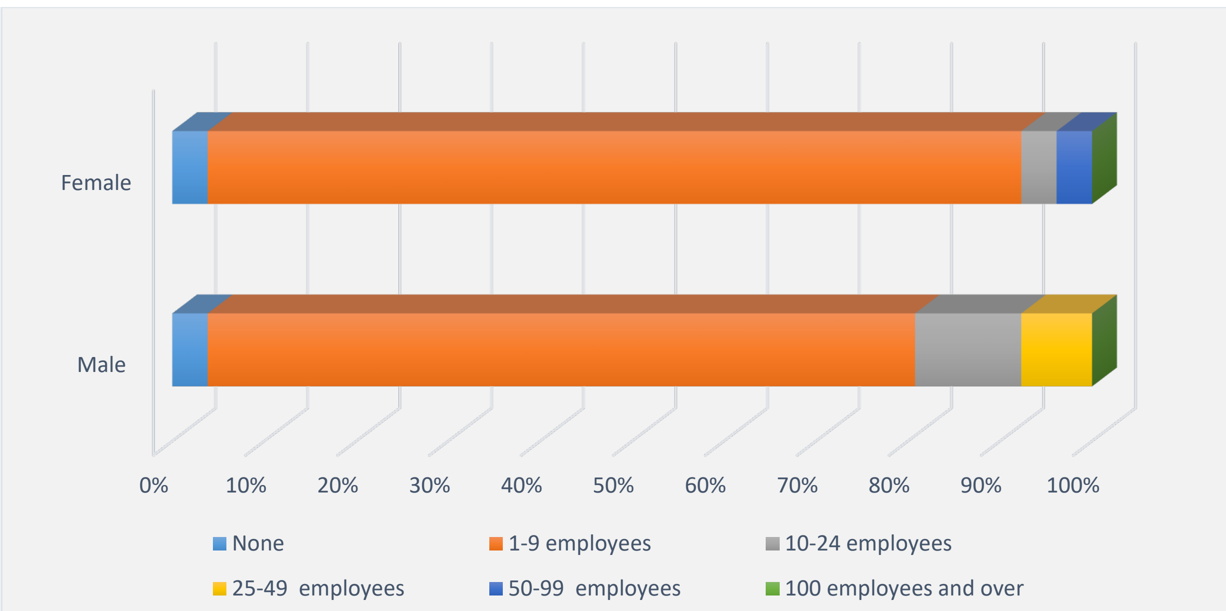


3. Characteristics of the Workforce

Gathering data on the characteristics of the workforce is important in order to understand the current composition of the workforce, identify skills mismatches and provide information to enable proper workforce planning. This section provides data on employees by gender, occupational group, STEM qualifications and STEM occupations.

In terms of gender, Figure 4 shows that the agro-processing industry employed more males than females. The percentage of establishments that employed males (96%) was similar to females (96%). However, male employment was higher than female employment in the industry as a higher percentage (20%) of establishments employed 10 or more male employees compared to 8% in the case of females.

Figure 4: Employment size by gender



The ILO's International Standard Classification of Occupations (ISCO) was used to describe the workforce by occupational groups. Figures 5 – 7 present the workforce of the agro processing establishments that responded to the survey by occupational group and gender. The main findings within occupational groups are summarised below.

- Managers:
    - This occupational group was the highest in terms of representation. The vast majority of establishments (96%) employed 1-9 employees in this category.
    - Females (69%) outnumbered their male counterparts (58%) in managerial positions.
- Professionals:
    - Overall, 27% of the establishments employed staff in this occupational group.
    - Male employment (23%) was marginally higher than female employment (19%) in this category.

- Technicians and associate professionals:
    - Over one-quarter (27%) of the establishments had employees in this occupational group.
    - A higher percentage of establishments employed males (19%) in this job category compared to females (8%).

- Clerical support workers:
    - Over one-third (37%) of the establishments that responded to the survey had Clerical support workers.
    - A substantially higher percentage of establishments reported females (35%) in this occupational group compared to males (8%).

- Service and sales workers:
    - This occupational group was the second highest in terms of representation. A substantial percentage (43%) of the establishments employed Service and sales workers.
    - The percentage (31%) of females employed in this occupational group was higher than males (23%).

- Skilled agricultural, forestry and fishery workers:
    - This occupational group represented (23%) of the workforce.
    - Males (19%) outnumbered females (12%) in these roles.

- Craft and related trades workers:
  - Only 4% of the establishments reported workers in this category and they were all males.

- Plant and machine operators, and assemblers:
  - Overall, 31% of the establishments employed staff in this occupational group.
  - Female (23%) employment was higher than male (19%) in this category.

- Elementary Occupations:
  - Over two-fifths (42%) of the establishments had workers in elementary occupations.
  - Males (31%) outnumbered females (23%) in this job category.

Figure 5: Employment by occupational group and gender – Both genders

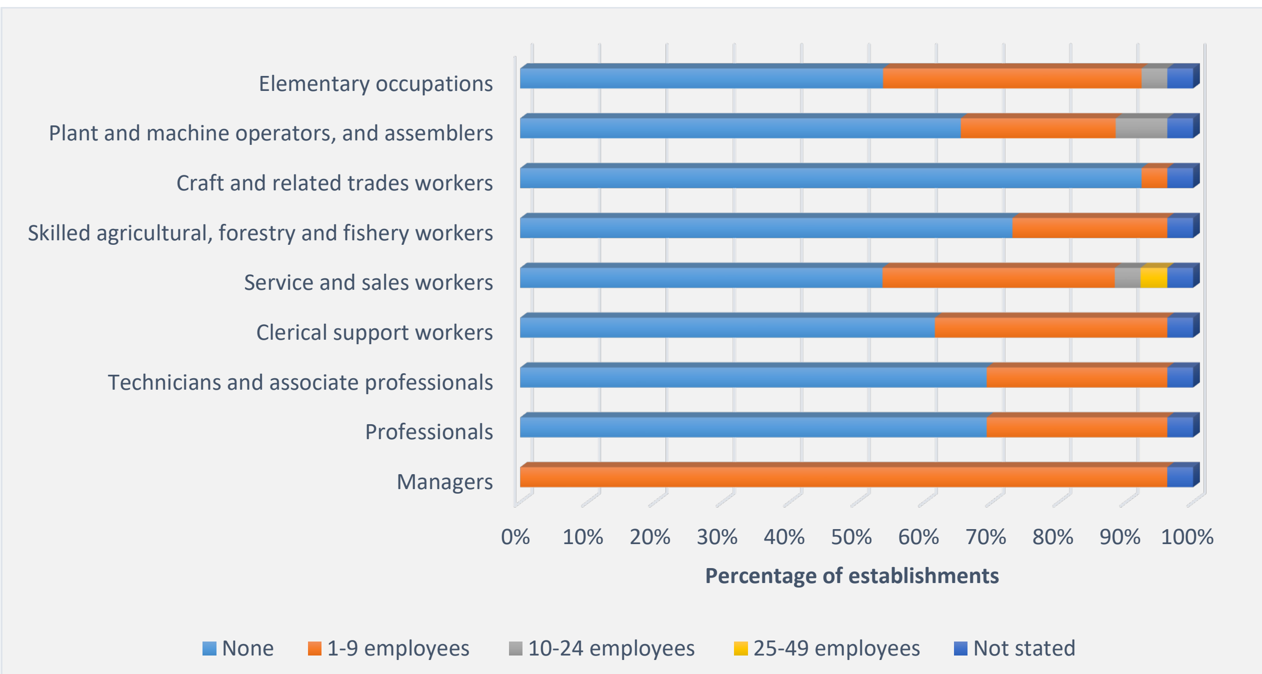


Figure 6: Employment by occupational group and gender – Males

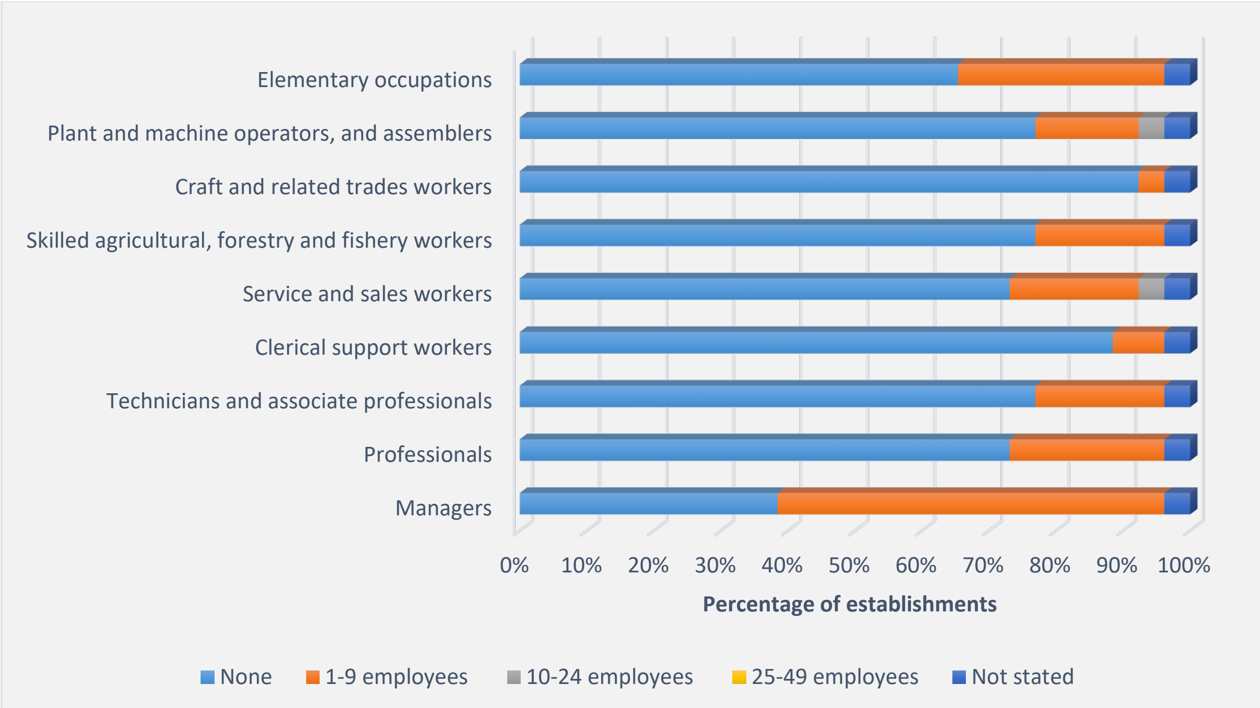
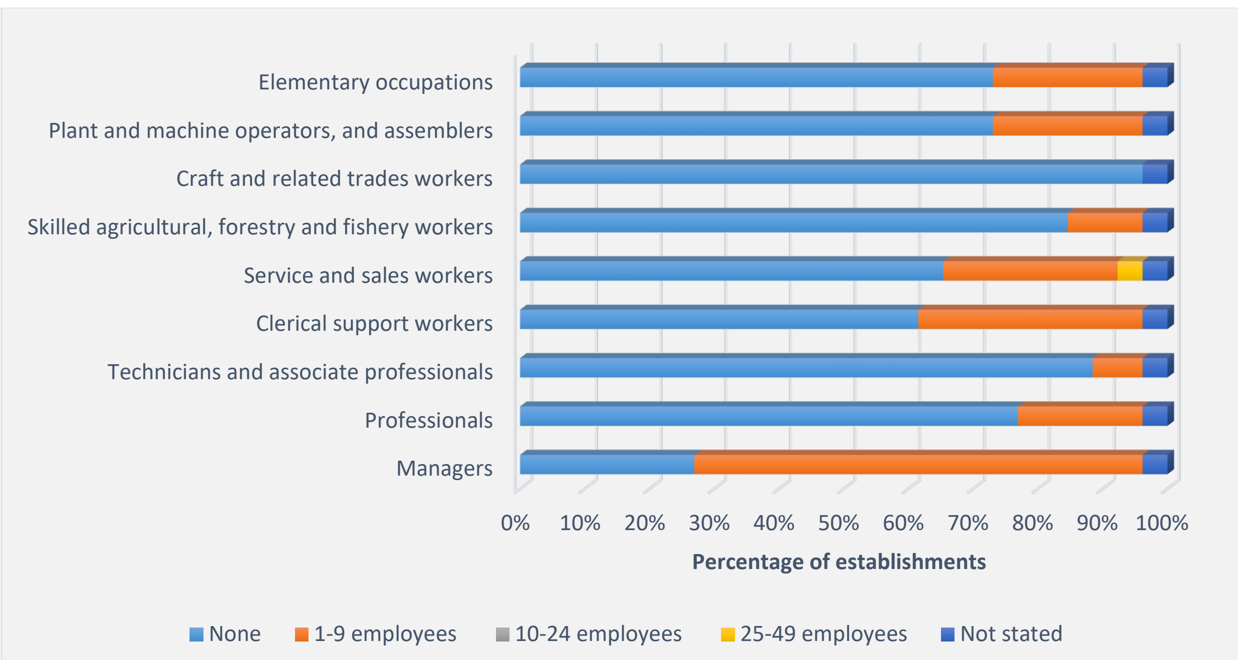


Figure 7: Employment by occupational group and gender – Females



In order to assess the STEM labour needs in the agro processing sector it is necessary to first establish the size and characteristics of the STEM workforce in the industry. The survey gathered data on the percentage of establishments with employees who possessed a bachelor’s degree or above in a STEM field by gender and occupational group. For the purpose of this study, STEM fields included Natural Sciences; Engineering; Computer Science/IT; Mathematics and Statistics; Food and Agriculture; Medical and Health; and Environmental Sciences.

Figures 8 – 11 summarise key data on employees with STEM qualifications by occupational group and gender. The percentage of establishments with employees with STEM degrees (50%) was similar to the percentage of establishments without (50%) (Figure 8).

A review of STEM academic qualifications within occupational groups shows that, in general, there was a low number of employees with STEM qualifications within each occupational group (Figure 9). All the establishments with STEM qualified employees reported less than 10 employees in each occupational category. The occupational group that recorded the highest percentage (38%) of employees with STEM degrees was Managers, followed by Professionals (20%).

A further examination of STEM qualifications by gender shows that females outnumbered their male counterparts in the following job categories: Managers, Technicians and associate professionals, and Clerical support workers (Figures 10 & 11). On the other hand, there was a higher percentage of males (16%) in the Professionals category compared to females (8%). There was a similar percentage of males and females with STEM degrees within the other occupational groups.

Figure 8: Percentage of establishments with employees with STEM degrees

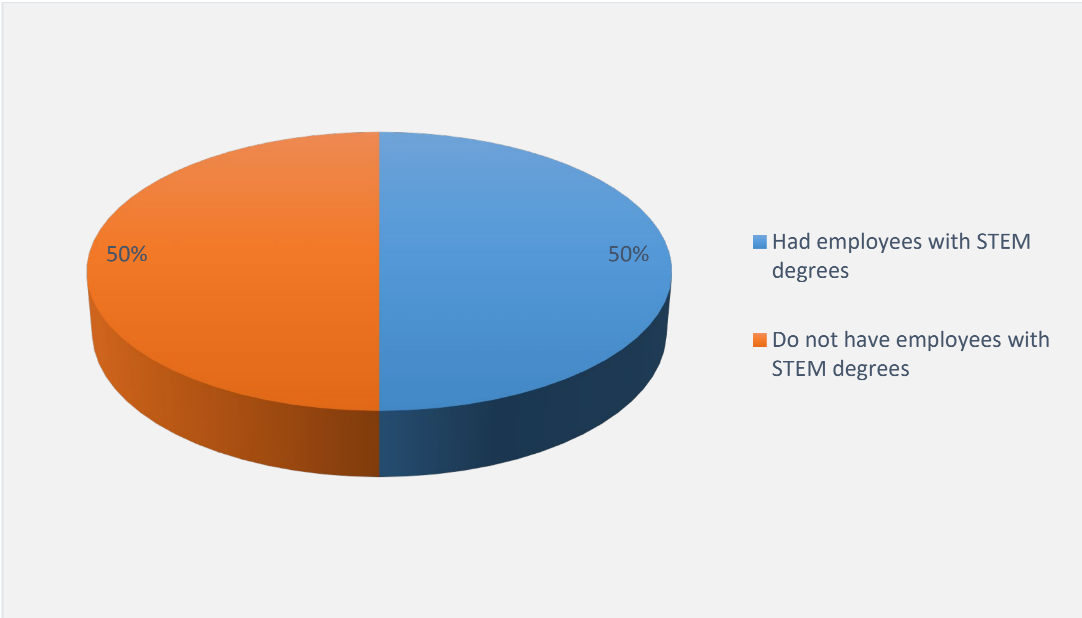


Figure 9: Percentage of establishments with employees with STEM degrees by gender and occupational group – Both genders

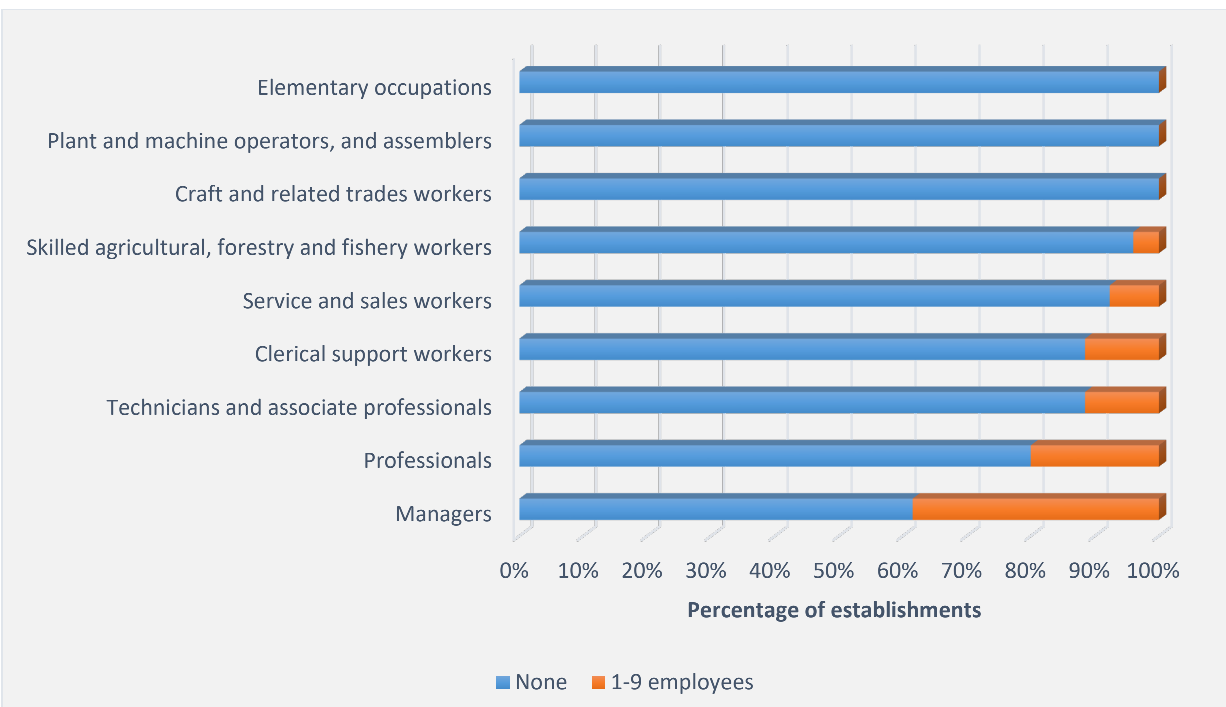


Figure 10: Percentage of establishments with employees with STEM degrees by gender and occupational group – Males

