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RECONFIGURING WORK IN THE AGRIFOOD CHAIN: PROFILING EMPLOYABILITY SKILLS VIA BIG DATA AND TRANSFORMER-BASED LANGUAGE MODELS

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Abstract

Shifting towards a circular economy requires a comprehensive and systemic overhaul of job functions and the associated skill sets, ensuring alignment with the core principles of resource efficiency, waste reduction, and sustainable value creation. This shift transcends traditional industrial boundaries, calling for the seamless integration of circular strategies across a wide range of economic sectors. Among these, the agri-food sector stands out as a pivotal arena for change due to its multifaceted role.

Realising this transformation demands a workforce equipped with highly specialised and flexible competencies capable of driving innovation, implementing circular economy solutions, and effectively coordinating circular strategies throughout the entire food supply chain. Such capabilities

encompass a robust understanding of interdisciplinary methods, advanced technological applications, and the ability to navigate complex sustainability challenges.

Despite the recognised importance of the agri-food sector in advancing circularity on a broader scale, previous research has largely treated circular economy-related competencies or agri-food-specific skills as isolated areas of inquiry, often failing to address the full supply chain in a cohesive manner. Moreover, while an expanding body of literature examines the skills needed for circular economy adoption across various industries, to the best of our knowledge, no study has systematically and holistically mapped the competencies essential for accelerating circularity in the agri-food system.

Accordingly, this study addresses that gap by applying an advanced topic modelling and semantic analysis framework to a curated dataset of 7,943 job advertisements collected between June and October 2024 from leading recruitment platforms and corporate career pages across the United States. The analysis focuses exclusively on job postings within the agrifood domain, aiming to uncover the most salient employability skills and their latent thematic groupings.

The methodological approach is grounded in natural language processing and unsupervised machine learning. Job descriptions were pre-processed through lemmatisation, tokenisation, and stopword removal, followed by the generation of dense sentence embeddings using a transformer-based large language model. These embeddings served as the input to Bidirectional Encoder Representations from Transformers (BERTopic), a neural topic modeling algorithm that integrates semantic representations with dimensionality reduction and density-based clustering.

The findings confirm that employability in the agrifood sector is increasingly defined by a hybrid profile of competencies. The methodological contribution of this study lies in the integration of large language models (LLM)-based text mining with interpretable topic modeling and correlation logic, offering a replicable and scalable approach to skills profiling in sectors undergoing technological and environmental transformation.

Keywords: agri-food industry; big data; circular economy; employability; skills; text mining.

I. INTRODUCTION

The transition towards a circular economy constitutes a foundational reconfiguration of industrial and organisational systems. It involves a structural shift from the traditional linear model of *take-make-dispose* towards regenerative models of production and consumption that aim to close material loops, extend product lifecycles, and minimise ecological impact (Borrello et al., 2017; Esposito et al., 2025; Kirchherr et al., 2017). As a result, labour markets are undergoing a corresponding transformation, whereby employability is progressively defined by a new logic of

sustainable value creation, ecological resilience, and innovation-led productivity (European Commission, 2020).

Within this evolving landscape, the agri-food sector is widely recognised as both a major contributor to environmental degradation and a potential enabler of circularity. Its global relevance, ecological embeddedness, and socio-economic complexity underscore its strategic position in the green transition (Burger et al., 2019). The sector's exposure to climate volatility, natural resource constraints, and regulatory pressures has intensified demand for workforce capabilities that transcend traditional agricultural knowledge and embrace sustainability as a core operational principle (Cedefop, 2012; Straub et al., 2023; Trivelli et al., 2019). Undeterred by the strategic importance of this sector, relatively few studies have attempted to systematically examine the employment implications of circular transition within the agri-food domain (Trevisan et al., 2024). Despite this urgency, the academic literature has yet to offer a comprehensive mapping of the employability requirements emerging across the agri-food supply chain in response to circular economy imperatives.

Research to date has primarily examined green skills in generalised settings or assessed agri-food competencies in isolation, thereby neglecting the integrative perspective required for systemic transformation (Merrifield, 2013; Smaldone et al., 2025a). Existing research has largely focused on either macro-level economic dynamics or firm-level innovation processes, with limited attention to how these changes alter the nature of work and the skillsets required across different phases of the agri-food value chain (Wu, 2025). The complexity of circular transitions demands not only technical proficiency but also interdisciplinary insight, adaptive capacity, and collaborative skillsets, dimensions often omitted from traditional workforce planning models (OECD, 2020; Trevisan et al., 2025).

