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Health Enhancing Foods

Opportunities for Strengthening the Sector in Developing Countries



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Acronyms and Abbreviations

ABIA	Brazilian Association of Food Industries
ADA	American Dietetic Association
ANVISA	Agencia Nacional de Vigilancia Sanitaria (Brazilian Sanitary Surveillance Agency)
CAC	Codex Alimentarius Commission (WHO/FAO)
CHD	coronary heart disease
CIP	Centro Internacional de la Papa (International Potato Center) (Peru)
CODEX	Codex Alimentarius
DSHEA	Dietary Supplement Health and Education Act (United States)
EIU	Economist Intelligence Unit
EMBRAPA	A Empresa Brasileira de Pesquisa Agropecuária (Brazilian Agricultural Research Corporation)
FAO	Food and Agriculture Organization of the United Nations
FDA	Food and Drug Administration (United States)
FOSHU	Foods for Specified Health Use (Japan)
FUFOSE	The European Commission Concerted Action on Functional Food Science in Europe, coordinated by the International Life Sciences Institute (ILSI Europe)
GMP	Good Manufacturing Practices
GRAS	Generally Regarded As Safe (United States)
HACCP	Hazard Analysis and Critical Control Points
IFIC	International Food Information Council (United States)
IFT	Institute of Food Technologists
ILSI	International Life Science Institute (Europe)
IPPN	Instituto Peruano de Productos Naturales (Peruvian Institute of Natural Products)
ISO	International Organization of Standardization
NLEA	Nutrition Labelling and Education Act (United States)
WHO	World Health Organization

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Executive Summary

Functional foods have entered the global markets with force in the past decade and have rapidly gained market share as value added products. Although the term “functional foods” currently lacks a common definition, this category is generally thought to include products that influence specific functions in the body and thereby offer benefits for health, well-being or performance, beyond their regular nutritional value. These products result from technological innovation, such as cholesterol lowering spreads, xylitol-sweetened chewing gum and dairy products fermented with specific lactic acid bacteria, or are from a naturally functional food such as soy, oats and grains high in fiber. Functional foods have been developed in most food categories and the global market size is conservatively estimated to exceed that for organic foods. In addition to providing new options for improving health and well-being, the functional foods sector offers potential for new economic opportunities.

Functional foods sell at higher prices and contain larger profit margins than conventional foods, which makes the sector attractive for all. Retail prices of functional foods are typically 30 to 500 percent above the comparable conventional foods. For developing countries, economic opportunities in this sector are likely to result from growing domestic markets and from export possibilities to the dominant markets of USA, Europe and Japan. Many developing regions host vast biodiversity that can be tapped for new sources of functional foods or ingredients. The economic returns from health or performance-enhancing functional foods in consumer markets can offer improved opportunities for all members in the supply chain: from raw material producers to retailers. Besides the opportunity for diversification of production and the increased unit prices, farming for the functional foods industry can benefit primary producers and rural communities in other ways. Firstly, contract growing and long-term partnerships benefit both suppliers and buyers; secondly, some of these crops may be native to areas, where more traditional farming is difficult and returns low; and thirdly, functional properties increase the value of otherwise potentially marginal plants, which can aid in biodiversity conservation if their sustainable use is carefully managed.

Although many developing countries could potentially benefit from investing in functional foods, relatively little is known about the current status of functional food production, products, and market development in most developing countries. The objective of this study was to review and assess the status of the functional foods sector in developing countries. Reviewing the available literature provides a general picture and assists in identifying gaps in knowledge of the sector. More details on two target countries, India and China, were collected in a concurrent study that will be reported separately. The present report includes a general literature review of the potential generated by functional foods and an assessment of the sector in five countries (China, India, Brazil, Peru, and Russia).

Description of the Functional Foods Sector

Although functional foods have been a topic of considerable interest in the food and nutrition field for years, a shared expert understanding of what is covered by the term is still lacking.

For the purposes of this report, *functional or health-enhancing foods are food-type products that influence specific physiological functions in the body, thereby providing benefits to health, well-being or performance, beyond regular nutrition, and are marketed and consumed for this value added property.*

Conceptually, functional foods fall in the grey area between conventional foods and medicine. In most countries, a suitable regulatory category for these hybrid products does not exist and most complications in market development arise from a lack of a clear definition and the consequent legal framework for functional foods. The confusing classification and terminology also make it difficult to estimate the size of this sector: global functional foods market size has been estimated at approximately US\$30 to US\$60 billion, depending on the definition. Regardless of the large range in estimates, it is clear that the global functional foods sector has experienced phenomenal growth over the past years with approximately 10 percent annual increase in value.

The development and marketing of functional foods require significant research efforts. This involves identifying functional compounds and assessing their physiological effects; developing a suitable food matrix, taking into account bio-availability and potential changes during processing and food preparation; and clinical trials on product efficacy in order to gain approval for health-enhancing marketing claims.

At the global level, the approach to regulating functional foods and their marketing is heterogeneous. This is largely due to the challenges in classifying these products and to the varying views on what is considered sufficient scientific evidence to determine functionality. Common concerns in all legislation are ensuring product safety and public health. Regulation of functional foods differs from that of conventional foods mainly with respect to labelling and advertising. In Japan and China, a manufacturer can apply for product approval and a “functional food” symbol can be displayed on the food label. In some European countries and the United States, a health benefit can be conveyed to the consumer using “nutrient-function claims” or “health claims”. The regulatory aspects are an important consideration in bringing new functional foods to market.

Besides a well-defined regulatory framework, factors that enable a successful market for functional foods include: consumer awareness of health issues and the role of diet in them; consumer acceptance of active components and food solutions to health issues; sufficient disposable income level; organized retail sector; and mature markets for processed foods.

Opportunities and Challenges for the Functional Foods Sector in Developing Countries

The five target countries in this study are at different evolutionary stages in the development of the sector. China and Brazil have advanced regulatory frameworks for the approval of functional foods and their advertising, although these differ in the specifics. Russia has recently introduced

regulations, while Peru and India still need to formulate regulations. Consumer demand for health-enhancing foods tends to be high and now the increasing levels of disposable income, especially in China, Brazil and Russia, provide a market for new value-added food products. Several target countries represent global biodiversity hotspots, and the potential this natural resource provides in functional food development is both recognized and embraced.