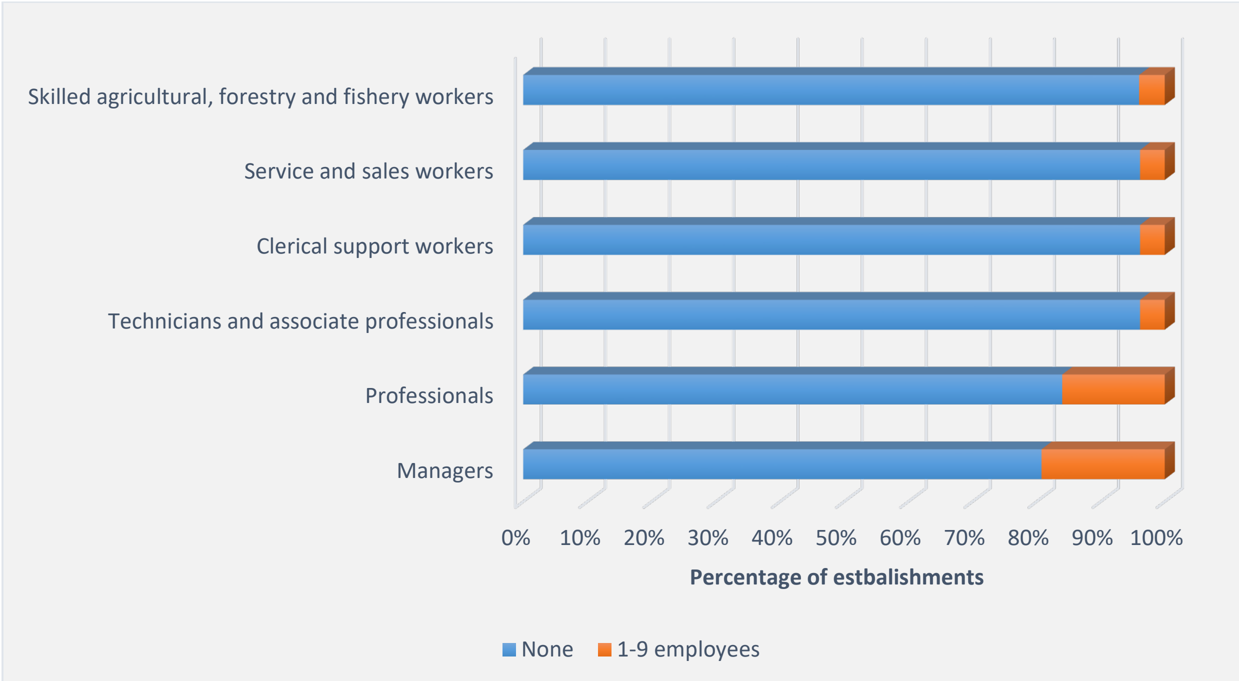


Figure 11: Percentage of establishments with employees with STEM degrees by gender and occupational group – Females

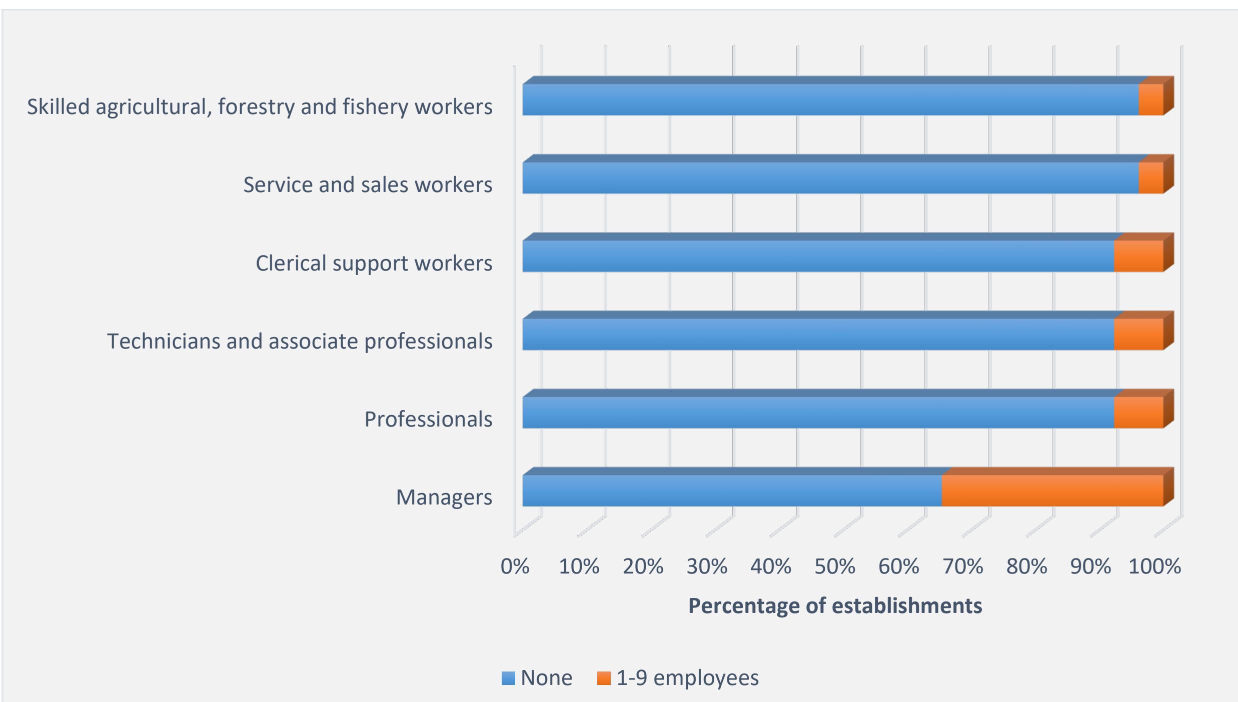


Figure 12 depicts the number of workers employed in STEM occupation groups within the establishments surveyed. For the purpose of this study, STEM occupations consisted of Natural Sciences; Engineering; Computer Science/IT; Mathematics and Statistics; Food and Agriculture; Medical and Health; and Environmental Sciences occupations. In addition, a list of STEM occupations is included in Appendix II. The data shows that over a half (58%) of the establishments reported no employment in each of the STEM occupation groups. The highest percentage of employees was observed in Food and Agriculture occupations (30%) followed by Engineering (19%) and Computer Science/ IT (14%) occupations. There were no employees in Mathematics and Statistics occupations.

A review of the number of employees in STEM occupations by gender shows that there were more males in Food and Agriculture, Engineering and Computer Science/IT occupations than females (Figures 13 and 14). Females outnumbered males in Natural Sciences and Medical and Health fields while a similar pattern of male and female employment was observed in Environmental Sciences occupations.

Figure 12: Employees in STEM occupation group by gender – Both genders

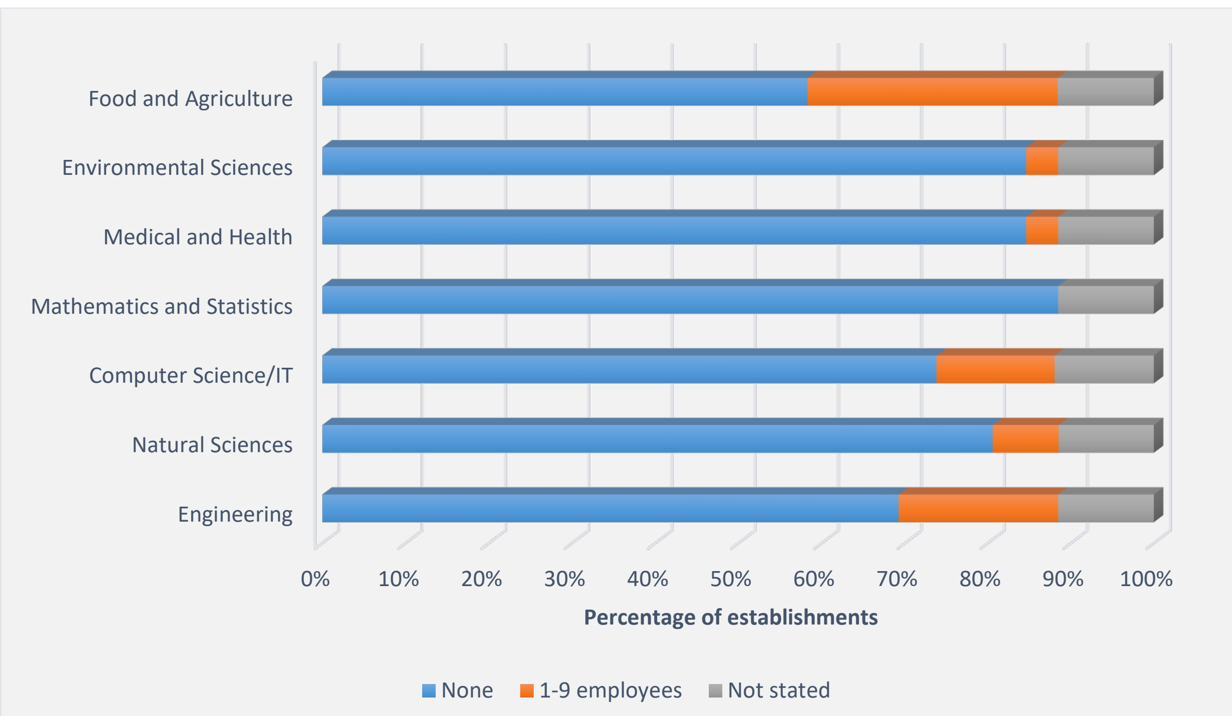


Figure 13: Employees in STEM occupation group by gender – Males

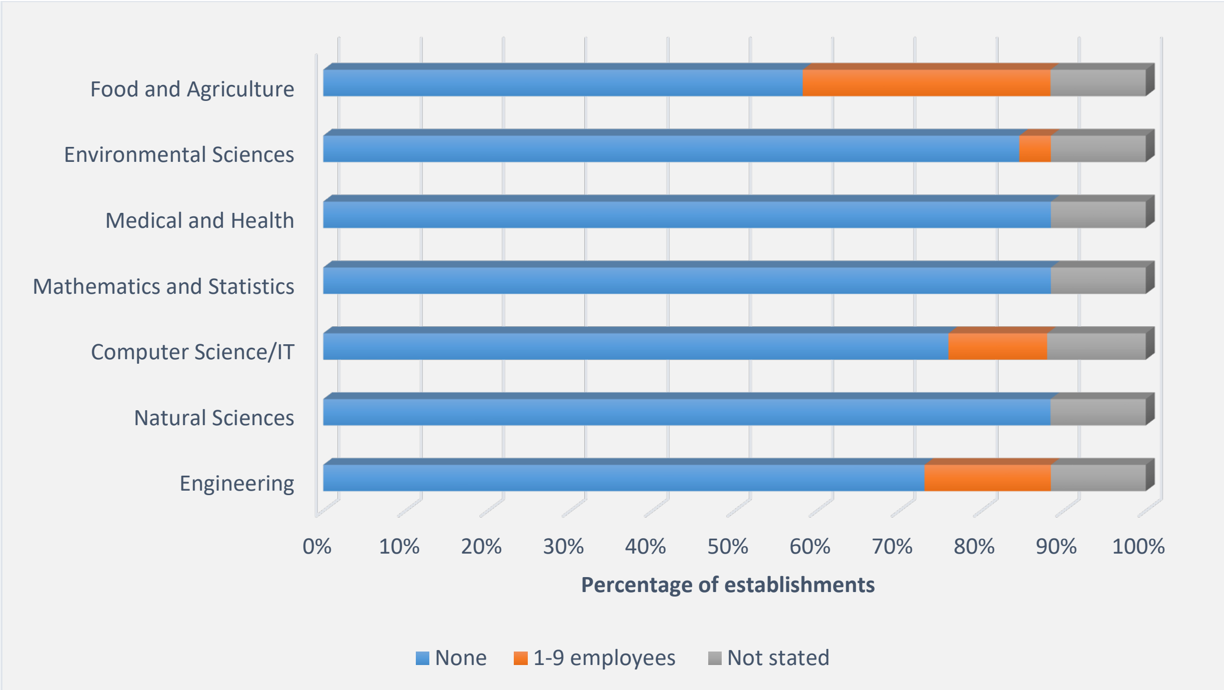
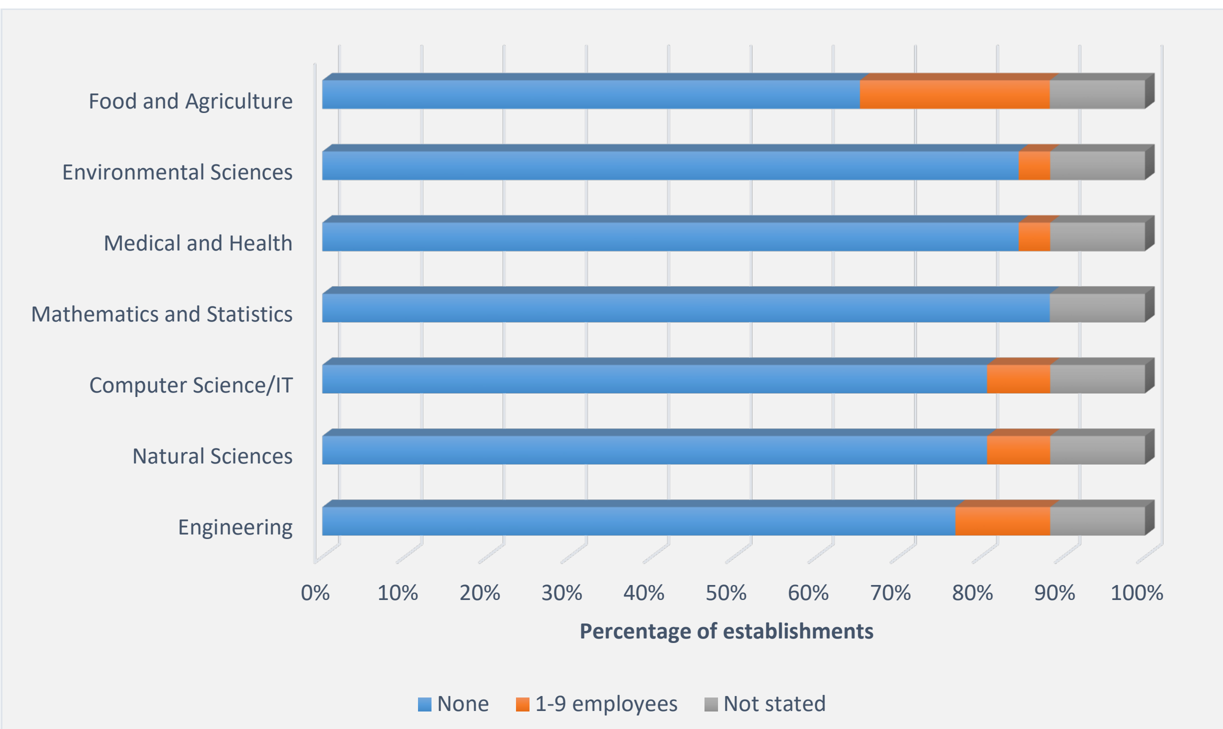


Figure 14: Employees in STEM occupation group by gender – Females



4. Recruitment and Vacancies

This section begins by identifying the proportion of employers with vacancies, particularly in STEM-related occupations, at the time of the survey. Although educational requirements vary, the survey focused on STEM occupations that required a bachelor's degree or higher. In addition, a comparison of STEM and non-STEM vacancies was undertaken to compare the employment opportunities available to STEM graduates and non-STEM graduates in the agro processing sector. The section also features the number of vacancies employers filled over the last twelve (12) months of the survey period and whether they had difficulties filling these vacancies. Additionally, this section offers recommendations from employers on actions needed to overcome these challenges encountered when filling STEM vacancies.

Figure 15 reveals that the number of vacancies was generally low in the agro-processing establishments that responded to the survey. A substantially lower percentage (23%) of the establishments reported vacancies during the survey period compared to 77% with no vacancy.

Figure 15: Percentage of establishments with current vacancies

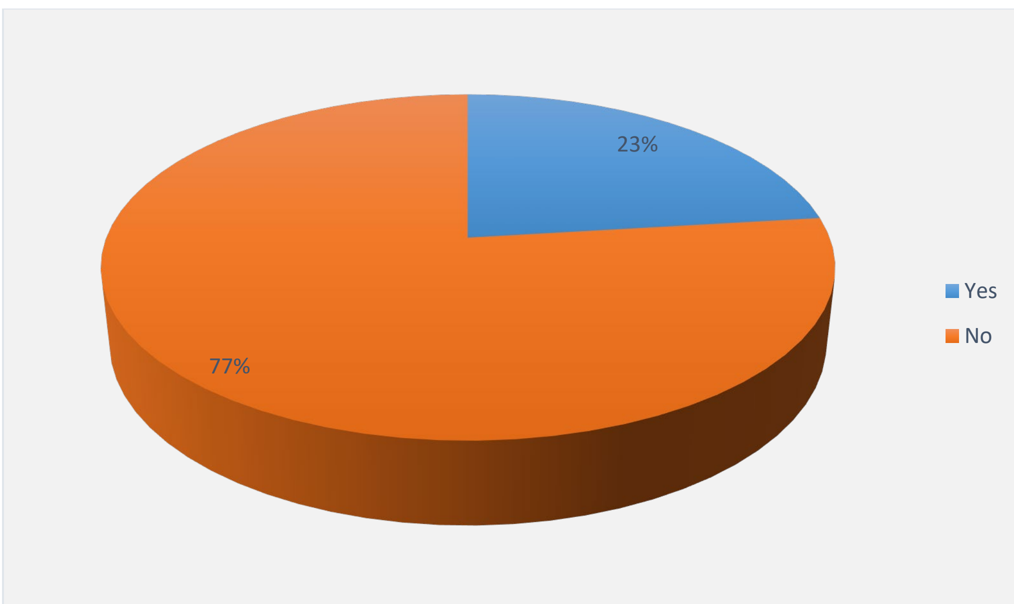


Figure 16 shows the percentage of establishments with current vacancies by STEM and non-STEM fields. The survey results reveal that a larger proportion (15%) of employers reported vacancies in non-STEM fields compared to vacancies in STEM fields (8%). In addition, the total number of non-STEM vacancies (8) was higher than the total number of STEM vacancies (3) (Figure 17). This implies that there were more job opportunities in the sector for graduates in non-STEM fields compared to graduates in STEM fields.

Figure 16: Percentage of establishments with STEM and Non-STEM vacancies

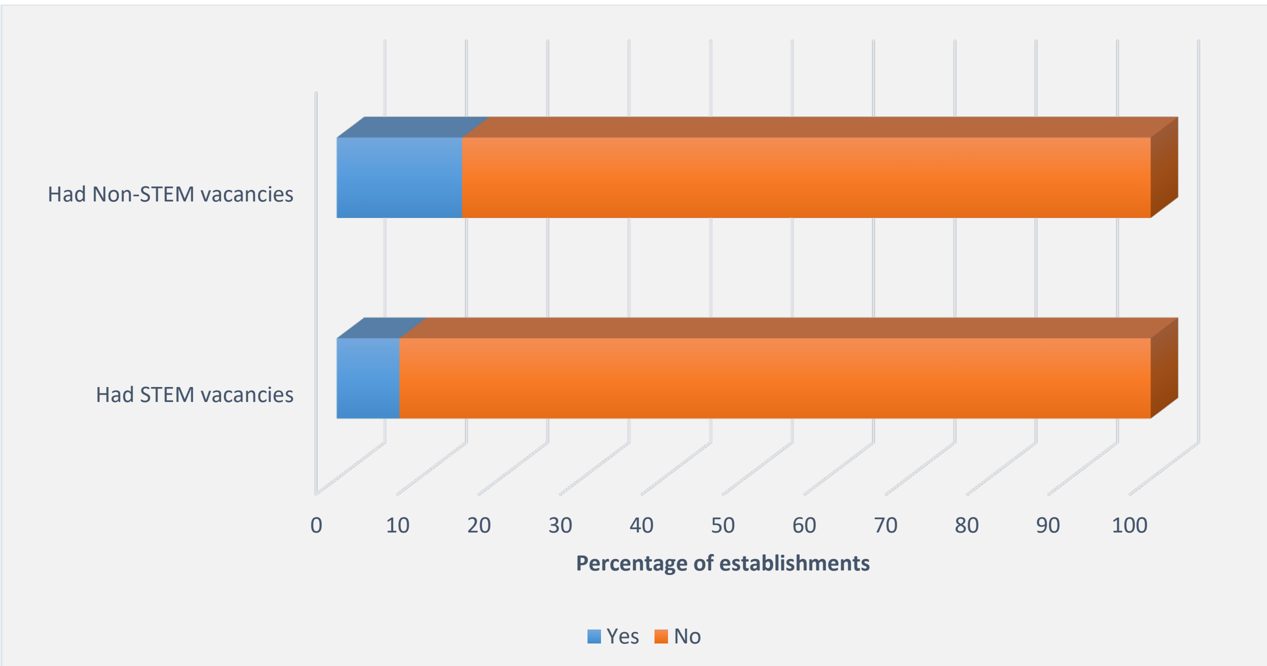
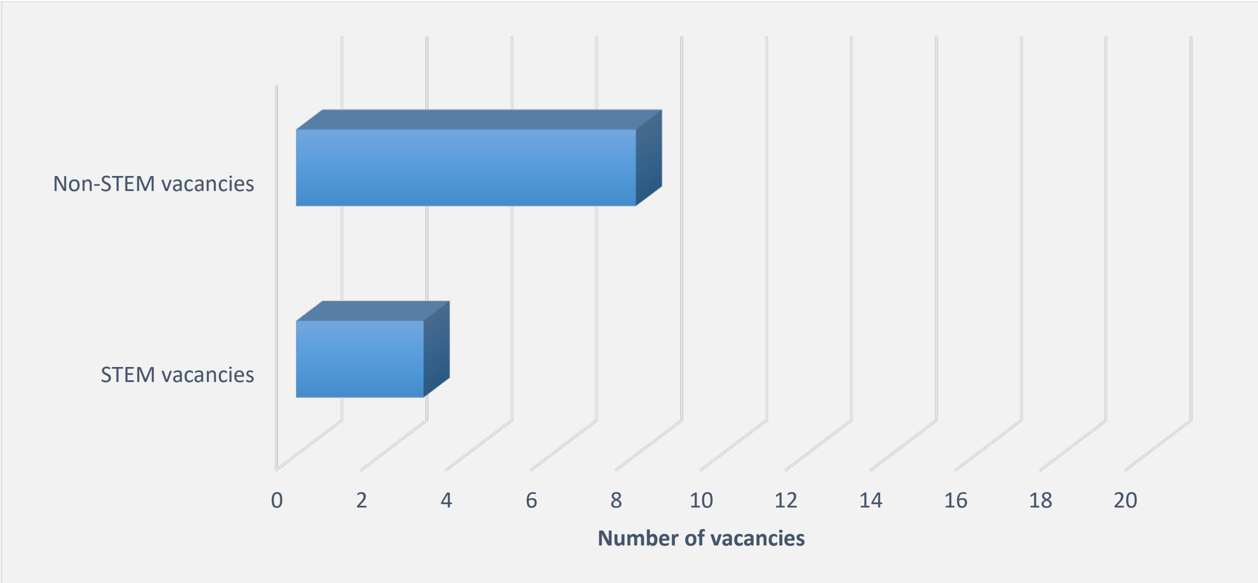
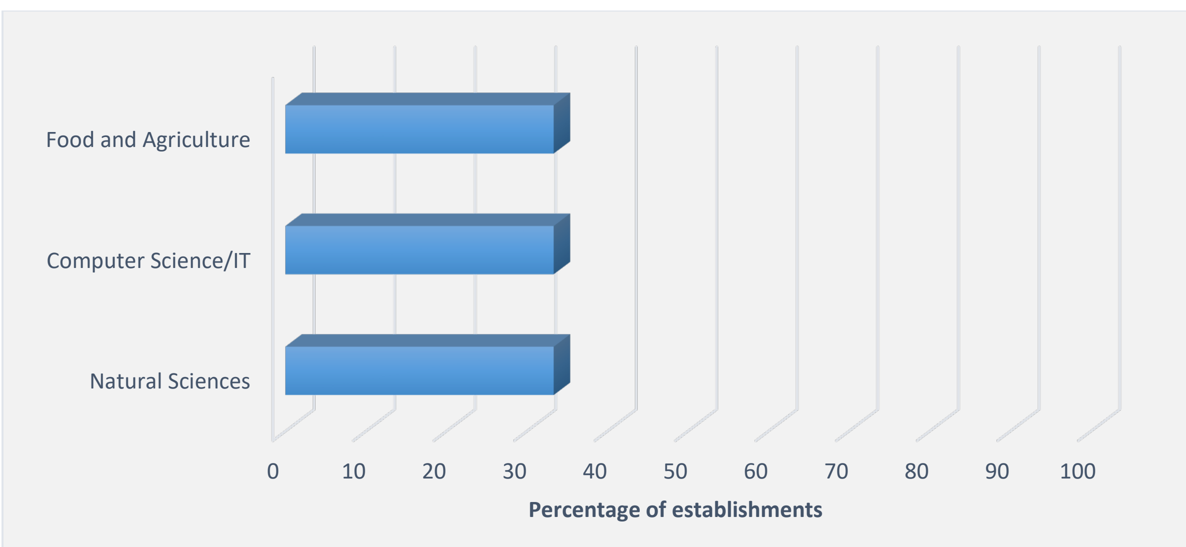


