

# Exploring the Determinants of World-Class Agriculture and Food Systems: An Overview

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*This study explores world-class agriculture and food systems in a framework of local and regional communities' values. We review global existing and emerging agriculture and food systems, explore a definition of food system, and provide a selective synthesis of best practices for such systems. Through content analysis we identify key variables and dynamics that determine world-class agriculture and food systems.*

**Keywords:** *Agriculture, food systems, triple bottom line, world class*

Technological progress in agriculture has made a tremendous contribution to increases in per capita food production over the past fifty years, despite the fact that the world population has more than doubled (2.5 billion in 1951 to 6.5 billion at present) during this period (Dyson, 1999; Herdt, 2006; U.S. Census Bureau, 2010). However, even with this progress, about 1.2 billion people remain undernourished, and in many parts of the world, food shortage, starvation, malnutrition, and food-related diseases continue (Food and Agriculture Organization, 2009). A growing body of literature suggests that, in the context of changing global and domestic environments, improper governance of agriculture and food systems at local, regional, and global levels is mainly responsible for these problems (Heffernan & Hendrickson, 2008; Koc & Dahlberg, 2004; Lawrence & Burch, 2010). Because rules of trade, information and communication technologies, climate change, depletion of natural resources, changing demographic and community structures, and rapid population growth will affect the security of the future food supply, it is of utmost importance for world

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agriculture to develop, adapt, and maintain a state-of-the-art, secured and sustainable food production and supply system. Public policy makers and stakeholders in the agri-food industry often popularly advocate the development of a world-class food system to provide potential solutions. The obvious questions that then follow are these: What constitutes a world-class food system? What are its composition and components? How does it function? What does it in fact achieve? What are its measures of success? Is there such a food system present? These questions need to be addressed for a clear understanding of the definition of a world-class food system and for its development and proper governance.

This article aims to provide an understanding of a world-class agriculture and food system by exploring its determinants in a conceptual framework of social expectations of improved world agriculture and food systems. The article is organized into six sections, which discuss the scope, significance, and the study approach: explore a general understanding of food systems on the basis of a review of the literature on different types of food systems; review the food systems of Canada and New Zealand, which are perceived as the best in the world; and identify the major determinants and ideal characteristics of a world-class food system in a conceptual framework.

### Scope, Significance, and Study Method

A food system can be viewed from different dimensions, such as local, community, regional, national, and global. Irrespective of its dimension, the success of a food system can be judged in many ways and assessed using different sets of criteria. The common practice is to judge from an economic point of view. However, there is a growing body of literature (Adam, 2006; Connell, Smithers, & Alun, 2005; Smithers & Johnson, 2004; Smithers, Johnson, & Alun, 2004; Stimson, Stough, & Roberts, 2006) suggesting that, in addition to seeking maximum economic outcomes, the success of food systems should be assessed using the criteria of sustainable development that attempts to generate benefits for people and business in communities or regions and a goal of reducing the long-term impacts of excessive environmental consumption. A qualitative approach is used in this study to judge the performance of a food system in terms of the governance of economic development processes and the use of available resources that result in the desired economic outcomes and meet the values and expectations of stakeholders in the food system, the region, and the society at large. In other words, the performance of a food system is judged by qualitative analysis of its governance in terms of balanced achievements of economic, social, and environmental (i.e., triple bottom line, or TBL, objectives. Triple-bottom-line objectives emphasize the efficient use of a food system to bring sustainability of a regional agriculture by taking into account the social, environmental, and economic values of the concerned community.

This is an exploratory study focusing on the review of food systems in developed countries, including Canada, the United States, the United Kingdom, New

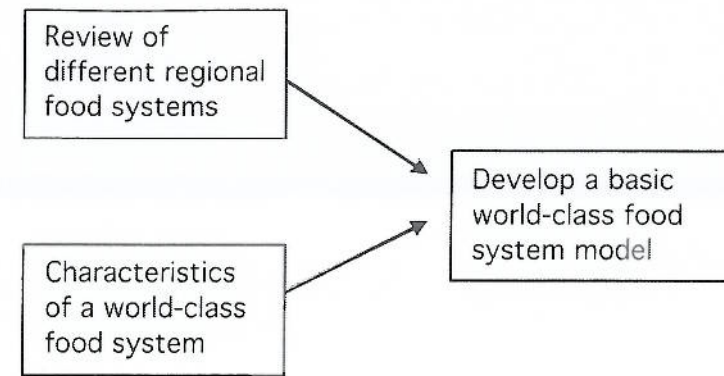


Figure 1 The research path

Zealand, some EU countries, and Australia. Much of the information and statistical data for this study were drawn from Statistics Canada, New Zealand's Ministry of Agriculture and Food, Department of Agriculture and Food of Western Australia, and the Australian Bureau of Statistics.