Functional foods represent a broad and heterogeneous food sector. The role of different supply chain players depends on the type of product and its physiologically functional characteristics. Additionally, cultural and regulatory factors influence the potential success of each type of product in different markets. However, there are many common issues that concern most functional food supply chains and products. Factors critical to success include existing scientific support for products; institutional capacity issues relating to research and regulation; and market-related aspects outlined above. In relation to these, the following challenges (although preliminary at this stage due to the limited data) in this sector in developing countries were identified as follows:

1. Legislation and regulatory frameworks require further clarification and strengthening. A clear regulatory system for production, sales, and advertising of functional foods, together with consistent enforcement are critical factors in building consumer trust in functional foods. Moreover, building institutional capacity may be necessary to better meet the demands. A credible system can also help to provide a level playing field to foster competition within the industry and encourage innovation. And, harmonization of still-evolving regulations with major export markets could help reduce potential trade barriers and reduce unnecessary duplication of work for different markets.
2. Continued presence in the functional foods market requires scientific evidence for product effectiveness. Even though certain foods may have been used for a long time for health-enhancement purposes, the definitive scientific support for claims as a functional product is often lacking. This necessary research requires time, financial and human resources, especially for products into the export markets, and for home markets as local regulations become stricter. Research investments are also needed for discovering new functional foods or ingredients in local sources.
3. Knowledge of end-market demand and regulatory requirements is lacking especially at the level of primary producers and ingredient processors. As this information is often available among the food sector experts, its distribution to all involved in the functional foods sector would enable better strategic decision-making and better coordination and collaboration within supply chains.
4. Producers, processors and exporters need market intelligence and knowledge of regulatory processes to create successful market development strategies. As market demand and the associated regulations differ in different markets, transaction costs in the export market are significant for individual companies. Specialized market development and export promotion services might offer a way to address this challenge.

5. Unique local biological resources may provide, much raw material for the functional foods industry and there are specific issues relating to this resource that need to be addressed. These are ecological and environmental sustainability, and intellectual property rights protection.

Conclusions

Opportunities in the functional food sector for developing countries exist in capitalizing on local knowledge on health-enhancing properties of foods and local resources, provided there are sufficient research, market development and institutional capacity in the sector. Because functional foods cover such a broad group of products and production systems, an assessment of the specific opportunities at the national level is necessary as increased benefits for farmers and food manufacturers need to be assessed on product-by-product basis. Specific export markets; regulations and consumer demand are product and/or or ingredient specific and largely dictate the possibilities for development. Further studies could establish the most critical bottlenecks in production systems and identify opportunities with the greatest potential for competitive advantage for small-scale farmers as producers of functional foods.

This review has indicated some critical success factors in the functional foods sector and suggested some of the common challenges faced by the sector in developing countries. Although further research is needed to identify specific entry points in each target country, this assessment has indicated the areas where there are needs, and where assistance might help strengthen the sector. The overall attitude towards the sector in the reviewed countries seems enthusiastic and promising functional food research areas and potential production systems were evident during this initial study.

1. Introduction

Functional foods have entered the global market with force in the past decade and continue to gain market share as value added products at a rapid pace. Although the term “functional foods” currently lacks a common definition, this category is generally thought to include products that influence specific functions in the body and thereby offer benefits for health, well-being or performance, beyond their regular nutritional value. These products result from technological innovation, such as cholesterol lowering spreads, xylitol-sweetened chewing gum and dairy products fermented with specific lactic acid bacteria, or are naturally functional foods including soy, oats and grains high in fiber. Functional foods have been developed in most food categories and even by conservative estimates, the global market size already exceeds that for organic foods. In addition to providing consumers options for improving their health and well-being, functional foods as an attractive market sector, provide new economic opportunities.

The rapidly growing market of functional or health-enhancing foods has emerged as a response to global trends in demographics, patterns of health and disease, innovation in food and health related research, and globalization. In developed countries, with increases in the ageing population and the increasing prevalence of lifestyle related diseases, many use functional foods and diet to reach and maintain optimal health.

In developing countries, similar demographic and public health trends are evolving among higher socio-economic groups, and functional foods have entered these markets. Growing domestic markets and the possibility of exports to the dominant markets of the United States, Europe and Japan provide economic opportunities in this sector. Many developing regions have vast biodiversity that can be tapped for new sources of functional foods or functional ingredients. This potential source and the increased economic value from functional foods can offer new or improved opportunities for all in the supply chain, starting from primary producers. However, while many developing countries could potentially benefit from investing in the production and development of functional foods, relatively little is known about their current status.

Objectives

The objective of the study was to review and assess the status of the functional foods sector in developing countries. Areas of interest included the actual and potential for functional food production, assessment of functional food products in the market, present human and institutional capacity, regulatory aspects, and present and future markets. The primary target audience for this report consists of policy makers, technical experts and operational staff in the World Bank, the case study countries and the development community at large. This report was the first effort to review the available literature and to provide a basis for developing further, more detailed studies. Additional details on India and China were collected in a concurrent study that will be reported separately.

Scope

For the purposes of this report, functional or health-enhancing foods are food-type products that influence specific physiological functions in the body, thereby providing benefits to health, well-being or performance, beyond regular nutrition, and are marketed and consumed for this value added property. The two terms are used interchangeably. Because these products are defined by the benefits they possess *beyond their regular nutritional value*, nutrient fortified products used to alleviate or prevent nutrient deficiencies were excluded. Similarly, the category does not include the “better-for-you” foods, for example low fat versions or other products marketed with a generally healthier image, such as organic products. In country assessments, all food products that are developed, marketed and consumed for their (function- or disease-) specific health-promoting properties were included, even when the existing scientific evidence for these benefits may not yet be substantial.

Initially, the scope was limited to products in the form of food or drink, consumed as part of regular diet, thus excluding dietary supplements in the form of capsules, pills, extracts, teas, and so forth. However, the area is ambiguous and this investigation underlined that in many instances it is not possible to separate products in food form from other products such as capsules. In some national regulations (reflecting cultural attitudes) there is no clear difference, and especially the raw materials and ingredient markets target all related sectors. Consequently, it was necessary to include a wider repertoire of products namely medicinal plants or natural plants and nutraceuticals in some parts of the report.

Functional foods are assessed in the context of developing countries and economies in transition¹ in Asia, Latin America and Eastern Europe. The five target countries: China, India, Brazil, Peru, and Russia were selected to represent different regions, different food and health related traditions, and different stages in the development of functional foods markets.

Methodology

The study was conducted as desk research including a review of existing literature and contacts with resource persons in target countries and elsewhere. The literature surveyed covered academic journals, trade journals, magazine and newspaper articles, market reports, proceedings, books and other publications. Web page content was used, as necessary. Only material in English was reviewed.

