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Food supply chains in developed countries and livestock production systems

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Key Points :

- 1 . Food will become increasingly linked with identity because competition for food will increase due to population growth , increases in affluence , and constraints on livestock production systems .
- 2 . Food markets will become increasingly fragmented and diverse offering livestock producers opportunities to grow their businesses .
- 3 . Livestock producers will need to adapt their systems so that they can be responsive to consumer requirements such as specific tastes or flavours , or specific health functions while maintaining environmental and economic resilience .
- 4 . Producers will need to become more closely engaged with consumers either through close alignment with processors and retailers or through direct sales ; producers must consider consumption .

Key words : food supply chains , production , consumption , risk , culture

Food , culture and food consumption

Most producers in developed countries are not concerned with food consumption , or even food consumers , but with the production of commodities (Belasco , 2002) . Generally , food is relatively invisible or unthought-of , especially in developed countries , with a few exceptions such as the emerging local food movements , and even taken for granted by many consumers . This is because traditionally , food production and preparation involved considerable effort , and the drive for technology to reduce or eliminate this burden (convenience and fast foods , processed foods at the preparation and consumption end ; and automation and mechanisation at the production end) have led to a distancing from the traditional rituals and practices of food production (Belasco , 2002) . The meat packing industry has spent the last 150 years trying to insulate consumers from the process of disassembling warm-blooded mammals into refrigerated plastic-wrapped chops and patties" (Belasco , 2002 , p9) .

Food is , and has always been an important part of culture , serving to create and maintain social relationships and group identities and is often connected to rituals (Mintz & Du Bois , 2002) . However , in many developed countries , this role has become vague due to processing , packaging and marketing . Consumers have also contributed to this vagueness , because processors , packers , marketers and retailers have largely been responding to consumer values of the day . Increases in education , greater rates of employment among women , less eating as a family (the rise in conflicting schedules of family members and single households) and more frequent food consumption outside of the home have changed the ways in which consumers view food (Michman & Mazze , 1998 ; Street , 1999 ; Fearne & Hughes , 2000 ; Belasco , 2002) . Time is of the essence in a world built around mobility and immediacy . Average meal preparation times , in many markets , are now less than 20 minutes (David Hughes , *pers . comm .* , 2005) . Basic cooking skills have deteriorated and perceptions of what constitutes cooking have also changed . For example , the Policy Commission on the Future of Farming and Food (2002) reported that 44% of 17-24 year olds thought that shop-bought pizza and a salad is home cooking .

For today's consumers , quality , freshness , safety and healthfulness are also of paramount importance (Fearne & Hughes , 2000) . The adequacy of supply and intensely competitive nature of the food industry allow consumers to more readily exercise these choices . Products without these basic attributes have virtually no market outlet in developed countries , although there is still a large market for frozen food products (Street , 1999 ; Belasco , 2002) . There is now a well-developed interest in exotic foods , not just because of ethnically diverse populations , but because consumers are seeking variety , and new flavours and eating experiences , or looking to replicate cuisine tasted through international travel (Michman & Mazze , 1998) . In addition , there is a trend towards "traditional" foods , driven largely by sophisticated consumers . Many of these traditions around food have only recently emerged , and probably in an attempt by these consumers to relocate or even define their culture (Belasco , 2002 ; Mintz , 2002) . It is ironic that many of these traditions and the construct of national cuisines are invented (Belasco , 2002) . In what appears somewhat of a reversal , "peasants are eating more industrial foods , [while] the more affluent residents of the most industrialised societies are eating like peasants" (Belasco , 2002 , p18) in their pursuit of a food culture . Food can after all be about pleasure and self-expression or identity . The consumption of food is again becoming a moral act or about the expression of identity for some consumers , and not just amongst vegetarians . For example , some consumers are seeking products with credence factors like natural production systems and private codes of practice . However , many consumers express these values only some of the time such as when they have time or are seeking to impress guests . At other times , many consumers continue to buy foods that are cheap and may well be produced industrially .

