A CONCEPTUAL PROJECT REPORT ON

"SUSTAINABLE PACKAGING IN FOOD PROCESSING INDUSTRY"

School of Logistics and Aviation Management

Bachelor in Business Administration
(Logistics & Supply chain Management)

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Certificate of Approval

The following Conceptual Project Report titled " **SUSTAINABLE PACKAGING IN FOOD PROCESSING INDUSTRY** " is hereby approved as a certified study in Supply Chain Management carried out and presented by **Govind agrawal in** a manner satisfactory to warrant its acceptance as a prerequisite for the award of **Bachelor of Business Administration in Logistics & Supply chain Management** for which it has been submitted. It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein but approve the Conceptual Project Report only for the purpose it is submitted to the Conceptual Project Report Examination Committee of the Galgotias University for evaluation of Conceptual Project.

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Summary

The demand for high quality, safe, nutritious processed foods will continue to increase as the global population and affluence increases. This imposes an enormous burden on the environment and the food processing industry has responded by making progress in reducing the carbon and water footprints of products and the amount of waste generated.

However,environmentalsustainabilitycannotbeconsideredinisolation becauseeconomic and social sustainability are essential to the industry. To ensure that the food processing industry is economically and environmentally sustainable, it is important to take an integrated approach of the whole food supply chain including farm and post operations. Life Cycle Assessment (LCA) is a tool that facilitates this approach and will enable meaningfulenvironmentalmessagestobecommunicatedtoconsumers whoarebecoming increasinglyawareoftheenvironmentalimpactoftheproductsthattheypurchase.Asthe foodprocessingindustrybecomesmoreglobaliseditisimportancethatanalysesstandardise socialandeconomicfactorsinenvironmentalassessmentsothatmeaningfulcomparisons can be made for monitoring environmental performance, regulatory compliance and consumercommunication.Aswellastechnologicaladvancestoenablethereductionofthe environmentalfootprintsofprocessedfoods,itisnecessarytochangeconsumerbehaviour to reduce consumption to ensure that the global food processing system issustainable.

Key words: Sustainability, food processing, life cycle assessment, food supply chain

Introduction

Sustainabledevelopmentfromabusinessperspectiveisdefinedas'meetingtheneedsofthebusiness withoutcompromisingtheabilityoffuturegenerationstomeettheirownneeds' Brundtland(1987). Issues relating to sustainable living and production systems are important topics that are driven mainly by economic, social, environmental and political factors. As the global foodconsumption continuestoincreasebecauseoftherapidgrowthintheglobalpopulationandincreasingaffluence inemergingeconomiessuchasChinaandIndia,globalresourcessuchasenergyandwaterarebeing consumed quickly and arable land utilised at an alarming rate. If this trend continues, our society will not be sustainable and future generations will not be able to enjoy the standard of living that we enjoy today. From a simplistic point of view, businesses could be sustainable by reducing the ecologicalfootprintbyreducingtheamountofresourcesthatareused,thewastethatisgenerated

and the amount of emissions produced. However, the business systems are complex and in order for the whole food supply chain to sustainable, it is important to understand the impact of food processingontheinputside(rawmaterialproduction,storageanddistribution) andtheoutputside (finished product storage, distribution, retailing and theconsumer).

The food manufacturing industry is highly competitive and multi nationals as well as small to medium sized enterprises strive to grow and remain profitable while complying with regulatory requirements,governmentpolicy(suchasreducingcarbonemissionstocomply withenvironmental regulations and the further development of the Kyoto protocol), operating in an ethical and an environmentallyresponsiblemannerandsatisfyingtherequirementsoftheconsumersandretailers.
Whileconsumersarecontinuingtodemandfreshandprocessedfoodsthataresafetoeat,convenient toconsume,contributetothehealthandwellbeing,areofhighsensoryqualityandareaffordable, another consumer demand that is becoming increasingly important is that the products havebeen manufactured in an environmentally sustainablemanner.

