

Uptake Of Sustainable Manufacturing Practices By Food Manufacturing Firms: A Systematic Review

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Abstract

A large number of food manufacturing companies are yet to thoroughly assimilate sustainable practices in their business model. In view of the pivotal impact the food supply chain exerts on food security, this paper consolidates and provides a comprehensive review on the adoption of sustainable practices by food enterprises in both developed and developing countries. This paper systematically reviews the heterogeneity of firm conditions and owner characteristics. It considers countries, type of sustainable practices and underlying adoption theories generally utilized by past literature. In addition, vote counting is employed to map key variables that influence sustainability practice uptake by firm owners. Key findings include economic motivation largely driving adoption decisions, followed by national legal obligations and learning capacity. Results also revealed adoption to be heavily skewed in the direction of developed countries versus developing countries and large food firms versus small-and-medium firms.

Index Terms: *Environmental management standards, Food manufacturing firms, Food security, Vote count*

Introduction

To be sustainable is to promote a holistic way of living without jeopardizing the quality of life for future generations. Businesses, being instrumental agents of change are expected to demonstrate sustainability (Adams & McNicholas, 2007; Babiak & Trendafilova, 2011). If a firm wishes to adhere to a sustainable business mode, a holistic improvement of the three facets i.e., economic, environmental and social indicators, must be initiated (Dyllick & Hockerts, 2002; Lund & Lindgreen, 2014). Fundamentally, a sustainable business model aims at procuring profits while simultaneously advocating environmental and social welfare (Dyllick & Hockerts, 2002; Schaltegger, Ludeke, & Hansen, 2012).

The food manufacturing sector is a pivotal sector globally (Boiral & Gendron, 2011; Hahn & Kuhren, 2013). Food is a basic human need that compels consumers to advocate strong ethical views on a) quality and safety b) how production elements e.g., water, energy, animals, labor are treated along the supply chain (Lund & Lindgreen, 2014). The supply chain consist of numerous stakeholders where both upstream production and downstream i.e., packaging and distribution actors are interdependent in their interactions. Quality food control emphasizing environmental amelioration and labor welfare is frequently voiced out by an increasingly aware consumer base (Ball, Wilcock, & Aung, 2010). A world-wide survey in 2005 by Nielsen revealed that half of the world's consumers have access to information on sustainable consumption and are willing to pay higher prices to procure safely produced food (Nielsen, 2005).

While there is an increase in literature pertaining to the role of multi-sectored companies in implementing sustainable initiatives, the role of food manufacturing firms remains marginal in both developing and developed countries. Closer examination of existing literature indicate it to not only be little but outdated at best This is unjustifiable given the immense sustainability impact meted out by this sector (Ilbery & Maye, 2005; Jin, Zhou, & Ye, 2008). The cumulative contribution of food manufacturing firms to pollution and environmental concerns is not extensively documented, yet is suggested to be equal, if not more than other sectors (Maldonado et al, 2005; Psomas, Vouzas, & Kafetzopoulos, 2014).

To the best of our knowledge, the adoptive findings of sustainable initiatives by food firms (large

and small) have not been synthesized collectively. Hence there is little information and awareness as to why some food firms are more prone to adopting sustainable initiatives versus others. Hence it is a motivation to contribute to the knowledge base by initiating an aggregation of information. To address the research gap, this paper attempts to review the literature centered on the adoption of sustainable standards or tools by food firms in both developing and developed countries. We also aim to identify and synthesize previously mentioned independent factors that influence adoption. A review of papers from diverse localities will prevent site-specific generalizations and provision of modest information relative to the existing knowledge base.

Literature review

The aftermath of globalization resulted in suppliers from diverse nations contributing inputs to the production chain. To maintain a standardized production quality, sustainable business management was introduced that simultaneously addresses environmental and social concerns (Adams & McNicholas, 2007; Babiak & Trendafilova, 2011; Schaltegger et al, 2012). There are numerous definitions as to what sustainability entails. However, many multinationals worldwide were identified to prescribe to the Triple Bottom Line (TBL) framework designed by Elkington that prioritized environmental and social engagement alongside economic gains (Babiak & Trendafilova, 2011; Henson & Holt, 2013). While companies tend to prioritize one or several concepts over the others, the interpretation of TBL justifies the concept of sustainable business as all elements are simultaneously promoted (Dyllick & Hockerts, 2002; Hahn & Kuhren, 2013).

