

SHIFTING PARADIGMS IN INTERNATIONAL ANIMAL HEALTH STANDARDS: THE NEED FOR COMPREHENSIVE STANDARDS TO ENABLE COMMODITY-BASED TRADE

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Introduction

In an era of globalisation, international trade in livestock and livestock products continues to be seriously hindered by epidemic animal diseases, in particular those categorised as 'transboundary animal diseases' (TADs). These diseases have substantial impact on the economies or food security of a number of countries, spread rapidly and require co-operation between countries for effective control. Zoonotic potential is a further important factor in the categorisation of TADs (Thomson and others, 2003). The 'List A Diseases' of the *Office internationale des épizooties* (OIE) is a group of TADs that are judged, on a global basis, to be the most important disease constraints to trade in livestock and livestock products (OIE, 2003). The OIE has indicated its intention to review classification of animal diseases at the end of 2004 (www.oie.int) and "List A" will likely fall into abeyance.

In the industrialised world, the devastating effects of TADs are epitomized by the events following the introduction of foot-and-mouth disease (FMD) into the United Kingdom in 2001. Direct and indirect losses were estimated to have resulted in a 0.2% reduction in gross domestic product in 2001, and direct costs approaching £3.5 billion (Thompson et al. 2002). Other recent TAD episodes in Europe include classical swine fever (CSF) in The Netherlands and Germany (Mangen and others, 2001; OIE Handistatus II; www.oie.int), and highly pathogenic avian influenza (HPAI) in Italy and The Netherlands (Capua and Marangon, 2003; OIE Handistatus II; www.oie.int). These events demonstrate the risks involved in both legal and illegal trade in livestock and livestock products and in many industrialised countries measures to counter these risks are under constant review.

In the World Trade Organization's (WTO) 'Agreement on the Application of Sanitary and Phytosanitary Measures' (SPS Agreement) the OIE is recognised as the agency responsible for promoting trade by setting appropriate global standards on animal health. The Codex Alimentarius Commission sets standards for food safety and is jointly administered by two agencies of the United Nations *viz.*, the World Health Organization (WHO) and the Food and Agriculture Organization (FAO). As awareness of both animal health and food safety issues increases among consumers and the food industry (particularly in industrialised countries), so does the demand for safer food. However, the OIE's Terrestrial Animal Health Code (2003), hereafter referred to as 'the Code', is based on the precept that countries need to eradicate TADs within their territories and prevent their reintroduction. Once this is achieved, trade between such countries is considered to present low risk. Although there is undeniable logic in this approach, events in the UK in 2001 clearly demonstrated that trade with countries that are free of TADs is not risk-free: the UK inadvertently re-exported FMD to Ireland, France and The Netherlands before becoming aware that FMD had entered the country. Furthermore, the endemic nature of TADs in many developing countries effectively excludes these countries from international markets in livestock and livestock products. For example, 12 of the 15 OIE List A Diseases are endemic to sub-Saharan Africa, and many occur naturally nowhere else. The net result

is that international trade in livestock and livestock products is greatly constrained by TADs and lack of progress in eliminating them.

This paper reviews the feasibility and necessity of global eradication of TADs from the combined perspective of global animal health standards, the need for such standards to facilitate safe trade, and the current isolation of many developing countries from international livestock commodity markets. The paper proposes an alternative commodity-based approach for enabling safer and more equitable international trade in livestock commodities, and explains the potential benefits and practical implications of this approach for both developing and industrialised countries.

Trends and opportunities in international trade in livestock commodities

Prospects for eradication of TADs

The recent FMD epidemic in Europe has prompted renewed debate on the importance and practicality of controlling and eradicating TADs to promote international trade in animals and animal products (The Royal Society, 2002). Substantial progress towards global eradication of TADs is evident only for rinderpest. The Global Rinderpest Eradication Programme (GREP), administered by the FAO, has successfully spearheaded the fight against rinderpest and the disease is now confined to conflicted-affected areas of the Horn of Africa. Although often perceived to be a relatively simple disease to eradicate, mild forms of rinderpest persist in the Somali ecosystem (Mariner and Roeder, 2003) and are proving difficult to counter. Difficulties experienced by GREP are also highly relevant to other TADs and include delays caused by logistical, technical, financial and political constraints found in many developing countries. Furthermore, in both developing and industrialised nations the eradication of some TADs (e.g. HPAI, Newcastle disease [NCD] and CSF) is seriously hindered by uncontrollable wildlife involvement. In summary, apart from rinderpest there is no immediate prospect of any TAD being eradicated on a global basis.

