TEAGASC TECHNOLOGY FORESIGHT 2030

The Global Consumer Landscape for Food: Paradoxes, Tensions and Contradictions

Key Messages

Continued growth in demand for food can be expected due to an increasing global population and rising incomes. While this presents a positive outlook for food producers it is tempered with concerns about the impact of the food system on the environment and the health and wellbeing of citizens. These macro level developments will influence the 'rules of the food business game' and shape future consumer food attitudes, beliefs and ultimately behaviour. The rules will also be guided by what technology can do for the consumer. Increasing levels of technology diffusion that support consumer knowledge, facilitate choice and enable the enactment of a desired lifestyle will result in new product forms and modes of delivery being demanded.

In tandem with these global macro-level changes, country and household level changes are being observed. These changes result in an on-going evolution in the role and meanings of food within households and across society. The continued changing roles of women within society, increasing levels of education across many cohorts of society, greater appreciation of health and social inequalities and income insecurity, for example, have already caused change in what food attributes are prioritised by consumers.

Traditionally policy addressing the food sector was focused on production, e.g. the Common Agricultural Policy. While policy influences on food production will continue, the impact of public policy on food consumption will increase over time with policy influences originating from a range of diverse issues. These include global challenges related to climate change, health challenges as a result of over/under consumption and demographic changes such as an aging population. Consumer behaviour cannot be sufficiently influenced through market forces to address these issues, e.g. in general consumers are not willing to pay for sustainable production of food. Moreover, some policy initiatives have been shown to be successful in this arena. Thus as the externalities associated with food production and consumption increase, they will increasingly be addressed from a policy perspective. This will have a significant impact on who is involved in influencing the food supply chain. Non-supply chain actors, e.g. municipal administrations and civil society actors, will have an increasing role to play in influencing the chain. Simultaneously, public goods associated with agri-food production (e.g. Carbon sequestration) will be made more visible to consumers, stimulating increased recognition of the value of such goods from a market perspective, as well as reinforcing policy initiatives.

Introduction

General socio-demographic changes for the next 20 years or so have been well documented. The most significant of these include dramatic increases in global population (forecast to increase to about 9.6 billion people by 2050 resulting in a demand for 70% more food (ETP, 2014), rising incomes particularly in developing countries (Meade and Rosen, 2013) and increased levels of

urbanisation[1]. These changes are resulting in complex changes in consumer behaviour in relation to food. At its most fundamental level, "nutrition transitions" are evident at population level as a result of economic development. Amongst other changes, food transitions are observed in many low and middle income countries with a trend (referred to as pattern 4) towards increased consumption of fat, sugar, processed foods and animal proteins (Henchion et al., 2014). However given the potential for food to fulfil a range of diverse needs, many other factors are influencing food consumption and shopping behaviour, either directly, or indirectly though policy initiatives.

In tandem with these changes are dramatic advances in the world of science and technology that impact on how these changes play out, i.e. they influence how socio-demographic changes will affect food production and processing. This paper outlines some developments in the global consumer landscape, highlighting paradoxes, tensions and contradictions that result from the complex interplay of a wide range of factors.

King Canute – stemming the tide on aging

In almost all countries across the globe the proportion of the population aged over 60 years is expanding at a rate faster than all other age groups. Globally 2 billion people will be over the age of 60 by 2050 (WHO, 2015[2]), while within Europe 25% of the population will be aged 65 and older by 2050. These consumers, many of whom have high levels of disposable incomes[3], along with governments concerned with rising health care costs, are looking for 'healthier' aging to occur, i.e. they want to "add life to years" not just "years to life". Indeed current European policy aims to enable EU citizens to lead healthy, active and independent lives while aging. Thus foods that fit with each life stage requirements will gain traction in the market over the coming years. Evidence of efficacy in health maintenance/protection will be central to their success.