This gap in the literature is particularly problematic when considering the increasingly hybrid nature of skill requirements in circular economy sectors. Today's professionals are expected to integrate technical expertise with cross-disciplinary thinking, digital fluency, and collaborative problem-solving abilities (De los Rios et al., 2017; Summerton et al., 2019). These transversal and adaptive skills become especially relevant in agri-food systems, where workers are called upon to navigate complex, interconnected processes spanning production, processing, logistics, and environmental compliance (Guyot Phung, 2019; Smaldone et al., 2025b).

Conventional approaches to identifying skills, reliant on surveys, classification frameworks, and qualitative foresight, risk underestimating the speed and heterogeneity of change in dynamic labour environments. By contrast, recent advances in data science and computational linguistics offer promising avenues for capturing real-time shifts in demand through large-scale text analytics of job advertisements (Smaldone et al., 2022; Smaldone et al., 2025a). These techniques enable the extraction of emergent competencies and latent thematic structures directly from employer-

generated data, thereby facilitating a bottom-up, demand-led model of skill intelligence (Janssens et al., 2021; Sumter et al., 2021).

The present study leverages these methodological innovations to analyse a curated corpus of 7,943 job advertisements collected between June and October 2024 from leading U.S. recruitment platforms. The analysis applies transformer-based natural language processing and neural topic modelling to uncover the implicit logic through which agri-food employability is articulated and operationalised in a circular context. Emphasis is placed on identifying and categorising core, advanced, and transversal skills, and on clustering them into semantically coherent domains across the supply chain. In doing so, the study seeks to contribute both to empirical labour market intelligence and to the development of scalable methodologies for skill profiling in sectors undergoing ecological transition.

II. METHODOLOGY

This study adopts an advanced text mining approach that leverages natural language processing and machine learning to explore the evolving configuration of employability skills in the agri-food sector. The analysis is based on a curated dataset comprising 7,943 job advertisements collected between June and October 2024 from leading employment platforms and corporate career websites operating in the United States. The selection criteria targeted postings explicitly referring to agri-food-related functions, including agricultural production, food processing, quality control, logistics, environmental compliance, sustainability consultancy, and innovation in food systems. To prepare the textual data for semantic analysis, a multi-step preprocessing pipeline was implemented. Initially, all job descriptions were subjected to lowercasing, lemmatisation, tokenisation, and the removal of stopwords, punctuation, digits, and extraneous symbols. Furthermore, terms with extremely low or high document frequency were filtered to eliminate lexical noise and enhance analytical precision. These procedures ensured the semantic tractability of the corpus and facilitated the extraction of meaningful linguistic structures from unstructured text (Munzert et al., 2015; Silge et al., 2017).

Following preprocessing, the corpus was converted into dense semantic vectors using Sentence-BERT (SBERT), a transformer-based language model tailored for sentence-level embedding generation. SBERT fine-tunes the BERT architecture using a Siamese network structure, enabling high-performance similarity detection across short texts, a key capability for identifying latent relationships among job postings and the skill terms they contain (Reimers & Gurevych, 2019). These embeddings were used as input for topic modelling. To identify thematic clusters of co-occurring skill expressions, the BERTopic algorithm was employed. This neural topic modelling framework integrates SBERT embeddings with dimensionality reduction via UMAP and density-

based clustering via HDBSCAN, allowing the model to autonomously infer the number and composition of topics based on the topological density of the embedded corpus (Grootendorst, 2022). Compared to traditional methods such as Latent Dirichlet Allocation, BERTopic is capable of retaining contextual nuance and offers a more accurate reconstruction of semantic fields within highly heterogeneous textual datasets. The resulting topic clusters were reviewed and interpreted as distinct thematic areas of skill demand. A keyword analysis was conducted to extract the most representative terms from each cluster, which were subsequently matched against internationally recognised skill taxonomies developed for green, digital, and transversal competencies (Cedefop, 2012; OECD, 2020).

II. RESULTS

The semantic analysis of the 7,943 agri-food-related job advertisements revealed a structured yet diverse demand for competencies reflecting both traditional operational functions and emerging circular economy priorities. A clear concentration of frequency was observed among a subset of core skills, with sustainability knowledge emerging as the most frequently required, appearing in 14.6% of all job postings. This skill was often associated with roles involving strategy implementation, reporting, and regulatory alignment, suggesting a widespread institutionalisation of sustainability principles across the agri-food value chain.