Retailers, who are becoming very influential in specifying the

requirements of the foods that consumer purchase, are also addressing the environmental issue and are exerting pressure on the foodmanufacturerstoadoptsustainablemanufacturingprocesses.Thisisevident fromdevelopments intheUKwheresomesupermarkets(Tesco,2008)haveintroducedanumberofproductswiththe carbonfootprintoftheproductontheproductlabel.Thistrendisspreadinggloballyandproducts with the carbon footprint on the labels will be launched in Australia later in 2010. Companies all over the world are adopting environmentally friendly practices into their business models and are conserving their natural resources, reducing waste, improving recycling practices and using sustainablepackagingandsupplychainsystems(Larson,2009).Sustainableprocessingisbecoming increasingly important in food ingredients as well as finished products and in the case of dairy ingredients,Berry(2010)pointsoutthatsocialresponsibility(howabusinessimpactsemployees, customersandcommunitiesinwhichitoperates),ecologicalintegrity(howacompany'soperations impact the world and its resources) and economic stability (how a company makes, spends and savesmoney)becomeimportantmessagesthatmarketersareusingtocommunicatetoconsumers on product packaging and websites.

Materials and Methods

In order to set goals and monitor sustainable performance in the food processing industry, it is necessarytodefinematricestomeasuresustainableprocessing.Typicallythese matricesincludethe amountofGreenHouseGas(GHG)emissions,waterusageandwastegeneratio nassociatedwith products.AsGHGemissionstakeplaceindifferentpartsofaproduct'slifecycle,i tisnecessaryto calculatethetotalGHGemissionsbycarryingoutalifecycleassessment(LCA).In LCAstudies, the GHG emissions during the production, storage and distribution of raw materials, product manufacture, distribution and storage of the product, consumption and disposal and recycling of packaging are taken into account and the GHG emissions for the whole life cycle of the product is expressed as grams CO2 equivalent per unit mass of product. This value is referred to as the carbonfootprintoftheproduct.Thegreenhousegasesincludemethaneandnitro usoxideemitted infarmingoperations,theenergyusedinthemanufactureoffertilizersandtheen ergyusedinpost farm operations including product manufacture.

Themethodofcalculatingthecarbonfootprint(usingaLCAapproach)isdocume ntedbyaPublicly Available Specification (PAS 2050) by the British Standard Institute (2008) and the associated CarbonLabelsystem(LCA-like)developedbytheUK'sCarbonTrust.Therearenowwidelyused globally as a standard method for calculating the carbon footprint of goods and services. A draft ISOstandard(ISO14067)forcalculatingcarbonfootprintsforproductsusingasi milarapproach to PAS 2050 has been product and the full standard is expected to be published in 2012. The use of LCA in the food industry inAustralia and Europe is described through case studies by Simons & Sanguansri (2009), Zufia & Arana (2008) and Andersson *et al*. (1994,1998).

Anothermetricthatisoftenquotedwhenreferringtothesustainabilityofaproductis‘foodmiles’. Quitesimply,foodmilesaredefinedasthedistancethefoodtravelsfromfarmtoplate.Accordingto thisdefinition,locallygrownandlocallymanufacturedfoodsaremoreenvironmentallysustainable than products that have to be shipped from long distances. However, this is not the case because itcanbemoreenergyefficientforaBritishhouseholdtobuytomatoesorlettucefromSpainthan from heated greenhouses in the UK. (Engelhaupt, 2008). The invalidity of using food miles as an indicatorofsustainabilityisfurtherconfirmedfromastudycarriedoutinNewZealandbySaunders *etal*.(2006)whoshowedthatthecarbonfootprintoflambfromNewZealandislessthanthecarbon footprintoflambproducedintheUKandarecentstudyinAustraliawhichshowedthattransport emissions are only 3% of the total GHG emissions for lamb exported from Australia to the USA (Sanguansri*etal*.,2010).Theseobservationsareconsistentwithastudycarriedoutin theUSAby Webber & Matthews (2008) who found that transportation of food accounts for only 11% of the GHGs generated by the food consumed by an average US householdannually.