"The elderly" is not a homogenous group (den Uijl et al., 2014). Differences among older consumers are evident in terms of factors such as their food behaviour and attitudes, the importance they attribute to taste and health, their interest in trying new foods and also the emotions they associate with mealtimes. These are strongly influenced by their life experiences and health status. Furthermore, there is strong evidence that eating behaviour changes significantly as adults' age due to many physiological changes including reductions in sensory perceptions; increased difficulties in chewing, swallowing, and digesting; loss of appetite as well as changing requirements for many macro- and micro-nutrients. This provides interesting opportunities in product design and development that focuses on maintaining the enjoyment associated with food among older consumers as well as meeting nutrition and health requirements. For example, foods that meet enjoyment needs and also address sarcopenia (loss of muscle mass, which is currently estimated to affect 5% to 13% of people aged 60 to 70 years and 11% to 50% of those aged 80 or above in developed countries (Von Haehling et al., 2010)), vitamin D deficiency and other health issues are likely to meet with market acceptance. Thus the development of new food products, targeted at

[1] It is estimated that even in less developed countries most of the population will be living in urban areas by 2017 (WHO, 2014).
[2] http://www.who.int/mediacentre/news/releases/2014/lancet-ageing-series/en/
[3] In Great Britain, 80% of private wealth is owned by older people and over 50% of discretionary income is the US is controlled by the over 50s (Bord Bia, 2013)

older consumers, needs to take account of food behaviour, health status and physical ability and social circumstances.

Along with independent living older consumers, the needs of those residing within institutions are increasingly being catered for at the individual level. In the future, we can expect that foods will be part of the 'medicine script' thus ensuring optimal living of the individual resident, given their health status. Food scripts will be written and food service providers will produce meals (that are enjoyable for the resident but also rich in desired macro and micro nutrients) to exacting specifications in food production facilities. Within this context the supply chain system will need to ensure timely delivery of food to these residents and apply technologies that maintain of the integrity of the food.

In addition to those at risk of malnutrition (up to 85% of older adults are malnourished in some countries with the highest prevalence observed in clinical settings such as nursing homes and hospitals (Chen et al, 2001)) there are sub- segments within the older cohort who are active and who want to age healthily. Increasingly these individuals will choose/be able to avoid a nursing home setting and avail of housing in a sheltered setting. These individuals will demand foods that help to preserve their quality of life and independence for as long as possible. Food products that improve/maintain cognitive function, muscle mass and nutrient balance will have a significant role in meeting this need. E-health covering electronic/digital processes in health including healthcare practices using the internet will also be important for this population. The potential to link e-health and tailored nutrition advice for such groups has yet to be explored.

Help Me but Leave Us Alone

The promise of longevity has resulted in attention focusing on the quality as well as numbers of years of life. The irony of many new medical technologies is that their use has resulted in many becoming dependant on medical care to sustain their life, which has a direct and significant negative effect on quality of life. The next generation of innovation is focusing on illness prevention or health maintenance. A confluence of technology advancements in medicine, digital media, food and genetics offers a digitally connected society the opportunity to become 'wardens' of their health. Monitoring devices will allow for personal objective 'diaries' on 'risk factors' that could set an individual on a sub-optimal health trajectory. This information could combine with, for example, biomarker data and provide the individual with advice on the relevant foods to consume to address deficiencies in their diets and lifestyles. Those interacting with these devices will look at food in terms of its macro- and micro- nutrients and will achieve balance in their food lives through aligning what they now know they are doing (though monitoring technology) with what they have been advised to do (to fit their personal genetic make-up and lifestyle). From a consumer perspective unconscious/subconscious food choices will become known to the individual through digital monitoring and real time awareness of the consequences of particular patterns of food/drink behaviour will facilitate timely corrective actions. This monitoring and mentoring will guide the individual on maximising physical and mental health and wellbeing. One could argue that these technologies will help place the fate of the individual in their own hands. The decisions of the 'warden' will be based on information provided about foods being consumed and the design of products that fit with the physiological and psychological needs of the body at various stages in life.