The increasing importance of non-tariff trade barriers

In 1947 the General Agreement on Tariffs and Trade (GATT) was established with the aim of liberalising trade between the initial 23 member countries. By 1999 membership of GATT had risen to 132 countries responsible for over 90% of world trade (Anon, 1998), and through successive rounds of GATT negotiations, average tariffs had been reduced from 40% in 1947 to 4% in 1998 (Leslie & Upton, 1999). The Uruguay Round of GATT (1986 to 1994) committed member countries to reduce export subsidies, with preferential treatment for developing countries. Whereas developed countries were required to cut tariffs and export subsidies by at least 36%, a cut of 24% was agreed for developing countries. Furthermore, a group of least developed countries were not required to cut tariffs at all. This trend in tariff reduction demonstrates considerable progress since the establishment of GATT and recognition of the particular needs and capacities of developing countries.

The Uruguay Round of GATT also led to the establishment of the WTO, with the additional task of minimising non-tariff barriers to trade. Health standards related to trade in animals and plants is covered by the SPS Agreement. As previously indicated, the OIE is mandated by the WTO to develop animal health standards for the SPS Agreement, and these standards are published in the Code (2003). Since the late 1990s the global meat and dairy market has followed a similar trends to markets generally, with gradual removal of tariff barriers according to GATT agreements. However, access to these markets for developing countries has been seriously hampered by the growing application of non-tariff barriers (Athukorala & Jayasuriya, 2003).

In spite of the mandated task of WTO, the dismantling of tariff barriers under GATT has increasingly been substituted in livestock commodity trade by non-tariff barriers, notably measures requiring higher SPS standards to protect domestic markets under the guise of animal disease and food safety concerns (Athukorala & Jayasuriya, 2003). It follows that attempts to improve international market access for livestock producers in the developing world must include improving the capacity of these countries to operate within the SPS Agreement and the Code (2003), while ensuring that the requirements are equitable, justifiable and effective. However, changes to the Code would have to be scientifically based to conform to the principles of the OIE and the WTO. The need for a more equitable system is evident not only from the continuing isolation of many poorer countries from global livestock commodity markets, but also from increasing opportunities for so-called 'least developed

countries' to supply the growing demand for meat and dairy products to 'more developed' developing countries (sometimes referred to as 'low income countries'), i.e. markets resulting from the 'Livestock Revolution' (Delgado and others, 1999).

Animal disease control and international trade

The conventional approach: disease eradication

Within the SPS Agreement of the WTO, the underlying principle of the Code is that countries that are historically free of TADs, or that have instituted measures to become so, present the lowest risk of exporting potentially damaging TADs through export commodities. Each important animal disease is covered by a different chapter of the Code (2003). As already indicated in relation to HPAI, NCD and CSF, it is not practically feasible for even developed countries to eradicate all TADs.

For developing countries disease eradication is even less feasible and has provided few benefits with regard to international trade. Even though rinderpest eradication has been achieved in most developing countries, the persistence of other TADs effectively limits trade opportunities. Crucially, unless a country can convince the international community and its trading partners that it is free in its entirety from most, if not all, trade-sensitive TADs/List A diseases, export of livestock commodities is difficult and often impossible. In developing countries, comprehensive disease eradication schemes covering more than rinderpest have rarely been implemented for a variety of resource, technical and operational constraints. Developing countries, especially those in sub-saharan Africa, are poor and tend to rely heavily on donor support for animal disease control programmes. Although these programmes may demonstrate impact during the life of the programme, the resources that are required to maintain the benefits of aid programmes are often beyond the capacities of these countries.

A possible alternative to national-level TAD eradication is eradication on a zonal basis. Indeed, the OIE recognises the potential to eliminate specific TADs from a zone or zones within an otherwise infected country. The 164 OIE member countries can apply to the OIE for official recognition of freedom from four diseases (FMD, rinderpest, CBPP and BSE) either on a national or zonal basis. For other TADs, the Code (2003) recommends measures to achieve acceptable levels of risk when imports are considered and accepts that complete freedom from risk, i.e. risk-free trade, is unachievable. However, approaches to eradication of TADs other than the 4 mentioned above and provisions for assessment by the OIE are not available.