To standardize the definition of a world-class food system, the characteristics of some food systems were explored and the determining variables were identified through relevant literature review and industry consultations. To ascertain the acceptance of the variables, they were then compared with two leading regional food systems, those of Canada and New Zealand. A content analysis confirmed the determinants of these regional food system success factors. Although this study is exploratory, qualitative, and limited to developed countries, its findings should have a broader application to theory, practice, and policy significance.

Figure 1 shows an overview of the research path. The first two boxes on the left are the review components, classified into two categories, and represent the strength of the research. The upper box investigates a few well-known world food systems, and the lower box identifies the generic characteristics of a food system. The third box shows a conceptual framework characterizing a world-class food system.

### Agriculture and Food Systems in the World

#### Meaning of a Food System

A food system involves complex and diverse activities and processes (Koc & Dahlberg, 2004), from primary farm production to final consumption of processed food, as well as all the processes required to feed a population (Kloppenburger, Lezberg, Master, Stevenson, & Hendrickson, 2000). The processes of a food system aim to create a direct link between food producers and food consumers. In this complex system there are several components, including production,



processing, distribution, consumption, and waste disposal (Heller & Keoleian, 2003). A newer aspect of the food system is sustainability, which refers to practices that are environmentally friendlier than older practices and give attention to food security. Historically, the idea of sustainability evolved after World War II as scientific and technological progress negatively affected the natural environment. Environmental concern became more acute and radical, with the fear that economic growth would endanger the survival of the human race and the planet. The notion of sustainable development emerged as an alternative to unlimited exploitation of natural resources for economic growth (Du Pisani, 2006). By focusing on sustainability through key sociocultural, environmental, and economic value requirements, the primary differences between food systems at the local, regional, national, or global level can be identified. The literature review suggests that there are different types of food systems in operation, and so we attempted to make distinctions among them to derive a broader meaning.

#### Types of Food Systems

We identified seven types of food systems in our review: conventional, global, local, community, organic, cooperative, and slow food. The diversity of food systems described in the following sections suggests that, on the basis of the social, geographical, and economic needs, different types of food systems have evolved and are in operation in different regions of the world. There is evidence that a diversity of factors motivates producers and influences social expectations, economic and environmental conditions, and the economy to shift toward food systems that better meet sustainability criteria in food production. However, none of these models is universally applicable in all regions, as national and global conditions, as well as each region's geophysical resources and socioeconomic needs, vary and require consideration in the establishment of sustainable food systems.

*Conventional food system* The conventional system was first established in the United Kingdom in the 1940s to support the food shortages in wartime and postwar periods (Vitterso, Lieblein, Torjusen, Jansen, & Østergaard, 2005). This model operates on economies of scale and across spatial range. The strength of this model is its contribution to reducing consumer costs and increasing production volume. However, the model does not have strong environmental credentials. The basis for the model draws from economic models such as vertical integration, economic specialization, and global trade. The conventional system also depends on inexpensive fossil fuel to reduce production costs and has significant impacts on local, regional, or global ecosystems through fertilizer application, pollution, and greenhouse gas emissions.

*Global food system* The global food system involves the worldwide production, distribution, and consumption of food. It has been developed around the

far-reaching influences of trade; globalization; labor; and market competition over production, processing, distribution, and consumption (Lawrence & Burch, 2010). This model is dominated by large business corporations, and some claim that the corporations are chartered solely to make a profit for those providing the capital (Heffernan & Hendrickson, 2008). Also, decisions are increasingly being made in the private sector, where profit generation is the goal, at the expense of rural and community resilience (Wardell-Johnson, 2008). Global corporate food models are based on strong food chains that separate producers and consumers through the businesses of processors, manufacturers, distributors, and retailers. The gap between the producers and consumers increases as the food system expands, and control of the food chain and food quality rests with intermediaries.

The critics of the global food system suggest that, despite large-scale increases in world food production, inappropriate policies and trade rules that favor large corporations constrain equitable distribution of benefit (Heffernan & Hendrickson, 2008; Kinver, 2008).

*Local food systems* A local food system aims to enhance local economic growth through the consumer's purchase of local produce (Feagan, 2008; Feenstra, 1997; Organic Food Directory [OFD], 2008). It encompasses sustainable food production, processing, distribution, and consumption to increase the economic, environmental, and social health of a particular locality. The system concentrates on buying locally grown foods and services and simultaneously managing food quality. The system also focuses on a consumer-producer relationship.