Clearly all consumers will not conform to this 'self-wardening' approach to food and lifestyle. Equally it will not be applied within all contexts. Indeed when the eating episode relates to the mundane, everyday aspects of life that are characterised by routine and habit a 'me' focus will steer individuals to engage with these monitoring and mentoring devices. Questions that will drive choice will revolve around what can this ingredient do for me (my health, my physical appearance, my mood)? Foods will be stripped back to their core nutrients and the benefits offered by these. However, when food is facilitating social interactions, (outside of the everyday family interactions) which are normally associated with happiness and joy, monitoring and mentoring will be set aside. In these cases sharing, enjoyment, adventure, connection and release will drive choices. Foods with personality and pedigree that are indulgent will be sought. Macro- and micro- nutrient details will be ignored within the consumption context but may be compensated for later. Thus a dichotomy in choice behaviours will be evident.

Polarisation of the role of food in fulfilling consumer needs

From birth, food is a central part of life however the need that food fulfils is not always the same. While for non-human animals food is primarily viewed as a source of nutrition, for humans, particularly where food supply is not restricted, nutrition is only one of many frames (Rozin, 1999)**.** In the developed world food fulfils a range of needs from functional requirements to status seeking. There is evidence now to suggest that consumers are looking for food to fulfil even higher order needs in terms of self-actualisation. Indeed the millennials (22-30 year olds) are shifting their focus from conspicuous consumption to using food as a means of being connected to the world. Food and drink products are chosen to express "goodness" credentials and green values (Bord Bia, 2014). Furthermore the transformation of food (by the individual) into meals that are 'real and connected' represents a truth about the role of food, and in a world of food abundance, the nutritive value of food has become more of a moral issue. This can be seen in concerns being expressed about the impact of social inequalities on diet, and thus food related illnesses.

Within this context, for certain market segments, one of the key drivers that will influence future food choice is that of "giving to society". Such giving to society will be actioned through choosing alternatives that are connected to place, people and/or particular processes. This will build on the concept of 'real-foods' and craftsmanship, but transparency in value creation is a prerequisite. The promise of, for example, ethically produced, environmentally sensitive, and handcrafted foods illustrates the increasing importance of credence attributes and underlies the need to create trusted brands that have character and credibility. These character rich products will need to be positioned accordingly to command a premium price within a market that is also concerned with value. In addition, brands that design products that attempt to alleviate the impact of social inequalities on diet (i.e. value line variants of health enhancing/maintaining food) will meet with the approval of many within society.

Non-identical twins – obesity and malnutrition, and food allergies

The worldwide cost of obesity is estimated at $2tn (Dobbs et al., 2014). It is a particular cause for concern amongst children with about 43 million children under the age 5 reported to be overweight in 2010 (WHO, 2014). This has led to a growth in opportunities for products with reduced/lower fat

levels with 0% fat options available in some products that would traditionally have included fat. It has facilitated product differentiation opportunities in some categories that were previously considered commodities. For example, liquid milk is available in full fat (3.5% fat), low fat and skimmed options. However the challenge in relation to food and health is much broader than obesity. The ETP (2014) reports the FAO as saying that more than half of the world population is food insecure with an unhealthy, nutrient poor diet consisting of too little or too many calories. The WHO (2010) estimates that there are about 104 million underweight children on a worldwide basis. Noteworthy also is the changing spatial distribution of under-nutrition. While traditionally under-nutrition has been associated with developing countries, it is also now of concern in developed countries in particular population segments (including the elderly as identified above, and children). Ljungqvist and de Man (2009) argue that an estimated 33 million people are at risk of malnutrition in Europe while Russell (2007) reported that the cost of treating patients with disease-related malnutrition within the EU is approximately twice that of the management of obesity and its consequences. Thus in parallel with the obesity challenge a significant concern with under-nutrition and the set of challenges it presents also exists.

Another growing health concern amongst consumers is food allergies. Food allergy is a major public health problem affecting between 2 to 6% of the European population. Depending on the definition used, up to 12% of children in the Western world are affected by food allergies, the most common of which are milk, eggs and nuts (Burks et al., 2012, cited in Stjerna, 2015). This is manifest in significant growth in the "free-from" market. For example in the liquid milk category "Fresh Unflavoured Milk" represented 42% of global milk spending of €142.7bn in 2013, however soy drinks and soy milk (i.e. dairy-free) were projected to become the fastest growing categories globally within the liquid milk category in the period 2013-2018 at 7.31% and 6.75% each respectively (Datamonitor, 2014a). This highlights a significant opportunity to develop dairy (nut/egg) alternatives in a number of food categories.