Many developing countries have strategies and policies aimed at establishing so-called 'disease-free zones' from which all TADs affecting trade will be eradicated. However, the requirements for free zones applicable to more than one disease are not covered by the Code (2003) because 'free zones' as defined in the Code (2003) are disease-specific. Many countries (particularly in Africa) have to deal with a range of TADs simultaneously and therefore technical considerations can be extremely complex. The question arises therefore as to whether these problems could be addressed more effectively by an alternative approach.

Alternative approach: Commodity-based trade

At present the Code (2003) accepts the principle that some livestock commodities pose little disease risk irrespective of the occurrence of TADs in the country or zone of origin. This is because some commodities do not contain transmissible quantities of infectivity. However, we propose that a comprehensive, commodity-based approach to enabling trade has yet to be developed in the Code, or appreciated by exporters and importers. Essentially, freedom from dangerous infections is not necessarily a prerequisite for countries to trade safely in some livestock commodities. The Code (2003) defines commodity as 'animals, products of animal origin intended for human consumption, for animal feeding, for pharmaceutical or surgical use or for agricultural or industrial use, semen, embryos/ova, biological products and pathological material'.

When considering the biological safety of traded livestock commodities, the concept of 'acceptable risk' is of fundamental importance; also referred to as the 'appropriate level of protection' (ALOP, Chapter 1.3.7). For some commodities – for example, beef from which the bones and lymph nodes have been removed – the risk of transmission of TADs is low because viruses that cause diseases

such as FMD, Rift Valley fever (RVF) and rinderpest are unable to withstand the low pH associated with *post mortem* maturation of beef. The animal disease situation in the region of origin clearly has much less influence on biological safety of such beef than the fact that the animals from which the beef was derived were healthy at the time of slaughter and the levels of hygiene practised in the abattoir and packaging plant (Sutmoller and others, 2003). Of course, for some commodities such as live animals, the animal health situation in the area of the animals' origin is vital in determining risk. We argue therefore that the nature of the commodity largely defines the risks posed and that risk management required is consequently largely dependent upon the nature of the commodity.

The overall risk of trade in a particular commodity is a function of the composite risks it may contain. For example, apart from multiple infectious agents, pesticide or drug residues may also potentially contaminate the commodity in question. Estimation of the overall risk posed by a commodity will determine not only the acceptability of the commodity for the importing country, but also the price the importer is prepared to pay. The current disease-by-disease approach of the Code (2003) presents a significant logistical problem to efficient trade because generic standards recommended for commodities are not provided. To assess overall risk of a commodity, users of the Code (2003) have to study several Code chapters and then reach a conclusion based on intuitive analysis of disparate information. Alternatively, a formal risk assessment considering all the important factors involved may be undertaken. However, this is expensive and time-consuming, and therefore beyond the capacity of many developing countries.

For countries in developing regions around the world a commodity-based approach would be a pragmatic way of ensuring levels of acceptable risk for particular commodities without necessarily being required to prove freedom from trade-influencing infections. This would provide opportunities for trade and improved income generation without threatening importing countries with outbreaks of TADs.

Commodity processing

Processing of commodities frequently provides an effective method for risk mitigation. It offers additional opportunities for access to export markets by countries where trade-influencing diseases or infections occur. Once again, although this concept is recognised by the Code (2003) there is arguably too much emphasis on disease-freedom and insufficient guidance on commodity processing for risk management.

The processing of agricultural products to improve their keeping qualities and appeal to human tastes is as old as the beginning of human civilization and, for that reason, is a highly developed art and science. Many of these processes, because they were originally primarily intended to inhibit putrefaction caused by bacteria, are effective in reducing microbial content and may therefore entirely remove human pathogens and TAD-causing agents, or at least reduce the risk of a given product containing transmissible quantities of infectivity. International trade in processed foods has increased rapidly in the last 30 years although fish and fruit products have dominated this increase (Athukorala & Jayasuriya, 2003).

Standards for processing edible livestock commodities are defined, as already indicated, by the Codex Alimentarius Commission and detailed in the Codex Alimentarius, while definition of risk mitigation measures against transmission of TADs is a function of the Code (2003). Thus, for situations where a commodity may pose risks for both transmission of TADs and agents pathogenic for humans, there is a dichotomy. This is recognised as a problem by the OIE and FAO/WHO and they have already taken steps to co-operate more closely to provide more integrated standards.