Figure 17: Number of STEM and Non-STEM vacancies



With regard to STEM vacancies, the survey captured data on the number of vacancies within each STEM fields. The data shows that all vacancies reported by employers who participated in the study were in the fields of Food and Agriculture (33%), Computer Science/IT (33%) and Natural Sciences (33%) (Figure 18).

Figure 18: Percentage of establishments by STEM vacancies



In assessing recruitment in emerging sectors, the survey also captured data on the percentage of establishments that filled vacancies over the last 12 months of the survey period and the number of vacancies filled. Additionally, this data was further disaggregated by STEM and non-STEM. Data on recruitment provides valuable insights into employment trends within the agro-processing industry and identifies the fields that have the most opportunities.

Figure 19 shows that over a half (54%) of the employers reported that they had filled vacancies over the last 12 months before the survey while the 46% did not. A review of the data by STEM and non-STEM reveals that a higher percentage (35%) of employers filled non-STEM vacancies compared to 23% who filled STEM vacancies. A further examination of the data on STEM vacancies shows that a higher percentage (19%) of establishments filled STEM vacancies over the last 12 months in the field of Food and Agriculture compared to the other STEM fields (Figure 20).

Figure 19: Percentage of establishments that filled vacancies over the last 12 months

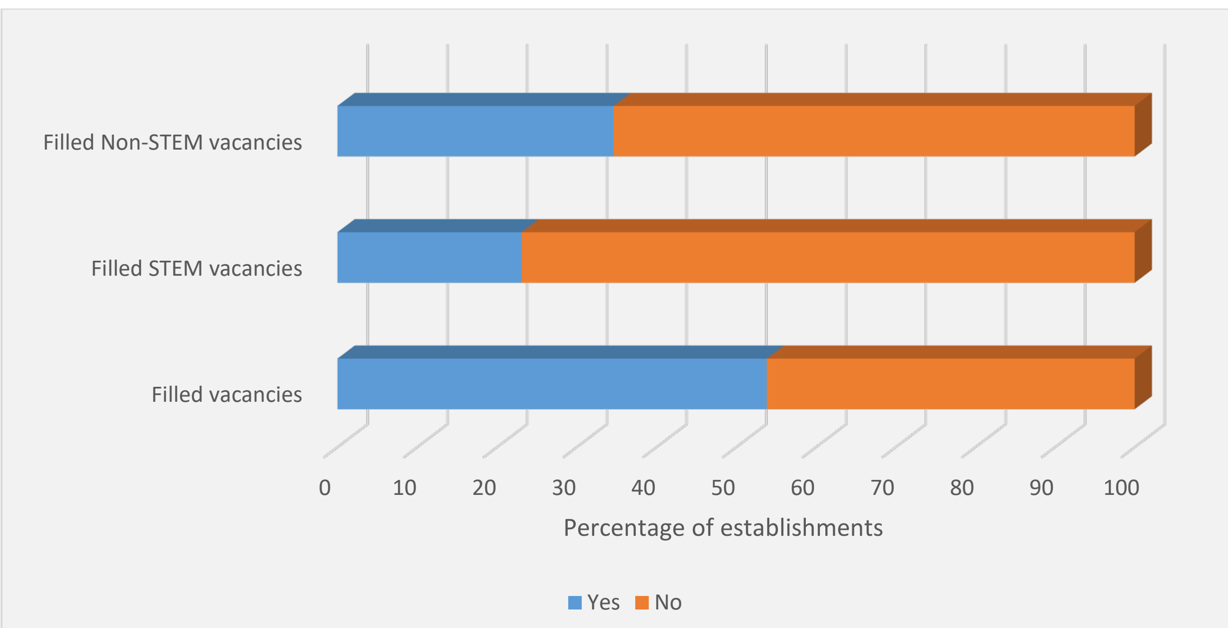
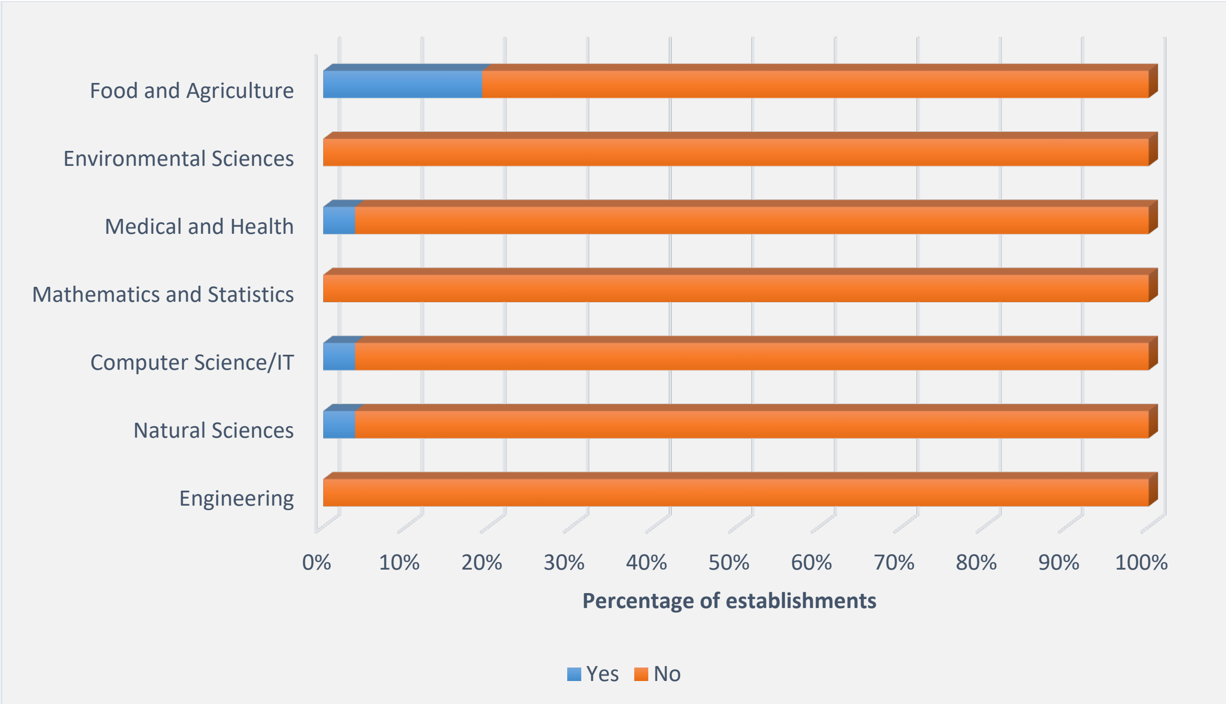


Figure 20: STEM vacancies filled over the last 12 months by field of study



The employers who filled vacancies over the last 12 months were asked if they experienced any difficulty when filling vacancies. Table 2 presents a comparison of the level of difficulty employers experienced when filling STEM and non-STEM vacancies within the various occupational groups. Generally, employers reported more difficulty filling STEM occupations compared to non-STEM occupations. A review of STEM vacancies by occupational group reveals that the highest level of difficulty was observed for Professionals (67%). With regard to non-STEM occupations, a half (50%) or more of the employers did not have difficulty filling vacancies in each occupational group.

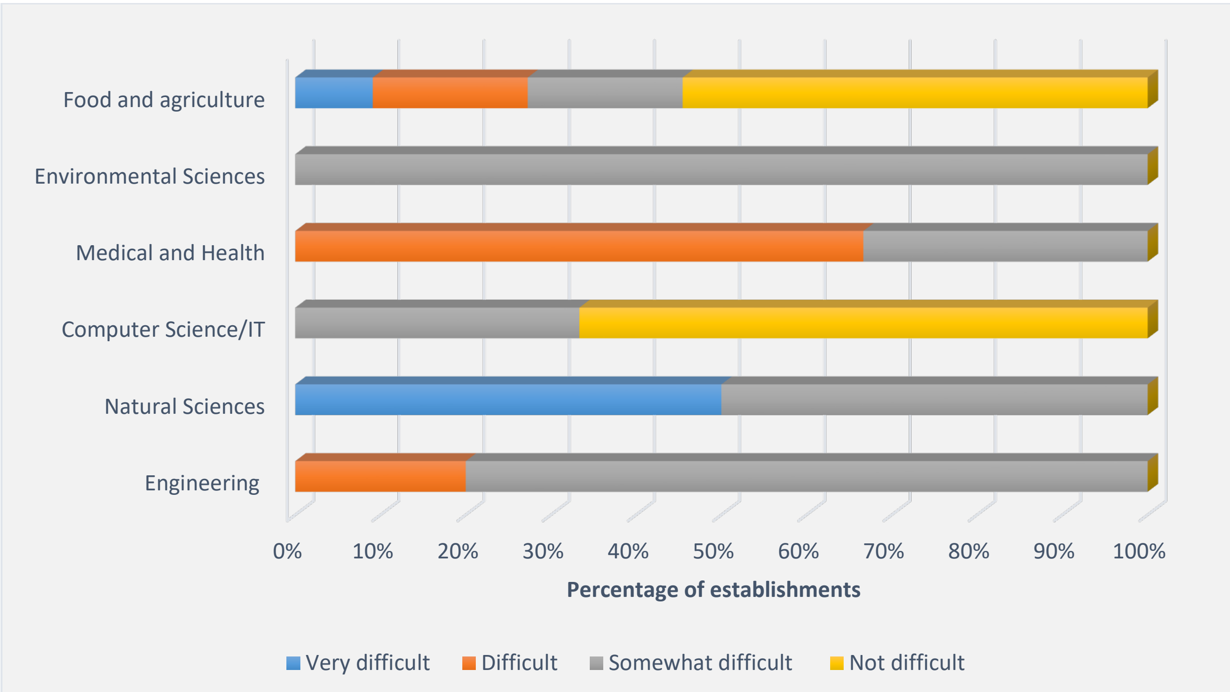
Table 2: Comparison of difficulty experienced when filling STEM and Non-STEM vacancies by occupational group

Occupational groups	STEM vacancies			Non-STEM vacancies		
	Difficult to fill	Not difficult to fill	Total	Difficult to fill	Not difficult to fill	Total
Managers	0	100	100	20	80	100
Professionals	67	33	100	33	67	100
Technicians and associate professionals	40	60	100	20	80	100
Clerical support workers	na	na	na	33	67	100
Service and sales workers	50	50	100	43	57	100
Skilled agricultural, forestry and fishery workers	na	na	na	50	50	100
Craft and related trades workers	na	na	na	0	100	100
Plant and machine operators, and assemblers	na	na	na	50	50	100
Elementary occupations	na	na	na	29	71	100

na – not applicable

A further breakdown of the level of difficulty employers encountered when filling STEM vacancies is shown by STEM fields in Figure 21. The highest level of difficulty was recorded for Natural Sciences occupations which a half (50%) of the employers reported was very difficult to fill.

Figure 21: Level of difficulty experienced when filling STEM vacancies



The significant factors contributing difficulties employers faced when filling STEM vacancies were also examined using a scale of 1 to 5 where 1 denoted not significant and 5 indicated very significant. Figure 22 shows the factors affecting recruitment and their level of significance. The most significant factors contributing to the difficulty (ratings 4 + 5) employers experienced while trying to fill STEM roles were a low number of applicants with the required attitude, motivation or personality (63%) and not enough people willing to do that type of job (54%). The least significant factors (ratings 1+2) were too much competition from other employers (67%) and outdated theory/education that was not applicable to the work environment (63%).

Figure 22: Significant factors why STEM occupations are difficult to fill

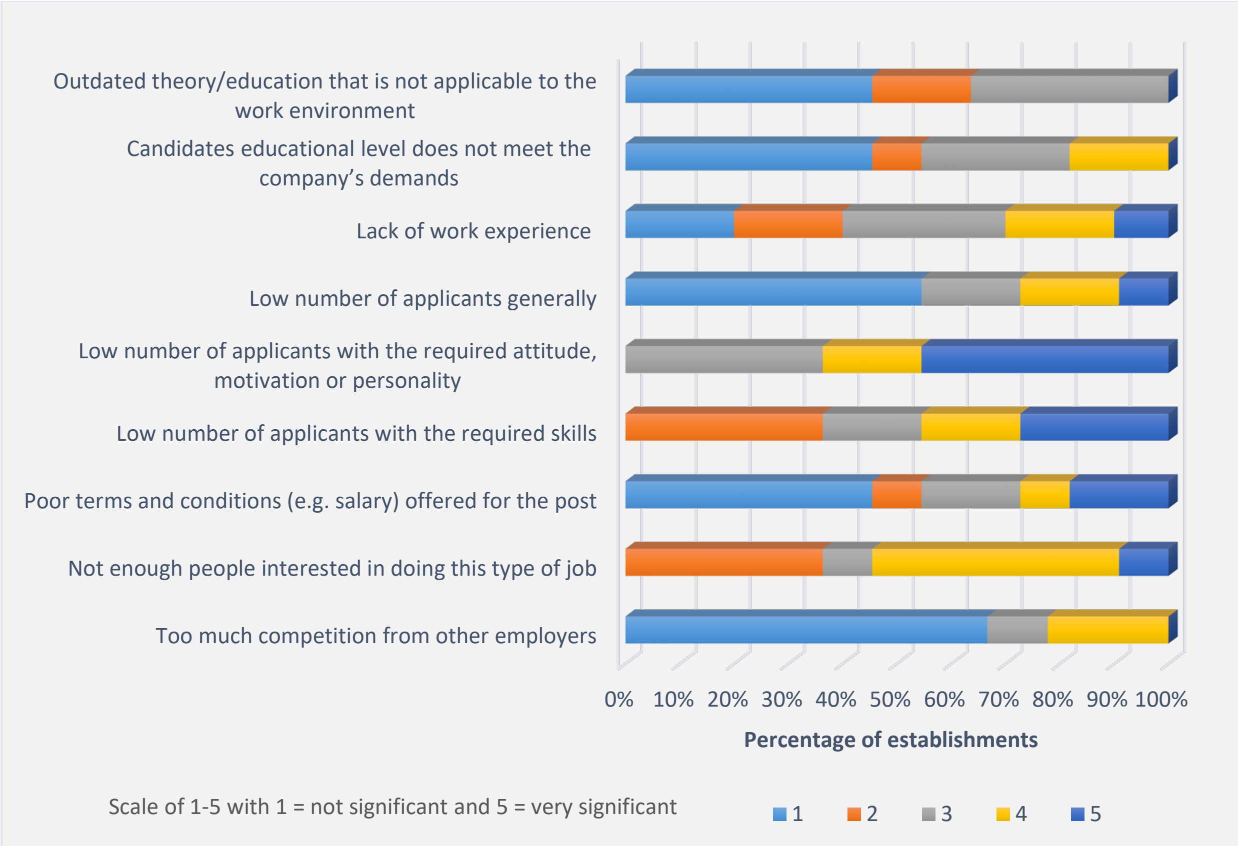


Figure 23 summarises the recommendations employers suggested to overcome problems experienced while filling STEM vacancies. The main recommendation from employers was to regularise the industry and provide benefits and job security for employees (30%). One-fifth (20%) of the employees in case recommended improving life skills among graduates and increasing government support for SMEs.