Critics of this system warn that it can lead to a narrow inward-looking attitude or local food "patriotism." Conversely, supporters claim that the system develops social relationships and trust-based connectedness between actors (Smithers, Lamarche, & Joseph, 2008). In comparison with industrial food systems, local food systems operate with reduced food transportation costs and carbon emissions, thus resulting in fewer processes that separate farmers, producers, and consumers from one another. Scholars view local food systems as effective in revitalizing communities and reducing food transportation distances, which provides environmental benefits (Hinrichs, 2000, 2003).

*Community food system* The community food system has emerged as a socioeconomic model of agriculture and food production in Canada and is commonly known as community-supported agriculture (CSA; Adam, 2006; Connell et al., 2005; Smithers & Johnson, 2004; Smithers, Johnson et al., 2004; Smithers, Joseph, & Armstrong, 2005). This model is also in practice in France, Japan, Portugal, Italy, Germany, and Norway, in response to the concern about food safety and the urbanization of agricultural land (OFD, 2008). This system is sustainable with respect to the way in which food is produced, processed, distributed, and consumed, and in the way waste is managed (Smithers, Lamarche et al., 2008). In this system a community of individuals supports a farm operation,



and growers and consumers share the risks and benefits of food production. Among the most important aspects of the CSA model is that there is increased participation by local residents (Smithers, Johnson et al., 2004). A sustainable community food system is achieved through goals such as a stable base of family farms, improved links between farmers and consumers, job creation, and recirculation of financial capital.

The system integrates the food-chain links and involves consumers and stakeholders in more direct and consolidated consumer-producer relationships. A community system's focus is on producing high-quality food using organic or biodynamic farming methods and on sharing production and marketing risks.

*Organic food system* The organic food system is considered a great way to meet current environmental needs (Vitterso et al., 2005). It aims to depend less on chemical inputs and to provide increased transparency and information on production and processing activities. An organic food system uses no chemical pesticides or fertilizers in production and no antibiotics or growth hormones in raising livestock. This system has been criticized as inaccessible and has been called an "elite" food system, as production costs are relatively high and accessible primarily to high-income consumers. There are several benefits of organic agriculture, such as the ecological benefit of reduced chemical application, the health benefit of lower chemical consumption, the economic benefit of farmers' price premium, and the social benefit of transparency in the food system (OFD, 2008).

*Cooperative food system* In a cooperative food system farmers create a cooperative to grow and market their products (Hendrickson & Heffernan, 2002). In some cases consumers buy shares of stores and create cooperative grocery stores, and then do not take surpluses as profits. Therefore, because these food co-ops do not work for profit, they have the potential to keep prices more cost representative. They share and redistribute risks and responsibilities among members (U.S. Department of Agriculture, 2009). However, this system has been criticized for reducing competition and efficiency.

*Slow-food system* The slow-food system is based on community initiatives to form part of a global trend that was constituted internationally in 1989. The initiative arose in response to the cultural homogenization, taste standardization, and public health problems associated with fast food (Germov & Williams, 2009). The key idea of slow-food system revolves around the notion of consumers acting as coproducers of their own food by forming close associations with producers. This provides dual benefits of increased economic return and social interactions with consumers. The system, however, has been criticized as elitist (Charzan, 2004) because of its focus on exotic foods and artisan techniques, which are relatively costly. However, the value of slow food lies in its notion of ethical consumption, which influences consumers to move toward

foods produced without exploitation of people or the environment (Germov & Williams, 2009).

### **Review of Two Best-Practices Food Systems**

In this section, we review and synthesize the variables and impact factors that define excellence in the regional food systems of Canada and New Zealand in order to define the criteria for a world-class food system.

#### **The Canadian Food System**

*Agriculture* Agriculture is the primary driver of food-related policy in Canada (MacRae, 1999). The agricultural policy of Canada has a significant impact on ensuring a sustainable food system. Although only 7 percent of Canada's land is used for farming, Canada remains one of the major agri-food exporting countries in the world. In considering the whole supply chain, the agri-food and agriculture of Canada are highly significant to the economy, contributing \$87.9 billion (about 8 percent) to the country's gross domestic product (GDP) and employing about 2.1 million Canadians in 2006 (Canadian Agrifood Policy Institute [CAPI], 2009).

The regulatory system, proper application of regulations, and significant government subsidies and supports have contributed to Canada's achievement of best-practices status in agriculture and food production (CAPI, 2009). The five most important agricultural production sectors of the country are grains and oilseeds, red meats and livestock, dairy, horticulture, and poultry and eggs. These account for the most significant portion of cash flow in Canada's agricultural economy. Grains, oilseeds, and red meat make strong contributions to both domestic and export earnings, but the dairy, poultry, and egg sectors operate under a supply-managed system to ensure that domestic production serves demand while also providing a fair return to producers. The supply-managed system aims to achieve self-sufficiency in the domestic market. Canada's largest agricultural export market is the United States, with half of total exports being food (CAPI, 2009).