Literature was collected using numerous search engines (for example, EbscoHost, ProQuest, Ingenta, Science direct, Google, Google Scholar, PubMed, LexisNexis) in addition to library databases and internet libraries of international development organizations. Key words in the search involved functional foods, but as the terminology in the international setting is poorly defined, also nutraceuticals, bioactive ingredients, and other variations were used. Contacts with parties in target countries and elsewhere were made to obtain additional material, such as reports, proceedings and unpublished information.

Resource person interviews were conducted by telephone to obtain a well-rounded picture of the sector in two target countries, Brazil and Peru.

Interviewees consisted of selected individuals and/or organizations from various stakeholder groups; food manufacturers, research community, agricultural producers, and so forth. These experts were selected on the basis of the literature review findings, contacts with participants in this sector globally and also on availability during the investigation. The initial interview questions were sent to the participants in advance by e-mail and in most cases the responses were used as a base for the interview. The questions were partly targeted to the stakeholder group, partly overlapping, and concerned the overall functional foods sector in the country.

Limitations

The resources for this literature review were limited, which constrained the depth of information included at this stage. The field of functional foods is vast, ranging from naturally functional foods to products resulting from a highly technical development process. The scope of this project only allowed investigating literature on the general topic of functional and health-enhancing foods and closely related industries when applicable. Research on specific subcategories under functional foods would likely provide more insight into the current situation.

Using primarily only literature in English limited the material available. Much of the information on the target countries was only available in the national language.

The terminology related to functional foods is not clearly defined and conceptual disagreement exists even among experts. Differing understandings of what functional or health-enhancing foods are were evident in the cross-cultural context of this review. Literature sources and personal contacts used the term “functional food” in varying ways ranging from a strict definition of “scientifically proven to elicit physiological benefits beyond regular nutrition” to a broader definition to include anything from fortified and low-fat products to capsules and extracts. As a result, comparison of information is not easy. The functionality of a raw material or an ingredient such as a plant or animal product, ultimately depends on the form and concentration in the end-product, the total food matrix properties, and the characteristics of the consumer and so the potential is only realized and the economic value captured in well-planned and managed production chains.

Structure of the Report

In this report Section 2 provides an overview of the functional foods sector and opportunities for developing countries; Section 3 presents figures on the current and future demand for functional foods; Section 4 discusses rationale and the economic opportunities and restrictions presented to the supply chain members; and Section 5 consists of final conclusions and recommendations.

2. An Overview of Functional Foods

Role of Diet and Foods in Human Health and Well-Being

Countries worldwide are going through a nutritional transition and are now affected by double burden of nutritional problems. Undernutrition and specific nutrient deficiencies continue to present a problem, and simultaneously imbalanced diets and chronic diseases are becoming alarmingly common. Non-communicable conditions (cardiovascular diseases (CVD), diabetes, obesity, cancer, and respiratory diseases) account for 59 percent of the 56.5 million deaths annually and 45.9 percent of the global burden of disease (WHO fact sheets).

The problem of chronic diseases and malnutrition is more serious in developing countries. About 79 percent of all chronic disease-related deaths globally are taking place in the developing world. Lack of access to health services and sufficient income needed to buy healthy and nutritious foods characterize majority of poor people in developing countries. This poverty-malnutrition nexus provides a strong case for improving income of the poor to help in reducing disease and malnutrition burden.

Globally, it is estimated that up to 80 percent of CHD, 90 percent of type-2 diabetes, and 1/3 of cancers can be avoided by changing lifestyle, including diet (WHO fact sheets). Diet-related high cholesterol, high blood pressure, obesity and insufficient consumption of fruits and vegetables are among the significant risk factors that cause the majority of this disease burden (WHO fact sheet). Change in diet could reduce four of the risk factors and thus reduce the chronic disease prevalence.

In recent years, there has been growing consumer awareness about health, nutrition and the food safety (often triggered by specific food incidents) especially in developed countries and high-income groups in developing countries. In the food industry there have been two broad trends. There has been recognition that hazards and contaminants can enter the food chain and can cause sickness, death and diseases, and so governments, often to deal with consumer and industry concerns, establish regulations and standards on food hazards including standards on pesticides, antibiotics, microbiological hazards and other chemical and physical contaminants. There is also a growing awareness of the health-enhancing properties for prevention and treatment of health concerns beyond the basic nutritional component of many foods.

In the past century, the link between nutrition and human health has also been strongly established by modern science (WHO 2003). Examples include the role of nutrients in curing clinical deficiency status was discovered and more recently, the role of either suboptimal or excessive consumption of certain nutrients in the development of chronic diseases (heart disease, cancer, diabetes and dental diseases) that are a major public health burden in both developed and developing countries (see Table 2.1). As scientific evidence for these linkages has accumulated, the possibility of foods to

influence more specific physiological functions in a beneficial way has become a growing area of interest.

Table 2.1 Selected Statistics on Non-Communicable Diseases and Role of Nutrition

- Heart attacks and strokes kill 12 million people annually.
- An estimated 177 million people have diabetes, mostly type 2. Two thirds of the cases are in the developing world.
- Over 1 billion adults worldwide are overweight.
- High blood pressure affects approximately 600 million people worldwide, and is estimated to cause 13percent of deaths and 4.4percent of disease burden. Two thirds of strokes and half of heart disease could be attributable to high blood pressure. High blood pressure is associated with risk of stroke, heart disease, and renal failure.
- High cholesterol levels increase the risk of heart disease, CVD and stroke. 18percent of stroke events and 56percent of heart disease are attributable to high blood cholesterol levels. High cholesterol thus causes 7.9percent of total deaths and 2.8percent of total disease burden globally.
- Low fruit and vegetable intake increases the risk of cancer, heart disease and strokes. Mechanisms of action behind this could involve various components in these foods, including antioxidants, flavonoids, carotenoids, vitamins and dietary fiber.

Sources: WHO Chronic Disease fact sheet and Global Strategy fact sheet.

However, dietary habits are notoriously difficult to change and even more difficult to sustain, even if the positive health effects are known. Functional foods can offer a means of providing some health or well-being benefits in a way that requires smaller behavioral changes by the individual consumer. Improved products may also provide dietary components that would otherwise be difficult to obtain in sufficient amounts from normal diets.

As more is understood about food components and physiological mechanisms, foods can be manipulated to reap the greatest benefits from their properties. The focus is moving beyond disease prevention to optimal health, optimal performance and maximum well-being. In addition to staying healthy, consumers seek to enhance functions such as mental or physical performance, perceived energy level, appearance, and even mood. Some experts suggest that in mature markets, these non-nutritional benefits (“softer benefits”) are in fact taking over ground from the earlier focus on disease prevention.