Adopting a sustainable management system can be a significant turning point in enhancing TBL values i.e., people, profit and planet (Kolk, 2004; Lopez, Garcia, & Rodriguez, 2007). An energy efficient business model will most likely result in expense reduction leading to higher savings (Ilbery & Maye, 2005; Tunalioglu, Cobanoglu, Demet, 2012). Reverting to an environmentally sustainable management aids as leverage in creating an image of trust, innovation and social accountability (Boiral & Gendron, 2011; Cwikel, Behar, and Rabson, 2000; Dora et al, 2013). This will appeal to a broad range of consumers that are increasingly informed on green consumerism and the impact of capitalism on the environment. They will be motivated by a sense of ethical obligation to purchase sustainably produced products or services (Escanciano & Santos, 2014). This differentiation provides businesses, large or small, with a competitive edge amongst the plethora of competitors (Zhou, Helen, & Liang, 2011).

Integrating sustainability within food manufacturing firms is in tandem with the Sustainable Development Goals (Macheka, Manditsera, Ngadze, Mubaiwa, & Nyunga, 2013), which highlights sustainable consumption and responsible employment patterns within global supply chains (Djekic, Rajkovic, Tomic, Smigic, & Radovanovic, 2014). Benefits of standard compliance include improved brand reputation and access to high value market segments i.e., organic produce, eco-green products (Ilbery & Maye, 2005; Macheka et al, 2013). Initiatives like certification and green labelling were made transparent in alliance with conscious purchasing by a growingly aware consumer base (Adams & McNicholas, 2007; Atkin, Gilinsky, & Newton, 2012).

While there are standard criteria as to what constitutes sustainable production i.e., absence of harmful chemicals, minimization of harmful environmental impacts, welfare of employees, achieving full scale firm sustainably is anything but a standard process (Chavan, 2005; Darnall, Jolley, & Handfield, 2008). The incorporation of multidimensional initiatives within a firm is a relatively complex process. In addition to numerous sustainability measuring indicators, there are varying definitions of labelling within the food industry i.e., eco-friendly, organic, green (Hahn & Kuhren, 2013; Psomas, Vouzas, & Kafetzopoulos, 2014). Food standards e.g., Good Agricultural Practices (GAP), Hazard Analysis and Critical Control Points (HACCP), integrated with quality management standards appear to be a legal requirement for food businesses to operate (Karaman, Cobanoglu, Tunalioglu, & Ova, 2012; Vladimirov, 2011). These interchangeable certifications may tend to confuse both firm owners and consumers alike.

Addressing sustainability within the food sector would not be thorough without considering the role of small-and-medium (SME) food businesses. SMEs are pivotal components of a nation's economy, constituting for over 95% of all businesses. SMEs contribute greatly to the gross domestic product (GDP), generates wealth and greatly impacts social capital and environmental health (Cordano,

Marshall, & Silverman, 2010; Lee & Klassen, 2008). Development of SMEs is of paramount importance not only in developing countries, but industrialized developed countries too (Psomas & Kafetzopoulos, 2015). While statistics may vary among countries, SMEs contribute approximately 50% to 80% of employment (Dora et al, 2013; Lee & Klassen, 2008), even in high income countries.

While food SMEs individually may appear to possess minor significance, their collective impact is immense (Charalambous, Fryer, Panayides, & Smith, 2015; Pullman, Maloni, & Dillard, 2010). Over the years, there have been significant interest by various change agents i.e., researchers, governments, non-governmental organizations, in the potential of SMEs to generate positive change. One is being an instrument in eradicating poverty amongst rural communities i.e., creation of jobs and income generation (Chavan, 2005; Cordano, Marshall, Silverman, 2010). Second is becoming hubs of innovation (Moore & Manning, 2009). Rural entrepreneurship is fostered via the establishment of SMEs. Small firms are majorly embedded in local communities, on which their survival depends (Revell, Stokes, & Chen, 2010). This phenomenon promotes a healthy business climate and economic efficiency.