Figure 23: Recommendations to overcome problems experienced when filling STEM occupations

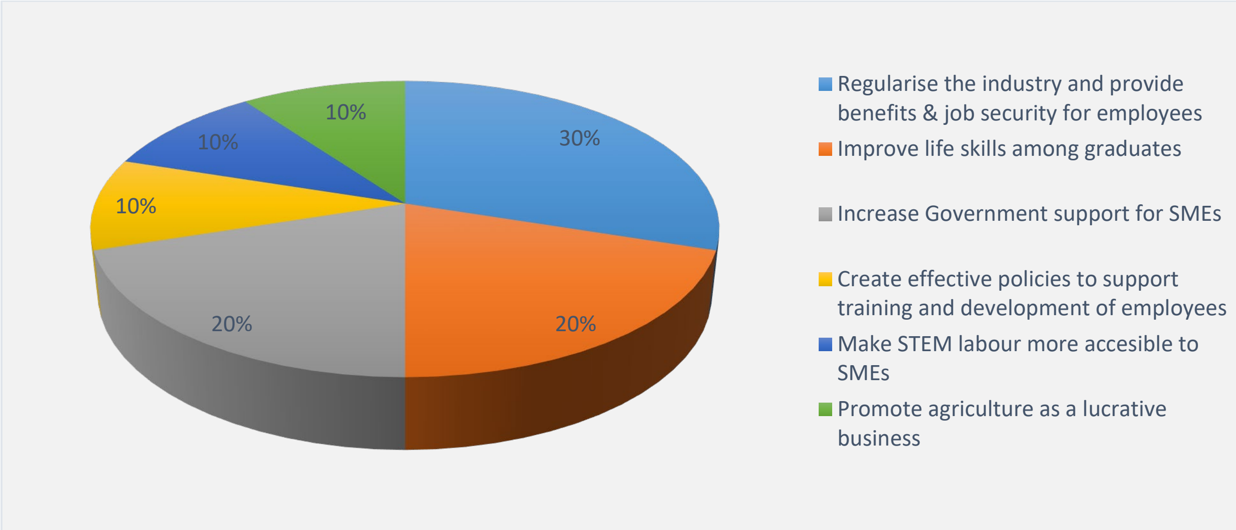
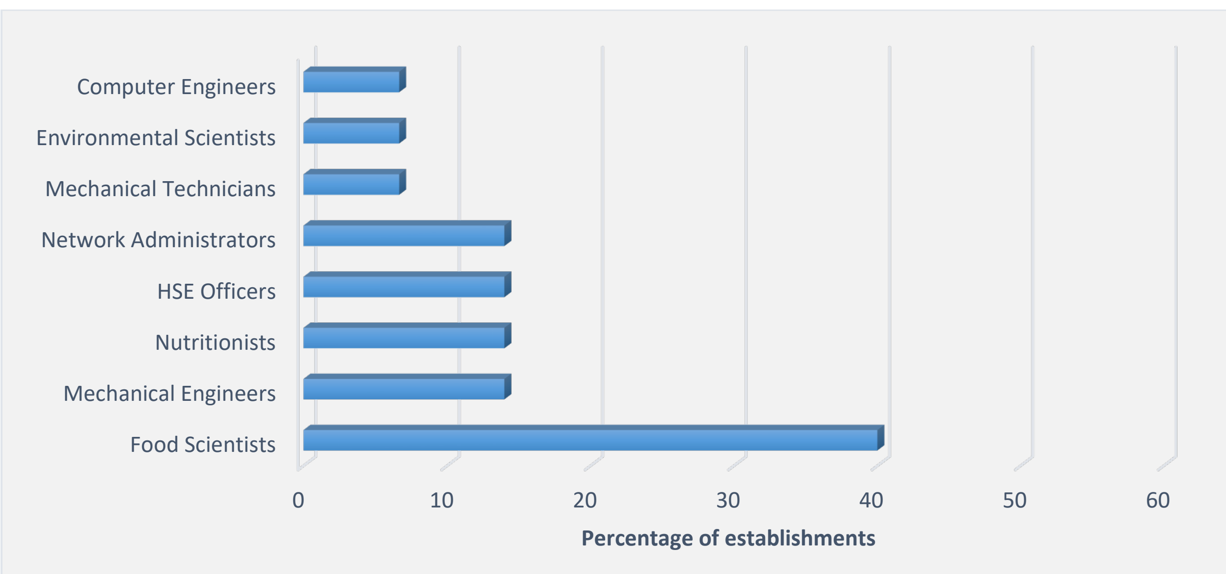


Figure 24 presents the STEM occupations that employers in the agro-processing industry identified as the most difficult to fill. The most difficult STEM occupation to fill was Food scientist (40%). The other STEM occupations listed were Mechanical Engineers (14%), Nutritionists (14%), HSE Officers (14%), Network Administrators (14%), Mechanical Technicians (7%), Environmental Scientists (7%) and Computer Engineers (7%).

Figure 24: Most difficult STEM occupations to fill



5. Skills of the Workforce

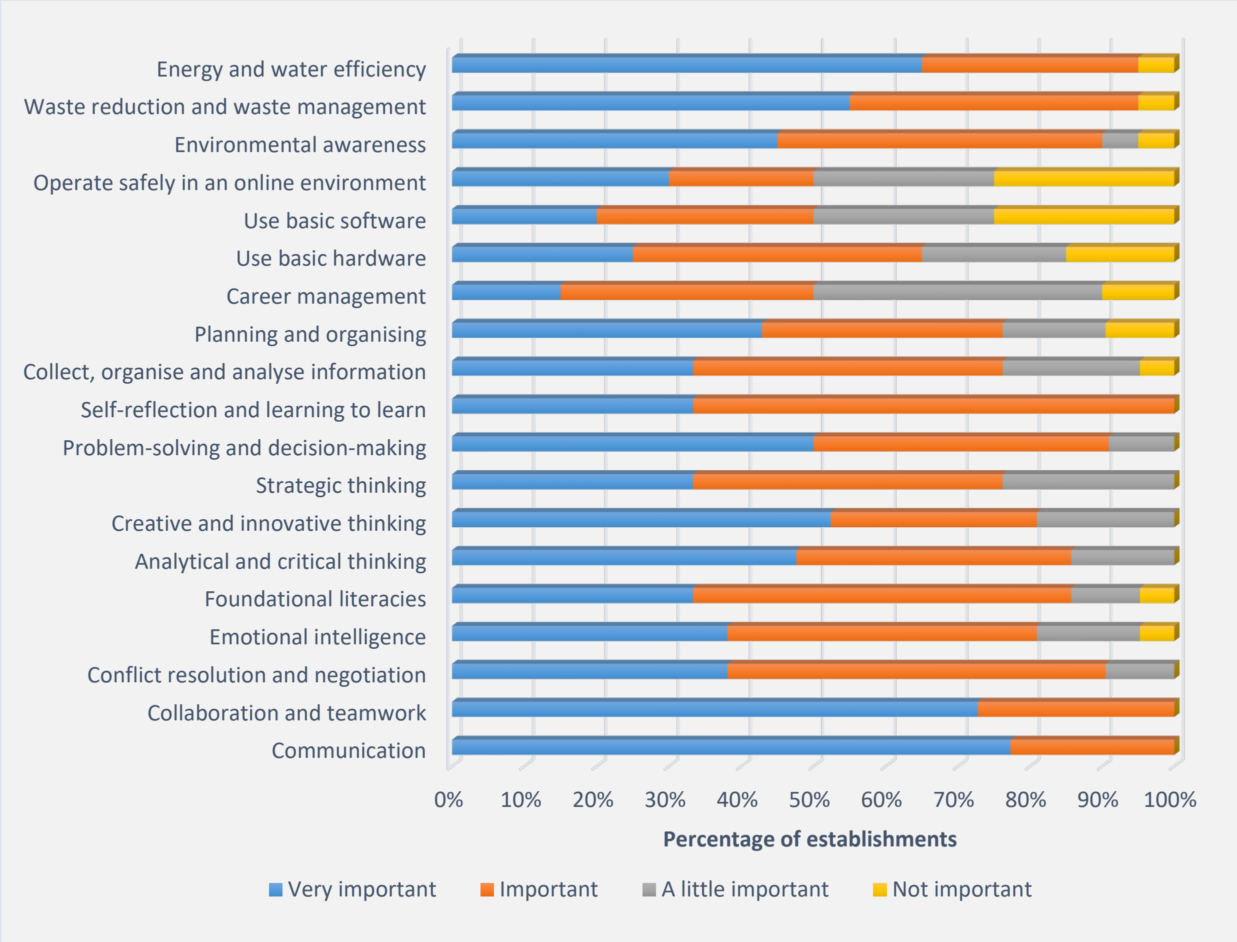
Skill development can be beneficial for both employers and their employees. Improving skills can change companies by increasing productivity and competitiveness. Regarding employee growth, core skills are crucial for boosting workers' job prospects, improving chances of securing good employment, and raising their quality of life. The core skills assessed in this study were identified and defined using the ILO Global framework on core skills for life and work in the 21st Century. The skills are detailed in Table 1 and further elaborated in Appendix III.

The purpose of this chapter is to assess the existing skills mismatches in the agro-processing sector. This section presents data on the skills employers identified as critical for employees to possess in order to meet organisational goals and objectives. Additionally, the findings on the internal and external drivers of change and the requisite skills needed to address these drivers are summarised in this section. Following the identification of core skills required by employers for achieving business goals and objectives, the skills of recent job applicants, university graduates and existing employees were examined mainly to determine the skill mismatches in the workforce. Lastly, this section provides data on how prepared university graduates are for the workplace.

5.1 Demand for Skills by Employers

Figure 25 presents employers rating on the level of importance for employees to have the 19 core skills in order to achieve the goals and objectives of the business. A half (50%) or more of the employers indicated that it was important (very important + important) for employees to possess all 19 skills. The most important skills were Communication (100%), Collaboration and teamwork (100%) and Self-reflection and learning to learn (100%), Energy and water efficiency (95%) and Waste reduction and management (95%). The skills that received the lowest ratings in terms of importance were Use basic software and operate safely in an online environment, which were both rated as a little important or not important by 50% of employers. This trend is concerning and should be monitored, given the importance of basic digital skills for employees to operate successfully in a technology-driven environment.

Figure 25: Employers' rating of skills employees should have to meet business goals



5.2 Drivers of Change and Skills Required

In order to establish what skills were important in the industry for both current and future development the internal and external drivers of change were identified. Recognising that drivers of change are important as they play a pivotal role in reshaping the industry and determining the skills that would be needed to adapt and succeed. This section also outlines the main skills required to address each driver.

The internal drivers of change reported by businesses are depicted in Figure 26. The main internal driver of change was people (73%) followed by profit (62%) and Technology (19%). Overall, Communication (33%) was viewed as the most important skill to address internal drivers of change followed by IT (12%) and

Creativity and Innovation (10%), which were ranked second and third, respectively (Figure 27). The following were the main skills identified to address each internal driver:

1. People – Communication (31%)
2. Profit – Communication (28%)
3. Technology – IT (50%)

Figure 26: Top internal drivers of change in establishments

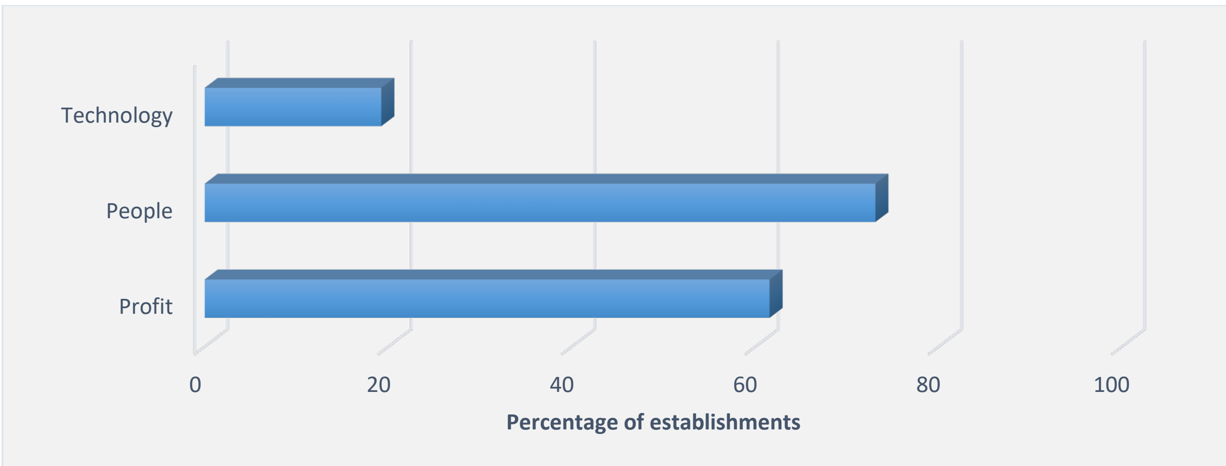
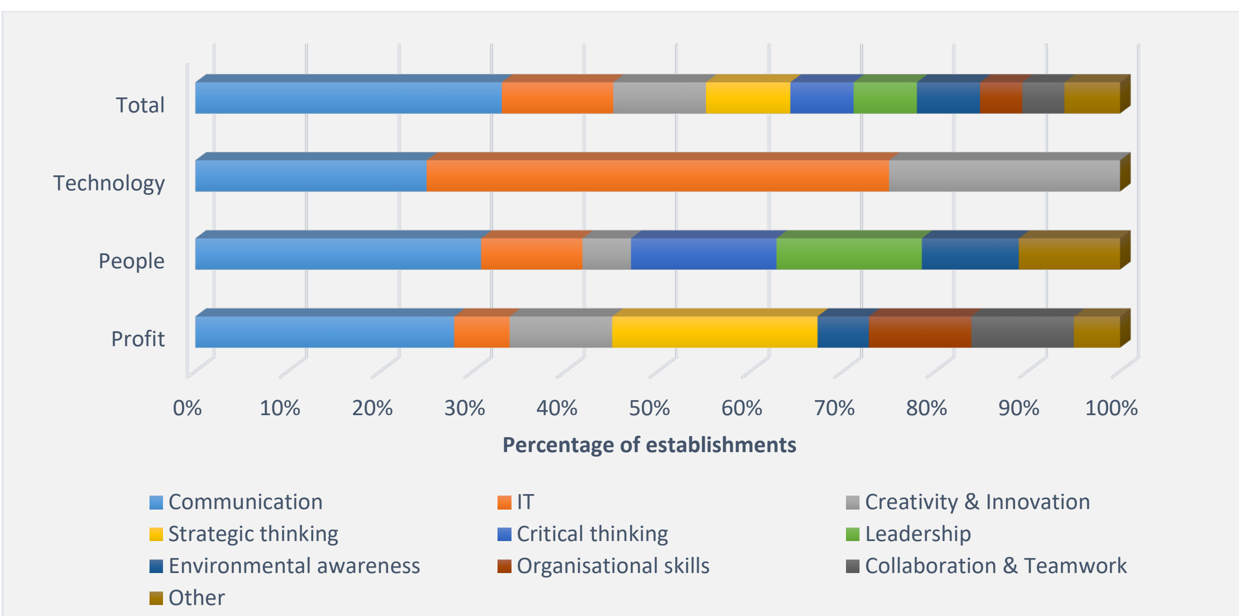


Figure 27: Main skills required to address internal drivers of change



In terms of external drivers of change in agro-processing establishments, employers were asked to list the top two (2) drivers of change and the skills required to address these drivers. The survey results revealed that the top external driver of change was competitors (63%) followed by climate change (37%) and technology (32%) (Figure 28). Figure 29 depicts the skills employers identified as necessary to address external drivers of change. Overall, the top two (2) skills recorded were IT (19%) and Creativity & Innovation (16%). The following were the main skills identified to address each internal driver:

1. Competition – Creativity & Innovation (29%)
2. Climate change – Environmental awareness (30%)
3. Technology – IT (56%)
4. Supply chain disruptions – Project management (100%)
5. Economic trends - Critical thinking (100%)
6. Demand – Emotional intelligence (50% and Critical thinking (50%)

Figure 28: Top external drivers of change in establishments

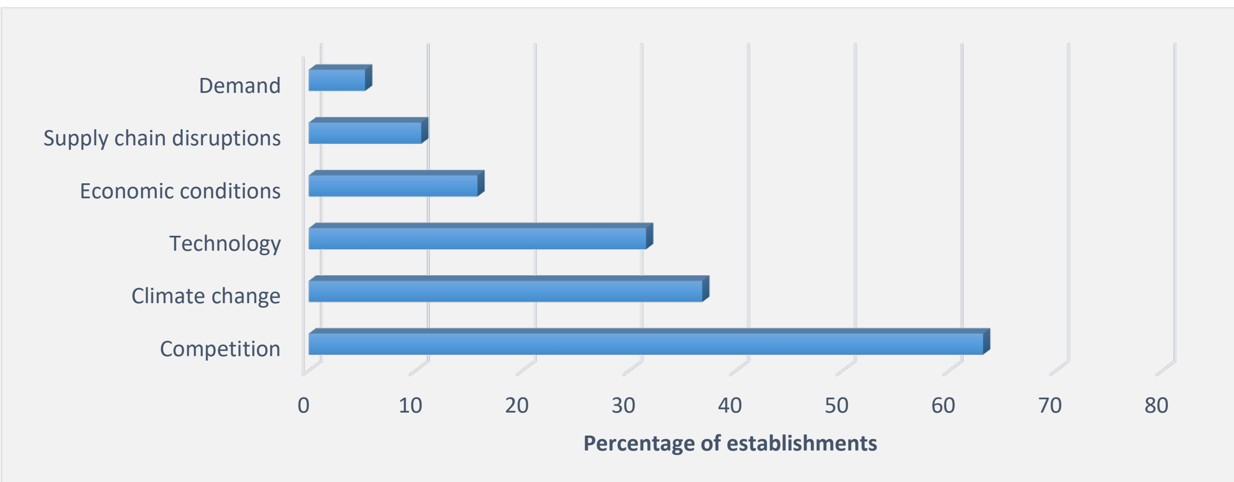
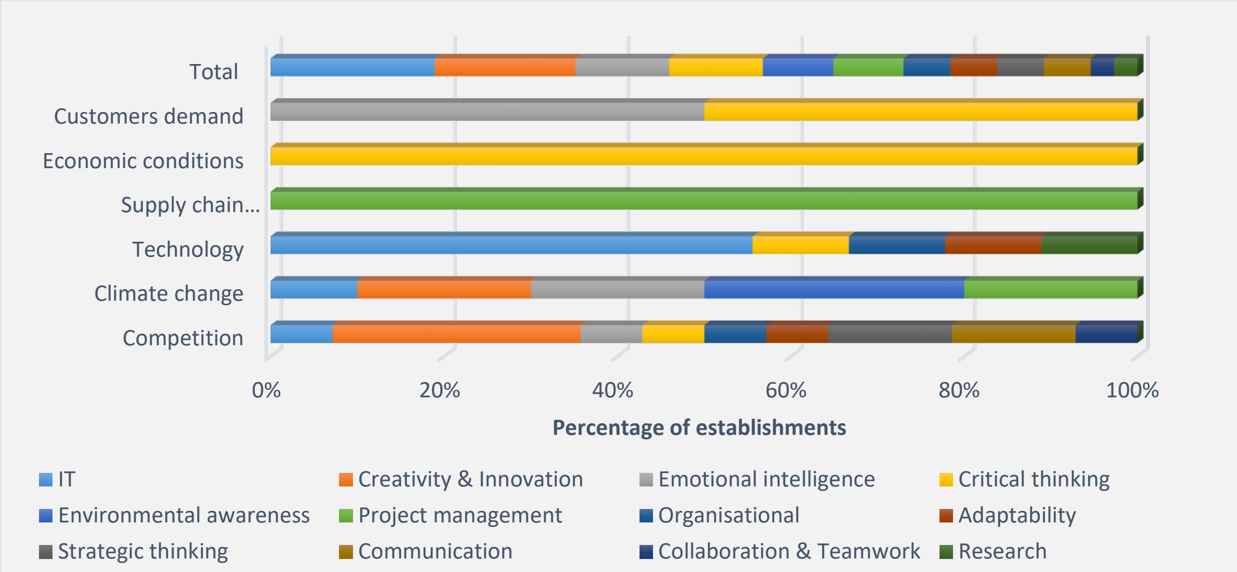


Figure 29: Main skills required to address external drivers of change

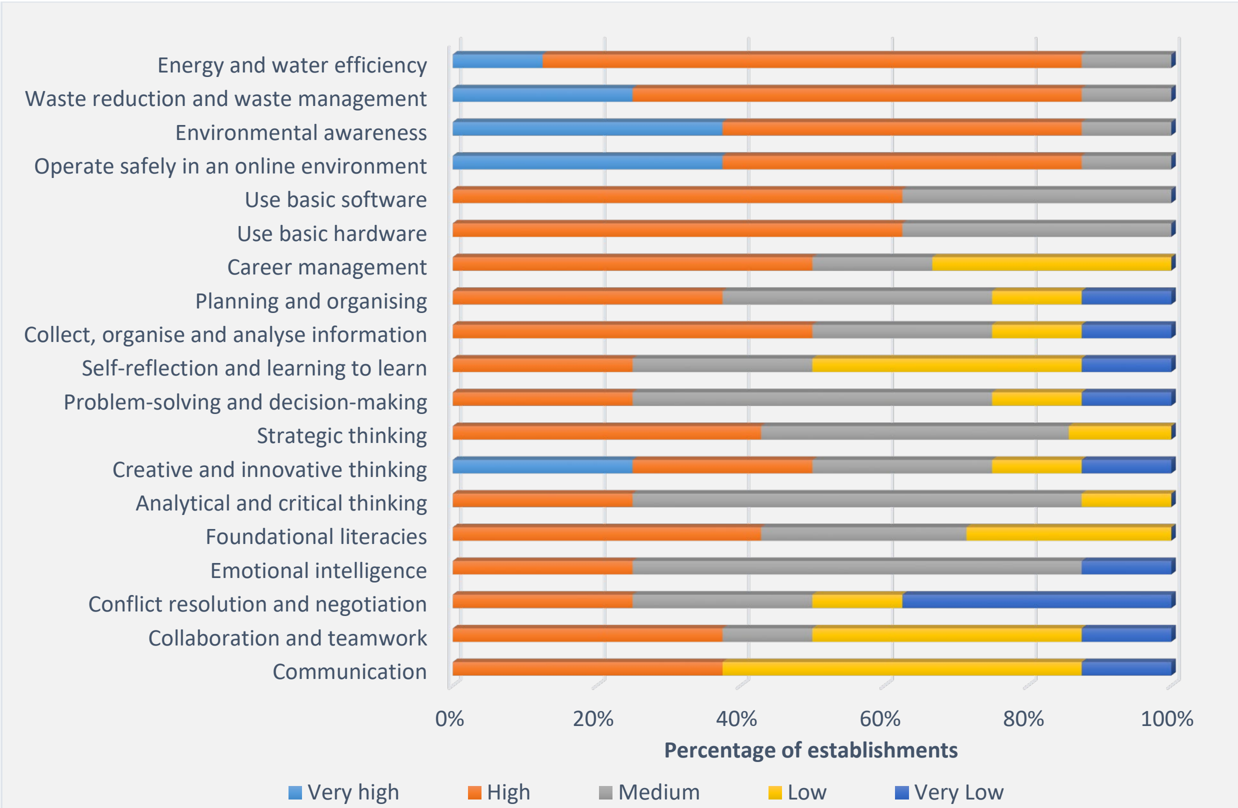


5.3 Employers' Perception on the Skill Levels of Employees

To gain a comprehensive understanding of the level of skills among employees in emerging sectors, employers were asked to assess their employees' proficiency across 19 core skills identified as crucial building blocks to lifelong learning and adapting to changes in the labour market. This included new entrants into the workforce and existing employees. The new entrants assessed were employees who graduated from university between the years 2021 and 2023.