Functional foods can, thus, have two general types of beneficial effects: to reduce the risk of a disease, and to enhance a specific physiological function (Roberfroid 2002). Disease reduction examples include reducing the risk of cardiovascular disease or dental caries, while physiological benefits include enhanced intestinal function, and mental performance. In reducing the risk of chronic health problems, foods exert their effect incrementally, over years and decades while for physiological functions foods and food components can offer benefits that are immediately evident, such as improved mental alertness, normal gut function, or feeling of higher energy state.

Currently, cost-effectiveness of functional foods in reducing disease burden and lost productivity is an important research gap. The popularity of

functional foods is increasing and the effect on the food industry is evident. Functional foods offer new options for consumers interested in improved dietary behavior, which may use dietary components from functional foods.

Goldberg (1994) suggested the following trends in developed countries that will drive the success of functional foods:

- Accumulating clinical evidence;
- Age wave, demographic changes;
- Health care cost containment;
- Media, access to more information;
- Nutritional labeling;
- Growing emphasis on healthy diet and overall prevention of chronic disease;
- Food technology innovations; and
- Brand differentiation.

Functional foods have displayed an annual growth in sales value at around 10 percent in global markets and this is expected to continue. Some listed trends are inevitable (demographic changes) but with others, systematic market development must involve many stakeholder groups from policy makers and food manufacturers to educators and the consumers. In addition, the relative strength of the driving factors varies as for example, some national governments have actively pursued the issue of functional foods as a response to growing public health problems. In other countries, the main driving factor comes from consumers or from emerging food science research.

The Concept of Functional and/or Health-Enhancing Foods

Functional foods have been developed in virtually all food categories. Dairy, bakery products, beverages, and confectionery are among the more popular. From a product point of view, the functional property can be included in numerous different ways (Ashwell 2002; Fogliano et al 2005; Roberfroid 1997), as illustrated in Table 2.2.

Innovations in functional foods can be based on new functional components (either those not previously found in foods or those for which new functional properties are discovered) or special processing technologies. In either case, the initial development work entails significant research efforts, whether the focus is on elaborating physiological mechanisms and beneficial effects of traditional foods products or developing entirely new process technologies. Market development often includes additional clinical studies, since in many markets this type of support is required by governments for making health claims in marketing.

Conceptually, functional foods fall in the grey area between conventional foods and medicine (see Figure 2.1): they are primarily foods and in food form, but as discussed above offer specific health-enhancing properties. In most countries a suitable regulatory category for these hybrid products is missing and individual products are forced under an existing category of either foods or medicines, which usually have separate and very distinct legislation.

Table 2.3 Selected Definitions of “Functional Food”

FUFOSE^a: A functional food is satisfactorily demonstrated to affect beneficially one or more target functions in the body, beyond adequate nutritional effects, in a way that is relevant to either improved stage of health and well-being and/or reduction of risk of disease. A functional food must remain food and it must demonstrate its effects in amounts that can normally be expected to be consumed in the diet: it is not a pill or a capsule, but part of the normal food pattern. (Diplock et al 1999)

IFT^b: Foods and food components that provide a health benefit beyond basic nutrition (for the intended population), including conventional foods, fortified, enriched or enhanced foods, and dietary supplements. They provide essential nutrients often beyond quantities necessary for normal maintenance, growth, and development, and/or other biologically active components that impart health benefits or desirable physiological effects. (MacAulay et al 2005)

ADA^c: functional foods are foods that have health benefits beyond the nutrients they contain. (ADA 2005)

IFIC^d foundation: Any food or food component that may provide a health benefit beyond basic nutrition (IFIC 2002)

Health Canada: A functional food is similar in appearance to, or may be, a conventional food, which is consumed as part of a usual diet and is demonstrated to have physiological benefits and/or reduce the risk of chronic disease beyond basic nutritional functions. (Health Canada 1998)

Food and Nutrition Board of the National Academy of Science (US): “potentially healthful products that may include any modified food or food ingredient that may provide a health benefit beyond the traditional nutrients it contains” (Food and Nutrition Board 1994)

- a) FUFOSE = The European Commission Concerted Action on Functional Food Science in Europe, coordinated by the International Life Sciences Institute (ILSI Europe)
- b) IFT = Institute of Food Technologists
- c) ADA = American Dietetic Association
- d) IFIC = International Food Information Council

As shown, the definition ranges from general to highly elaborate even among professional organizations. Some definitions include only products that have been manipulated in some way, which would exclude the so-called “naturally functional foods” such as oats and carrots. Others emphasize the importance of the totality of scientific support for the physiological function as inclusion criteria. In the latter case, new emerging functional foods would potentially not be included in this category in years until sufficient scientific evidence is collected. Views of nutrition and/or health experts, the government and the consumers are typically divergent.

It should also be noted that from a scientific point of view, not all functional foods are functional for the entire population. They may only provide beneficial effects in individuals with specific risk factors. An intake at a certain threshold level may also be necessary for a physiological effect. Many functional foods may thus be functional only under specific conditions of usage.

Some national views consider functional foods a distinct product category (for example Japan—Foods for Specific Dietary Uses (FOSHU); China—“health foods”). For others, the question is more about a concept—small improvements in the properties of existing food products (Hilliam 1998). In most countries, the general consensus suggests that functional foods must be

in the form of regular food or drink that can be incorporated in a regular diet. However, some cultures also include certain products in the form of capsules, extracts, and so forth, that are elsewhere classified as dietary supplements or even drugs (Verschuren 2002). In China and Japan, functional foods may be in a form that would be considered a supplement in other countries, while in the US, a product in food form can be sold as a supplement (provided safety and quality regulations are met), with the only distinction being the place of purchase and product labelling.

Further complications are the large number of terms often used interchangeably and in a confusing manner such as health foods, nutraceuticals, designer foods, pharma-foods, and so forth. None have clear and generally accepted definitions.

For the purposes of this report, functional or health-enhancing foods are food-type products that influence specific physiological functions in the body, thereby providing benefits to health, well-being or performance, beyond regular nutrition, and are marketed and consumed for this value added property. Other definitions will be provided when discussing the differences in “functional foods” definition in the selected countries.

Potential Benefits of Functional Foods to Developing Countries

With prevalent poverty and high rates of malnutrition and escalating rates of diet-related diseases in developing countries, growing functional foods markets provide opportunities for developing countries through improvements in public health, and for generating employment and income in the development of functional foods and their supply chains.