*Grain regulatory system* Following World War II, Canada gradually developed a consistent grain management system that led to the success story of its food systems (Kensington, 2009). The system leverages the power of single-desk selling for the benefit of Canadian grain producers. The Canadian public, including farmers and others in the food system, is keenly aware of the country's grain management practices. Canadians show concern for food production and how associated factors affect the environment and local economies (Nanos Research [NR], 2009a). Canadians want to know where their food comes from, who grew it, and under what circumstances, which indicates an awareness that their food choices have far-reaching health and nutrition impacts.



In a survey of 1,001 Canadians, NR (2009b) found that there is a strong public view in Canada in favor of attending to the processes of small-scale farming to consider it as an important way to create a sustainable food system. There is also public pressure on the Canadian government to raise consumer awareness of the food that consumers buy and eat.

*Environmental issues relating to food-system quality* In recent decades, in response to globalization, market pressure, and technological opportunities, increases in agricultural output and related activities have increased public concern about the possible impact of food production on the environment, soil, water and air quality, and biodiversity (Carney, 2008). Canadians have supported a growing array of domestic and international agreements, regulations, and research programs designed to protect the environmental systems with which agriculture interacts (Agriculture and Agri-Food Canada [AAFC], 2009). Growing awareness of farmers, government, and other stakeholders of the links between agriculture and the landscapes in which they operate has motivated the integration of environmental factors into the agricultural decision making-process.

This integration has also led the relevant government agencies to develop a set of agri-environmental indicators (AEIs) specific to the agriculture and agri-food sector to assess the management of agriculture and agri-food systems and to conserve natural resources (AAFC, 2009). The AEIs are calculated using mathematical models or formulas that integrate biophysical information (on soil, climate, and landscape) with land use and farm management data, which are generalized to portray specific environmental conditions in the landscape at a given time (AAFC, 2009). This integrated evaluation system provides Canada with a means of assessing the impact of agriculture and food systems on the supporting environment and agri-ecological landscape. Overall, the results have suggested that considerable progress has been made in achieving environmental sustainability.

*Product grading system* Canada has developed an independently enforced product grading system to ensure that buyers get exactly what they pay for. This grading system, supported by the government, sets a series of tolerance levels for several important quality and operational characteristics. It guarantees the operational characteristics of grain shipments and implements strict procedures for ensuring grain cleanliness and safety. All shipments are twice inspected by the government: first when the grain arrives at major terminals and then again before it is sent overseas. Parcels of grain are sampled and tested for insect infestations, with rigorous standards assessing contamination by other cereal grains, as well as chaff, straw, weeds, and other more harmful foreign materials. The government attaches the Certificate Final sticker, a highly regarded official assurance of quality, to export shipments to assure customers that they are receiving the specific class, grade, and quality of grains they have purchased. Similarly, Canadian horticulture and meat production also

maintain a strict tracking and tracing system that identifies contaminated batches of food or food-borne diseases, thus ensuring high-quality, safe food and effectively maintaining existing markets and capturing niche markets for premium products (AAFC, 2009).

In short, through its policies, Canada has developed a successful food system that produces food to meet local, national, and international needs while also improving economic, social, and environmental sustainability. Nonetheless, Canada is still working to develop approaches to achieving sustainable social, economic, and environmental performance. The success of its food system provides economic benefit to all regions of Canada, as it produces sufficient food for export, which contributes to the national economy, and strengthens regional communities and small farms while maintaining a high level of environmental sustainability. Moreover, Canada considers the ethics of its role in a global community by preparing for extended world food needs through more effective and sustainable production.

The most significant factors of the Canadian food system that have been identified so far are strong regulatory control; community development; grading and inspection systems; producers' security; skilled women workers; information and technology transfer systems; fair trade and investment rules; soil, air, and water quality; biodiversity; and organic food. Appendix 1 summarizes factors, achievements, and challenges for Canada's sustainable food systems and classifies them into the three components of the TBL objective.

### The New Zealand Food System

*Agriculture* Agriculture and agricultural products are very important to New Zealand's economy, contributing 56 percent of the total exports (Ministry of Agriculture and Forestry [MAF], 2009). Leading agricultural exports include dairy products, meat, forest products, fruit and vegetables, fish, and wool. Dairy and meat exports are the top two export commodities, accounting for 33 percent of total exports.

To increase the contribution of food exports to the economy, New Zealand has focused on an organic strategy. The strategy promotes policies that emphasize opportunities to develop organics as an emerging sector in the broader context of New Zealand agriculture (MAF, 2009). The organic food export target is set to reach NZ\$1 billion by 2013, from \$70 million in 2000. This target indicates New Zealand's vision to bring organics to the forefront as agriculture moves to address social concerns about the environmental sustainability of food production systems, consumer health, community well-being, and food safety (Nath & Islam, 2011).