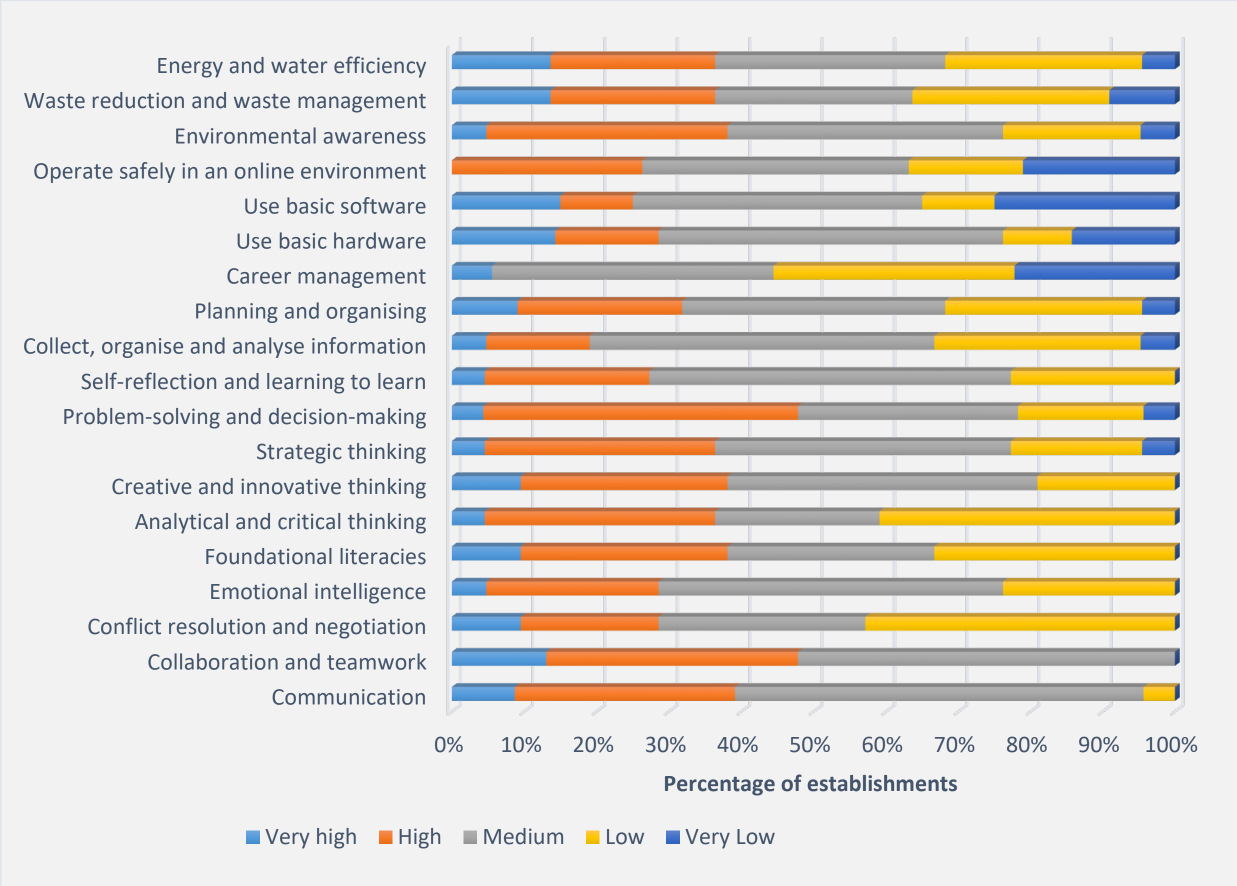
Figure 30 presents employers' perception on the skill levels among recent university graduates, focusing on the 19 core skills. These skills were evaluated on a 5-level scale, ranging from very low to very high. The data shows that a half (50%) or more of the employers rated recent university graduates' level of skill as high (very high + high) or medium in 18 of the 19 core skills. Graduates were rated the highest for Basic skills for green jobs followed by Basic digital skills. This suggests that the future workforce is becoming more climate-conscious and tech-savvy. The lowest ratings (very low + low) were assigned to Communication (63%), Collaboration and teamwork (50%), Conflict resolution and negotiation (50%) and Self-reflection and learning to learn (50%). While a climate-conscious and technologically proficient workforce is important to improve productivity, innovation and sustainable practices in the industry, employees must also possess crucial skills such as Communication and Collaboration and teamwork for this to happen.

Figure 30: Employers' rating of level of the skills among recent university graduates



A review of the skill set of existing employees was also undertaken in order to fully understand how their skills aligned with the needs of businesses. Figure 31 shows that over a half (50%) of the employers rated their employees' level of skill as medium or low (very low + low) in all 19 core skills. Employees were rated the highest (very high + high) for Collaboration and teamwork and Problem solving and decision making (48%). The low ratings assigned by employers indicate a need for increased upskilling of existing employees to not only to increase their current productivity and opportunities for higher employment but also to better prepare them for the future of work.

Figure 31: Employers' rating of level of the skills of existing employees

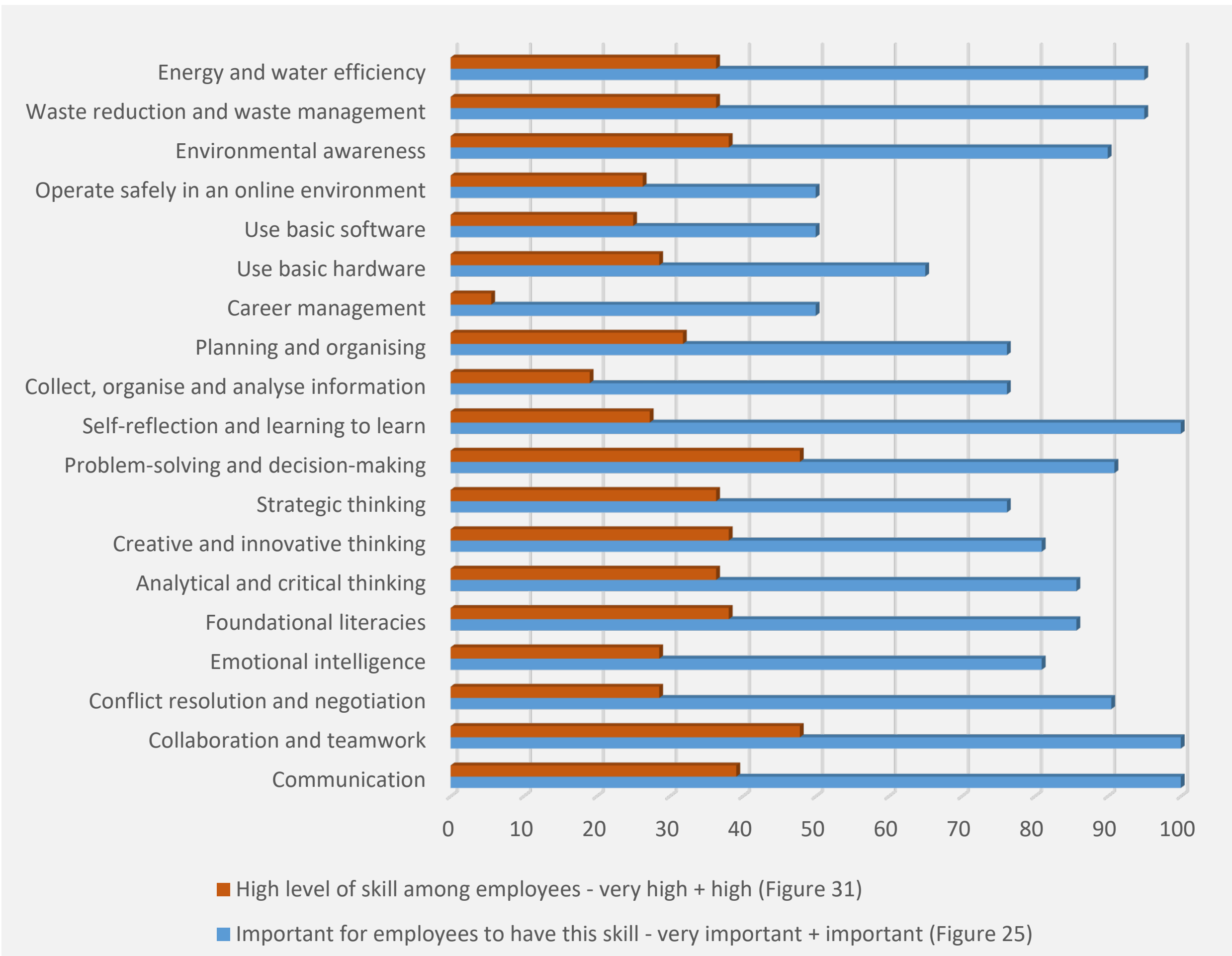


5.4 Skills Mismatch

An analysis of the skill mismatches was undertaken by comparing the data provided by employers on the skills that were important for employees to possess with how they rated the skills of their existing workforce. This comparison revealed the areas where there was a mismatch between the required skills and the current skill levels of employees.

Figure 32 presents a comparison between the percentage of employers who reported as important (very important + important) (Figure 25) for employees to have and the percentage of the workforce possessing a high (very high + high) (Figure 31) level of these skills. This comparison highlights the gaps in the level of skills employers required from employees and the actual level of skills among employees in agro-processing establishments. Employers consistently rated the importance of all 19 core skills higher than the actual proficiency levels observed among employees highlighting a widespread skills gap. The largest gaps were recorded for Self-reflection and learning to learn (73%), Conflict resolution and negotiation (62%) and Communication (61%). The lowest disparity was observed for basic digital skills. The extensive gap between the skills deemed important by employers and what they perceived as the actual proficiency levels within their workforce is a significant issue. This mismatch can lead to several problems, including lower productivity, innovation, and economic growth.

Figure 32: Comparison of employers' rating of skills required to meet business goals and current level of the skills of employees



5.5 Level of Difficulty Employers Experienced in Finding Core Skills among Recent Job Applicants

The study also captured data on the challenges employers face in acquiring core skills from new entrants into the workplace. This data is crucial in identifying specific skills that are lacking in new employees. Understanding these difficulties is essential for addressing the root causes of the skills mismatch and implementing effective solutions that can improve education and training programmes for greater alignment of the skills of the workforce to industry needs.

Figure 33 shows the percentage of employers who found it difficult to find seven (7) key skills – Creativity, Critical thinking, Collaboration, Communication, IT, Decision-making and Problem solving - among recent job applicants within each occupational group. The data shows that it was not difficult for over a half of the respondents to find the seven selected skills among recent job applicants within each occupational group. Overall, the skills that recorded the highest level of difficulty were problem solving and critical thinking. By occupational group, the highest level of difficulty was observed among Clerical support workers, Service and sales workers, and Skilled agricultural, forestry and fishery workers. The skills employers encountered the most difficulty to find among recent applicants within the different occupational groups are outlined below:

- Managers - Collaboration (29%) and Communication (29%)
- Professionals - Communication (24%)
- Technicians and associate professionals – Critical thinking (19%) and Problem solving (19%)
- Clerical support workers - Problem solving (44%) and Creativity (38%)
- Service and sales workers – Problem Solving (33%), Critical thinking (33%), Collaboration (28%) and Decision making (28%)
- Skilled agricultural, forestry and fishery workers - Problem solving (44%)
- Craft and related trade workers- Critical thinking (25%)
- Plant and machine operators and assemblers- Critical thinking (31%) and Problem solving (31%)
- Elementary occupations – Communication (24%) and IT (24%)

Figure 33: Employers' rating on the difficulty experienced to obtain skills from recent applicants by occupational groups

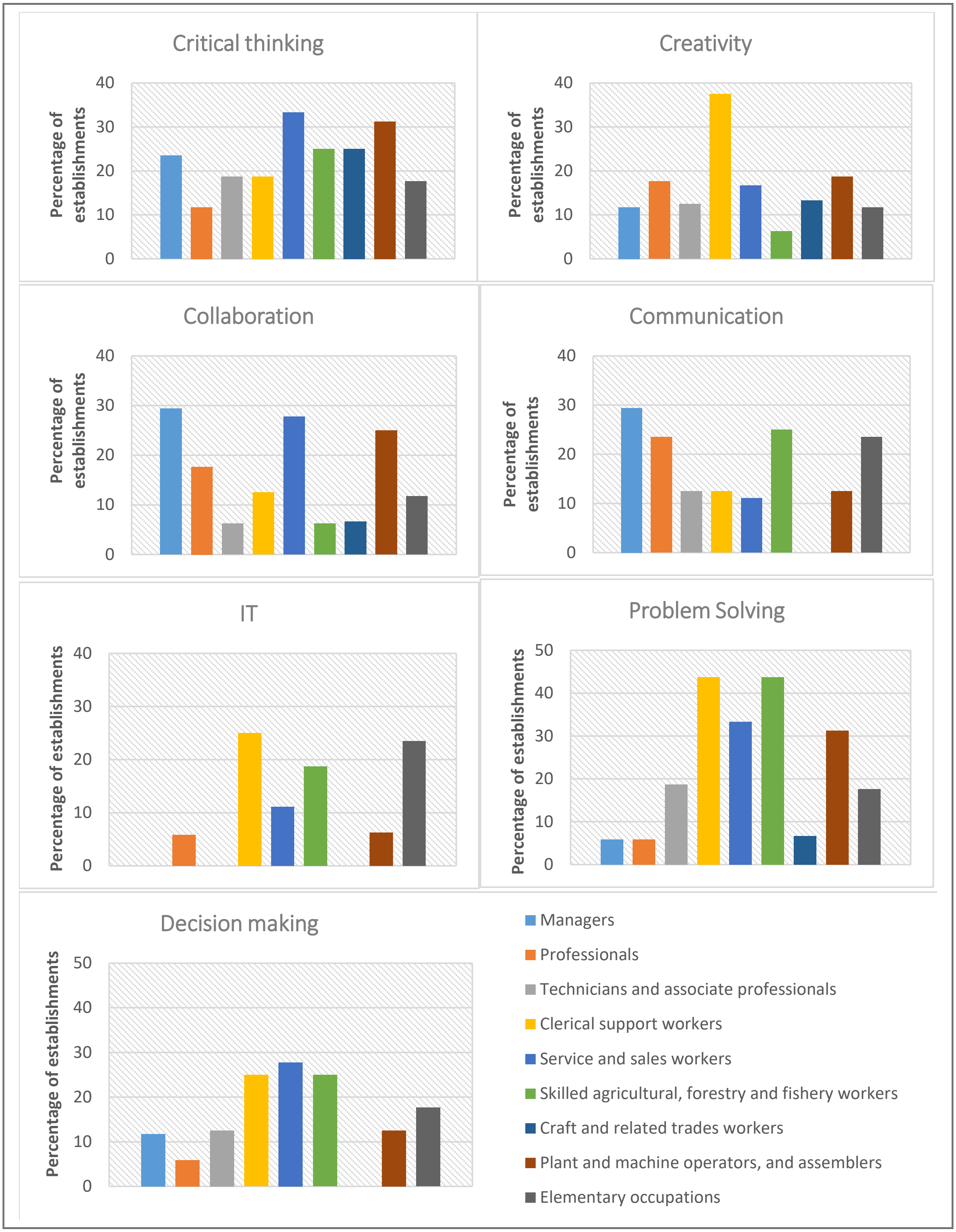
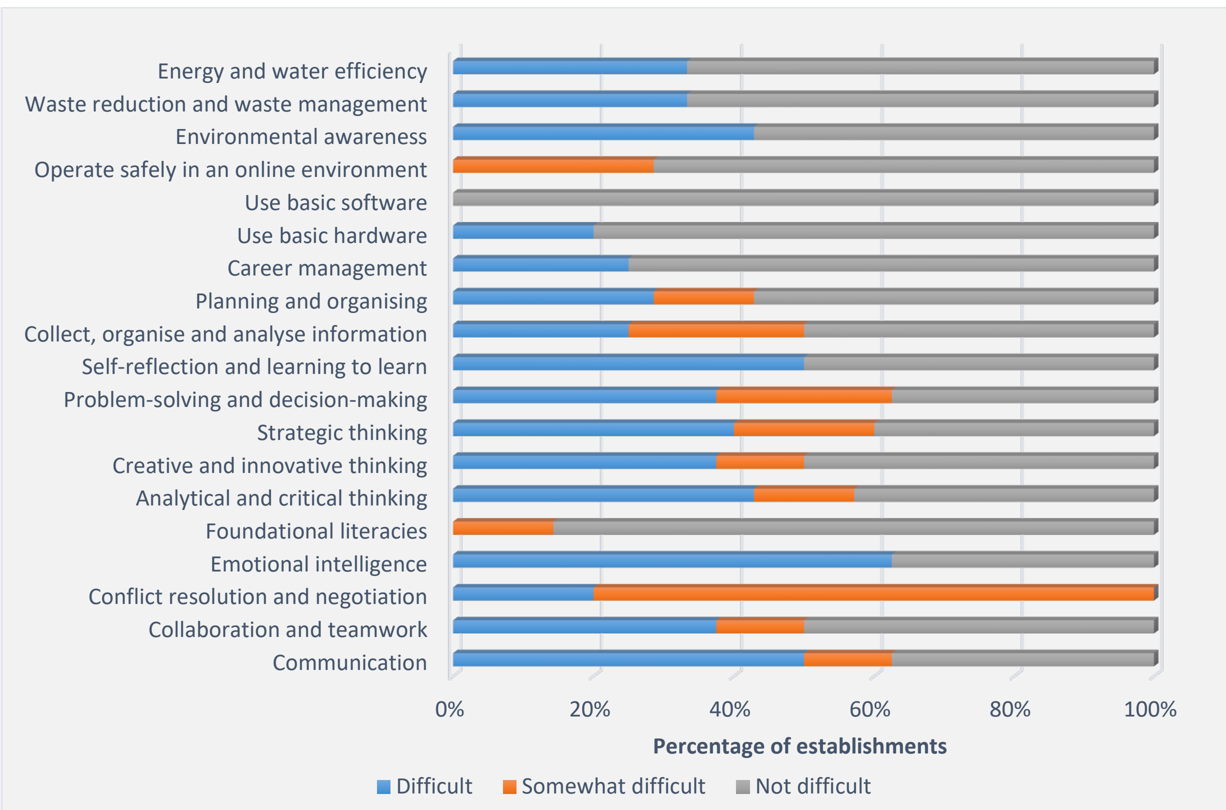


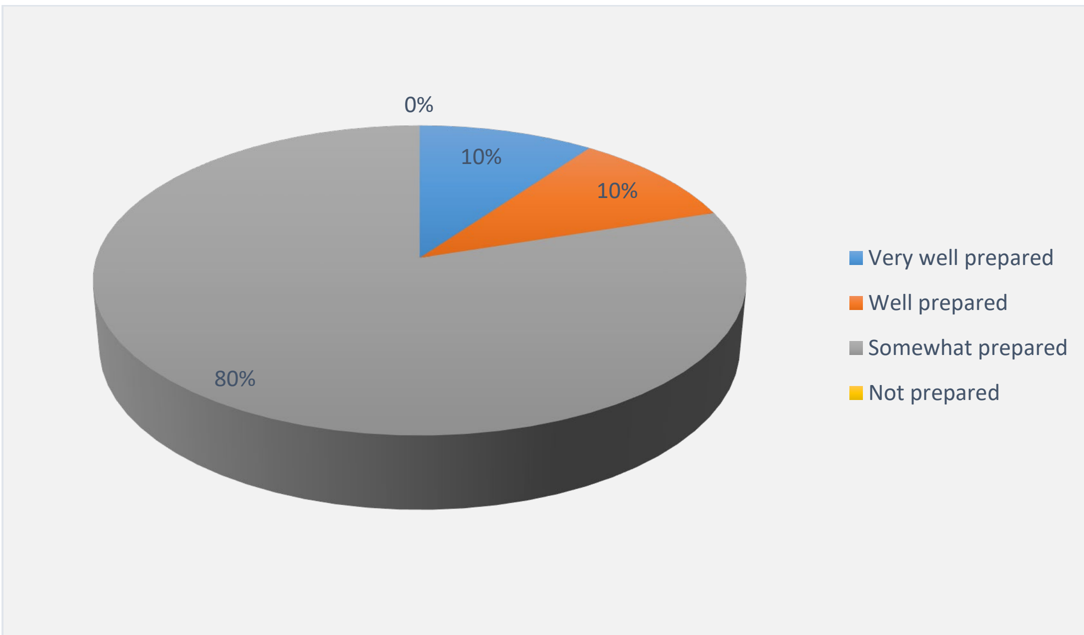
Figure 34 shows that, overall, employers encountered less difficulty in finding most skills among university graduates who graduated between the years 2021 to 2023. A half (50%) or more of the employers who responded to the survey reported that they did not encounter any difficulty in finding 13 of the 19 skills listed. The skills that recorded the highest level of difficulty were Emotional intelligence (63%), Communication (50%) and Self-reflection and learning to learn (50%). All of the employers (100%) reported at least some difficulty in finding Conflict resolution and negotiation skills among recent university graduates applying for jobs in their establishments. The skill that employers found least difficult to get from recent university graduates was Use basic software, which was rated as not difficult by all (100%) respondents. Additionally, a substantial proportion of the employers reported no difficulty for other basic digital skills: Use basic hardware (80%) and operate safely in an online environment (71%). This is a positive indication that the future workforce is becoming increasingly technologically proficient.