At present, demand for functional foods is concentrated in developed countries and high-income groups in developing countries. Functional foods are still considered expensive, although research has been carried out to cover issues of affordability and access, especially by the poor. Moreover, there is growing research on the potential of biotechnology in the development of functional foods for improved health effects of the staple foods in developing countries including high-iron rice, high vitamin A rice, improved oil content in legumes, improved protein content in legumes and soybean and orange-fleshed sweet potato (Niba, 2003). To date, however, none of these genetically modified products have reached large-scale production (see Box 4.9, section 4). A few developing countries have been considering functional foods as part of their plan to tackle malnutrition. For example, in China, the Center for Public Nutrition and Development has proposed that essential consumables such as salt, flour, edible oils, baby foods and soy be fortified to help reduce malnutrition especially in poverty-stricken regions (Japan Development Institute, 2006). In India’s rural areas, food companies have introduced specific products with high vitamin A at affordable prices (Japan Development Institute, 2006). At present, there is a weak case for functional foods to be used as an instrument to improve public health in developing countries, as development of traditional agriculture is likely to produce more affordable supply of food to cater to the basic nutrition and health needs of the public. There is, however, a stronger case supporting the development of functional foods and their supply chain needs for employment and income-generation opportunities. Demand for functional foods in both developed

and developing countries is growing (as discussed in Section 3) and there are increasing examples of supply chain development of functional foods in developing countries to meet these growing demands (as presented in a Section 4).

3. The Demand for Functional Foods

Global Market Description and Future Prospects

The global functional foods sector has experienced phenomenal growth over the past years. Since the late 1990s, the rapid expansion (approximately 50 percent to 60 percent growth in value sales over a five year period) is expected to continue only at a slightly slower pace over the next five years (Benkouider 2004; Datamonitor 2004). The indicated growth rates are significantly higher compared with the approximately two percent growth annually for the food sector as a whole (Menrad 2003). Growth forecast for main emerging markets as a group (Hungary, Poland, Russia, Mexico, Brazil, China, and South Korea) is similar to the global forecast (Benkouider 2005).

In dollar terms, the estimates of total market value of functional foods currently range from US\$31 billion² to nearly US\$61 billion³ (Datamonitor 2004; Benkouider 2005).⁴ In Europe, the market share of functional foods was less than 1 percent of total food market (which is valued at about US\$1 to US\$1.5 trillion) in the late 1990s (Menrad 2003). In the US, functional foods account for approximately 3 percent of food sales valued at more than US\$500 billion, and percentage is expected to double by 2008. (Benkouider, 2004) More conservative forecasts suggest that even though the market share of functional foods will continue to grow, it will not surpass a 5 percent share in the near future (Menrad 2003; Hilliam 1998). For comparison, the size of the global organic foods market was estimated at approximately US\$36 billion in total revenues in 2005 (Datamonitor 2005). In organic foods, compound annual growth rates in revenues have been over 15 percent globally in 2001–2005 and are expected to continue at nearly 13 percent until 2010 (Datamonitor 2005).

Globally, dairy products represent the highest value sales (39 percent to 56 percent of total in 2003, depending on the source); functional confectionery, soft drinks and bakery and/or cereal groups (not in order) follow in popularity (Benkouider 2004; Datamonitor 2004). The three main markets exhibit somewhat different characteristics and focus areas. In both Japan and Europe, gut health forms the most prominent area; in the U.S., heart health and cancer prevention are emphasized (Arai et al 2002). Globally, segments with most promise include probiotic products, cholesterol-lowering segment, and cosmeceuticals (Benkouider 2004); gut and bone health (Euromonitor 2003); and heart health, weight management, and physical and mental (Weststrate et al 2002). Consumer health concerns and product preferences between markets vary.

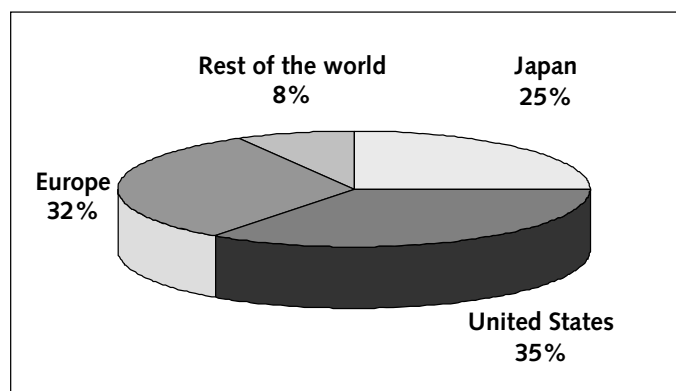
Statistics on international trade of functional foods are not directly available as functional foods are traded in the tariff code categories of “among other foods”. Similarly, a large portion of botanical ingredients are funnelled into the pharmaceutical, natural medicine or dietary supplement markets, along with the portion used in the production of functional foods making commodity trade figures of limited informational value. In trade reports, the

ingredient markets for cosmetics, dietary supplements as well as functional foods are examined together because, at least in the major destination of the U.S., many or most of the natural ingredient manufacturers and distributors have positioned themselves as suppliers to manufacturers of all these sectors. (Brinkmann 2003)

Growth in Functional Food Demand in Japan, Europe, and United States

The United States, Japan and Europe are dominant global markets, contributing over 90 percent of total sales (see Figure 3.1).

Figure 3.1 Share of Global Functional Foods Market in 2003



Source: Datamonitor 2004.

Japan

With an estimated demand for nutraceuticals and functional foods of between US\$4 and US\$15 billion annually, Japan represents the most sophisticated market in the world for this industry (SWMI, 2002). The industry is expected to grow at a rate of about 12 percent per year through 2005 (SWMI, 2002).

In Japan, functional food products have been sold since the 1930s. The sector's world leadership began in 1980s, driven by major forces from demographic and public health trends, strong government involvement as a response to these changes, and favorable characteristics in local demand.

The government push into functional food research programs in the mid 1980s was a response to the ageing population with its increasing health problems and the expected increases in health care costs as a result. The purpose of the government-initiated research was to investigate, in-depth, the role foods can play in reversing and preventing the prevalent chronic health conditions. Following these national research efforts, legislation was soon crafted to bring newly developed functional foods onto the market. In 1991, a distinct category, Foods for Specific Health Use (FOSHU) was created for products, which may improve specific health conditions. The key reason for this distinct product category and labelling system was to curb misleading marketing of non-proven products (Arai 2002).