Themainflawoffoodmilesisthatittakesintoaccountonlytheghgemissionsduringstorage andtransportoftheproductandignorestheGHGemissionsduringthegrowingoftherawmaterials andprocessing.Theproduct’scarbonfootprintontheotherhand,includesGHGemissionsduring every stage of the product’s life cycle and is therefore a much better indicator of the product’s impact on the environment. As it is necessary to calculate the GHG emissions for each stage of theproduct’slifecycleinordertocalculatethecarbonfootprint,manufacturerscanusethecarbon footprint to make important management decisions on the sourcing of the raw materials, location ofmanufacturing,sourcesofenergyusedandthetypeofpackagingusedsothattheenvironmental impact of the product is minimised. It is not possible to make such management decisions from food miles alone.

Although the methodology for calculating the carbon footprint for a product is well defined and documented, this is not the case with water footprints. The term ‘virtual’ water usually means ‘embedded’ water in commodities such as grain and is used in the context of international trade when ‘virtual water’ moves from one country to another when commodities are exported (Allan, 1996). The water footprint on the other hand, like the carbon footprint, is calculated using a life cycle assessment for the product.

However, the conventional method of calculating the water footprint is flawed because it only refers to the total volume of the water used in the product life cycle and does not take into account the type of water used, for example 'green' (rain water) or 'blue'(waterfromriversandreservoirs),norwhetherornotthewatercomesfrom awaterstressed or water sufficientareas.

Thus,theimpactontheenvironmentwhenrainwaterisusedinanareawherethe reisanabundance of water is very different to the scenario where irrigated water is used in a water stressed area. Ridoutt & Pfister (2010) have suggested a revised method of calculating the water footprint of a productbytakingintoaccountthetypeofwaterused,theWaterStressIndicatoro fthe areawhere thewaterisusedandthevolumeofthewaterused.Thiscorrectiongivesamuchbe tterresultonthe environmental impact of making that product compared to using the volume of water alone. This methodology was effectively used in a study carried out in Australia by CSIRO (Commonwealth IndustrialandScientificResearchOrganisation)withMarsAustraliaonfourco mmercialproducts and opportunities to reduce the environmental impact of these products (for water and carbon) were readily identified (Ridoutt *et al*.,2009*a*).

The amount of food waste generated is another important metric in measuring sustainable food processinganditisimportanttoquantifytheamountofwastegeneratedatevery stageofaproduct's lifecycle.Theamountofwastegeneratedissimplyreportedastheweightofwaste perunitmassof thefinishedproduct.Thesefigurescouldthenbeusedforcomparativepurposes andbenchmarking and to identify opportunities to develop waste minimisation strategies. Identifying opportunities for the use of ungraded produce, out of date products or packaging compromised products will be a significant area of future innovation in the food processing sector. This is because there are growingmarketsforfinechemical(e.g.Plantantioxidants)andbioethanol(raws ugarandstarch) feedstocks.

Future research andrecommendations

Whileitiscrucialtodeterminetheextentandcausesoffoodwasteatprocessinglevel,future research should also assess the effectiveness and feasibility of prevention and reduction measures. Especially for food processing companies, there is still a need to use innovative managementsystemssuchasleanmanufacturing,SixSigmaandotherte chniquestoprevent foodloss(Doraetal.2013b).Whiletheconceptofleanmanufacturinghasonlybeenapplied recently in the food industry to reduce food loss during processing, it has already been shown to be an effective tool that can be successfully implemented in various companies, eveninSmallandMedium-sizedEnterprises(SMEs),andacrossfoodsectorsandcountries (SimonsandZokaei2005;Lehtinenand Torkko2005;DoraandGellynck2015;Doraetal. 2013b). In addition, as also observed during data collection, the inclusion of food loss in KeyPerformanceIndicators(KPI)aswellastheuseofappropriateplanningandscheduling tools can also help companies to reduce the problem to manageable proportions. While KPIscanimproveawareness,targetingandmonitoringoffoodloss(Vlajicetal.2012), holisticapproachestoequipmentmaintenancecanavoidbreakdowns,smallstops,defectsor accidents (Tsarouhas 2007; van Kampen and van Donk 2014). Thereby, further research is neededtodetermineeffectivestrategiestoempoweroperatorsandcreatesharedresponsibility forequipmentmaintenanceandfoodlossmeasurement,suchasthrough visualizationoffood loss objectives (Vlachos2015).