*Food safety and regulatory system* Since the establishment of the New Zealand Food Safety Authority (NZFSA) in 2002, New Zealand has implemented a policy on food safety to promote public health through improved regulatory and food



safety systems. This independent government authority sets an enforceable standard for food production and marketing, and it has effectively achieved key improvements (NZFSA, 2009a, 2009b) in protecting and promoting public health and safety, and in facilitating access to markets for New Zealand's agri-food products.

The NZFSA implemented a food regulatory program to meet New Zealand's health and food safety needs for the foreseeable future. The program aims to take account of rapidly shifting consumer behavior and expectations, changing food production and distribution systems, and new and emerging pathogens and risks.

On the marketing side, NZFSA works to raise New Zealand's position as a trusted exporter of agri-food products and to maintain and enhance trade according to international rules. This has facilitated international market access for New Zealand's agri-food products. The process involved implementing a world-leading regulatory program to increase the confidence of stakeholders. This is believed to have been achieved in terms of international reputation for food safety and access to international safe-food markets (NZFSA, 2009a). An assessment of impact conducted by the Australia New Zealand Food Standards Code reflects a similar view, as the group found increased knowledge of safe and improved food-handling practices since the implementation of the food safety standards (Productivity Commission, 2009).

*Undertaking the TBL accounting approach* The New Zealand Ministry of Agriculture and Forestry has undertaken a TBL accounting approach to better understand and account for economic (i.e., sustainable economic growth and prosperity), social (i.e., healthy citizens and a vibrant rural community), and environmental (i.e., maintained and enhanced natural environment) impacts of the country's agricultural practices (MAF, 2009). In this approach MAF adjusts and refines the outcomes of agriculture annually to align activities by identifying major data gaps. This approach helps MAF assess outcomes against its objectives of promoting a clean and green image to export markets. One such policy initiative was to maintain and enhance outcomes for market access to New Zealand's animal and plant products. The MAF (2009) measured this by identifying an increase in the number of new bilateral or multilateral free-trade agreements. The TBL accounting approach provides New Zealand with key criteria for evaluating the impact of food production on landscape systems that accommodate the needs of communities, economic success, and ecological systems.

Many factors have contributed to achieving a robust and sustainable food system in New Zealand, including protecting and promoting food safety, community engagement in the food system, access to markets, a leading food regulatory system, consistency in applying trade and market rules, organic farming, an environmental management system, rural support trusts, and others. Appendix 2 summarizes a full list of factors, relevant achievements, and challenges identified from this review. These characteristics, and those of Canada, provide

a means for developing a ground-up conceptual model for a world-class food system.

### Exploring World-Class Food Systems

The term *world class* is generally used to mean the best attribute of an objective in terms of excellence in quality and character. Our review suggests that, with respect to food systems, *world class* should refer not just to the best and most affordable food but also to other attributes of excellence, such as community, economy, environment, regional differences, trade rules, technology, and people and processes involved in food production and distribution. The concept must encompass a clear understanding of responsibility for planning about food production and include information on what food is produced, as well as when, where, and how. Also, information on equitable and ethical access to food, irrespective of demographic, cultural, and economic circumstance must be taken into account (Heffernan & Hendrickson, 2008). This conceptualization of food systems foregrounds the ethics of production in the context of sustainability, encompassing triple-bottom-line values and social justice in a global context.

To be considered world class, a food system must start from local or regional contexts and then link across production and consumption scales to national and global food systems. This cross-scale change requires an understanding of the process of developing sustainable regional food systems that promote regional economies but evolve and integrate development in a world-class food context. Food systems such as those identified in Canada and New Zealand have realized these needs and exploited their capabilities to include the competitive advantage; thus, they stake a claim in world-class standards.

To enhance effectiveness, world-class food systems should use the food system components that could be identified. From this viewpoint the primary characteristics of a world-class food system should include the following components:

- *Agricultural development:* Agricultural production systems should be able to account for the welfare of labor and producers through consistency in regulation; sympathetic and appropriate land development and management policies; and support for disadvantaged farmers through technical, marketing, and professional development opportunities.
- *Economic development:* In contributing to an economy, agriculture should be able to provide low-cost services with the potential to increase income and to facilitate economic diversification, market access, and pricing that reflects value for money.
- *Community development.* A food system should have the capacity to reflect community participation that strengthens rural development, increases employment opportunities, and provides education and training. The food system can enhance the capacity to build links between local people and national governance in food and regulatory systems.