A long-standing problem in developing countries is that raw agricultural products are often exported at low prices only to be processed elsewhere, where relatively high value is added to the product. In the case of livestock commodities, importers have accepted that a commodity from an 'infected' location is inherently risky. However, well-organised and regulated commodity processing in developing countries would enable local processing and, therefore, local capture of value-added benefits while concomitantly reducing risk of pathogen transmission.

Certification

A crucial issue affecting safe trade in livestock commodities is the certification of 'acceptable risk' (or ALOP) of commodities by exporters, and the degree to which importers trust the certification process. By international convention, the head of the veterinary service of the exporting country has ultimate responsibility for certification (Article 1.2.1.3 of the Code, 2003). However, non-acceptance of health certificates in relation to animals and animal products is a world-wide problem and is especially acute in developing countries. For example, disease freedom accorded by the OIE to member countries is frequently not accepted without further verification by major trading nations/blocks such as the USA and European Union that have additional requirements.

A list of general responsibilities with which the exporting country should comply, and therefore which the head of the veterinary administration or delegated representative should certify, is provided in article 1.2.1.3 of the Code (2003). These include details on matters relating to the general animal disease situation in the country concerned, reporting of disease occurrence, diagnostic capacity, control measures, details of vaccines and testing procedures as well as the structure and functionality of the veterinary service. There are also provisions dealing with the competence, integrity and impartiality of officers responsible for certification. For some specific commodities the OIE recommends measures instead of or additional to these general provisions. However, these are generally made on a disease-by-disease basis and not, as previously indicated, generically for commodities. The difficulty of establishing methodologies to measure the credibility of such certification has been highlighted (Stärk and others, 2002).

The above system is logical where assurances as to the disease- or infection status of the region of production is important because, arguably at least, the only body capable of defining the animal health situation of a large geographic area is the veterinary administration appointed by the State to maintain and protect animal health in that area. When it comes to certification of commodities other than live animals the issue is usually more complex because other factors such as the quality of processing come into play and there may be significantly different requirements between commodities. Importers often require assurances of quality that are wider than microbiological safety in respect of TADs, e.g. standards of hygiene involving contamination potentially pathogenic for people, definition of hormone/drug residue/pesticide/heavy metal content as well as commodity-specific quality standards. Increasingly, other factors are also important to importers in developed countries such as assurance that environmentally friendly production methods have been employed as well as issues related to exploitation of labour, other social considerations and animal welfare. Clearly, the certification process will become more complicated with time and veterinary administrations responsible for certification will have to build links with those qualified to provide the additional requirements.

A possible scenario is that whilst governments retain authority and responsibility for safety of commodity exports, the certification be sub-contracted or even devolved to specialized bodies affiliated to international standards organizations. Such bodies – which could be either in the international agency or private sector domains – would themselves need to be registered and audited by the parent international standards authority. It may not be wise for the OIE to fulfil this role because the OIE would then be both standard-setter and technical advisor to the WTO in trade disputes that may arise.

Discussion

Increased agricultural trade is recognized as a vital means of alleviating poverty and stimulating international growth (Beierle and Diaz-Bonilla, 2003; Orden and others, 2004), and this paper has highlighted the importance of non-tariff barriers in relation to trade in livestock commodities. A review of existing international standards designed to reduce the transmission of TADs shows that these standards do not guarantee health safety for industrialised countries and contribute to the exclusion of many developing countries from international markets (Athukorala & Jayasuriya, 2003). This paper proposes that a commodity-based approach to livestock trade offers the benefits of achieving acceptable levels of risk for particular commodities without necessarily requiring proof of absence of trade-sensitive TADs. Greater recognition of these principles would greatly facilitate global trade and provide more equitable access to international markets for developing countries. Furthermore, such an approach is likely to benefit trade between developed countries when it comes to commodities derived from animals.