Closely following were quality assurance (12.8%) and food safety regulations (11.7%), which together reflect the sector's ongoing preoccupation with compliance, traceability, and product integrity. These skills were particularly prevalent in job roles linked to processing, manufacturing, and distribution, aligning with both consumer safety mandates and international trade standards.

Supply chain coordination appeared in 10.3% of job postings, underscoring the sector's growing reliance on logistics optimisation and integrated value chain planning. This demand aligns with the increasing complexity of circular logistics frameworks, particularly in managing reverse flows, waste segregation, and bio-based production. The skill of environmental compliance was cited in 8.9% of advertisements, further confirming the relevance of regulatory awareness and monitoring capabilities in the circular transition. Other frequently occurring competencies included technical reporting (7.5%), process optimisation (6.7%), and agricultural monitoring (5.9%), all of which support operational efficiency and resource-sensitive management practices. A cluster of specialised skills associated with circular strategies appeared in smaller but significant proportions. Circular production planning was found in 4.8% of postings, often connected to positions in innovation, sustainability engineering, or system design. Similarly, data interpretation (4.1%) emerged as an increasingly transversal requirement, not confined to analytical roles but distributed across managerial and field-level functions.

Less frequent yet notable were skills such as waste-reduction strategies (2.7%), resource-efficiency management (2.4%), and product innovation (3.2%). Their distribution indicates a gradual diffusion of circular-economy logic into operational practices, particularly among firms engaging with environmental certifications or eco-labelling schemes. Low-frequency skills included those of high specialisation, such as Life Cycle Assessment (1.4%), biowaste valorisation (1.2%), and eco-design (0.7%). While quantitatively marginal, the presence of these terms highlights an emerging niche in agri-food employment requiring advanced training and interdisciplinary expertise. Overall, the frequency distribution suggests that agri-food employability is currently defined by a hybrid profile in which traditional compliance and safety roles coexist with an expanding demand for system-level thinking and circular innovation. This dual structure reflects both the sector's regulatory inertia and its potential for sustainable transformation underpinned by data, technology, and design-oriented skills.

The application of BERTopic to the corpus yielded a three-topic solution that captured the latent semantic organisation of skill-related demands in the agri-food sector. Each topic reflected a coherent thematic nucleus and was categorised based on the prevailing nature of the competencies it encompassed, namely, hard, soft, or transversal skills. The largest topic, accounting for 61.4% of all job postings, was dominated by hard skills. These included competencies such as food safety management, HACCP implementation, quality assurance protocols, technical reporting, environmental compliance, and production process monitoring. Job roles associated with this topic were primarily situated in operational and regulatory domains, indicating the centrality of technical expertise and conformity to legal and quality standards in agri-food employability.

A second topic, comprising 22.3% of the advertisements, corresponded to transversal skills. The lexical composition of this cluster revealed high-frequency references to project management, sustainability coordination, supply chain logistics, data analysis, and cross-functional collaboration. Unlike the previous group, this topic cut across multiple organisational areas, reflecting the increasing demand for integrative, system-level roles that require interaction between technical, managerial, and sustainability-related functions. These skills often appeared in job descriptions that combined planning responsibilities with operational oversight and reporting duties. The third and smallest topic, representing 16.3% of the corpus, captured soft skills. Terms such as communication, teamwork, adaptability, flexibility, initiative, and problem-solving featured prominently in this cluster. Postings in this category frequently referenced collaborative environments, stakeholder engagement, and interpersonal dynamics, often in the context of project facilitation or client-facing functions. Despite its lower overall weight, the soft skill topic revealed a distinct communicative and behavioural component of employability, embedded particularly in positions that demanded responsiveness to changing operational contexts or multi-actor coordination.

The topic model confirmed a clear quantitative predominance of hard skills, followed by transversal and soft skill clusters, respectively. This tripartite distribution suggests a layered architecture of skill demand, in which technical specialisation remains foundational, while system integration and behavioural competence are emerging as essential complements in the evolving agri-food labour market.