In addition to causing ill-health and potentially death, food allergy can significantly detrimentally affect quality of life, not only for those suffering from food allergies, but also others within their environment, including schools and work environments. This can result in food being a source of conflict. Risk management requires constant vigilance by the person affected (and the parents if a child is affected) and often times responses by people not affected by the condition. Consequently people with allergies may be faced with social as well as health risks, and there may be a tension for parents seeking to control and protect their children on the one hand and allowing them increased independence and freedom over time (Stjerna, 2015). While the social needs fulfilled by food are appreciated, increased appreciation of the impact of the social circumstances of consumption for specific groups (including the elderly as highlighted above) could provide opportunities for innovative product formats and delivery modes.

Sustainable Food Production and Consumption

Combating climate change is one of the most important challenges of the 21st century. While greenhouse gas emissions (GHGE) primarily arise from the combustion of fossil fuels in the energy sectors, agriculture and food production have also been highlighted as significant contributors to

anthropogenic climate change. The carbon footprint of food is important in this regard. Other sustainability challenges include water shortages, pollution of soil and water, decreasing biodiversity and waste throughout the supply chain. Food consumption is implicated along with food production in these broader sustainability challenges.

In principle, given the increasing recognition of the impact of food choices, eating habits and food consumption patterns on climate change, biodiversity, and the use of natural resources (Steinfield et al., 2006; Dagevos and Voordouw, 2013) there should be significant market opportunities for products promoted on a sustainability platform. Indeed Buttriss and Riley (2011) point out that nutrition and sustainability provide an opportunity to harness two drivers for dietary change. However, according to Henchion et al (2014) it is not yet clear whether there is a strong direct market opportunity for industry in addressing consumers' environmental concerns. For example, the market for organic foods represents a niche in most markets and consumer willingness to pay for products offering environmental benefits is low. Datamonitor (2014b) highlight an "ideal-reality gap" between consumer concerns and either understanding or willingness to do something about it. Lack of understanding of sustainability, and related concepts such as biodiversity, and their importance, is a significant barrier to changing behaviour (Datamonitor, 2014b). A lack of willingness is partially because consumer concerns relating to environmental sustainability tend to be collective and operate at the societal level, rather than individual operating at the consumer level (this is in contrast to concerns relating to safety, health and organoleptic properties which tend to be individual) (Dransfield, 2005). A further reason relates to the practical difficulties of providing advice to consumers. For example, seeking to integrate guidance to reduce GHGE's of the diet with dietary recommendations for health adds a significant level of complexity and oftentimes represents a change from precedent. (An example of the latter is the historically intentional influences from a public health perspective designed to increase meat consumption but a change more recently with certain governmental dietary guidelines designed to decrease meat consumption (Kanerva, 2013)). A further reason could be a lack of visibility of, and thus appreciation of the value, of the public goods associated with food production (e.g. landscape features, local traditions and culture). Given this market failure, there is pressure on policy makers, amongst others, to seek to influence consumer behaviour and achieve more sustainable consumption. Many non-supply chain actors believe they have a role in raising awareness among the general public regarding the impact of food production on the environment, and of the role of many actors in encouraging measures for mitigating such damage. The FAO in particular highlighted the "*the very substantial contribution of animal agriculture to climate change and air pollution, to land, soil and water degradation and to the reduction of biodiversity*" to "*encourage decisive measures at the technical and political levels for mitigating such damage*" (Steinfeld et al., 2006, p.iii). This approach suggests that externalities associated with food consumption are likely to end up being paid for by the tax payer rather than the consumer as a result of government policies that could seek to influence production and/or consumption of food so as to reduce its environmental impact.