The FOSHU regulations recognize various health conditions, for which food products can be approved (see Table 3.1). In 2001, this regulation was expanded and a new category of “foods with health claims” was created to include both FOSHU and a group of “foods with nutrient-function claims”. This latter type of claim has now been approved for twelve vitamins, five minerals and beta-carotene (Ohama et al 2006). FOSHU approval is determined on a case-by-case basis while nutrient-health claims are generic for any product meeting the stipulated requirements. Since 2005, disease risk reduction claims are also allowed, and a possibility for “qualified FOSHU” products based on emerging scientific evidence has been included (Ohama et al 2006).

FOSHU function	Approved products (#)	Main functional ingredients
Foods for gastrointestinal health	254	Oligosaccharides, Lactobacillus, Bifidobacterium, Psyllium husk, indigestible dextrin, wheat bran, low molecular sodium alginate, partially hydrolyzed guar gum
Foods for people with high cholesterol/triglyceride level and body fat	117	Soy protein, chitosan, low molecular sodium alginate, peptides, diacylglycerol, plant sterol/stanol (esters), green tea catechin, middle chain fatty acid, Drug and Health Administration, Environmental Protection Agency, degradation products of globin protein, Psyllium husk
Foods for those with high blood glucose	71	Indigestible dextrin, L-arabinose, wheat albumin
Foods for those with high blood pressure	64	G A B A, peptides
Foods for dental health	34	Xylitol, polyols, tea polyphenols, CPP-ACP
Foods for bone health	26	Soy isoflavone
Foods for those prone to anemia	3	Heme iron
<i>Source:</i> Ohama et al 2006. *Foods for Special Use.		

Since 2001 FOSHU products can take the form of capsules and tablets (that is dietary supplement form) in addition to food and drink, although a great majority of products are still in more conventional forms (Ohama et al 2006) .

Even with the clear category of functional foods and the possibility of obtaining government FOSHU certification, many companies choose to use other means of promoting products. This is partly because relying on consumers’ awareness of nutritional components may be equally effective. In the late 1990s, it was reported that 90 percent of functional food products do not have a health claim on their packaging (Farr 1997). The FOSHU label may allow for higher pricing of the product but even without it, functional foods present a lucrative business sector. FOSHU approved products constitute only approximately 18 percent of all functional food revenues in Japan (Hayes 2004).

At the end of 2005, more than 569 products had been approved as FOSHU (Ohama et al 2006). Since 1990, an estimated 5,500 or more new functional foods (FOSHU or non-FOSHU) have been introduced in Japan. At any one time there are 1,500 to 2,000 functional foods on the market, of which approximately 400 qualify for FOSHU status (Mine 2005). At the present time, the Japanese spend US\$126 per person annually on functional foods compared with US\$67.9 per person per year in the U.S., US\$51.2 for Europeans, and an estimated US\$3.20 for other Asians (Mine 2005).

Japan has pioneered functional foods and remains the world leader. The factor driving this market's emergence and continued thriving include purposeful government involvement that regulates the field, but does not overly restrict it. In addition, the demographic shift and population health trends create demand. The Japanese culture also is receptive; innovation is appreciated and consumers are willing to try new products and even demand them (Heasman 2001).

Europe

The functional food market in Europe is estimated in excess of US\$15 billion, and is growing quickly, expected to increase by as much as 16 percent annually (SWMI, 2002).

From the European perspective, functional foods are more a concept than a distinct product category. The approach is function rather than component- and or product oriented. The European taskforce FUFOSSE has set the following six physiological functions as focus areas in research: growth, development, and differentiation; substrate metabolism; defense against reactive oxidative species; cardiovascular system; gastrointestinal physiology and function; and behavior and psychological functions (Diplock et al 1999).

Common legislation regarding health claims and labelling among EU countries is still missing. EU-wide regulations on types of claims approved and the necessary conditions for them have been under intense debate in the past years. Until the EU regulations have been written, national regulations have different rules regarding the acceptability of structure or health claim (Hawkes 2004).

In the heterogeneous European markets, there are large regional differences in use and acceptance of functional foods (Menrad 2003): traditionally, southern Europeans have appreciated natural, fresh foods and consider those good for health, in northern Europe many food technology innovations have experienced remarkable market success such as the daily dose probiotic dairy products which have been the most popular product category across Europe (Menrad 2003; Arai 2002). European consumers tend to use functional foods mostly for their health-promoting or disease risk preventing properties (Arvanitoyannis 2005).

United States

Similar to Japan, the American functional foods market tends to be product, component, and marketing driven (Diplock et al., 1999). The food labelling regulations in the United States are complex, constantly evolving, and disagreements about content and wording issues have been even resolved in court (Heasman & Mellentin 2001). The two pieces of legislation relevant to functional foods are 1990 National Labelling Education Act (NLEA) and the

1994 Dietary Supplement and Health Education Act (DSHEA) and are administered by the Food and Drug Administration (FDA).

In the U.S, two types of claims related to health and/or well-being are allowed for foods: health claims and structure-function claims. Health claims describe a relationship between a substance in food and a disease or health condition and are generic in that any food that contains an indicated level of the respective nutrient⁵ can use them. (See below for a list of currently-approved health claims.) Health claims must be supported by the all publicly available scientific evidence and there must be significant scientific agreement among qualified experts that this support exists (IFT 2005).

The current regulations also recognize “qualified” health claims for products that currently do not meet the extensive demands for supporting scientific evidence. The FDA, however, reserves the right to formulate the wording on these claims. The results in many cases have been poor; the claims are seen as confusing by consumers and they may unintentionally even placed the quality of the product in bad light. Health care claims are one of the most significant areas of the U.S. functional foods regulations (Burdock et al 2006).

Table 3.2 Generic Health Claims Approved in the United States

- Calcium and **Osteoporosis**
- Dietary Lipids (Fat) and **Cancer**
- Dietary Saturated Fat and Cholesterol and **Risk of Coronary Heart Disease**
- Dietary Non-cariogenic Carbohydrate Sweeteners and **Dental Caries**
- Fiber-containing Grain Products, Fruits and Vegetables and **Cancer**
- Folic Acid and **Neural Tube Defects**
- Fruits and Vegetables and **Cancer**
 - Fruits, Vegetables and Grain Products that contain Fiber, particularly Soluble fiber, and **Risk of Coronary Heart Disease**
- Sodium and **Hypertension**
- Soluble Fiber from Certain Foods and **Risk of Coronary Heart Disease**
- Soy Protein and **Risk of Coronary Heart Disease**
- Stanols and/or Sterols and **Risk of Coronary Heart Disease**

Source: U.S. Food and Drug Administration website, <http://www.cfsan.fda.gov/~dms/lab-ssa.html>. Accessed: Jan. 25, 2006

Structure-function claims, which describe the role of a nutrient in the maintenance of a normal physiological function, do not have to be pre-approved. These claims may only refer to normal physiological processes or states and follow the format such as “calcium helps maintain healthy bone structure.” Using structure-function claims requires notification to the FDA 30 days prior launching the product.