Assuming that the concept of commodity-based trade becomes more widely accepted, two immediate challenges arise. The first is the need to amend current international agreements, guidelines and modes of operation to better facilitate trade in commodities. Key stakeholders for these tasks are the OIE and its member states. The second challenge is to define and agree on internationally acceptable levels of risk for particular commodities (i.e. the ALOP). This should recognise the increasing potential of commodity processing for reducing the risk of transmission of human and animal pathogens and, consequently, the need for greater cooperation between FAO/WHO (the Codex Alimentarius Commission) and OIE. Food processing as a way of reducing risk of transmission of TADs has been under-utilized. It is necessary that the bodies responsible for regularizing these interacting factors be prepared to discuss the issues and reach new accommodations. This may not occur rapidly unless some outside force makes such a development imperative and facilitates the interaction. Perhaps it will require developing countries to collectively espouse the idea and propagate it in the various international forums that are available to them.

In addition to these major tasks, the question of certification, its reliability and independence and ways of meeting the challenge of rapid turnover in complex commodity transactions needs to be considered. The authors agree with the Code that certification needs to be independent to be reliable and have suggested that there are innovative ways of achieving this, for example, by devolving some of the tasks and responsibilities to agents/bodies that have authorization, affiliation and contractual obligations to abide by the principles and practices of an international standards organization. This would imply concurrent strengthening of the OIE and Codex Alimentarius for setting standards for safe commodity-based trade and veterinary administrations of the exporting countries in continuing to ensure effective animal health services and sanitary control as laid down in the Code (2003).

Although we consider detailed revision of the Code (2003) and possibly the Codex Alimentarius to support commodity-based approaches to be a priority, two other important issues arise. The first is the tendency for large trading blocks/powerful nations to set their own standards and practices that are not always in accord with the OIE or Codex Alimentarius. As an example, although the European Union has recently published laudable and ambitious intentions so far as removal of export subsidies and other measures to aid developing countries are concerned (EuropaWorld: 6/4/2004), the same document outlines agricultural commodity import procedures that are not strictly in line with international procedures and standards. Thus developing nations are effectively excluded from the standard-setting mechanisms.

The second issue is the dominant position of giant trans-national food processing and retail companies in international markets for agricultural products. It is estimated that a group of around 30 trans-national companies currently control one third of retail sales of agricultural products globally, and these companies have sufficient buying power to set their own health and welfare standards (Vorley, 2004). This situation supports supply chains characterised by vertical integration, and consequently, the exclusion of producers who cannot meet the private standards. In practice this manifests as promotion of relatively large suppliers with capital, access to technology and capacity to respond rapidly to changing buyer demands. Furthermore, the WTO appears to have limited capacity to police these private sector initiatives.

Regarding tariff barriers, at present the most lucrative markets for most commodities are in the Developed World. However, agricultural production in developed countries is sometimes highly subsidised, leading to both artificially low prices of local produce and subsidised exports (Athukorala & Jayasuriya, 2003). The scale of this problem is illustrated by the gross disparity between the cost of subsidising agriculture in industrialised nations and the benefits from trade in agriculture for exporters in developing countries. Industrialized countries spend approximately 1 billion US\$ in agricultural subsidies every day, equivalent to the gross annual revenue Africa derives from the export of livestock commodities (Tambi and others, 2002). Global levels of poverty require that such imbalances and access to developing markets by poor countries be urgently addressed. Although over 1.2 billion people continue to live on less than \$1 per day and twice that number (nearly half the world's population) survive on less than \$2 per day (Steinfeld, 2003), dairy cows in the European Union are subsidised at the rate of \$2 per day (Oxfam, 2002). Industrialised countries have recently made commitments to reduce global poverty through the United Nations Millennium Development Goals and to reduce their agricultural subsidies, but such change is likely to be both slow and complicated as a result of domestic political pressures.

We conclude that the trend towards increasing application of inappropriate non-tariff trade barriers, particularly animal health standards, needs urgent redress. A concerted effort by the relevant international agencies to promote commodity-based livestock trade would be an important contribution to economic growth in developing regions, while also encouraging trade between developed regions.

References

ANON (1998). World Trade Survey. *The Economist* 349, 3 October, 3-46.

ATHUKORALA, P-C. & JAYASURIYA, S. (2003). Food safety issues, trade and WTO rules: A developing country perspective. Blackwell Publishing Ltd: Oxford, UK and Malden, Md., USA.

BEIERLE, T. and DIAZ-BONILLA, E. (2003). The impact of agricultural trade on the rural poor. Background paper on: Agricultural trade liberalization and the poor, resources for the future. International Food Policy Research Institute, Washington D C. October 20 2003.