Materials and method

Data Collection

The papers selected for review were based on a binary choice of whether sustainability practices have or have not been adopted by food firms. These papers were selected through a systematic search of Google Scholar, Science Direct and Scopus. The discrete words inserted into the search platforms were (1) food manufacturing firms'/ enterprises/companies/businesses (2) adoption (3) sustainable initiatives/standards (4) developing countries and (5) developed countries. The scope of search was intentionally broad to capture a range of practices without limitations. Numerous review papers, conference papers and articles were generated via the search.

While this research aims to provide a diverse perspective, only papers that fulfilled the following criteria were selected a) peer reviewed publications b) methodology includes either qualitative, quantitative or mixed method c) written in English. The process flow chart is highlighted in Figure 1.



Figure 1: Systematic review flow chart

Review Procedure

While varied keywords were inserted into the search platforms in the hope that many publications will be generated, only 31 papers fulfilled our search criteria. It was decided that the findings will be classified by the categories: (1) author(s) (2) research country/region (3) type of sustainability practice(s) (4) sample size (5) underlying research theory or assumption and (6) statistical method, emulating the methodology carried out by [13]. The information is outlined in Table 1.

Table 1: Summary of 31 studies on sustainable initiatives

Ref.	Country/ Region	Sustainable Practice	Sample Size	Theory/ Assumption	Statistical Method
[2]	Thailand	Safety	217	Utility maximization, Rational choice	Descriptive analysis
[3]	United States	EMS	98	Competitive advantage	MANOVA
[5]	Canada	FSMS	13	Planned behavior	CFA
[7]	Cyprus	ISO 22000	50	Stakeholder, Institutional	Descriptive analysis
[12]	Serbia, Bosnia	HACCP, ISO 9001	60	Profit maximization	Descriptive analysis

[13]	Europe	LMP	35	Profit maximization	Descriptive analysis
[15]	Spain	ISO 22000	189	Rational Choice	EFA
[16]	Greece	HACCP	107	Critical success factors	CFA EFA
[17]	United States	HACCP	13	Creative cognition	Affinity model, Descriptive analysis
[19]	United Kingdom	HACCP, ISO9000	192	Utility maximization	Logit
[20]	Canada	HACCP	854	Profit maximization	EFA
[21]	United Kingdom	Safety	43	Reasoned action, Profit maximization	CFA Multinomial logit
[22]	Canada	HACCP	34	Market, judicial, political process	N-Vivo
[23]	China	HACCP	117	Profit maximization	Descriptive analysis
[24]	Greece	ISO 9001 HACCP	347	Business greening	EFA, CFA
[25]	Greece	HACCP	335	Profit maximization	EFA, CFA
[26]	Turkey	HACCP, Safety	28	Profit maximization	Descriptive analysis
[32]	Zimbabwe	HACCP ISO 22000	30	Profit maximization, Planned behavior	Descriptive analysis
[33]	Mexico	HACCP	160	Cost-benefit analysis	Descriptive analysis
[34]	Malaysia	LMP	61	Profit maximization	EFA
[35]	Lebanon	ISO14001	121	Rational choice	Bivariate cross tabulation matrices
[39]	Greece	TQM, Six Sigma	90	Rational choice	EFA, Multiple linear regression
[40]	Greece	HACCP, ISO 9001	92	Utility optimization	EFA, CFA
[41]	Greece	ISO22000	74	Rational choice	Chi-square test, Mann–Whitney test
[42]	United States	ISO, TQM	117	Business greening, Rational choice	CFA
[45]	Canada	TQM, HACCP, LMP, Six Sigma	46	Stakeholder theory	Descriptive analysis
[46]	Serbia	HACCP	77	Profit maximization	Descriptive analysis
[47]	Turkey	HACCP	59	Consumer theory	EFA
[48]	Bulgaria	GAP, HACCP	422	Utility maximization	Multiple linear regression
[49]	Canada	HACCP	22	Capital theory, Rational choice	Descriptive analysis
[50]	China	HACCP, ISO,	139	Capital theory,	Ordinal logistic

		GMP		Utility maximization	model
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Notes:

Ref.	Reference
HACCP	Hazard Analysis and Critical Control Points
EMS	Environmental Management System
FSMS	Food Safety Management System
ISO	International Organization for Standardization
LMP	Lean Manufacturing Practice
TQM	Total Quality Management
GAP	Good Agricultural Practice
GMP	Good Manufacturing Practice
MANOVA	Multivariate Analysis of Variance
CFA	Confirmatory Factor Analysis
EFA	Exploratory Factor Analysis

Results and discussion

The variations among the 31 publications (locale of investigation, type of sustainable practices) made summarization relatively challenging. Almost all variables displayed mixed significance or a lack of convergence, with a few exceptions. A probable explanation would center on the variations in sustainable practices, countries involved and type of statistical method utilized.