III. DISCUSSIONS

The three-topic structure identified through BERTopic modelling offers important insights into the configuration of employability within the agri-food sector, confirming and expanding upon recent theoretical and empirical contributions to green labour market transformation. The quantitative predominance of hard skills, found in over 61% of analysed job postings, is aligned with prior observations that the agri-food industry remains highly regulated and operationally structured, relying on a workforce capable of ensuring compliance with increasingly stringent environmental and safety standards. The prominence of terms such as HACCP, food safety, and environmental monitoring echoes findings by Janssens et al. (2021), who described the circular transition in this sector as primarily “compliance-led”, whereby firms engage with sustainability through institutionalised control mechanisms rather than through radical reorganisation of work processes (Esposito et al., 2025). This regulatory and technical orientation, while unsurprising, suggests a partial mismatch between the complexity of circular challenges and the linearity of skill expectations still prevailing across many segments of the industry. The modelled topic dedicated to transversal skills, which accounted for 22.3% of the corpus, provides evidence of an ongoing expansion in the semantic space of agri-food employability. Skills such as project management, sustainability reporting, supply chain integration, and cross-departmental coordination point to the growing demand for system-level professionals who are capable of mediating between technical knowledge and organisational adaptation. These findings resonate with the OECD’s (2020) conceptualisation of transversal green skills as catalysts for innovation in traditionally conservative sectors, enabling the embedding of sustainability principles across structural silos (Guyot Phung, 2019).

Equally noteworthy is the emergence of soft skills as an autonomous cluster within the topic model, comprising 16.3% of the analysed postings. Although often underrepresented in technical literature, behavioural competencies such as teamwork, flexibility, initiative, and communication were frequently mentioned in association with leadership, problem-solving, and stakeholder engagement. This aligns with the argument advanced by Sumter et al. (2021), who emphasised the relevance of “sustainable work” frameworks in which soft skills serve not as auxiliary attributes but as central components of employability in socially complex and environmentally dynamic contexts (Smaldone et al., 2022). Moreover, the clear separation of soft skills from both hard and transversal

clusters in the model indicates a shift in how employers articulate expectations, reinforcing the trend toward hybrid professional profiles that blend operational fluency with social and cognitive agility. Taken together, the distribution of the three topics reflects a labour market undergoing a staged but multidimensional transformation. The continued dominance of hard skills suggests that many employers still interpret circularity through the lens of compliance, technical optimisation, and regulatory adherence. At the same time, the significant presence of transversal competencies suggests a parallel evolution toward integrative roles that are structurally positioned to facilitate systemic transition. Soft skills, while quantitatively less dominant, appear to function as enabling traits for those tasked with navigating uncertainty, mediating institutional change, or fostering innovation from within. This layered configuration of skill demand is consistent with the thesis advanced by Smaldone et al. (2025) thesis that productivity in knowledge-intensive green sectors depends not merely on technical expertise but on the strategic orchestration of heterogeneous competencies. The tripartite architecture revealed by this study thus confirms the coexistence of distinct but interconnected domains of employability in the agri-food sector. While circularity as a principle has become increasingly visible in job advertisements, its operationalisation still relies heavily on traditional regulatory frameworks. At the same time, the gradual incorporation of transversal and soft dimensions signals the early emergence of more adaptive, holistic, and strategic workforce models. This suggests that the agri-food sector, despite its structural conservatism, is beginning to develop internal pathways for innovation-compatible labour practices, though these remain unevenly distributed and often under-recognised in recruitment language.

IV. CONCLUSIONS

This study has provided a data-driven reconstruction of employability dynamics in the agri-food sector under the lens of circular economy transition. Through the application of transformer-based topic modelling on a corpus of nearly 8,000 job advertisements, a tripartite semantic structure was identified, encompassing hard, transversal, and soft skills. The quantitative predominance of hard skills confirms the continued salience of technical and regulatory competencies in a sector shaped by safety, quality, and environmental standards. However, the meaningful presence of transversal and soft skill clusters indicates a gradual evolution toward more integrated and adaptive workforce profiles. The methodological contribution of the study lies in the combination of large language model embeddings and unsupervised clustering techniques, which allowed for the extraction of latent thematic structures from unstructured labour market data. This approach offers a replicable framework for semantic skill profiling that may be applied to other sectors undergoing technological, ecological, or normative transformation. In conceptual terms, findings suggest that employability within the agri-food system cannot be fully captured through

static taxonomies or linear definitions of professional roles. Instead, it is increasingly shaped by hybrid logics that reflect the convergence of regulatory compliance, cross-functional coordination, and behavioural flexibility. This layered configuration reinforces the importance of viewing circular economy transitions not only as technical shifts but as organisational and human capital challenges. Future research may expand upon these insights by integrating temporal dynamics and longitudinal comparisons, or by linking job ad analysis with educational curricula, workplace performance indicators, or policy implementation outcomes. For workforce developers, educators, and institutional planners, the results underscore the need to design skill-building strategies that embrace complexity, promote versatility, and align with the evolving grammar of sustainability-oriented employment.