In contrast to foods, dietary supplements also regulated by the FDA can be marketed more freely with various structure-function claims, although labelling must also identify the product as a dietary supplement. Functional food additives can be used in supplements with fewer restrictions compared to foods.

Skilful marketing and consumer oriented product development are key features of the American market. Marketing possibilities created by the healthy eating trends have been fully utilized for example in marketing traditional foods such as oats and tomatoes as functional, once their health benefits have been established (Heasman & Mellentin 2001). Although the

labelling regulations are complex, consumers do use label information as sixty-four percent of North American (US and Canada) consumers report "mostly" understanding nutritional information on food packaging (A.C. Nielsen 2005b). In a recent survey, food product labels were found to be one of the three most common reasons for change of diet, along with information from health professionals and family and friends (IFIC 2006a).

The most interest in functional foods has been in reducing the risk of cancer and heart disease (Arai 2002). In 2005, the most discussed functional foods or food components in the media were: general fruits and vegetables and omega-e fatty acids (IFIC 2006b). After these came garlic, fiber, foods with antioxidants, lycopene, plant estrogens, and unspecified functional foods (IFIC 2006b). While the top five health benefits from functional foods were: reduced risk of cardiovascular diseases, reduced risk of cancer, weight loss/management, improved general health, and improved memory (IFIC 2006b). The biggest health concerns, reported by consumers, have been heart health (heart disease, blood pressure, and cholesterol level) and cancer (IFIC 2000).

Small but Growing Demand in Developing Countries

The demographic, economic, and cultural changes that have driven the development of functional food markets in developed countries are occurring also in developing countries. Small ageing populations and the continuing and increasing prevalence of chronic diseases are producing interest in the benefits of improving dietary habits. With the increasing globalization of the market place, especially in the food and pharmaceutical sectors, there has been an increase in the demand for new innovative products including in the functional foods sector.

Developing countries are currently at very different stages of market maturity. In Southeast Asia, Latin America and Africa, traditional knowledge has always been appreciated with considerable knowledge of the functional, preventative or even curative properties certain foods. As a result, the idea of health promoting foods is readily acceptable and welcomed, even though the term "functional food" is unknown to consumers. A further element in the use of traditional methods, such as functional foods for health maintenance, is the high costs of pharmaceuticals.

Although disparities in income are great in most countries in the regions, increasing numbers have income levels that enable the purchasing higher priced food items, including functional foods. High prices exclude low-income people buying these special products and this is the population group that could potentially gain the most from products.

While the domestic market environment and demand sophistication a factors in the opportunities available for companies developing countries, export markets may offer profitable opportunities to overcome their limited domestic demand of functional foods. Commercial export opportunities exist in value-added raw materials, functional ingredients, and even in consumer products for the functional food sector in the more mature markets. The following section examines the functional foods sector in the five case study countries, China, India, Brazil, Peru and Russia. For a more in-depth review, see Annex 4.

China

China's functional foods market is approximately US\$6 billion per year, and this is expected to double by 2010 (Sun, 2006). It is still heavily influenced by Traditional Chinese medicine, even though western influences are moving in. All types of functional foods are increasing in popularity and increasing numbers of consumers can afford to use them

China's "health food" industry experienced rapid growth from late 1980s to late 1990s, with fastest increase among the urban higher income population. Continued expansion in the functional foods market is predicted with per capita spending on functional foods expected to grow two-fold or more between 2004 and 2010. (Benkouider 2005; U.S Commercial Service 2006) Currently, it still a small fraction of that in the developed markets.

The Chinese health food market will be driven by: economic growth, nutrition awareness, efforts to extend health food markets to rural areas, and the ancient tradition in herbal medicine that provides a platform for the development of the functional foods market (U.S. Commercial Service 2006a). Increasing health care costs to deal with chronic diseases and an increasingly aging population may act as an incentive for using self-care methods such as health foods.

Table 3.3 sets out the claims made for functional foods. The regulations for the past decade involve 27 classes of claims.

• Enhanced immunity	• Help in lowering blood pressure	• Eliminate acne
• Sleep improvement	• Increase bone density	• Eliminate chloasma
• Enhance tolerability to oxygen deficiency	• Help in the protection against liver damage caused by chemicals	• Help in the protection against the damage caused by radioactive matters
• Relief of physical fatigue	• Relieve eye fatigue	• Improve oil content of skin
• Weight loss	• Improve moisture of skin	• Improve growth and development
• Help in lowering blood glucose	• Anti-oxidation	• Improve nutritional anemia
• Lactation improvement	• Help in memory improvement	• Adjust enteric bacteria colony
• Promote lead excretion	• Promote digestion	• Clear the throat
• Help in the protection of gastric mucosa	• Promote lactation	• Catharsis
<i>Source: Xie 2005.</i>		

Between 1995 and late 2005, approximately 7000 domestic and 500 imported products had received government functional food approval (Xie 2005). Overall, according to a locally conducted survey (not original report), 89 percent of all health foods are functional foods, while 11 percent are in a supplement form. Imports account for 40 percent of health food (including

supplements) sales, although imported products fall mainly in the dietary supplement category. Approved products primarily target enhancement of the immune system (34 percent), combating fatigue (18 percent) and regulating cholesterol levels (16 percent) (U.S. Commercial Service 2006a).

India

India's health foods history dates back centuries. Developments of the last few decades, have taken the traditions of ancient medicines and natural health foods to a new stage. With its strong tradition of healthful eating, India ranks among the top ten nations in buying functional foods (Watson, 2006). India's nutrition industry is generating US\$6.8 billion in annual revenue, and that number is expected to nearly double in the next five years (Ismail 2005).

The functional food industry in India is strong and growing with aims of becoming a major force in the international health foods market (Japan Development Institute 2006). The government is working hard and fast at shoring up its intellectual property rights laws and food legislations; productivity is growing; and investment in research and development infrastructure continues to increase year-over-year (Ismail, 2005). This ambitious state of affairs is due to cooperation at all levels. Unanimity of purpose exists between major companies and in the government, where both ministers and the substantial state research organization are behind the idea (Shrimpton, 2004). In addition, the functional food market has met with popular acceptance from consumers at large.