Figure 34: Level of difficulty employers experienced in obtaining core skills from recent university graduates



Further to the assessment of the skills of recent university graduates, the survey also gathered information on employers' views on the level of preparedness for work among recent university graduates employed over the last two (2) years. The majority (80%) of respondents reported that recent university graduates were somewhat prepared for work while 10% indicated that graduates were very well prepared and a similar percentage said they were well prepared. None of the employers reported that recent graduates were not prepared for work (Figure 35).

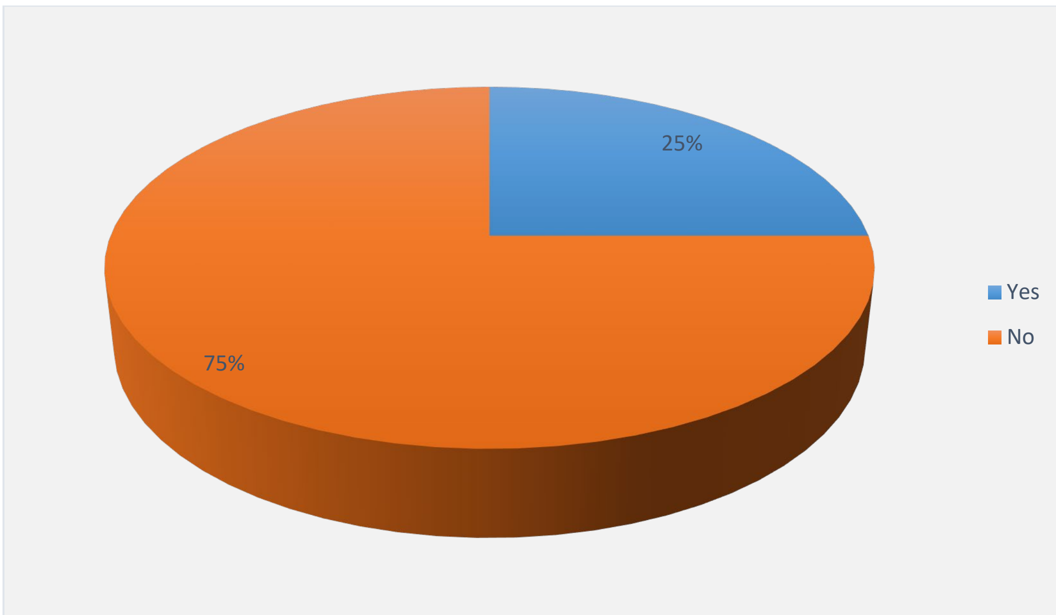
Figure 35: Level of preparedness of for work among university graduates employed over the last two (2) years



5.6 Impact of Skills-Shortages on Establishments

The effects of the lack of requisite skills within the workforce can hinder business operations. However, in the case of the establishments that completed the survey, three-quarters (75%) reported that the lack of skills among workers did not affect their operations while (25%) disagreed (Figure 36).

Figure 36: Lack of skills among employees affected business operation



6. Demand for STEM Labour

A critical component of the assessment of STEM labour needs in the agro-processing sector was identifying and understanding current and future demand for STEM workers. This activity should help policymakers and employers develop evidence-based policies and strategies that address existing labour gaps and strengthen the workforce. In terms of future demand, forecasting the jobs of the future will help businesses adapt to global changes that are transforming economies, businesses, workforce structures and society as a whole.

Figure 37 shows the current demand for STEM occupations reported by agro-processing companies. During the survey period, the demand for STEM occupations was generally low. The highest demand (48%) was recorded for Food and Agriculture occupations. The lowest demand was observed in the field of Medical and Health for which the majority (69%) of employers reported no demand. The low demand for STEM occupations may be attributed to the fact that most businesses were MSEs and generally required less labour.

In terms of STEM jobs, the top job currently demanded was Food Scientists (19%), followed by Web and Digital Interface Designers (10%), Mechanical Engineers (10%) and HSE Officers (10%) (Figure 38).

Figure 37: Current demand for STEM occupations

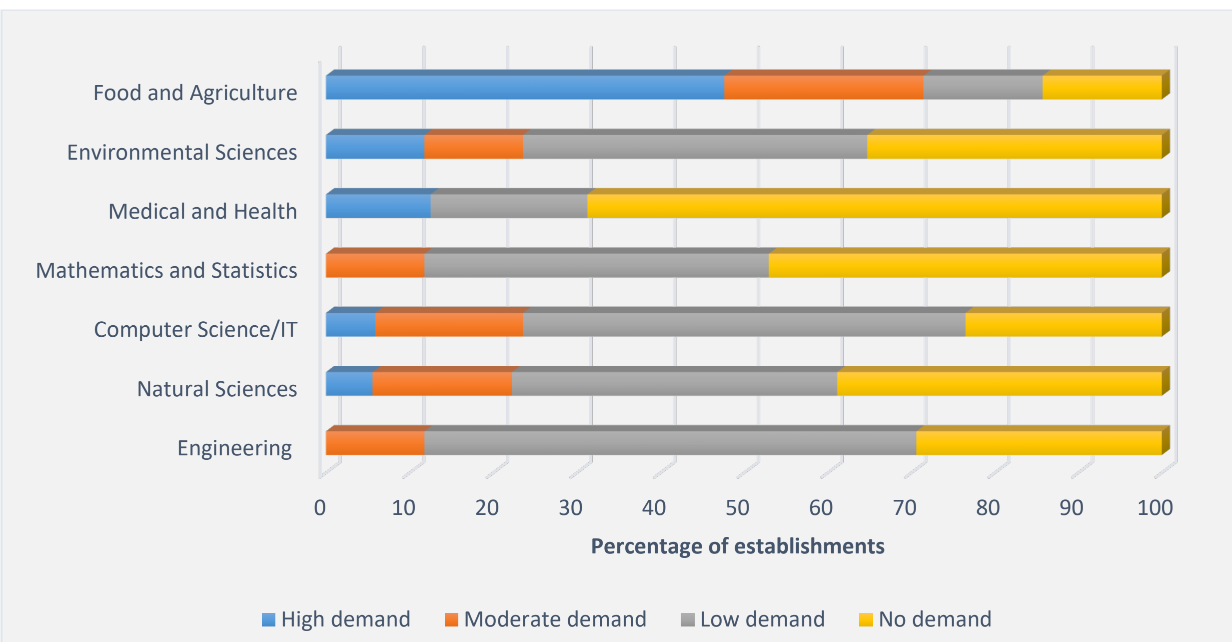
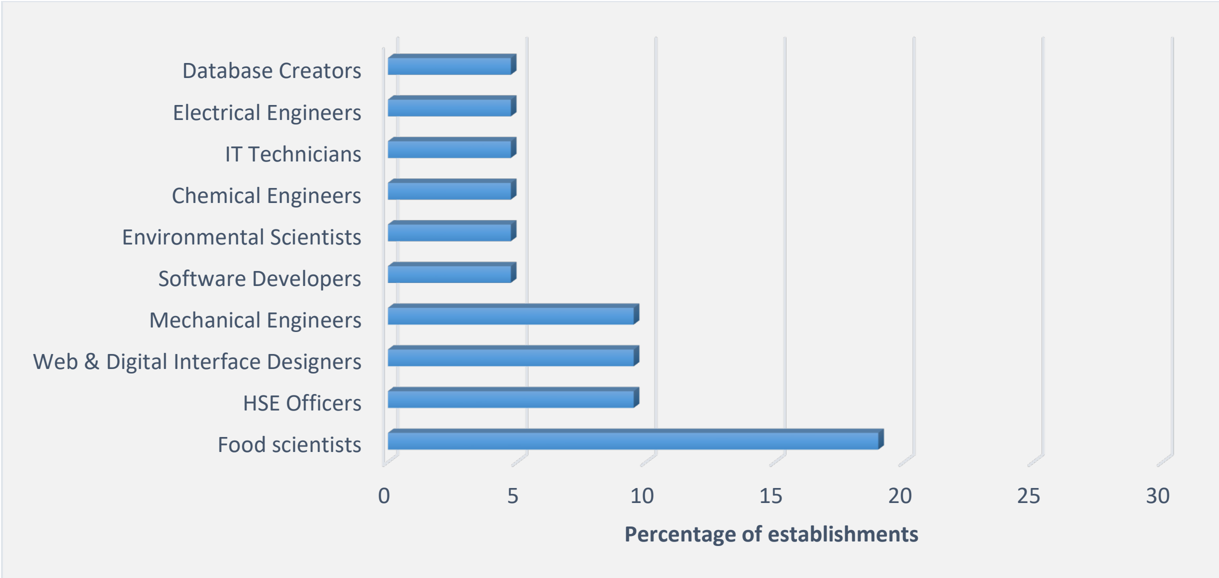
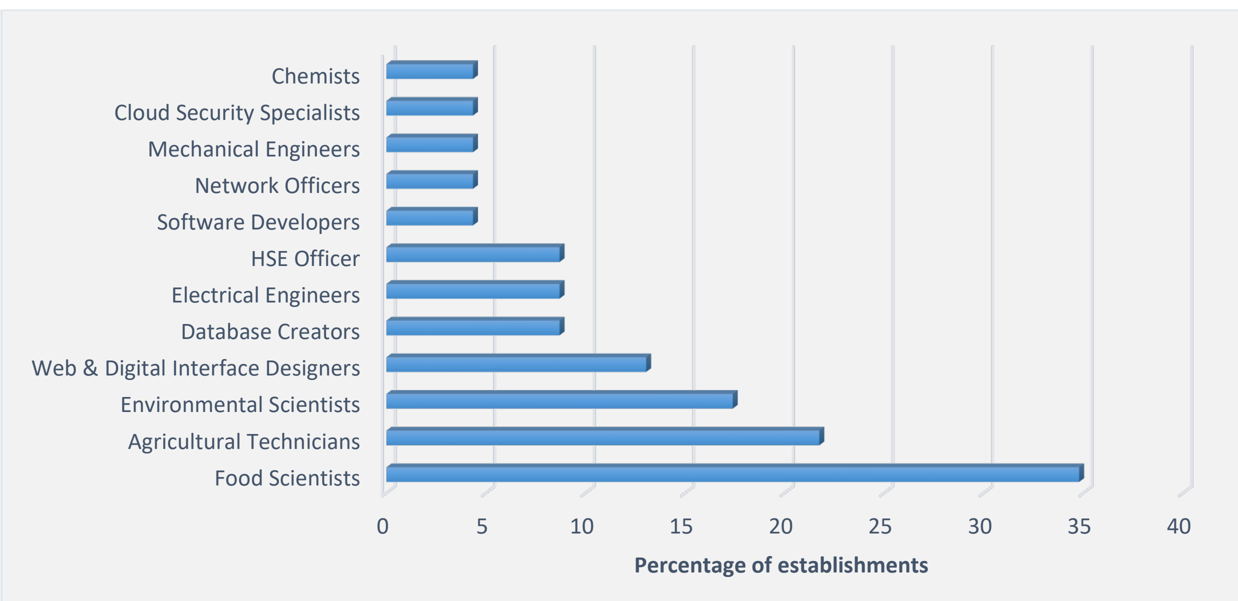


Figure 38: Top STEM occupations currently demanded by establishments



Employers were asked to list the three (3) top STEM occupations for their business in the next five (5) years based on their strategic plan. The three (3) most important STEM occupations identified by employers were Food Scientists (35%), Agricultural Technicians (22%) and Environmental Scientists (17%) (Figure 39).

Figure 39: Most important STEM occupations for companies in the next five (5) years



7. Technical and Vocational Education and Training (TVET)

As part of the assessment of STEM labour needs in the agro-processing sector the STEM competencies at the Technical and Vocational Education and Training (TVET) level were also identified. The survey utilised the STEM in TVET Curriculum Guide developed by the ILO Women in STEM for Workforce Readiness and Development Programme to gather data on STEM competencies among TVET workers. The STEM in TVET Curriculum Guide identified four (4) major domains of STEM competencies for better alignment of TVET STEM-oriented learning activities. These included: STEM knowledge, thinking skills, multiliteracies, and socio-emotional intelligence. STEM competencies in these four domains were used in the questionnaire elaborated for this survey and are defined in Appendix IV.

Generally, there were few responses to TVET-related questions. The data presented below relates to the employers who responded to the survey. Table 3 shows the level of difficulty companies experienced in finding STEM-related competencies among recent TVET graduates applying for job vacancies. A larger proportion (60% or over) of employers did not respond to the question and those who responded experienced varying level of difficulty in finding the 25 core skills among recent TVET graduates who applied for jobs.

Table 3: Level of difficulty employers experienced in finding STEM-related skills among recent TVET graduates applying for jobs

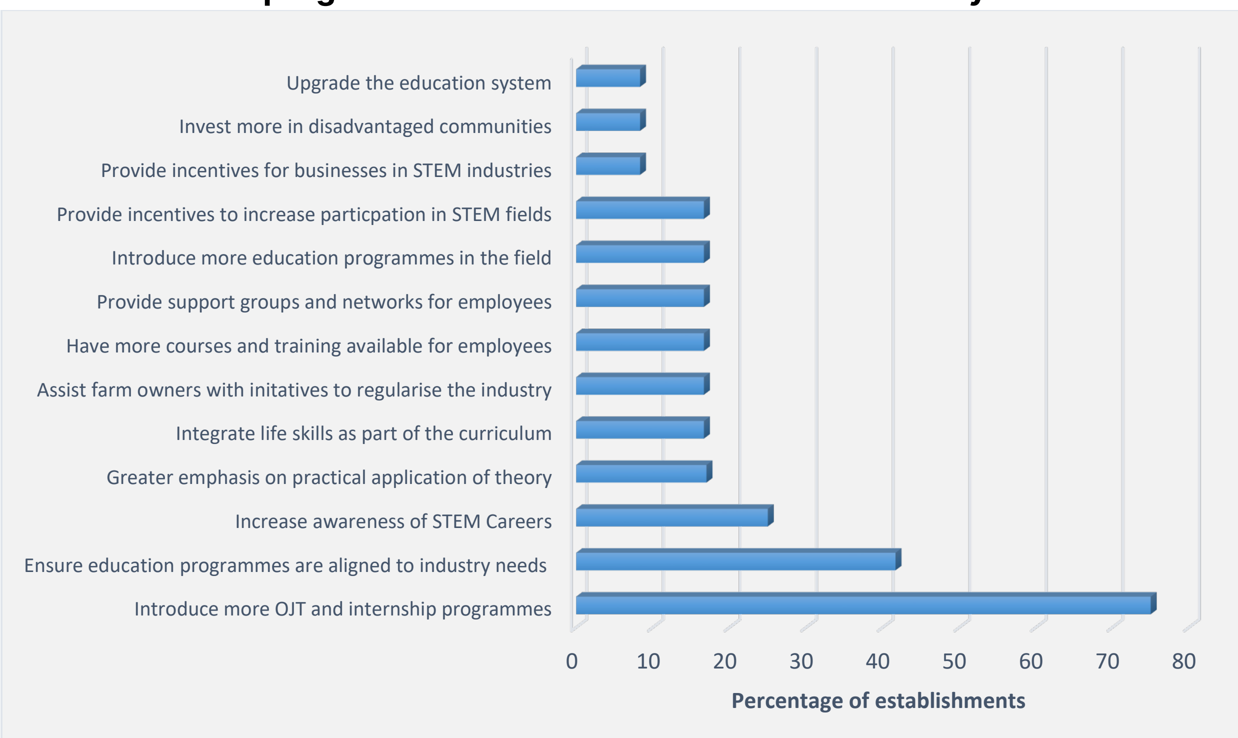
Skills	Difficult	Somewhat difficult	Not difficult	Not stated	Total
1. Critical thinking	20	20	0	60	100
2. Problem solving	20	20	0	60	100
3. Systems thinking	20	20	0	60	100
4. Creative/inventive thinking	20	0	20	60	100
5. Transdisciplinary thinking	20	20	0	60	100
6. Decision-making	20	20	0	60	100
7. Ethical thinking	20	0	20	60	100
8. Computational thinking	20	0	20	60	100
9. Communication	20	0	20	60	100
10. Collaboration	0	20	20	60	100
11. Empathy	0	20	20	60	100
12. Lifelong/Lifewide Learning	33	0	17	50	100
13. Agency	0	20	20	60	100
14. Resilience	20	0	20	60	100
15. Leadership	20	20	0	60	100
16. Service Orientation	0	20	20	60	100
17. Project Management	20	20	0	60	100
18. Glocal Mindset	20	0	20	60	100
19. Numeracy	20	20	0	60	100
20. Digital Literacy	20	0	20	60	100
21. Civic Literacy	20	0	20	60	100
22. Cultural Literacy	20	0	20	60	100
23. Occupational Health Literacy	0	40	0	60	100
24. Organisational Literacy	20	20	0	60	100
25. Entrepreneurial Literacy	20	20	0	60	100

8. Employers' Recommendations

Employers from the agro-processing sector provided recommendations on the actions needed from Government, industry and tertiary institutions to strengthen STEM education and STEM labour.

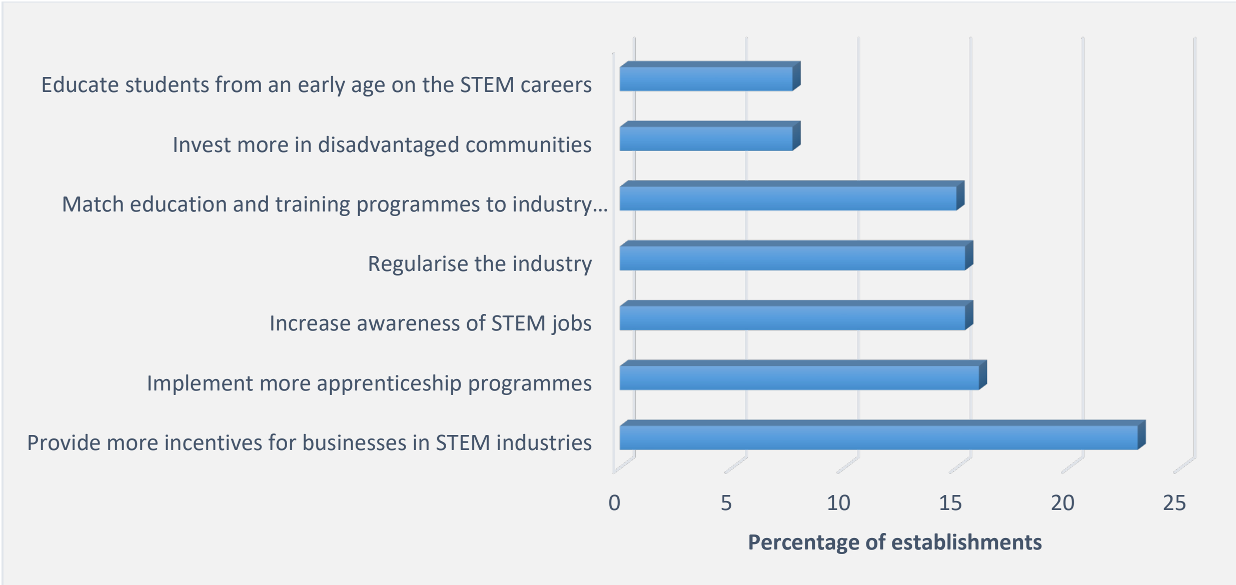
Employers provided suggestions for improving tertiary education programmes to meet the needs of the industry. The main recommendation cited by employers was to introduce more on-the-job (OJT) and internship programmes (75%), followed by ensuring education programmes are aligned to the needs of industry (42%) (Figure 40).