- *Environmental sustainability:* A food system should contribute to reduction of the carbon footprint; minimize waste and apply appropriate waste management through facilities that are regularly checked; and apply water management and conservation strategies appropriate to the local context by accommodating predicted climate changes, conserving biodiversity, minimizing erosion, and preventing environmental degradation.
- *Food security:* A food system should ensure food security so that all people at all times have physical, social, and economic access to sufficient food for a healthy life. This may include food aid and ethical consumption, rationing and food banks, food sovereignty, and facilitation of resource allocation.
- *Food quality and safety:* The meeting of high quality and safety criteria is a prerequisite for inclusion in the world safe-food market. This facilitates a strong regional and national economy while supporting and contributing to world food needs.
- *Health and nutrition:* The delivery of nutritious food to consumers is an important component of a world-class food system. Consumers must be informed of food nutritional values and fat content. Programs to prevent human health problems should include inspection, enforcement, certification, and verification to ensure access to healthy foods.
- *Other management issues:* Fair competition and fair trading regulations ensure equitable value for competing sectors and nations. This ensures social justice for agricultural workers and fair income for producers. Equitable access to technology and agricultural innovation must be ensured, and access to natural resources and energy should benefit all contributors and consumers in food systems.

### Defining World-Class Food Systems

The previously discussed characteristics suggest that a food system involves complex and diverse activities and processes. Food systems comprise all activities from primary farm production to final consumption of processed foods, and they involve all the processes that are required to feed a population. Food systems operate within and are influenced by social, political, economic, and environmental contexts. A food system requires human resources for labor, research, and education, and it depends on natural resources for the production and transformation of primary farm produce into processed foods. A food system therefore encompasses issues related to community, economic, and agricultural development, as well as justice, nutrition, food, and health. In other words, a food system is a network that efficiently and effectively integrates food production, processing, distribution, and consumption and takes into account externalities such as waste management to enhance the environmental, economic, and social health of a particular region in a balanced way. To be brief, a

world-class food system can therefore be considered as providing a well-managed process that includes the production, processing, distribution, and consumption of high quality safe and secure food and well management of waste, contributing to a growing, competitive and market oriented agriculture and to the well being of the rural community, farm security, environmental sustainability, and economic diversification while responding to the domestic and international changing food needs with a secured high quality and nutritious food supply.

### A Generic Model for a World-Class Food System

The foregoing definition provides a basis for developing a basic framework for a world-class food system (figure 2). We believe that this generic framework can be used to assess the world-class standards of a food system. The framework can also be used for developing models for a regional world-class food system to provide a basis for national agricultural economies that meet criteria for food security, social justice, and environmental sustainability as global citizens. The specific variables for a particular region require identification and inclusion in this basic framework for a complete, world-class regional food-system model. We present the process of developing a world-class food system here through three sets of core components.

The first set of components involves the processes of food production, supply, and consumption in a standard food supply chain. The first row in figure 2 containing four linked boxes represents these components, the basic food supply chain or the life cycles of a food system. The second set involves the core policy components for developing, implementing, and evaluating a world-class food system. The second row in figure 2, which comprises eight boxes, shows the components of policy objectives. They are primary variables of a world-class food system required for effective governance and management. The third set of components comprises the three key areas required to address sustainability, the triple-bottom-line values. The model shows the relationships between a food chain, policy, and governance and the explicit and differentiated conceptualization of sustainability. The fourth row in figure 2 contains the economic, social, and environmental criteria of sustainability for the effective management of all policy components, which are presented as primary policy objectives in the second row. The final box represents the criteria for successful management of a food system that aims to provide effective economic, social, and environmental (TBL) values. This conceptual model presents the criteria for developing and evaluating an ideal world-class food system. When these criteria are accommodated to integrate the processes of a world-class food system, then development, implementation, and evaluation of a successful food system becomes possible.

There is, however, an additional set of components involved that are unique to local, regional, and country context. The third row with eight boxes in the figure represents the high-level variables corresponding to each of the policy