In adhering to the aim of the review, the identified variables were aggregated into four major categories. It is hoped that this further aggregation would provide extra insight not available at field level. The variable with the highest count was listed first, followed by the second highest count and so on for each category. Table 2 outlines 28 factors inventoried within four categories (1) Firm and owner attributes (2) Perceived benefits and costs (3) Behavioral attributes and (4) Exogenous variables.

Table 2: Factors influencing the adoption of practices

Category	Variable	Sig (+)	Sig (-)	Not significant	Total
Firm and owner attributes	Firm size	21	0	4	25
	Existing facilities/infrastructure	0	14	6	20
	Labor	10	0	0	10
	Education level	9	0	0	9
	Age	1	6	0	7
	Firm ownership	2	0	0	2
	Gender	0	1	0	1
Perceived benefits and costs	Operation cost	0	24	0	24
	Business efficiency	20	2	0	22
	Brand reputation and imaging	19	0	2	21
	Product quality	18	0	1	19
	Access to new markets (domestic/international)	16	0	3	19
	Food safety	14	0	1	15
	Environmental maintenance	9	0	1	10
	Labor welfare	8	0	0	8
	Waste management	4	0	0	4
	Technological complexity	0	3	1	4
	Ethical trading	3	0	0	3
Industrial safety	1	0	0	1	
Behavioral	Self-innovation attitude	19	0	0	19
	Awareness on sustainability	13	0	1	13

attributes	Personal commitment	11	0	0	11
	Community engagement	5	0	0	5
Exogenous variables	Legislative pressure	17	6	0	23
	Access to training and advisory service	12	5	0	17
	Access to credit /Funding	15	0	2	17
	Societal/ Stakeholder pressure	11	2	0	13

Firm and Owner Attributes

The adoption of quality management standards requires extensive expenditure (Escanciano & Santos, 2014; Macheke et al, 2013, Moore & Manning, 2009). As an example, firm owners who wish to obtain the ISO certification is required to generate a hefty expenditure of approximately US\$ 1 million for large firms and US\$ 35,000 for small firms (Maldonado et al, 2005). This investment also entails for system installation auditing, automated documentation and training of employees at all levels. Larger firms that possess adequate resources, skilled workforce and specialized auditors will be able to handle the changes more efficiently (Dora et al, 2013; Jin, Zhou, & Ye, 2008). In contrast, SMEs are identified to possess a limited number of resources (Cordano et al, 2010; Lee & Klassen, 2008). From an economics of scale viewpoint, reverting to a costly form of production is not justified (Charalambous et al, 2015; Escanciano & Santos, 2014). This was a consistent theme echoed in many papers.

Labor availability was revealed to be skewed towards positive significance. A thorough management system requires many processes to be implemented and maintained e.g., waste management, quality assurance, auditing. Allocation of labor is diverted to cater to these extraneous activities (Djekic et al, 2014; Escanciano & Santos, 2014; Ilbery & Maye, 2005). It is inherently more difficult for food SMEs to attract and retain new employees due to the relatively lower economic prospects provided (Cordano et al, 2010; Grover et al, 2016). Moreover, existing personnel may lack the expertise in managing technical aspects of quality assurance systems (Kolk, 2004; Moore & Manning, 2009).

A formally educated firm owner is open to new ideas and paradigms that enhance business opportunities (Djekic et al, 2014; Massoud et al, 2010; Tomasevic, 2013). Education was found to positively influence adoption rates. Business owners with higher education levels are generalized to display higher learning and management capacity (Djekic et al, 2014; Joyasinghe & Henson, 2006). The intricacies of a complex sustainability system is easily understood and managed by them (Cordano et al, 2010).