A brief history of food supply systems in developed countries and livestock systems

Domestication of plants and livestock for food was a major human technical achievement , enabling the capture and control of energy (Mintz , quoted in Belasco , 2002) , and was the principal driver of civilisation (Diamond , 1997) . Technology ; the changing value of food industry resources , as food became a varying set of wants rather than solely a need ; and increases in

scale and globalisation have all contributed to the migration of power within the food chain . When supermarkets first opened , it became rapidly apparent that this retail format provided consumers with autonomy , choice and lower prices , so essentially a newfound sense of power built around factors that consumers valued (Belasco , 2002) . This situation offers consumers and retailers the power to become increasingly discerning about the attributes of the food they purchase ; and continually raises demands upon producers and others upstream in the food chain (Michman & Mazze , 1998 ; Street , 1999) .

The ways in which food and other agriculture-sourced products reach consumers are and will continue to change . Food supply chain structures are moving away from commodity-focused spot markets , towards tighter and more closely aligned relationships supplying differentiated food products that have been produced to quite specific private codes of practice (Boehlje et al . , 1998 ; Henson & Reardon , 2005) . Food supply chains are now competing against other supply chains rather than the traditional firm versus firm competition associated with commodity-focused supply chains . However , some food supply chains continue to focus on price but vertical relationships assist in ensuring certainty of supply and food safety . Supply chains are the unit of competition and of value creation . These changes are driven by four significant shifts :

- 1 . The globalisation of markets and product sourcing-Transport and communication technologies have advanced to the stage that international boundaries have effectively disappeared ; although significant trade barriers still exist . In addition , as consumers become increasingly urbanised , they have lost their links with food production systems and the associated understanding , because they no longer have family on farms , and quite possibly do not know anyone living on a farm . This has encouraged the demand for year-round supply of otherwise seasonal fresh products .
- 2 . The consolidation of stakeholders in the food industry-The increased opening of markets has encouraged the emergence of global retailers in addition to further growth of the global manufacturers who have been with us for much longer . These global retailers , driven by the need to satisfy increasingly discerning customers , are creating global networks for sourcing food products . This is happening especially quickly in the fresh food sector because of the absence of co-ordinated global fresh food suppliers . It also means that they can readily own-brand fresh foods .
- 3 . The shift from supply driven food chains to demand driven food chains-Cost was once a criterion solely for commodity products . However , now it is becoming an important factor in the purchasing decision for novel and differentiated products as retailers try to increase sales volume . Taste , appearance , healthiness , nutritive value , safety , quality assurance and freshness , once attributes offering differentiation , are all now basic requirements with respect to any food product . The factors that are now driving the differentiation of products are consumers values and lifestyles . Consumer values regarding animal welfare , ethical and organic production systems , local food production , the environmental impact of food production , and food safety are being encouraged by the media and lobby groups , together with the numerous recent food scares . Many of these concerns are being raised by non-consumers and groups quite remote from the supply chain . Stakeholders inside food supply chains often perceive these values to be irrational and illogical (Slovic , 1999) . This is one of the major challenges supply chains will have to overcome .
- 4 . The shift in power along the supply chain towards consumers-Power in a supply chain lies with the stakeholders who own the least substitutable resources (Boehlje et al . , 1998) . At one stage , the least substitutable resource was the knowledge of how to efficiently produce raw food products . Such skills were adequate for meeting the consumer need for nourishment and survival , but the food products were standardised , bland and unattractive with no thought given to consumers . In commodity-focused supply chains , this has been labour and capital which favoured the processing and manufacturing sectors . This encouraged the shift towards industrialisation so that food could be delivered at lowest cost . Economies of scale were important . However , for differentiated products targeted to particular consumer segments , the source of power is knowledge about those consumers and their requirements . This situation favours retailers because they are closest to consumers and are more able to collect such information and knowledge . This knowledge resource is not about lowering cost , but about adding value , delivering precisely to the wants of consumers . Retailers have the capacity to communicate and dictate these demands to others along the food chain (Boehlje et al . , 1998) . In fact , ensuring that everybody involved is focusing on delighting their consumers with product attributes they most value , is one of the retailer's core functions within the food chain .