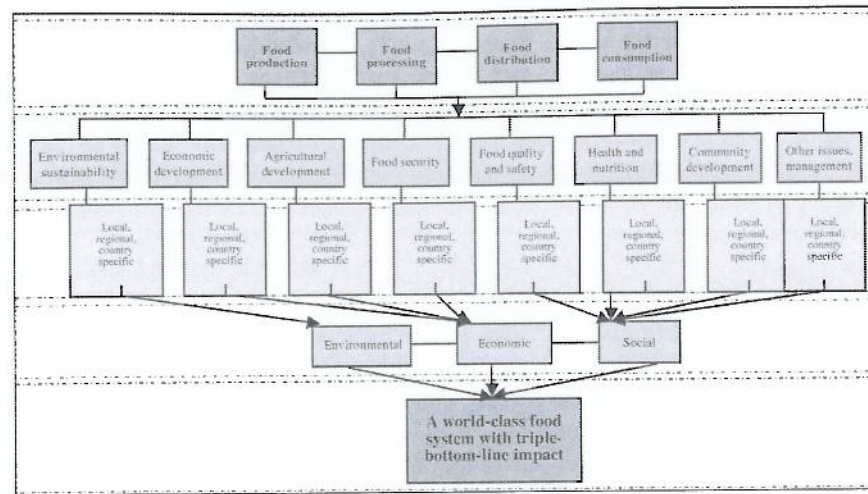


Figure 2 The basic model for a world-class food system

components in the second row. We have already briefly described these high-level variables. The high-level variable may differ from one system to another, as the variables are specific to locality, region, or country.

### Summary and Conclusion

In the process of identifying the characteristics of a world-class food system, we have reviewed and analyzed a few existing and emerging food systems in the world to develop a generic definition of a world-class food system.

Various regional food systems have successfully fulfilled national and international food needs. Nonetheless, a global shortage of food has increased world hunger, with resultant undernourishment for too large a proportion of the world population. Impending human-induced changes to the world's climate and the depletion of natural resources exacerbate this situation. Few individual regional food systems continue to meet the world needs.

The two best-practices food systems reviewed and synthesized in this study are of Canada and New Zealand. The Canadian food system and food policy ensure the nourishment of the Canadian people, as well as supply to the export markets with a world-recognized regulatory framework and inspection policy that supports the agriculture sector financially, environmentally, and socially. The TBL achievements of Canadian agriculture in an integrated food system involve strong regulatory control, inspection and enforcement, consumer engagement, community and development of skilled female workers, biodiversity, eco-efficiency, organic farming, and more. Canada has developed and applied agri-environmental indicators to assess soil, water, and air quality, and

biodiversity indicators to understand the conservation of natural resources. Such indicators have applications in a wide range of regions for improving the accountability of environmental sustainability in agri-food systems.

The New Zealand food system has achieved outstanding, internationally recognized credentials that address the TBL values of sustainability. Eight years after its establishment, the New Zealand Food Safety Authority has successfully achieved two key improvements: "protecting and promoting public health and safety" and "facilitating access to markets for New Zealand's food and food related products." Any regional agricultural system could undertake a similar approach to that of TBL accounting in New Zealand to assess annual agricultural activity and understand the TBL balance of food systems performance.

This study has identified the characteristics of a world-class food system and provides an understanding of how different regional food systems have and/or can become successful in achieving TBL objectives through policies and regulations. The linking of standard food-chain models with governance and policy imperatives assessed in the sustainability framework of the triple bottom line provides the basis for criteria needed to implement world-class food systems that account for social justice, food security, and environmental sustainability.

The policy components identified in this conceptual model for world-class food systems can help successfully balance TBL values for a regional food system. Identification and implementation of the success factors underpinning sustainable food systems increases the potential to transform a substandard food system to achieve world-class standards. These parameters provide important pathways to focus food-systems research, development, and policy in order to meet future food needs in the face of changing sociodemographics and geoclimatic environments.

To understand the characteristics of a world-class food system, it is worth identifying the different internal and external factors that can challenge a food system. Government plays a role in providing adequate food for its citizens by managing food systems without manipulating private and particular interests. In most cases, though, private-sector interest and activities restrict the government's ability to perform this role. One such example is the regulatory changes in the Canadian agri-food system, which are claimed to represent private (corporation) rather than public interest (Sinclair & Grieshaber-Otto, 2009). Other factors and issues affect the sustainability of food systems, including food production and processing, which are increasingly challenged by climate changes; dwindling supplies of cheap oil; and declining water and soil resources (Han-nick, 2008). In addition, hidden environmental costs have increased the costs of food production, thus raising the price of food. To face these challenges, food-system policy relating to agricultural and economic development, environmental sustainability, health and nutrition, food quality and safety, food security, and community resilience are essential and constitute the primary variables of a world-class food system. Identifying the high-level variables of these components that focus on specific regional needs is necessary to develop a sustainable



food system that characterizes the components of a detailed regional world-class food system.