While age was not a frequently investigated variable, it was directly related to an owner's learning and managing comprehension. Age was noted to possess negative significance (Scott, Wilcock, & Kanetkar, 2009). As age progresses, older firm owners who are set in their ways are hesitant to implement new practices that require skills and learning upgrade (Revell, Stokes, & Chen, 2010; Tomasevic et al, 2013). Also noted to have shorter career spans, the motivation to implement a knowledge-intensive business model declines as positive gains can only be observed in the long term i.e., environmental amelioration.

Perceived Benefits and Costs

Results reveal cost of practice implementation to negatively influence the rate of adoption. Sustainability is cited to be an opportunity cost in which the expenditure on implementing sustainable practices in a firm outweighs the purpose of profit saving (Arpanutud, Keeratipibul, Charoensupaya, & Taylor, 2009; Djekic et al, 2014; Macheke et al, 2013). Research by Massoud et al (2010) indicate several Lebanese owners choosing to dissociate from implementing the ISO 14001 standard after observing a hike in supplementary requirement costs. Environmental systems like the ISO 14001, while globally recognized are generally designed to fit the business models of large firms (Psomas & Fotopoulos, 2015; Tomasevic et al, 2013). SMEs generally do not possess the resources, specifically labor, to help maintain the system. Certification costs already prove to be burdensome to financially

challenged owners' without factoring in extraneous costs e.g., purchase of new machines (Choralambous et al, 2015; Moore & Manning, 2009).

Quality assurance systems like the ISO standards and HACCP are viewed as efficiency improvement tools of internal operations (Escanciano & Santos, 2014; Henson & Holt, 2000; Kafetzopoulos & Gotzamani, 2014). As an example, the ISO 9000 aids in preparing automated documents on operational processes and auditing (Kafetzopoulos et al, 2013). Positive implications involve allocation of less labor to handle quality control, decrease in failure rates, and establishing a holistic corrective mechanism (Hahn & Kuhren, 2013; Machela et al, 2013).

While the extent of branding and imaging may vary across firms, it can be postulated that sustainably produced products creates a positive image of accountability and transparency in the eyes of consumers (Escanciano & Santos, 2014; Pullman et al, 2010; Scott et al, 2009). This leads to repeated purchases, signaling customer loyalty (Hahn & Kuhren, 2013; Psomas & Kafetzopoulos, 2015). Also associated with product quality, a certified firm would also gain a positive public reputation. Companies that prioritize environmental sustainability are perceived as innovative and leaders of the business market (Tunalioglu et al, 2012). It generates a positive sense of respect from a range of consumers. The review reveals larger food businesses to benefit largely in contrast to smaller firms. Well established food enterprises may utilize the benefits of positive branding to expand their business beyond domestic domains whereas SMEs are still relegated to generic local markets (Dora et al, 2013).

Existing export markets i.e., European Union that require food products to be eco-certified largely benefits large firms who possess the resources to adhere to such stringent requirements (Herath et al, 2007; Wilcock, Ball, & Fajumo, 2011). Overcoming this challenge proves to be a hindrance to SMEs, hence their sales are confined to local markets (Charalambous et al, 2015).

Behavioral Attributes

Adopting sustainable mechanisms involves cognitive evaluation and a readjustment of behavioral facets (Henson & Holt, 2000). Motivation to engage in sustainable practices can originate internally i.e., self-innovation, personal commitment and awareness, or externally i.e., community engagement.

Firm owners with a high inclination to self-innovate may be willing to experiment, create novel ideas and differentiate themselves from conventional thinking competitors (Ilbery & Maye, 2005; Jin et al, 2008). Companies who wish to expand their products and influence beyond domestic markets could consider environmental and social welfare as strategic marketing tools to cater to an increasingly aware consumer base (Djekic et al, 2014; Grover et al, 2016; Revell et al, 2010). Personal value or ethics of the firm owner was noted for its high count across studies. Compliance with sustainability mechanisms is heavily influenced by personal priorities of a firm owner. It reflects an individual's preference in prescribing a suitable solution (Dora et al, 2013; Karaman et al, 2012). Moreover, when information pertaining to sustainability or related subjects are heavily inaccessible, one's values becomes a driving guide of what is appropriate and what is not (Tomasevic et al, 2013).