Figure 40: Employers' recommendations to improve tertiary education programmes to meet the needs of the industry



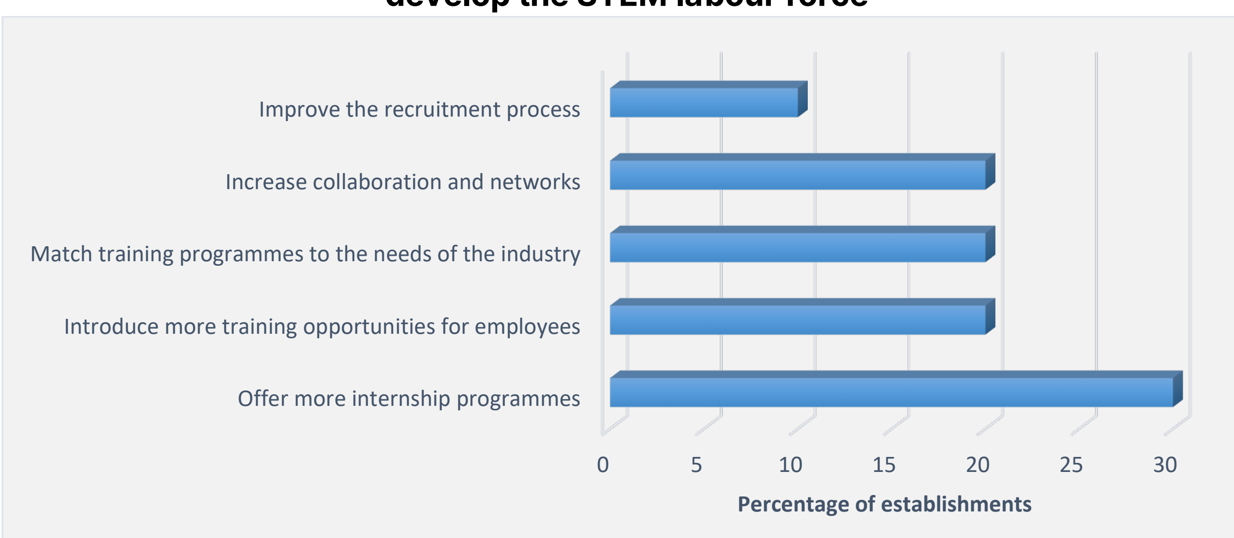
Employers provided several recommendations on how Government could help develop the STEM labour force (Figure 41). A higher proportion of employers stated that Government should provide more incentives for businesses in STEM industries (23%); implement more apprenticeship programmes (16%); increase awareness of STEM jobs (15%); regularise the industry (15%); and align education and training programmes to industry needs (15%).

Figure 41: Employers' recommendations on how Government can help develop the STEM labour force



Employers were also asked to provide recommendations on how private sector could help develop the STEM labour force. Figure 42 shows that 30% of the employers recommended introducing more internship programmes while 20% in each case suggested introducing more training opportunities for employees, matching training programmes to the needs of the industry and increasing collaborations and networks.

Figure 42: Employers' recommendations on how private sector can help develop the STEM labour force



With regard to TVET education, employers recommended integrating core skills into TVET teaching and learning (Table 4). In addition, employers suggested that Government should increase collaboration with the private sector to introduce more internship programmes to help improve TVET education and labour. Several recommendations were put forth on how the business sector could help develop the TVET labour force. These recommendations included increase partnerships with educational institutes to offer mentorship/training opportunities; develop a database of TVET personnel including their qualifications; increase focus on TVET education; and have more understanding about the lack of job experience of recent secondary or tertiary level graduates when hiring employees.

Table 4: Employers' recommendations to improve TVET education and labour

To improve TVET education programmes to meet the current needs of the industry: • Integrate core skills into TVET teaching and learning
For government to help develop the TVET labour force: • Increase collaboration with the private sector to introduce more internship and apprenticeship programmes
For the business sector to help develop the TVET labour force: • Increase partnerships with educational institutes to offer mentorship/training opportunities • Develop a database of TVET personnel including their qualifications • Increase focus on TVET education • Be more understanding about the lack of job experience of recent secondary or tertiary level graduates when hiring employees

9. Technological Advancements in Agro-Processing

9.1 Overview

Technological innovations, particularly in automation, smart technologies and biotechnology, have brought about significant changes in agro-processing. These advancements are reshaping the sector, driving both economic growth and competitiveness while also creating demand for essential STEM-related roles. This section outlines some key transformative technologies driving software development forward, explores the associated STEM careers and highlights the wide-ranging benefits they could bring to local businesses. It also presents examples of countries that are leading in technological innovations in agro-processing, along with a case study on agro-processing in the Netherlands. This research offers valuable insights into the relevance and potential benefits of adopting emerging technologies in the local agro-processing industry.

9.2 Key technologies reshaping the agro-processing industry

Key technologies that are transforming agro-processing include:

1. **Automation and Robotics:** Automation in processing plants has increased efficiency and reduced labour costs. Robots are used for sorting, packaging, and processing, improving speed and precision while reducing human error. For example, robotic arms are commonly used in fruit and vegetable processing to increase the throughput of handling perishable goods.

2. **Smart Technologies (IoT and AI):** The IoT and AI are improving traceability and monitoring across the supply chain. Sensors and IoT devices allow for real-time monitoring of temperature, humidity, and other factors in storage and transportation, ensuring product quality. AI helps in predictive maintenance of equipment and in optimising production lines for better resource allocation and energy use.

3. **Biotechnology:** Advances in biotechnology, such as genetic engineering and fermentation technology, are improving the quality and safety of processed food. These innovations have led to the creation of enhanced plant varieties with better nutritional profiles, increased shelf life, and resistance to pests. For instance, genetically modified crops like soybeans

and corn are increasingly being processed into oils and other food ingredients, improving yields and lowering costs.

4. **Digital Agriculture:** Digital platforms that connect farmers directly to agro-processing companies have streamlined supply chains. This allows for better planning and integration of raw materials, reducing waste and improving sustainability.

5. **Sustainable Practices:** Technologies like water-efficient processing methods and renewable energy integration (e.g., solar-powered processing units) are promoting more sustainable agro-processing practices. This reduces the environmental impact of food processing, addressing global concerns about climate change and sustainability in agriculture.

6. **3D-Printed Food:** Although still emerging, 3D food printing is showing potential in the agro-processing sector, allowing for personalised food products, such as printed snacks or meals with specific nutritional content. This has particular relevance for medical or space applications. 3D printed food can play a significant role in food security and sustainability by minimising food waste and utilising alternative proteins.

7. **Agro-informatics:** integrates technology with agricultural data management to design targeted interventions, utilising new technologies like satellite imagery and remote sensing to transform data into actionable information.

8. **Blockchain**: This technology is being used for traceability, providing consumers with transparent data on where their food comes from, from farm to fork.

9.3 Growing STEM jobs in the agro-processing

As technology continue to transform the agro-processing sector, there is an increasing demand for STEM professionals to innovate, create, operate and manage emerging technologies. Some key STEM roles are listed below:

Table 5: Key STEM careers associated with technological advancements in the agro-processing industry

Some key technological advancements	Examples of associated stem careers
Automation and Robotics Internet of Things (IoT) Artificial Intelligence (AI) Biotechnology Digital Agriculture 3D Printing Renewable Energy Blockchain Technology	**Data Analysts:** To process and interpret the vast amounts of data from IoT devices, AI systems, and blockchain technology. **Automation Engineers:** To design, implement, and maintain automated systems in factories. **Biotechnologists:** To enhance food production quality through genetic modifications, enzyme technologies, and fermentation. **Software Developers:** To develop custom software for automation, AI, and IoT applications in agro-processing plants. **Food Scientists:** To create innovative new food processing techniques, work with biotech to create healthier, longer-lasting products. **3D Food Printing Technicians:** To apply 3D printing technology to create customized food products. **Sustainable Systems Engineers:** To design and integrate environmentally friendly and energy-efficient processing systems into agro-processing operations to reduce environmental impact.

9.4 Examples of leading countries in agro-processing

Several countries are leading the integration of advanced technologies in agro-processing, leveraging innovation to improve food security, competitiveness and sustainability. Some notable examples include:

Table 6: Examples of countries leading in technological advancements in agro-processing

Country	Some key technologies
The Netherlands	A global leader in food technology, the Netherlands uses advanced robotics, AI, and biotechnology. The Dutch government supports the development of food innovation hubs, facilitating collaboration between research institutions and private companies.
United States	Known for its leadership in biotechnology, the U.S. has large-scale investment in AI and IoT for agro-processing, particularly in processing corn, soybeans, and meat.
Israel	Israel focuses on water-efficient processing technologies, especially in dairy and crop processing. Their technological innovations in water and energy conservation make their agro-processing sustainable.
China	With a focus on automation and AI, China is advancing quickly in automating food processing industries and enhancing supply chains using blockchain technology.
Brazil	Brazil is a leader in agro-processing in Latin America, especially in the processing of soybeans, coffee, meat and sugar. The country has made substantial investments in agro-processing technologies and continues to be a leading exporter of processed agricultural goods.

9.5 Benefits of applying emerging technology to the local agro-processing industry

There are several benefits associated with the integration of technological innovations in agro-processing, including:

- **Increased Efficiency:** Automation and AI reduce human error and improve the speed and precision of production.
- **Cost Reduction:** Technology reduces labour and energy costs, particularly with sustainable energy integrations like solar power in processing plants.
- **Improved Product Quality and Safety:** Technological innovations help ensure that products meet health and safety standards and there is greater control over processing conditions such as temperature and contamination risks.
- **Enhanced Sustainability:** Biotechnology enables the development of crops with better yields and longer shelf lives, reducing food wastage. Technologies that optimise water and energy usage also contribute to environmental sustainability.
- **Improved Processing of Raw Materials:** Technologies like automation, AI, and IoT can optimise the processing of raw agricultural products into a wide range of high-value products.
- **Enhanced Traceability:** Blockchain and IoT ensure transparency in sourcing, allowing for faster recalls and higher consumer confidence.

Ease of Adoption by Local Businesses

The ease of adopting these technologies in Trinidad and Tobago will depend on several factors:

- **Investment Costs:** The initial investment in automation and IoT infrastructure may be high, especially for smaller agro-processing businesses. However, grants, loans, or government subsidies could make it more feasible.
- **Skills Gap:** There may be a gap in STEM skills needed to operate advanced systems, but this could be mitigated through training programs and partnerships with educational institutions.
- **Infrastructure:** Local companies need to ensure they have the digital and physical infrastructure (e.g., reliable internet and energy sources) to support advanced technologies like IoT and AI.
- **Government Support:** Policies supporting innovation, tax breaks for tech investments, and access to research collaborations will be crucial in accelerating adoption.

9.6 Case Study: The Development of the Netherlands Agro-processing Industry and Technological Advancements

Introduction

The Netherlands is a world leader in food and agriculture technology. The country is transforming the agri-food industry by developing new technologies such as sensor technology, digital technology, robotic technology, and biotechnology for plant breeding and sustainable plant health.[9] The Netherlands is also home to the world's number one agri-food university, Wageningen University and Research (WUR). In addition to WUR, other universities also contribute to maintaining a steady pipeline of skilled talent for the agri-food sector. The Dutch agricultural technology industry is a hub for innovation and collaboration, with a triple helix

[9] The agri-food ecosystem encompasses 'all operators in the food supply chain (farmers, food industry, food retail and wholesale, and food service) and their suppliers of inputs and services (seeds, pesticides, fertiliser, machinery, packaging, repair, transport, finance, advice and logistics)'. (European Commission, 2021)

commercial-academia-government approach. The country's focus on synergy and complementary solutions drives positive solutions in agricultural technology. Some examples include the AI for Agro-Food lab, RoboCrops, and the Farm of the Future, which are promoting agronomy, ecology, and technology in the agtech space. The Netherlands efforts are aimed at addressing the challenges the world food system faces, such as sustainability, efficiency, and food security.

This case study examines the role of technological innovation in driving the development of the Netherlands' agro-processing sector, with particular emphasis on automation, digitalisation, and sustainable practices.

1. **Early Development and Technological Roots:**

Historically, the Netherlands' agricultural sector was heavily based on traditional farming practices. However, in the post-World War II era, the Dutch government and industry players began investing in mechanization and automation to meet the increasing demand for food products.

2. **Advancements in Automation and Robotics:**

In the 1990s and 2000s, automation emerged as a central theme in the Netherlands' agro-processing industry. Dutch agro-processing firms started implementing automated systems to increase efficiency, reduce costs, and ensure higher product quality. Automation in sorting, packaging, and processing led to faster production cycles, less waste, and lower labour costs.

One notable example is Friesland Campina, one of the world's largest dairy companies. Friesland Campina invested heavily in automated production lines and advanced machinery for cheese production, milk powder, and yogurt. By integrating automated systems with AI for predictive maintenance and process optimisation, the company reduced downtime and improved output quality.

Robotics also began playing a significant role in agricultural production. Companies such as Lely, known for its robotic milking systems, revolutionised dairy farming in the Netherlands. These robots allow cows to be milked without human intervention, increasing efficiency, reducing labour costs, and enhancing animal welfare. Lely's innovations also incorporated AI to monitor cow health, improving productivity and ensuring high-quality milk.

3. Digitalisation and the Internet of Things (IoT):

The digital transformation of the Dutch agro-processing industry was driven by the increasing adoption of IoT, big data, and AI. These technologies enabled real-time monitoring of the entire supply chain, from farm to processing plant, improving decision-making and resource management. In 2015, WUR launched initiatives to digitise farming. Through projects such as Smart Farming, they integrated IoT-based sensors into farms to monitor soil moisture, temperature, and crop health. This allowed farmers to optimise irrigation, reduce water waste, and increase yields, benefiting both agro-processing firms and the environment. Dutch company ZLTO, a farming cooperative, has also developed an integrated platform that connects farmers with processors, offering data-driven insights into production and market trends. This collaboration between technology firms and farmers has resulted in a more responsive agro-processing value chain, where information is shared in real time, improving product traceability and reducing waste.

4. Sustainability and Environmental Technologies:

As sustainability became a critical global concern, the Dutch agro-processing industry began leveraging technology to minimise its environmental footprint. The sector's reliance on sustainable practices has been a key driver of technological innovation, with a focus on reducing energy consumption, managing waste, and increasing resource efficiency. One major technological development has been the use of biotechnology and enzymes in food processing. Biotechnology has enabled the development of more sustainable food production processes, reducing the need for chemical additives and improving the nutritional profile of processed foods. Dutch company DSM (Dutch State Mine), for example, uses enzymes in food processing to reduce sugar levels in products and improve the efficiency of food production.

The Netherlands is also a leader in the development of closed-loop systems for waste management in agro-processing. Many Dutch agro-processing companies have adopted anaerobic digestion technology to convert organic waste into biogas, which can be used to power plants or be sold as renewable energy. Unilever, with significant operations in the Netherlands, has developed technologies for converting food waste into compost or energy, reducing its environmental impact.

In 2023, DSM merged with Swiss company Firmenich, which brought together a global leader in health, nutrition and bioscience. DSM-Firmenich is a Swiss-Dutch company that manufactures nutrients, flavors, and fragrances for various industries. They use natural and renewable ingredients, science, and technology to create products that are essential for life, desirable for consumers, sustainable for the planet, and a force for good.

5. Precision Agriculture and Smart Processing:
Precision agriculture, utilising GPS, drones, and sensors, has become increasingly popular in the Netherlands as farmers and agro-processors aim to optimise resource use and maximise crop yields. By using precision agriculture techniques, Dutch farmers can better monitor soil conditions, weather patterns, and pest management, leading to more efficient harvesting and better-quality raw materials for agro-processing industries. For example, Rijk Zwaan, a leading seed company based in the Netherlands, integrates precision farming technologies with crop genetics to help farmers increase yields while reducing input costs. By using drone-based mapping and AI-powered analytics, they can optimise the planting and harvesting process, improving the quality and quantity of vegetables supplied to processing plants.

Additionally, Dutch agro-processing companies have increasingly invested in smart processing technologies, such as AI-powered sorting systems that use machine vision to identify imperfections in raw materials like fruits and vegetables. This technology reduces waste by allowing processors to sort products with greater precision, resulting in higher yields and more consistent product quality.

Conclusion:
The development of the Netherlands' agro-processing industry has been deeply intertwined with technological advancements. From early mechanisation to the current era of automation, digitalisation, and sustainability, technological innovation has allowed the Dutch agro-processing sector to maintain its competitive edge globally. As new technologies such as AI, precision agriculture, and biotechnology continue to evolve, the industry is likely to see even greater transformations in terms of productivity, sustainability, and the creation of new value-added products. The Netherlands' ability to innovate and adapt to technological changes will ensure its continued leadership in the global agro-processing market.

10. General Recommendations

The recommendations below are guided by the research undertaken during this study and the results of the industry survey. The recommendations are intended to help to increase STEM capacity and capabilities of the workforce.

STEM Education:

1. Increase the practical/training component in tertiary education programmes. This is widely recognised as essential for preparing graduates better for the workplace. By integrating more hands-on experiences, students can put theory into practice in real-world situations, helping them gain the necessary skills and experience to transition smoothly into the workplace.

2. Greater alignment of tertiary programmes to the needs of industry. Achieving greater alignment of tertiary education programmes with industry needs is crucial for ensuring that graduates are equipped with the skills and knowledge demanded by industry. This alignment can lead to increase employment, productivity and growth.

3. Increase incentives and promotion for students to pursue studies and careers in STEM fields demanded by industry. Increasing incentives and promoting STEM studies and careers that are demanded by industry is essential for addressing labour gaps. This can also result in higher employment rates for graduates and greater success for businesses.

4. Increase research on STEM careers emerging from technologically advanced agro-processing sectors and promote these careers locally. This is crucial for preparing the workforce for the technological transformation needed to ensure business continuity. Furthermore, these findings should be available to educators, employers, students and all key stakeholders.

5. Introduce more STEM programmes based on current and future needs of industry. This would lead to increase productivity and profitability for businesses and employability of graduates.

6. Make STEM fun so that children can enjoy and as a result pique their interest in STEM. Increasing students’ interest in STEM is essential to increasing their participation in STEM education and their pursuit of STEM careers.

7. Fully integrate STEM skills into the curriculum at an early age. Students will have a greater understanding, appreciation and interest in STEM from a young age. Furthermore, integrating STEM skills into the curriculum at an early age would help develop STEM skills that are essential in an increasingly technology-driven world.

8. Create/introduce more resources that help parents and teachers make STEM more relatable and fun for children. This would help students develop an appreciation and enthusiasm for STEM, which can lead greater interest and participation in the field.

9. Fostering partnerships between government, businesses, universities and all stakeholders to continue promoting and enabling skills development. These collaborative efforts help bridge the gap between education and industry needs and increase the STEM capacity of the workforce.

STEM Labour Force Development:

1. Provide more training and apprenticeship programmes based on the needs of the industry. This will ensure that graduates are able to transition smoothly into the workplace and reduce the mismatch of skills.

2. Provide more career guidance for young people through mentorship, structured programmes or career paths. This would help increase the participation of young people in STEM careers and satisfy anticipated future demand for STEM jobs.

3. Retrain employees to meet the current and future demand of the workplace. This is essential for addressing labour shortages and remaining competitive, in a rapidly evolving industry. Increase awareness among employers and employees on core skills required to successfully operate in a digital environment. This would not only help employers recognise the importance of investing in upskilling their workforce but also drive employee to upgrade their skills.

4. Provide more support and incentives to promote STEM. Providing incentives to pursue STEM careers is crucial for driving innovation and competitiveness in businesses.

5. Encourage more labour force studies on STEM skills and STEM jobs. Undertaking more labour force studies on STEM skills and STEM jobs is crucial for understanding labour market trends and gaps. This data will enable policymakers to develop policies and programmes to address these gaps and facilitate greater alignment of education and training with industry needs.

6. Provide data on technological advancements within the sector and the benefits of investing in these technologies for employers. Many employers operate small businesses and therefore it is important to raise awareness of emerging technologies that are transforming the industry and the benefits of adopting these technologies. This could stimulate demand for STEM jobs that are needed to keep up with emerging technologies and ensure the industry's long-term sustainability.

7. Promote STEM jobs agro-processing employers identified as key for future growth. This will increase employability of students and increase the STEM talent in the workforce.

8. Increase investment in Research, Development, and Innovation to drive the development of the agro-processing sector. Technological advancements are key to transforming the sector into an automated, resource-efficient and competitive industry. This investment would also stimulate the demand for STEM talent associated with emerging technologies

9. Regularise the industry to help make it more efficient and sustainable. It is essential to formalise the industry by establishing clear standards, oversight mechanisms, and legal frameworks.

10. Given the low response for the TVET section, undertake studies that focus solely on TVET.

11. Establish and regularly update a comprehensive business registry for this sector to enable accurate and more seamless measurement of growth, both at the sectoral level and within individual businesses.