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**Appendix 1 Factors Contributing to the Success of the Canadian Food System**

TBL	Canadian food-system variables	Achievements	Challenges
	Strong regulatory control	Grain quality and consistency	
	Grading and inspection system	Safety and quality of Canadian food	
	Grain producers' security program	Ensured payment for the grain producers	
	Community development	Increased nutritional awareness	
	Growth of private- or control-label products	Maintenance of customer loyalty	
	Efficient consumer response	Removal of unnecessary costs and inefficiencies from the agri-food supply chain	
Social	Education of Canadians about food security issues	Social safety	To make food equally available to all regions and to boost the agri-food-based economy in the regions properly
	Access to food	Investments to reduce the depth of child poverty, development of new opportunities for labor-force participation through targeted scholarship and job-creation programs, funding of community-based programs to address health disparities and assist vulnerable populations, and subsidized transportation of nutritious foods to 140 isolated northern communities.	
	Food recall and emergency response program	Food safety, investigation, decision making, recall implementation, recall effectiveness, and follow-up	

TBL	Canadian food-system variables	Achievements	Challenges
	Inspection and enforcement activities	Consumer loyalty and high prices internationally	
	Grain transportation and handling system	Segregated wheat class according to functional class and grade, to ensure uniformity and consistency from shipment to shipment and from year to year	
	Skilled women workers	Increased labor-force participation by women	
	Closely related distribution system and retail system	One of the world's most affordable food systems (low overhead costs contribute to low product prices)	
Economic	Effective public information and technology transfer mechanisms and increased research in bioproducts and bioprocesses	Sustainable agriculture	Increased global food needs and economic imbalance, and changes in government legislation to maintain food quality and safety (changes will eliminate government inspection of grain delivered to major elevators around the country)
	Open, fair, and predictable rules for trade and investment	Increased food security by stimulating investment, gearing production to demand, increasing incomes and employment, and offering consumers a broader choice of foods	
	Food retail and food services subsectors	Increased consolidation in the food distribution sector	
	Strategic trade policy initiatives	Expansion of market access for Canadian producers and increased food security, including development of industry partnerships and alliances, and harmonization of domestic and international food inspection standards	
	National procurement and centralized purchasing	Fewer buyers control business of suppliers to place greater pressure on suppliers to deliver quality products at lower prices	



TBL	Canadian food-system variables	Achievements	Challenges
Environmental	Soil, air, and water quality	Contamination- and chemical-free soil, air, and water	To fight carbon emissions, agricultural waste, and food-borne diseases
	Biodiversity	Wildlife habitat availability on Canadian farms	
	Eco-efficiency	Reduced use of energy, material, and water; more recycling; elimination of hazardous emissions	
	Emergency prevention and preparedness	Increased management capability to face food-related emergencies and protect biotechnology from being a risk to human health or the environment	
	Development of new methodologies to reduce food contamination during production and processing	Safe food and healthy life	
	Organic food	Environmentally friendly agriculture	
	Establishment of protocols to address food-borne disease incidents	Food safety	

**Appendix 2 The Most Important Variables and Achievements of New Zealand's Food System**

TBL	New Zealand food-system variables	Achievements	Challenges
Social	Protecting and promoting public health and safety	Healthy New Zealanders with access to safe and quality food	To provide continuous benefits to the regional community and engage them in the regulatory system
	Maori engagement in the agriculture, food, and forestry sectors	Rural agricultural development	
	Community engagement	New Zealanders who are informed and involved participants in MAF's regulatory systems	
	Innovation	Business environment for the agriculture, food, and forestry sectors that supports innovation, enterprise, and high performance	
Economic	Access to market	Adding value to the food industry's future	To exceed organic production targets to capture the growing organic market and to reduce food imports for strong economic balance
	World-leading food regulatory system	Increased confidence of stakeholders	
	Consistency in application of international sanitary and phytosanitary rules and regulations	International market access	
	Pest and disease control system	Prevention and reduction of harm from pests and diseases	
	Commercial forestry	Commercial forestry has protected soil erosion in affected areas and has saved farmlands from erosion, thus boosting agriculture's contribution to the economy	
	Organic farming	Organic export-market access and addressing global concerns about the environmental sustainability of food production systems, consumer health, community well-being, and food	



TBL	New Zealand food-system variables	Achievements	Challenges
Environmental	On-farm adverse-event recovery measures	Increased individual and rural community responsibilities for responses to adverse climatic events and natural disasters that affect farm business viability (e.g., agriculture, horticulture, forestry).	To fight land salinity and to protect against erosion while maintaining a strong regulatory system to keep natural resources safe and maintain a safe food image in international markets
	Rural support trusts	Contribute to assist rural communities and individuals during and after adverse events (e.g., floods, droughts)	
	Community irrigation fund	Building of resilience in agricultural producers and rural communities, and ensuring of their long-term economic growth in sustainable environmental limits by reducing risks they face from water shortages caused by climate change	
	Environmental management system	Confirmation of the achievement of environmental goals	
	Legislation and programs to conserve natural resources	Promotion of conservation at the national and local levels	
	Strict regulatory and quarantine requirements for the importation of new genetic material	Balance of the risks and benefits of import regulations and access to new genetic material	
	Environmental performance evaluation	Organization's ability to measure, assess, and communicate environmental performance	