The believe that businesses are instruments of change and implementing a sustainable business model was not just for tangible benefits e.g., reducing wastage, energy saving, but also a contribution to societal development spurs firm owners to adopt green practices (Charalambous et al, 2019; Massoud et al, 2010). In this regard, this value revolves around a sense of responsibility and ethics, rather than being primarily motivated by economic gains (Henson & Holt, 2000; Scott et al, 2009). A commitment to sustainability, especially pertaining to maintaining the environment signaled leadership qualities and a charitable act that would benefit communities (Lepoutre & Heena, 2006; Zhou, Helen, & Liang, 2011). Engaging in practices like water reduction wastage, recycling, and emission control are instrumental in enhancing community health and welfare.

Some SME owners however, perceived themselves as being insignificant in the food supply chain. While being aware of environmental issues, the small operation size and minor product supply to bigger firms made them perceive commitment as small or even negligible (Cordano et al, 2010). The relatively anonymous exposure of SME operations lead to a decrease in adoption rates since their impacts were not acutely surveyed by the public (Lee & Klassen, 2008).

Exogenous Variables

The mixed significance associated with legislative requirements is related to firm size and how large and small firms differ in their adherence to legal compliance. Stringent legal requirements pertaining to waste management and green service were positively accepted by owners of larger firms (Escanciano & Santos, 2014; Fotopoulos et al, 2009; Vladimir, 2011). These owners cited adequate infrastructure and workforce availability to promote the uptake of a sustainable business model. However, several food SMEs perceive mandatory implementation of quality standards and excessive pressure from national regulation bodies as forceful and inconsiderate given their limited resources e.g., time and labor (Chavan, 2005; Cordano et al, 2010). Firm owners were noted to display a reactionary disposition when dealing with tedious compliance regulations i.e., implementation, evaluation, documentation. Low awareness and low motivation to access information also contributed to the situation (Dora et al, 2013; Zhou et al, 2011).

Access to training and advisory services was revealed to be a positively significant adoption factor. Firm owners' experienced higher motivation to revert to green management when governmental consultants cooperated in providing technical information on a periodic basis (Dora et al, 2013; Jin et al, 2008). This finding was mainly consistent with both large firms and small firms globally in relation to the adoption of ISO 14001, lean manufacturing and HACCP standards. Effective mediums include training seminars and one-to-one consultancy (Dyllick & Hockerts, 2002; Massoud et al, 2010). However there were research implying that after receiving technical information, owners perceived the costs far outweighed expected benefits to be obtained (Lee & Klassen, 2008; Moore & Manning, 2009). Moreover, consultancy services were deemed to be costly and delivered in technical terms that were not easily understood by owners.

While large firms do experience pecuniary uncertainties, the review revealed food SMEs to benefit more from funding or sponsorships (Escanciano & Santos, 2014; Massoud et al, 2010). Generally, financial assets in SMEs are designated to finance core business functions, and not extraneous aspects such as environmental management (Arpanutud et al, 2009; Lee & Klassen, 2008). This is especially so when the capital is solely generated by the owner. Sponsorship and governmental subsidies provided for preliminary implementation costs is a form of assistance, especially in developing countries (Grover et al, 2016). Identified as a risk buffer, this facility is beneficial in the event of profit loss and enable financially restrained owners to allocate their own resources for core business purposes (Escanciano & Santos, 2014; Karaman et al, 2012).

Conclusion

It is hoped that this aggregation of information would be a significant contribution to existing literature. In addition to learning and management abilities, economic and exogenous variables have been revealed to influence firm owner behavior. Suggested policy implications include a participatory learning approach in which owners suggest their own personalized ideas for management improvement, evaluating perspectives, attitudes and capacities of firm owners before enforcing mandatory legislation and implementing sustainable practices in stages to enable adopters to adjust to changes periodically (monetary and non-monetary). However, the research is far from being conclusive. New research is necessitated in regards to food firms in developing countries i.e., Southeast Asia. The paucity of papers investigating sustainable initiatives adopted, especially by SMEs, highlights the fact that this is an understudied area. It necessitates more empirical research to understand firm owner's reaction in entirely different socioeconomic settings and regulations.

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