Public procurement is seen to be an important policy instrument for supporting sustainability. European policy makers have identified the "greening" of public procurement as supporting sustainable production and consumption and many public authorities at local, regional and national level within Europe have adopted sustainable procurement practices (Barling et al., 2013). Indeed Barling et al. (2013) argue that "*public procurement is one of the most powerful tools urban governments have at their disposal to fashion sustainable food systems that prioritise quality foods*"

(p9). Alternative food sources are seen as presenting an opportunity in this market in the medium to long term. For example, significant research funding has been put into alternative sources of protein (including protein derived from plants, insects and algae) in an effort to feed the growing global population without having significant detrimental environment impacts. Cultural barriers to acceptance of such food sources are being researched (O'Callaghan et al, 2014) including presenting such products in different formats, e.g. insect flour as opposed to whole insects (Datamonitor, 2014b). Technology developments, e.g. intelligent fridges, which result in "smart" food, also have the potential to improve efficiency of food production and reduce waste (Davies and Doyle, 2015).

Knowledge of link between diet and health and awareness/interest in agriculture/food production

As new knowledge becomes available, the role of food in relation to health continues to evolve with a consequential impact on consumer attitudes and behaviour regarding for example what constitutes a healthy product. Traditionally food had a role in providing for basic nutritional needs. As knowledge of the role of diet in relation to health has increased, food is no longer just associated with fulfilling basic nutritional needs or presenting diseases associated with particular nutritional deficiencies (e.g. vitamin C and scurvy). It is now increasingly about maintaining health and wellbeing through products with added health benefits as well as foods known to be health enhancing. The trend is evolving to place growing emphasis on the positive health benefits of products rather than highlighting that the product is "free from" something that may have a negative health impact. As our knowledge of food and health increases, and the healthcare sector exploits this knowledge more, the role of food in relation to treatment will increase. In the USA, approximately two thirds of shoppers are using dietary means to manage specific health conditions (IFT, 2011).

In the past "healthy" products were associated with sensory limitations and higher price. Nowadays health cannot be delivered at the expense of taste for most consumers; shoppers using dietary means to address specific health conditions are also demanding that these foods deliver on taste and value (Cargill 2015). With advances in science and food technology, healthy products may not have to be delivered at the expense of taste. However this can result in concerns about naturalness which may be a challenge as consumers sometimes tend to define healthy products in terms of what is not in the product, e.g. no additives, colours or preservatives. Interestingly however, consumers do not necessarily associate reformulated foods that are lower in salt, sugar or fat foods with being healthier according to MMR Research Worldwide in 2015. (In fact, consumers are not interested in reduced salt to the extent that food manufacturers do not necessarily communicate to consumers that they have reformulated their products to reduce salt. Reformulation tends to be undertaken in response to regulatory pressures). Food companies are responding to this changing health trend and evolving consumer demands by reducing, balancing and enriching products.

Health is also linked to other trends, e.g. convenience and increased interest in ethics. Consumers value animal-welfare friendly as they associate animal-friendly production practices with a healthier resultant product. With regards to convenience, "health on the go" products will be in favour. This indicates an opportunity to develop products that can be marketed on a multi-attribute platform, e.g. health and ethical benefits linked together.

Verbeke et al. (2010) illustrate that while credence attributes such as safety were generally assessed using extrinsic cues, such as brands, use-by-date and independently certified quality labels, evaluation of the healthy attribute involves an amalgam of intrinsic and extrinsic uses. Importantly they note the significance of confidence and trust in the use of extrinsic cues and draw attention to the value placed on independent institutions' certification. Therefore, regardless of these advances in science and knowledge, consumers want any nutrition and health claim to be verified by independent authorities, highlighting the role and influence of 3rd parties on the food supply chain.

In contrast to a reduced knowledge and awareness of how food is produced and processed in an increasingly urbanised society, there is an increasing interest in urban agriculture. The "green roof" concept is popular in North America. Gotham Greens in the US is reported to be "New York State's leading producers of premium quality greenhouse-grown vegetables and herbs" (Datamonitor, 2014b, p32). In addition to resulting in new connections between food production and place for consumers, such urban agriculture highlights the increasing role for municipal administrations, urban and national governments, civil society and the wider academic community in the food system.