The characteristics of food supply chains in developed countries

Alongside these market shifts , there are three other motives for stakeholders to want to establish tightly aligned supply chain structures (Boehlje et al . , 1998) :

- 1 . To improve efficiency and control costs through leveraging assets and capabilities ;
- 2 . To reduce , transfer or change risk ; and
- 3 . To better match consumer demand .

Retailers having recognised consumer concerns , and the power of their demands , are implementing a vast number of quality assurance and traceability schemes in an attempt to increase food chain transparency on one hand , and to differentiate the products they sell on the other . Governments have introduced food safety regulations in response to consumer and lobby group demands to protect consumers . Often these have the additional benefit of protecting their own country's food chains and

producers (Henson & Reardon, 2005) .

Associated with the shift in power towards retailers , is the increasing importance of branding . Brands are a means by which margins are captured from knowledge about consumers . Over time , as consumption levels increase , retailers want to capture a larger share of the margin and consumers are less willing to pay premiums for differentiated products . This means that the cost of production must be reduced and margins of less powerful stakeholders are squeezed . In the United Kingdom (UK) , own-brand products account for nearly half of all food products purchased in supermarkets , and the fresh produce categories are almost exclusively own-brand . These brands are not focused at price-sensitive , quality-insensitive customers , but rather the most discerning shoppers . Retailers now recognise that fresh fruit , vegetables , meat and wine are the main destination categories for which customers will switch stores (Fearné & Hughes , 2000) . Therefore , these are the areas of their business they have focused most of their efforts , through the introduction of initiatives such as quality assurance , supplier relationships and risk management .

Impacts on livestock systems

In response to these pressures and trends , the designs of livestock system have been modified . Appropriate signals have been successfully transmitted along some food supply chains so that producers linked into those chains can change their systems to better meet consumer requirements . For example , producers have reduced the amount of chemicals used in their production systems ; adopted quality assurance programmes ; and removed livestock from cages . These signals may often be affected through government policy , such as the protection of land from grazing to allow reforestation or increases in biodiversity . Sometimes , processors have been able to manage supply through improved co-ordination across geo-climatic regions (e . g . to reduce seasonality of supply) , while in other situations , specialisation and intensification of livestock finishers have allowed this to occur .

However , many of the changes that have occurred on-farm have not been in response to markets and consumers . As mentioned above , most producers have been focussed on producing commodities for sale . The changes have been implemented in order to increase efficiency and lower production costs . This has been necessary due to land prices appreciating in many developed countries and product prices in real terms have tended to decline . Such changes have included increased livestock fertility , improved nutritional management of livestock , increased use of chemical fertilisers , and farm consolidation to achieve economies of scale to lower unit management costs and allow greater mechanisation , all in order to improve farm-level productivity and profitability .

Threats to livestock and food supply systems in developed countries

There are a number of threats facing global food supply systems . These threats are general to the entire system , but can also be specific to individual food supply chains . The critical threats are around certainty of supply including volume , cost and safety ; and the level of demand including growth in demand and changes in demand .

The supply-side threats exist because of widespread changes in land use , in particular the urban expansion onto flat and fertile land , the pursuit of more profitable (non-livestock) agricultural activities ; and more recently the emphasis on producing energy from agricultural crops in the United States (US) and Europe . A further compounding influence is variation in weather conditions which has been highlighted by recent long-running and widespread droughts in key exporting agricultural regions such as Australia , US and New Zealand (NZ) . This is compounding because as intensive livestock production is pushed out of regions with high quality soils and reliable rainfall , to more marginal areas , the overall production system becomes less resilient and capable of tolerating severe shocks . This land is also likely to be more prone to stresses such as erosion and introgression of pests and diseases . Certainly , the mitigation of these stresses is more expensive than on high quality land classes , with production systems less flexible in terms of timing of production being reliant on more variable weather patterns . Retailers , processors and manufacturers along food supply chains are increasingly concerned about any reduction in production flexibility .