CAPUA, I. & MARENGON, S. (2003). Vaccination policy applied for the control of avian influenza in Italy. *In*: Brown, F. & Roth, J. (eds.): Vaccines for OIE List A and emerging animal diseases. *Developments in Biologicals*, 114, 213-219.

DELGADO, C., ROSEGRANT, M., STEINFELD, H., EHUI, S. & COURBOIS, C. (1999). Livestock to 2020: The Next Food Revolution. 2020 Vision for Food Agriculture and the Environment Discussion Paper 28. Washington D.C., International Food Policy Research Institute.

EURPOAWORLD home page, 21/5/2004. Facilitating food and agriculture trade: EU's strong commitment.

HARGREAVES, S.K. & BELEACHEW, H. (2004). Consultancy report on livestock export zones. FAO Project GCP/RAF/365/EC. Nairobi, African Union/Interafrican Bureau for Animal Resources.

LESLIE, J. & UPTON, M. (1999). The economic implications of greater global trade in livestock and livestock products. *Scientific and Technical Review, Office international des epizooties*, 18, 440-454.

MANGEN, M-J. JALVINGH, A.W., NIELEN, M., MOURITS, M.C.M., KLINGENBERG, D. & DIJKHUIZEN, A.A. (2001). Spatial and stochastic simulation to compare two emergency-vaccination strategies with a marker vaccine in the 1997/1998 Dutch classical swine fever epidemic. *Preventive Veterinary medicine*, 48, 177-200.

OFFICE INTERNATIONAL DES EPIZOOTIES (2003). The Terrestrial Animal Health Code. Paris, *Office International des épizooties*.

ORDEN, D., TORERO, M. & GALATI, A. (2004). Agricultural markets. Draft background paper for the workshop on the Poverty Reduction Network. March 5 2004. <http://dfid-agriculture-consultation.nri.org/theme2/keypap>

OXFAM (2002). Milking the CAP: How Europe's dairy regime is devastating livelihoods in the developing world. Oxfam Briefing Paper 34, pp 32.

STÄRK, K.D.C., SALMAN, M., TEMPLEMAN, Y. & KIHM, U. (2002). A review of approaches to quality assurance of veterinary systems for health-status certification. *Preventive Veterinary Medicine*, 56, 129-140.

STEINFELD, J., 2003. Free trade: Win win? *Issue brief: Carnegie Endowment for International Peace*. 1779 Massachusetts Avenue, NW, Washington, DC 20036. USA. (www.ceip.org)

SUTMOLLER, P. & CASAS OLASCOAGA, R., 2003. The risk posed by the importation of animals vaccinated against foot and mouth disease and products derived from vaccinated animals: a review. Scientific and Technical Review, *Office internationale des épizooties*, 22, 823-835.

TAMBI, E.N., MAINA, O.W. & BESSIN, R., 2002. Animal and animal products trade in Africa: New development perspectives in international trade for Africa. Journal of International Food and Agribusiness Development, 14, 49-67.

THE ROYAL SOCIETY, 2002. Infectious diseases in livestock. Policy document 15/02. ISBN 0 85403 579 6 (www.royalsoc.ac.uk).

THOMPSON, D., MURIEL, P., RUSSEL, D., OSBORNE, P., BROMLEY, A., ROWLAND, M., CREIGH-TYTE, S. & BROWN, C. 2002. Economic costs of the foot and mouth disease outbreak in the United Kingdom in 2001. Scientific and Technical Review, *Office internationale des épizooties*, 21, 675-687.

THOMSON, G.R., DUNGU, B., TOUNKARA, K., VOSLOO, W., BASTOS, A. & K. BIDJEH. (2003). Suitability of currently available vaccines for controlling the major transboundary diseases that afflict sub-Saharan Africa. In: Vaccines for OIE List A Diseases and Emerging Animal Diseases. Brown, F. & Roth, J. (eds). *Developments in Biologicals*, 114, 229-241. Karger: Basel.

UNITED NATIONS DEVELOPMENT PROGRAMME (2003). Human Development Report. Washington D.C., United Nations Development Programme.

VORLEY, B. (2004). Food, Inc.: Corporate concentration from farmer to consumer. UK Food Group, 89 pages.