Technophiles with risk aversion tendencies

Rapid developments in science and technology have had differential impacts on consumer behaviour. On the one hand the use of information, communication technologies (ICT) is ubiquitous and levels of adoption are high in developing as well as developed countries. Consumers are using such technology as a way to access and share food related information. Mobile devices allow consumers to, for example, share information in online discussion fora, search company information and see who endorses products. Such technologies are also used for non-utilitarian/functional reasons (e.g. social media) to allow consumers share information and build or contribute to the development of online communities. "Foodie" social networks and other advances in ICT have resulted in these becoming trusted sources of information and are rapidly becoming an integral part of the food decision process.

While sophisticated traceability systems give significant assurances with regards to food safety, technological advancements in the design of foods are continually met with resistance, distrust and cynicism. Consumers will not accept novel foods and novel food technologies (e.g. nanotechnology) without consideration of the risks as well as the benefits. This has implications for the regulatory framework around food. Regulation related to food safety has evolved to include chemical as well as food safety risks, and is now addressing potential risks associated with novel foods and emerging food technologies. The challenge however continues for such regulatory frameworks to keep pace with scientific and technological advances (Handford et al., 2014). The emerging challenge for the scientific community is to identify and develop the tremendous additional potential that arises from synergies as a result of using different food technologies, and more significantly from using food technologies together with technologies that may be more strongly associated with other sectors, without alienating consumers.

Conclusions

Consumers, being individuals, will continue to behave according to their individual motivations, subject to environmental constraints, cultural norms, etc. The resulting range of permutations and combinations means that there will be paradoxes, tensions and contradictions in such behaviour when examined at market segment or population level. While this results in increased complexity, on the positive side, it means there is significant potential to develop products that can be marketed on a multi-attribute platform, e.g. health, convenience, sustainability and ethical benefits within one product.

The issues highlighted above have implications for the supply chain and the extent to which non-supply chain actors influence food production and consumption. For example, it is likely that there will be increasing policy interventions in relation to food production and consumption as governments seek to improve public health, promote healthy aging and address issues such as sustainability. They also have implications for the development of science, technology and innovation as conflicting and diverse demands necessitate scientific solutions and in many cases require multi-disciplinary research and innovation, involving collaboration with other sectors such as ICT, manufacturing, energy, transport, water, agriculture, etc. This in turn has implications for public engagement/science communication as consumer acceptance of such solutions will depend on how consumers make sense of such technologies and oversimplified assumptions of consumers' acceptance of novel foods and novel food technologies may lead to counterproductive commercialisation and communication strategies (Greehy et al., 2013). The role of the media (including social media) in framing these issues for consumers/citizens also needs to be understood.

References

Barling et al, 2013, Revaluing Public Sector Food Procurement in Europe: An Action Plan for Sustainability. Retrieved from: http://www.foodlinkscommunity.net/fileadmin/documents_organicresearch/foodlinks/publications/Foodlinks_report_low.pdf on 30/3/15

Bord Bia, (2013.) Healthy Aging: the Seniors Market, Retrieved from: http://www.bordbia.ie/industry/manufacturers/insight/publications/bbreports/Documents/Healthy%20Ageing%20Seniors%20Market%202013.pdf on 30/03/2015

Bord Bia, (2014). Understanding millenials for better connections, July 2014, Retrieved from: http://www.bordbia.ie/industry/manufacturers/insight/publications/bbreports/Documents/Understanding%20Millennials%20for%20Better%20Connections.pdf on 30/03/2015

Burlingame, B. (2010). Sustainable Diets and Biodiversity Directions and Solutions for Policy, Research and Action. Rome: Food and Agriculture Organisation. Retrieved from http://www.fao.org/docrep/016/i3004e/i3004e.pdf

Buttriss, J., and Riley, H. (2013). Sustainable diets: harnessing the nutrition agenda. *Food Chemistry*, 140(3), 402–7.

Cargill, S. (2015). Three Mega Trends to Watch Redefining Value, Luxury and Wellness to Create Meaningful Food Experiences. Retrieved from: https://cargillsaltinperspective.com/three-mega-trends-to-watch/

Chen, C. C.-H. , Schilling, L. S. and Lyder, C. H. (2001). A concept analysis of malnutrition in the elderly. *Journal of Advanced Nursing*, 36, pp131–142.