The very success of human civilisation , driven by our expansion of agriculture , is paradoxically also now threatening the complex bio-physical eco-system which humanity and all other species require to exist (Steinfeld , et al . , 2006 ; Lovelock , 2007) . In an attempt to stem the rate of negative change on the Earth's eco-systems , largely for the benefit of humans which requires the ability to farm for food , livestock producers in many developed nations will increasingly be required to accept the costs of greenhouse gas emissions . This will increase the cost of food production , which historically producers have absorbed as they are generally unable to readily pass costs on to consumers . However , food producers in many developed nations are currently operating at low profit levels or indeed losses , so there is a very real risk of collapsing the farming sector , and hence running out of safe food produced in systems amenable to affluent consumers . Thus , food price inflation appears imminent . Recent high world grain and dairy prices , although driven by drought and the bio-fuel boom , indicate that inflation is underway . Retailers and consumers have yet to feel the full impact , and it will be quite unusual for them . The long-term real price trend for livestock food products has been a decline (FAO , 2004) .

The success of civilisation and capitalism has created a further challenge for food supply chains . The number of affluent consumers is increasing and this means that the demand for food produced in ways that meet the requirements of highly discerning consumers is also increasing . Meeting these demands at low prices puts even further pressure on already stretched production systems , encouraging further intensification in increasingly fragile landscapes . The other demand-side threat is the potential for consumers to change their expectations and values . This change could occur rapidly and be widespread . Already in countries like the UK and US there are significant moves towards a preference for locally produced food consumption , driven by perceptions of environmental-friendliness , quality , taste , choice (although this is probably reduced by the restrictions on local sourcing) , autonomy and support for local economies . These are also some of the attributes that supermarkets provide consumers , which have made them so successful . Some other developed countries , such as France , never lost the connection between consumers and producers . However , the question remains as to how successful and durable these new local and traditional food movements will be .

Future livestock and food systems

The critical questions associated with how livestock and food systems might function in the future include where will the production systems be located ; who will own them ; what livestock will be produced and how ; who will producers supply and who will be their ultimate customers ?

In many developed countries there are too many people to be fed by their domestic producers without either substantively changing the types of livestock produced and/or importing considerable quantities of grain or other feedstocks . This means that either , consumers eat a less diverse diet (and probably one containing less animal protein) or these countries continue to import food to ensure their consumers can eat in the ways in which they have become accustomed . As the externalities associated with livestock production (e.g. greenhouse gas emissions , eutrophication) begin to be accounted and producers subsequently charged for them , the costs will eventually trickle down to consumers . As a result , livestock protein may price itself off the shopping list on at least some days of the week for some consumers . However , as the middle classes expand in many of the currently transition economies such as China , India and Russia , there will be an increasing number of customers seeking the very food products that have , until recently , largely been the domain and privilege of customers in developed countries . Furthermore , some of these countries could become constrained in food production . This creates greater competition for animal proteins and food products produced to high quality , safety , ethical , animal welfare and environmental standards , and that taste good . Such competition will also exist for food produced in intensive feeding systems because of the non-food demands on grain supplies , which may further increase demand for extensively farmed red meats . This increase in demand competition could be a further driver of food price inflation , and see marked changes in the directions in the trade of food products . A NZ example could be that Western Europe may not dominate the purchase of quality lamb in the future ; the market may become much more diversified and include increased sales of specialised cuts to Asia .

If greater diversification of markets away from the traditional , developed country markets does occur , then taste will become the critical determinant of price . Asian consumers are much more taste-oriented than Western consumers (Tom Reardon *pers. comm.* 2008) . This means that livestock production systems for high-end final food products (e.g. beef and lamb) will need to be designed to deliver safe , ethical and environmentally friendly food that *really* delivers on taste . Culture , and food culture in particular , is going to have a profound influence on demand . These systems may involve quite radical changes in terms of livestock diets to include plant species against which many modern agricultural systems have selected . In turn , this is likely to require a reduction in intensification of the farm system , and may assist in attaining some of the environmental standards possibly required by communities and governments , as well as by customers . However , livestock prices are going to have to be higher to enable these changes to occur , unless these production systems are established in countries that are currently focussed on domestic supply . If governments collectively become more involved in globally regulating resource use , then production systems will be located where the natural resource cost is lowest , and therefore , production can be achieved efficiently from a natural resource perspective . Agricultural grasslands will be able to be managed to deliver the multiple objectives society demands if this diversification of markets occurs . Farms will be viewed as "managed , harvested eco-systems" because many of the factors affecting production will be considered within the agro-ecosystem (Weiner , 2003 , p373) . These production systems will appeal to consumers with a "food culture" . If this proves too expensive for many consumers in developed countries , then alternative food supply chains will establish and expand with production systems where the environment is valued less .