Furthermore, estimation of the monetary impacts of food losses is crucial for creating awarenessamongfoodcompanies,astheycontinuouslyseekcost-efficiencyintheirproduc- tion process, including through waste reduction. As our data shows, relative costs of food loss vary substantially (between £0.6 and £5.9 per unit), which confirms the recent Waste &ResourcesActionProgrammestudy(WRAP2012).Thesefinancialfoodlossimpactsare

underestimated,asthetruecostgoesbeyondthemonetaryconsequences ofreducedsalesby including costs associated with, for example, the production and removal of waste, such as energy and labor (Beretta et al. 2013). As such, the real economic cost of food loss within food companies could be as high as 4% of the turnover (WRAP 2011,2012).

There is also a need to better evaluate the interaction between different stakeholders in the food chain (Dreyer et al. 2016). Such a whole chain approach requires the involvement ofdownstreamactors,suchasretailersandconsumersasthemajorcontri butorstofoodloss andwasteindevelopedcountries(Kummuetal.2012;FAO 2013),butalsoupstreamactors, likefarmers.

Discussion

Forabusinessenterprisetobesustainablefromaneconomicandanenvironmentalpointofview it has to use its resources efficiently and minimise waste generation. In a study carried out with 13companiesinEastAnglia,UK,itwasfoundthatannualsavingsof£1.1mcouldberealisedby reducingtheuseofrawmaterials,energy,waterandwastegeneration(Henningsson*etal*.,2004). Food waste occurs in every part of the supply chain and the magnitude of the problem is well documented by Stuart (2009). Food waste has an adverse effect on the environment because it contributestotheproblemoflandfillandwhenfoodiswasted,italsocontributestoGHGemissions and water usage because energy and water are used in growing the raw materials, processing the product and in storage and distribution. In a recent life cycle assessment carried out with fresh Australian mangoes, it was shown that waste contributed to 53% of the overall GHG emissions duringproduction,distributionandconsumptionphases(Juliano*etal*.,2010).As wellasminimising food waste, consideration should be given to value adding to waste by recovering valuable by productsfromwasteandusingfoodwasteasasubstratetogenerate energy, thusclosingtheloop and having a 'zero waste' system. However, this is not always possible or economically feasible. Large amounts of packaging are used in the manufacture of consumer foods and consideration should be given to minimising the amount of packaging used without compromising the quality orshelflifeoftheproductwithinasustainablefoodprocessingsystem.Arangeof biodegradable plasticsarebecomingreadilyavailablenowandalthoughtheyhavecertainlimitationsintermsof barrier properties and strength, and may not be suitable for all the food packaging requirements, developments in biodegradable packaging are likely to overcome these limitations. As a result, biodegradable packaging will be used in more applications and they will have market appeal for environmentally conscious consumers.

As the cost of energy has been steadily rising, the food industry has made advances in reducing its energy consumption through process optimisation and control, energy recovery and recycling systems and good manufacturing practices. As a result, GHG emissions have been reduced. This trendislikelytocontinuebecauseoftheenforcementoflegislationincarbontradingsystemsand escalatingenergyprices.Inparallel,advancesoftechnologywillmakefoodfacto

riesmoreenergy efficient as shown by a recent study of the Australian prune drying industry, whichdemonstrated that up to 60% energy could be saved by optimisation and control of the process and utilising solar energy (Sabarez, 2010). However, in order to reduce the carbon footprint significantly, it is necessary to use renewable sources of energy and technological advances will continue to makerenewableenergysourcessuchassolarandwindenergyandlignocellulosetechnicallyand economically feasible.

Althoughsteadyprogresshasbeenmadeinenergyandwasteminimisationinthefoodindustry, waterminimisationhasbeennotaseffective.Thisismainlybecauseoflegislationagainsttheuse ofrecycledwaterinprocessedfoods,consumerperceptionandthefactthatinmostcountries,water isstillrelativelycheap.Asaresult,recycledwaterisnotusedinprocessedfoods.Therefore,even thoughitispossibletopurifywastewatertohighstandardsofqualityandsafetythroughfiltration and membrane technologies such as reverse osmosis, recycled water is not used because very often it is cheaper to pay for fresh water than investing capital in water purification plants. This observationappearstoberelevanteveninadrycontinentlikeAustraliaasshowninarecentstudy (Coventry *et al.*, 2009). However, it is likely that recycled water will be used in food processing plantsinthefutureasthecostofwaterincreasesandbecomemorescarce(especiallyincountries such as Australia). Furthermore, changes in legislation will allow recycled water to be used as technologieswillbedevelopedtoensurethattherequiredsafetyandqualitystandardswillbemet and consumer perceptions towards the use of recycled water in processed foods willchange.