Datamonitor, (2014a). Consumer and innovation trends in milk 2014, Datamonitor Consumer, August, 2014

Datamonitor, (2014b). Biodiversity promoting global species balance and preventing extinction through responsible ingredient sourcing, Consumer Insight, TrendSights Series, November

Dagevos, H., & Voordouw, J. (2013). Sustainability and meat consumption, is reduction realistic. *Sustainability: Science, Practice & Policy,* 92(2), pp60-69.

Davies, A. R. and R. Doyle (2015). Transforming Household Consumption: From Backcasting to HomeLabs Experiments, Annals of the Association of American Geographers, 105:2, 425-436.

Den Uijl, L.C., G. Jager, C deGraaf, J Waddell and S Kremer, (2014), It's not just a meal, it is an emotional experience – A segmentation of older persons based on the emotions that they associate with mealtimes, *Appetite,* 83 (1), pp287-296

Dobbs, R., Sawers, C., Thompson, F., Manyika, J., Woetzel, J., Child, P., McKenna, S. and A. Spatharou (2014), How the world could better fight obesity, McKinsey Global Institute, November, Retrieved from: http://www.mckinsey.com/insights/economic_studies/how_the_world_could_better_fight_obesity on 30/3/2015.

Dransfield, E. (2005). Consumer importance in creating demands for meat and meat product safety. *Tehnologija Mesa,* 46(1-2), pp3-10.

European Technology Platform Food for Life (ETP)(2014) Strategic Research and Innovation 2015-2020 and Beyond Implementation Plan under Horizon 2020, Retrieved from: http://etp.fooddrinkeurope.eu/documents/2014/141201_SRIA_update.pdf on 30/03/2015

Greehy, G. M., McCarthy, M.B., Henchion, M.M., Dillon, E.J, and McCarthy, S.N. (2013). Complexity and conundrums. Citizens' evaluations of potentially contentious novel food technologies using a deliberative discourse approach. *Appetite* Vol. 70, 1 November 2013, pp37–46

Handford, C., Dean, M., Henchion, M., Spence, M., Elliott, C. & Campbell, K. (2014). Implications of nanotechnology for the agri-food industry: Opportunities, Benefits and Risks. *Trends in Food Science and Technology*. Vol. 40, No. 2, 12.2014, pp226-241.

Henchion, M., McCarthy, M., Resconi, V. and D. Troy (2014). Meat Consumption: Trends and Quality Matters, *Meats Science,* 98 (2014), pp. 561-568 DOI information: 10.1016/j.meatsci.2014.06.007

IFT 2011 Top Ten Food trends. Retrieved from: http://www.ift.org/food-technology/past-issues/2011/april/features/food-trends.aspx?page=viewall

Ljungqvist O & de Man F., (2009). Undernutrition – A major health problem in Europe. *Nutricion Hospitalaria* 24, pp368–370.

Meade, B. and Rosen, S. (2013) International Food Security Assessment 2013-2023 GFA 24 US. Department of Agriculture, Economic Research Service, June 2013

O'Callaghan, J., Henchion, M. and M. McCarthy (2014), An Offal Way to Add Value to Cattle, *Todays Farm,* July August, p10-11

Rozin, P. (1999). Food is fundamental, fun, frightening, and far-reaching. *Social Research*, 66, pp9-30

Russell, CA. (2007). The impact of malnutrition on healthcare costs and economic considerations for the use of oral nutritional supplements. *Clinical Nutrition Supplements*, 2(1), pp 25–32.

Steinfield, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M., & de Haan, C. (2006). Livestock's Long Shadow, environmental issues and options, Food and Agricultural Organization of the United Nations, Rome.

Von Haehling, HS, Morley JE, & Anker SD (2010). An overview of sarcopenia: facts and numbers on prevalence and clinical impact. *J Cachexia Sarcopenia Muscle* 1, pp 129-133.

WHO, (2014). *Healthy ageing*. [Online] Available at: http://www.euro.who.int/en/healthtopics/Life-stages/healthy-ageing