REFERENCES

Borrello, M., Caracciolo, F., Lombardi, A., Pascucci, S., & Cembalo, L. (2017). Consumers' perspective on circular economy strategy for reducing food waste. Sustainability, 9(1), 141.

Burger, M., Stavropoulos, S., Ramkumar, S., Dufourmont, J., & van Oort, F. (2019). The heterogeneous skill-base of circular economy employment. Research Policy, 48(1), 248–261.

CEDEFOP. (2012). Future skills supply and demand in Europe: Forecast 2012. Publications Office of the European Union.

De los Rios, I. C., & Charnley, F. J. (2017). Skills and capabilities for a sustainable and circular economy: The changing role of design. Journal of Cleaner Production, 160, 109–122.

Esposito, B., Smaldone, F., Raimo, N., Sica, D., & Vitolla, F. (2025). Enhancing circular economy disclosure towards Net Zero: The role of circular economy capabilities. International Journal of Productivity and Performance Management.

European Commission. (2020). A new Circular Economy Action Plan: For a cleaner and more competitive Europe. European Commission.

Grootendorst, M. (2022). BERTopic: Neural topic modeling with class-based TF-IDF. arXiv:2203.05794.

Guyot Phung, C. (2019). Implications of the circular economy and digital transition on skills and green jobs in the plastics industry. Field Actions Science Reports, Special Issue 19, 100–107.

Janssens, L., Kuppens, T., & Van Schoubroeck, S. (2021). Competences of the professional of the future in the circular economy: Evidence from the case of Limburg, Belgium. Journal of Cleaner Production, 281, 125365.

Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. Resources, Conservation and Recycling, 127, 221–232.

Merrifield, A. (2013). The politics of the encounter: Urban theory and protest under planetary urbanization (Vol. 19). University of Georgia Press.

Munzert, S., Rubba, C., Meißner, P., & Nyhuis, D. (2015). Automated data collection with R: A practical guide to web scraping and text mining (Vol. 1). Wiley.

OECD. (2020). Green skills and innovation for inclusive growth. OECD Publishing.

Reimers, N., & Gurevych, I. (2019). Sentence-BERT: Sentence embeddings using siamese BERT-networks. arXiv:1908.10084.

Silge, J., Robinson, D., & Robinson, D. (2017). Text mining with R: A tidy approach (p. 194). O'Reilly.

Smaldone, F., Ippolito, A., Lagger, J., & Pellicano, M. (2022). Employability skills: Profiling data scientists in the digital labour market. European Management Journal, 40(5), 671–684.

Smaldone, F., Lagger, J., & Mainolfi, G. (2025a). Profiling employability skills for life cycle professionals amid the circular and digital economy. The International Journal of Life Cycle Assessment, 1–18.

Smaldone, F., Supino, S., Sica, D., & Esposito, B. (2025b). Uncovering employability skills for circular food systems: A big data approach. International Journal of Economic Behavior.

Straub, L., Hartley, K., Dyakonov, I., Gupta, H., van Vuuren, D., & Kirchherr, J. (2023). Employee skills for circular business model implementation: A taxonomy. Journal of Cleaner Production, 410(1), 137027.

Summerton, L., Clark, J. H., Hurst, G. A., Ball, P. D., Rylott, E. L., Carslaw, N., … & McElroy, C. R. (2019). Industry-informed workshops to develop graduate skill sets in the circular economy using systems thinking. Journal of Chemical Education, 96(12), 2959–2967.

Sumter, D., de Koning, J., Bakker, C., & Balkenende, R. (2021). Key competencies for design in a circular economy: Exploring gaps in design knowledge and skills for a circular economy. Sustainability, 13(2), 776.

Trevisan, A. H., Arcebi, F., Dukovska-Popovska, I., Mascarenhas, J., Terzi, S., & Sassanelli, C. (2024). A research agenda advancing circular economy skills. In International Conference on Interoperability for Enterprise Systems and Applications (pp. 207–220). Springer Nature Switzerland.

Trevisan, A. H., Boscarato, A., Acerbi, F., Terzi, S., & Sassanelli, C. (2025). Enhancing circular economy education and training for the manufacturing sector: A holistic skills framework. Journal of Environmental Management, 380, 124982.

Trivelli, L., Apicella, A., Chiarello, F., Rana, R., Fantoni, G., & Tarabella, A. (2019). From precision agriculture to Industry 4.0: Unveiling technological connections in the agrifood sector. British Food Journal, 121(8), 1730–1743.

Wu, Y. (2025). Identifying and prioritizing essential skills for the circular economy workforce. Journal of Environmental Management, 393, 127237.