11. Conclusion

In conclusion, this study offers a comprehensive assessment of the current and future STEM labour needs within the agro-processing industry of Trinidad and Tobago. As automation and technological change continue to reshape global labour markets, businesses must adapt by cultivating a workforce equipped with essential 21st century skills. The most competitive businesses will be those that are able to develop these core skills among their employees. The WEF reported that analytical thinking, creativity and flexibility were among the top skills needed in 2025, skills that are also vital for competitiveness in agro-processing. The results of this survey highlight key insights into the skill set of the current workforce and the emerging demand for STEM competencies as the industry evolves. The findings of this study underscore the crucial role that technological advancements, such as AI, Robotics and Biotechnology, will play in reshaping the workforce. Moreover, the study emphasises that the most competitive businesses in the sector will be those that invest in developing core skills among their employees, enabling them to effectively adapt to the evolving demands of the work environment.

While the findings reveal that the current STEM workforce within the agro-processing industry in Trinidad and Tobago is relatively small and demand was generally low, there is potential for expansion as the industry embraces digitalisation and innovation. This technological shift presents a strong case for expanding STEM roles in agro-processing. Employers anticipate a growing need for roles such as Food Scientists, Agricultural Technicians, Environmental Scientists and Web and Digital Interface Designers over the next five years. However, there is a shortage of interest in agro-processing careers and therefore difficulty in recruiting such skilled personnel. This indicates a clear need for targeted workforce development and training strategies in these STEM fields to meet the evolving needs of the industry. Career guidance programmes must prioritise these areas, with targeted incentives to encourage students to pursue higher education in these essential STEM fields.

Furthermore, the study highlights a significant gap between the skills demanded by employers and employee competencies. While most employers believed that it was important for employees to possess all 19 core skills to achieve business objectives, the majority rated the core competencies of existing employees as medium to low. This meant that the overall skill levels fell considerably short of what was required to meet organisational goals. There were noticeable gaps, especially among existing employees, in critical areas such as self-reflection and learning to learn, conflict resolution and negotiation, communication, emotional intelligence and problem solving. Furthermore, the majority of employers indicated that universities only prepared graduates for the world of work to some extent, this suggests that there is a disconnect between education and industry. The ability to address these gaps will be crucial for employers seeking to maintain their competitiveness and their ability to adapt to future challenges. While over a half of the employers indicated that the mismatch of skills has not yet severely affected operations, there is a potential risk that these gaps could impact their future growth and sustainability if left unaddressed.

Encouragingly, recent university graduates were generally perceived to possess stronger digital and green job-related skills than current employees, indicating a positive shift in workforce readiness. Moreover, this trend suggests that the emerging workforce is becoming more tech-savvy and climate-conscious, better preparing to operate in a digital and environmentally sustainable work environment. Therefore, to build on this progress, it is vital that education and training systems continue to develop these core skills among students, ensuring they are fully prepared for the future of work.

21st Century Skills within the agro-processing sector is critical not only for the sector's development but also for ensuring the broader economic growth and sustainability of the nation. The implications of these findings are significant. First, there is an urgent need for a strategic approach to workforce planning and development that aligns education and training programmes with the demands of the agro-processing industry. This includes improving the STEM curriculum at various levels to ensure a STEM talent pipeline that can effectively meet the industry's evolving needs. Collaboration between industry stakeholders; education and training institutions; and government will be key to developing relevant training and apprenticeships programmes. By enhancing alignment between curriculum and workplace needs, the future workforce can be better prepared to meet industry challenges.

Addressing the skill shortages in key STEM areas will require a multi-faceted approach, which would involve increased promotion of STEM education and careers pathways in the agro-processing industry. To remain competitive in a rapidly evolving agro-processing industry, employers must prioritise upskilling and reskilling their existing workforce to adapt to technological advancements and emerging work processes. International examples, such as the Netherlands' integration of workforce development with agro-innovation through institutions like Wageningen University, provide valuable models. Countries that are adopting emerging technologies in the agro-processing industry are leveraging AI, blockchain technology, robotics, biotechnology and other innovations to increase productivity and efficiency. These advancements require a workforce capable of managing and innovating within tech-enhanced environments. Reskilling initiatives thus not only equip employees to thrive in increasingly digital workplaces but also mitigate job displacement by aligning human capabilities with the demands of automation and smart agro-processing systems.

Ultimately, the insights from this assessment will inform policy decisions and guide the development of programmes aimed at addressing the skills disparities in the agro-processing industry sector. Data-driven policies and strategies will ensure that both the current and future workforce are well equipped to meet the challenges posed by technological advancements and global sustainability goals. By addressing these labour needs proactively, Trinidad and Tobago can increase the productivity, innovativeness and competitiveness of its agro-processing industry, driving growth and development in this critical sector and strengthen its position in the global market.

Appendix I: Occupational Groups

1. **Managers -** Includes occupations whose main tasks consist of planning, directing, coordinating and evaluating the overall activities of government, enterprises and other organisations, or of organisational units within them, and formulating and reviewing their policies, laws, rules and regulations. Formal preparation for these occupations may be supplemented or replaced partly or wholly by on-the-job training and/or experience. Examples**:** Managing Directors, Senior Officials, Hotel Managers and ICT Managers.

2. **Professionals -** Includes occupations whose main tasks require a high level of professional knowledge and experience. The main tasks consist of increasing the existing stock of knowledge, applying scientific and artistic concepts and theories, teaching about the foregoing in a systematic manner or engaging in any combination of these activities. Competent performance in most occupations in this occupational group requires skills which have been acquired from tertiary-level education leading to a university or post-graduate university degree. On-the-job training and/or experience may supplement formal preparation or replace it partly or wholly. Examples**:** Farming, forestry and fisheries professionals, Mechanical Engineers, Software Developers and Visual Artists.

3. **Technicians and Associate Professionals -** Includes occupations involving the performance of mostly technical and related tasks connected with research and the application of scientific or artistic concepts, operational methods, and government or business regulations. Most occupations in this occupational group require skills which have been acquired from post-secondary education leading to an award not equivalent to a first university degree. On-the-job training and/or experience may supplement formal preparation or replace it partly or wholly. Examples**:** Civil engineering technicians, Agricultural technicians, Ships' deck officers and pilots and Web technicians.

4. **Clerical Support Workers -** Includes occupations which involve the recording, organising, storing, computing and retrieving of information and performing a number of clerical duties in connection with money-handling operations, travel arrangements, requests for information and appointments. Most occupations in this occupational group require skills which have been acquired from secondary-level education lasting about five years. On-the-job training and/or

experience may supplement formal preparation or replace it partly or wholly. Examples: Secretaries, Office Clerks, Hotel receptionists and Transport clerks.

5. **Service and Sales Workers -** Includes occupations involving personal and protective services related to travel, housekeeping, catering, personal care, or protection against fire and unlawful acts, or demonstrating and selling goods in wholesale or retail shops and similar establishments, as well as at stalls and in markets. Most occupations in this occupational group require skills which have been acquired from secondary-level education lasting about five years. On-the-job training and/or experience may supplement formal preparation or replace it partly or wholly. Examples: Travel Attendants, Conductors, Guides, Cooks, Waiters and Bartenders.

6. **Skilled Agricultural, Forestry and Fishery Workers -** Workers in this group grow and harvest field or tree and shrub crops, gather wild fruits and plants, breed, tend or hunt animals, produce a variety of animal husbandry products, cultivate, conserve and exploit forests, breed or catch fish and cultivate or gather other forms of aquatic life in order to provide food, shelter and income for themselves and their households. Most occupations in this occupational group require skills which have been acquired from secondary-level education lasting about five years. On-the-job training and/or experience may supplement formal preparation or replace it partly or wholly. Examples: Market gardeners, Crop growers, Poultry producers and Deep-sea fishery workers.

7. **Craft and Related Trades Workers -** Workers in this group apply specific knowledge and skills to construct and maintain buildings, form metal, erect metal structures or set machine tools. They make, fit, maintain and repair machinery, equipment or tools, carry out printing work, and produce or process foodstuffs, textiles, or wooden, metal and other articles, including handicraft goods. Most occupations in this occupational group require skills which have been acquired from secondary-level education lasting about five years. On-the-job training and/or experience may supplement formal preparation or replace it partly or wholly. Examples: Riggers, Cable splicers, Aircraft engine mechanics and repairers and Musical instrument makers and tuners.

8. **Plant and Machine Operators and Assemblers -** Workers in this group operate and monitor industrial and agricultural machinery and equipment on the spot or by remote control, drive and operate trains, motor vehicles and mobile machinery and equipment, or assemble products from component parts according to strict specifications and procedures. Most occupations in

this occupational group require skills which have been acquired from secondary-level education lasting about five years. On-the-job training and/or experience may supplement formal preparation or replace it partly or wholly. Examples**:** Cocoa, coffee and chocolate processing machine operators, Assemblers, Mobile farm and forestry plant operators and bus drivers.

9. **Elementary Occupations -** Covers occupations which involve the performance of simple and routine tasks which may require the use of hand-held tools and considerable physical effort. Most occupations in this occupational group require skills which have been acquired from primary education. On-the-job training and/or experience may supplement formal preparation or replace it partly or wholly. Examples**:** Cleaners and helpers in offices, hotels and other establishments, Crop farm labourers, Kitchen helpers, Messengers, package deliverers and luggage porters.

Source: International Labour Organization. 2012. *International Standard Classification of Occupations*

Appendix II: STEM Occupations

Science, Technology, Engineering and Mathematics (STEM) occupations include computer and mathematical, architecture and engineering, and life and physical science occupations, as well as managerial and postsecondary teaching occupations related to these functional areas and sales occupations requiring scientific or technical knowledge at the postsecondary level.

Science	Computer Science/ IT	Engineering	Mathematics
• Natural Sciences Managers • Animal Scientists • Food Scientists and Technologists • Soil and Plant Scientists • Biochemists and Biophysicists • Microbiologists • Zoologists and Wildlife Biologists • Biological Scientists, All Other • Conservation Scientists • Foresters • Epidemiologists • Medical Scientists, Except Epidemiologists • Life Scientists, All Other • Astronomers • Physicists • Atmospheric and Space Scientists • Chemists • Materials Scientists • Environmental Scientists and Specialists, Including Health • Geoscientists, Except Hydrologists and Geographers	• Computer and Information Systems Managers • Computer Systems Analysts • Information Security Analysts • Computer and Information Research Scientists • Computer Network Support Specialists • Computer User Support Specialists • Computer Network Architects • Database Administrators • Database Architects • Network and Computer Systems Administrators • Computer Programmers	• Architectural and Engineering Managers • Architects, Except Landscape and Naval • Landscape Architects • Cartographers and Photogrammetrists • Surveyors • Aerospace Engineers • Agricultural Engineers • Bioengineers and Biomedical Engineers • Chemical Engineers • Civil Engineers • Computer Hardware Engineers • Electrical Engineers • Electronics Engineers, Except Computer • Environmental Engineers • Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	• Actuaries • Mathematicians • Operations Research Analysts • Statisticians • Data Scientists • Mathematical Science Occupations, All Other

Science	Computer Science/ IT	Engineering	Mathematics
• Hydrologists • Physical Scientists, All Other • Agricultural Technicians • Food Science Technicians • Biological Technicians • Chemical Technicians • Environmental Science and Protection Technicians, Including Health • Geological Technicians, Except Hydrologic Technicians • Hydrologic Technicians • Nuclear Technicians • Forest and Conservation Technicians • Forensic Science Technicians • Life, Physical, and Social Science Technicians, All Other • Computer Science Teachers, Postsecondary • Mathematical Science Teachers, Postsecondary • Architecture Teachers, Postsecondary • Engineering Teachers, Postsecondary • Agricultural Sciences Teachers, Postsecondary • Biological Science Teachers, Postsecondary • Forestry and Conservation Science Teachers, Postsecondary • Atmospheric, Earth, Marine, and Space Sciences Teachers, Postsecondary	• Software Developers • Software Quality Assurance Analysts and Testers • Web Developers • Web and Digital Interface Designers • Computer Occupations, All Other	• Industrial Engineers • Marine Engineers and Naval Architects • Materials Engineers • Mechanical Engineers • Mining and Geological Engineers, Including Mining Safety Engineers • Nuclear Engineers • Petroleum Engineers • Engineers, All Other • Architectural and Civil Drafters • Electrical and Electronics Drafters • Mechanical Drafters • Drafters, All Other • Aerospace Engineering and Operations Technologists and Technicians • Civil Engineering Technologists and Technicians • Electrical and Electronic Engineering Technologists and Technicians • Electro-Mechanical and Mechatronics Technologists and Technicians • Environmental Engineering Technologists and Technicians • Industrial Engineering Technologists and Technicians	

Science	Computer Science/ IT	Engineering	Mathematics
• Chemistry Teachers, Postsecondary • Environmental Science Teachers, Postsecondary • Physics Teachers, Postsecondary • Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products • Sales Engineers		• Mechanical Engineering Technologists and Technicians • Calibration Technologists and Technicians • Engineering Technologists and Technicians, Except Drafters, All Other • Surveying and Mapping Technicians	

Source: Bureau of Labour Statistics, Department of Labour, US. 2021. *'Occupational Employment and Wage Statistics Survey'*

Appendix III: 19 Core Skills

1. **Analytical and critical thinking** - The ability to assess issues appropriately and adequately, and analyse relevant information to form an opinion or take an individual or a collective decision. The ability to think clearly, logically and rationally; to evaluate and interpret information; and to objectively analyse and evaluate an issue to make a judgement.

2. **Career management** - The ability to establish, plan and work towards the achievement of short- and long-term goals having both tangible and intangible success criteria. The ability to exchange information and ideas with individuals and groups that share a common interest, developing relationships for mutual benefit. The ability to use labour market information and intelligence to help identify work opportunities, understand work contexts and work conditions and apply job-search skills.

3. **Collaboration and teamwork** - The ability to work in diverse teams effectively and respectfully, assuming shared responsibility for outputs and demonstrating willingness and flexibility. The ability to identify and acknowledge the feelings, experiences and viewpoints of others, showing care, affection and kindness.

4. **Collect, organise and analyse information** - The ability to search, select, evaluate and organise information in order to effectively and efficiently mobilise relevant information. The ability to re-structure and model sourced information to produce personal interpretations of data.

5. **Communication** - The ability to listen effectively in order to decipher meaning; articulate thoughts and ideas effectively; exchange information; and express opinions, desires, needs and fears using oral, written and non-verbal skills in diverse environments for a range of purposes.

6. **Conflict resolution and negotiation** - The ability to reach a consensus between divergent interests by utilising logical argument and influencing others to cooperate, thereby resolving disagreement or dispute.

7. **Creative and innovative thinking** - The ability to utilise a wide range of idea creation techniques, so as to generate, articulate and apply inventive and original ideas and perspectives, thereby solving complex tasks and life issues through original ideas.

8. **Emotional intelligence** - The ability to identify, understand and manage one's own emotions, as well as helping others to do the same. It can comprise of four domains: self-awareness, self-management, social awareness, and

relationship management, which together have 12 competencies, including empathy, adaptability, achievement orientation and positive outlook.

9. **Energy and water efficiency** - The ability to use energy and water efficiently in ways that sustain the natural and physical environment.

10. **Environmental awareness** - The ability to understand and demonstrate an awareness of the physical environment and the need for it to be protected.

11. **Foundational literacies** - Literacy, numeracy, health, financial, scientific, cultural, and civic
    - Literacy: the ability to understand, identify, interpret, create and communicate effectively utilising inscribed, printed, or electronic signs or symbols for representing language.
    - Numeracy: the ability to understand and have the confidence and skill to work with numbers and mathematical approaches in all aspects of life.
    - Health literacy: the ability to gain access to, understand and utilise information in ways which promote and maintain good health.
    - Financial literacy: the ability to understand and apply financial management skills appropriately and to be able to make a financial plan, manage debt, calculate interest, understand the time value of money in order to make informed and effective decisions about personal financial resources.
    - Scientific literacy: the ability to understand those scientific concepts and processes required for personal decision-making, participation in civic and cultural affairs, and economic productivity.
    - Cultural literacy: the ability to understand the perspectives of people from diverse backgrounds instead of considering one's cultural beliefs and practices as the correct ones.
    - Civic literacy: the ability to participate effectively in civic life through knowing the rights and obligations of residents at local, state and national levels.

12. **Operate safely in an online environment** - The ability to safely use basic online functions, applications, digital learning and communication platforms and media to explore, analyse and share information safely and ethically.

13. **Planning and organising** - The ability to plan and organise tasks in order to fulfil the job responsibilities satisfactorily within a given time and appropriately for a complex environment and situation.

14. **Problem-solving and decision-making** - The ability to identify and assess issues and problems, utilise available resources to generate and "brainstorm" potential solutions, evaluate the pros and cons of solutions and decide on a solution.

15. **Self-reflection and learning to learn** - Self-reflection is the ability to apply reason to thought and behaviour, reflecting upon personal characteristics, assessing progress and identifying areas of for self-improvement. Learning to learn is the ability to apply the cognitive process of personal learning (what and how we learn) and to make use of guidance to continuously pursue learning new knowledge and skills and strive for improvement.

16. **Strategic thinking** - The ability to think conceptually, imaginatively, systematically and opportunistically, leading to a clearly defined set of goals, plans, and the new ideas required to survive and thrive in competitive and changing environments.

17. **Use basic hardware** - The ability to operate a personal computer, tablet, mobile phone or other digital device using the hardware functionalities, such as a keyboard, mouse, navigation buttons and touchscreen technology, where appropriate.

18. **Use basic software** - The ability to use and troubleshoot basic programs and applications, and able to word process, manage files, and access and adjust privacy settings.

19. **Waste reduction and waste management** - The ability to use, manage and dispose of resources in ways that sustain the natural and physical environment.

Source: International Labour Organization. 2021. *Global framework on core skills for life and work in the 21st century*

Appendix IV: STEM Competencies that Support TVET

1. **Creative/Inventive** - Thinking Combine or connect ideas and information in unique and novel ways to generate new ideas, applications, products, processes, or services

2. **Critical Thinking** - Apply logic and reasoning to make sense of data or information by posing questions, putting forward arguments, exploring counterexamples, searching evidence, identifying relationships, recognising patterns and trends, evaluating pros and cons, and synthesising information

3. **Systems Thinking** - Understand the bigger context of a system, its emergent properties, and behaviour over time by knowing the connections, interrelationships, and dynamics of its constituent parts

4. **Problem Solving** - Identify feasible and efficient solutions to solve problems and to create new opportunities

5. **Transdisciplinary Thinking** - Put together relevant concepts and processes from multiple disciplines to generate solutions and new applications

6. **Decision-making** - Make a logical choice of action by looking at evidence, exploring alternatives, considering likely impact, evaluating options and providing justifications

7. **Computational Thinking** - Develop or apply computational models, tools and techniques to interpret and understand data, solve problems, and guide decision-making

8. **Ethical Thinking** - Use value system as guide for making choices that adhere to acceptable standards and protocols.

9. **Numeracy** - Apply mathematical ideas in personal, occupational, societal, and scientific contexts by reasoning, creating representations, or using measuring instruments or calculating tools

10. **Digital Literacy** - Search, evaluate, create, and share digital information using ICT device, equipment, tools, platforms, and applications for communication, collaboration, or problem solving

11. **Civic Literacy** - Contribute to the broader goals of the community by participating proactively in community affairs and observing social responsibility

12. **Cultural Literacy** - Be sensitive and respectful of the culture where an individual is immersed in

13. **Occupational Health Literacy** - Understand and apply occupational safety standards and protocols as well as take care of one's health and well-being to maintain productivity

14. **Entrepreneurial Literacy** - Detect an opportunity and make it grow in a sustainable way applying relevant knowledge, skills, and attitudes

15. **Organisational Literacy** - Negotiate way within an organisation by understanding its structure, dynamics of its members, communication channels, and appropriate procedures

16. **Communication** - Convey and exchange thoughts, ideas and information effectively through various mediums and approaches

17. **Collaboration** - Work effectively in a team to achieve shared goals either through face-to-face or virtual interaction

18. **Empathy** - Sense, share and respond positively to the feelings of another

19. **Agency** - Manage own behaviour and emotions to act professionally and independently, make choices freely, and pursue goals persistently

20. **Lifelong/Lifewide Learning** - Find opportunities to enhance one's knowledge and skills for continual learning; Maintain curiosity, passion, and growth mindset; Connect learning to a purpose and real-world context

21. **Resilience** - Thrive or prosper despite difficult circumstances; Be adaptable and flexible

22. **Leadership** - Lead others to attain shared goals by managing relationships, respecting diversity, recognising talent, and empowering people

23. **Service Orientation** - Support a culture of service excellence within the organisation by producing products or providing services that exceed the expectations of the customers

24. **Project Management** - Use resources (human, material, and time) wisely to deliver work-related tasks or projects

25. **Glocal** - Mindset Be adaptive to global standards but remain responsive to local needs

Source: International Labour Organization. 2021. *STEM in TVET Curriculum Guide*

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