A sustainable diet has the least amount of impact to the environment. Therefore, a high protein, meat based diet is not so good for the environment because meat products have a high carbon footprintcomparedtoavegetariandiet.Forexample,basedontheannualconsumptionperperson, a vegetarian diet produces only about half the amount of GHG emissions of a typical meat based Australian diet (Wright *et al.*, 2009).Therefore, environmentally conscious consumers maywant

to switch from a meat based diet to a vegetarian diet. However, it is important to consider the nutritional as well as the environmental implications of consuming a vegetarian diet.

Theimportanceofenvironmentallyfriendly(socalled'green'or'eco')products toconsumersis demonstratedfromarecentstudybyManget*etal*.(2009)oftheBostonConsultingGroup,where aglobalconsumersurveywascarriedouttoassessgreenattitudesandshoppingbehavioursacross nine countries. This study found that the green market share is growing and that consumers want tobuygreenproductsevenduringtheeconomicdownturn.Whatisinterestinginthisstudyisthat it appears that consumers are willing to pay a little more (5–10%) for green products. This is not always the case however and generally, except for a niche market of environmentally conscious consumers,mostconsumerswillnotpaymoreforgreenproducts.Thiswasconfirmedinarecent focus group carried out in Australia (Sellahewa, 2010), where the participants pointed out that although the consumer awareness and demand for green products are increasing, the cost of the product is still one of the most important factors in consumerchoice.

Consumercommunicationwithrespecttoenvironmentallyfriendlyproductsisalsoimportant.As withnutritionallabelling,consumersbecomeconfusedwithtoomuchinformationontheproduct labels and it is important to communicate the environmental friendliness of a product simply, so thataninformeddecisioncouldbemadeatthetimeofpurchaseofaproduct. Oneofthedifficulties in communicating the environmental impact of a product to the consumer is not knowing what an environmentally friendly product really mean because currently there is no clear definition or standardforsuchproducts.Generallyaenvironmentallyfriendlyproduct willhaveapositiveimpact on the environment in terms of low carbon and water footprints and minimum waste generation. Asthefoodprocessingindustryisaglobalindustrywithmanyimportedproductsonsupermarket shelves, it is necessary to standardise the methodology used for quantifying the environmental impactofproducts.Thecarbonreductionlabel(CarbonTrust,2009)isonesuchexample.Inorder tominimiseconsumerconfusionwithrespecttoproductlabelling,itisimportantthatretailersand

manufacturersimproveconsumerawarenessofenvironmentallyfriendlyproductsandcommunicate the environmental messages to consumers clearly and succinctly.

Although environmentally friendly products are important to consumers, from a business perspective, environmental friendliness on its own is not sufficient for the sustainability of a company.Ultimately,acompany'ssustainabilityisdependentonitseconomicviability.Therefore, a business has to consider sustainability from a holistic viewpoint and integrate all activities in the food processing system and the supply chain, including the production and sourcing of raw materials,storageanddistributionofrawmaterialsandproducts,manufacturingprocesses,product formulation, packaging and waste minimisation and management as well as efficient business practices. With such an approach, as well as improving its environmental credentials, it will also bepossibleforacompanytoreduceitsoperatingcostsandthusproduceandsellenvironmentally friendly products without charging a premium from theconsumer.

Conclusion

Although considerable advances are being made towards a sustainable food system in food processingandintegratingfarmandpostfarmoperations,realsustainabilitywillonlybepossible by reducing consumption. This will not be easy because of increasing global affluence and will only be possible by adopting behavioural changes by consumers so that good quality, nutritious food could be eaten in adequate quantities without imposing a burden on the environment, thus conserving our finite resources towards a sustainablefuture.

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