One of the other attributes consumers will be seeking from foods will be improved health or wellness . In addition to providing safe food , which is a base criterion ; the foods have a "functional" benefit beyond just meeting basic energy and nutritional needs . This trend can currently be observed with the wide range of products that are low in saturated fat , high in specific healthy fats/oils or marketed on their naturally high or elevated level of vitamins , minerals or anti-oxidants . The improved health trend may be more important to livestock producers who produce ingredients for food products , for example , dairy producers . Production systems designed to deliver these types of foods or ingredients may also involve radical interventions , but will see a continuance of the view of the "farm as a factory" (Weiner , 2003 , p373) . These types of systems may be located in limited areas focussed on intensive production of food or ingredients with environmental considerations limited to those that are

legislated .

In the medium term , retailers , as the agents for consumers , will be seeking to assume even greater control over their supply chains for fresh meat and other livestock products in order to remove risks (supply , quality and price) and to match consumer demands . Similarly , processors will seek to achieve these same objectives because they have responsibility for securing supply for retailers or integrators who prepare food into retail-ready packs . Processors will attempt to control their supply chains to manage risk and responsiveness by various ways . Processors could :

- Integrate backwards themselves through taking ownership of production systems (e .g . chicken and pork in most developed countries) ;
- Take ownership of livestock and require producers to follow prescribed management protocols , effectively leasing the land and labour (e .g . beef in US) ; or
- Contract producers to deliver livestock/products of specified quality and volume at agreed times (e .g . lamb and dairy in Australia and NZ) .

These options offer processors differing levels of certainty , differing types of risk and require quite different levels of investment . Similarly , producers obtain different returns with different levels of risk . They may become more , or less , embedded or engaged in the food system , and this may more closely align with their own personal values and aspirations .

Producers can however seek to take greater control of their livelihoods and reclaim control of the food supply chain . This requires producers to get much closer to consumers through direct sales . Technologies such as the internet allow producers to market and sell finished food products directly to consumers . Many supermarkets have already implemented internet-shopping routes with varying degrees of success . Other means for producers to connect with consumers include the recent rise in farmers markets and farm stores . In these market channels , scale and year-round supply may well be of less importance because the shopping experience is providing many of the other attributes some consumers are seeking . Customers for farmers markets are limited to people in the local region because of the geographic restrictions on sales , but the internet opens up the potential for wider domestic markets and even exports . However , it is unlikely that these channels will dominate food systems in developed countries . Rather these channels will attract consumers in both the food activist segment and those with a "food culture" .

Conclusions

Consumers are what they eat . As the competition for food increases through population growth , increases in affluence , and increase in constraints on livestock production systems , food will become increasingly linked with identity . Food will no longer be invisible , unthought-of , or taken for granted because the types of foods that affluent consumers desire will not be cheap . Food price inflation will reverse the historical decline in the cost of eating well . This means that food markets will become increasingly fragmented and diverse offering livestock producers an enormous array of opportunities to grow their businesses , including both high-value niche markets and high volume commodity markets .

However , to realise this potential , livestock producers will need to adapt their systems so that they can be responsive to consumer requirements while maintaining environmental and economic resilience . These adaptations may involve adopting practices or technologies to deliver specific tastes or flavours , or specific health functions or benefits . It will also involve producers somehow becoming more closely engaged with consumers either through close alignment with processors and retailers or through direct sales . It is essential that producers consider consumption . If producers can implement these changes , then the 21st century will be the century of the food producer , and in particular , grassland livestock producers .

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