Robust growth is expected to continue in the functional food industry. India's population is large and predominantly young, with 516 million people between the ages of 20 and 55 today, this number is expected to increase to 800 million within the next 40 years. As the younger generation moves toward middle age and disposable income increases⁶, the need to maintain and/or establish a healthy diet will drive functional food consumption increasingly higher.

However, despite all the positive support for functional food there are problems within the food industry including the low level of organization in the retail sector, inadequate infrastructure, and lack of capacity in value-added processing. In addition, while the internationally recognized Central Food Technological Research Institute in Mysore has extensive research facilities and activity in this sector, food laboratory capacity in general is currently insufficient for the industry needs especially considering the need to regulate and implement international standards.

Brazil

The income gap in Brazil is large, but even with only 2.4 percent share affluent families amount to 1.16 million families creating a sizable target market for value-added foods, including functional foods. The size of the middle class is estimated at a significant 61.9 million. More than half of wealthy families are concentrated in Sao Paulo state. These affluent consumers follow international trends and are demanding in their purchase decisions (Fonseca 2005a; Fonseca 2005b).

The market for functional foods in Brazil is relatively young, but growing. Despite the narrow target consumer segment, the total population size, developed retail network and local demand increase the attractiveness of this

market. Currently products are mainly focused on micronutrient fortification, probiotic products, and cholesterol lowering spreads.

Regardless of the needs, health foods have a limited presence in the Brazilian market but the sector is relatively young, growing rapidly and has significant room for further growth. The small size of domestic target market has discouraged local companies from stronger market development efforts (Fonseca 2005). The Brazilian functional foods market is currently a small niche market that, however, has been forecasted to reach value sales of US\$1.9 billion by 2009. However, the growth of 29 percent in per capita spending on functional foods during this period is considerably lower than forecasts for some other emerging markets (Benkouider 2005).

Dairy products present clearly the largest category of Brazilian functional foods sales. Functional dairy⁷ accounts for 73 percent of total functional foods sales, and 11 percent of all dairy sales in Brazil (Nutraceuticals World 2005). From a functional ingredient point of view, the currently available functional foods are products fortified with vitamins and minerals, dietary fibers or probiotics. Recently, probiotic products have been receiving increasing media attention. Cholesterol-lowering spreads are also available; the first product with an approved health claim in the Brazilian market was in this category. Supermarkets are becoming the mainstream distribution channel for functional food products in Brazil (Benkouider 2005).

Since 1999, over 200 products with labelling claims have been approved with 14 different functional property claims (see Table 3.4). There are 25 types of substances or micro-organisms to which these functions have been attributed. To date, no products with a disease risk reduction claim had been approved (ANVISA 2005; Bellaglia 2006; Cleber Ferreira dos Santos 2006).

Several challenges in developing the domestic functional food market include: most functional ingredients must be imported; previously emphasis on low-level processing of bulk commodities, and high cost of ingredients and meeting regulations.

Table 3.4 Brazil Food Components and Related Functions Approved for Health Claims
Omega 3 and the maintenance of healthy blood triglyceride levels
Lutein and the protection against cellular damage from free radicals
Lycopene and the protection against cellular damage from free radicals
Dietary fiber and intestinal function
Lactulose and intestinal function
Bifidobacter animalis and intestinal function
Fructo-oligosaccharides and balanced intestinal flora
Inulin and balanced intestinal flora inulin Probiotics (9 species specified) and balanced intestinal flora
Beta-glucan—helps reduce absorption of cholesterol
Psyllium—reduces the absorption of fats
Chitosan—reduces the absorption of fats and cholesterol
Plant sterols—reduce the absorption of cholesterol
Soy protein and reduction of cholesterol
<i>Source: ANVISA 2005.</i>

Peru

The market for healthful products in Peru, in general, is still in early stages, but has potential for growth. As in the entire region, demand for better-for-you type low-fat and sugar-free products is increasing, but mainly among high-income consumers with rising health consciousness (Gutierrez 2004; EIU 2005).

Local demand for more specific functional food products seems to be directed at products made with local edible plants traditionally believed to have functional or even therapeutic properties, even though the effects have often not been substantiated by scientific studies. These fruits and vegetables can be purchased and used raw, home cooked, or processed (personal interview).

Processed functional or health-enhancing foods are also sold in Peru by at least the local branches of the largest multinational companies⁸. Consumer attitudes regarding functional foods in Peru is a research gap.

Barriers to the growth of the functional foods market in Peru include low-income level of consumers, lack of organized retailing, absence of clear regulations especially in labeling. Lack of analytical laboratory capacity, and the need to meet stringent quality demands for export would require more resources.

Russia

The Russian functional foods market is still relatively small but shows promise; improving nutrition awareness combined with the large population with rising incomes result in an increasing demand for health-promoting foods. The current market is mainly concentrated in the functional dairy sector.

Diet-related issues have recently gained publicity for Russia; the most prominent public health problem in Russia is cardiovascular disease (CVD), which accounts for over 50 percent of deaths. In large part because of CVD,⁹ life-expectancy in Russia is 12 years lower than in the U.S., and 5 years lower than in China. Inappropriate diet is a major determinant of CVD risk factors.¹⁰ About 60 percent of Russian adults have blood cholesterol levels above recommended levels and 20 percent need medical attention. Overall, death rates from non-communicable diseases are three times higher in Russia compared with the EU average (World Bank 2005).

Although the Russian functional foods market is still undeveloped, numerous new products have been introduced in the past few years, and the demand for functional foods is high among the higher income population. A trend towards healthy lifestyle and healthier eating is evident (Spiridovitch 2005; Taybakhtina 2005b).

The value of Russian functional foods market was estimated at US\$75 million in 2004, and annual growth of 20 percent is expected (Patton 2005). However, the definition for functional foods behind this figure was not explained. Growth in certain sectors, such as enriched products has been extremely rapid (Drujinina 2005c).

The dairy industry has taken the lead in the functional foods movement and the largest growth is expected in this sector (Spiridovitch 2005). Probiotic products currently hold a noteworthy 35 percent market share in kefir and

25 percent in drinking yogurts (Drujinina 2005c). Functional properties are also becoming popular in the bakery and beverage sectors and functional foods differentiation strategies are used in oils, dietary fats, and confectionery, and even in spirits (Drujinina 2005a). The main driver for the functional food market is consumer demand that comes from rising affluence and increasing health awareness, partly induced by public health education efforts and aggressive advertising of functional foods. In the dairy sector, 80 percent of advertising expenses in 2004 went into marketing functional products (Spiridovitch 2005). Consumer awareness has improved particularly about the role diet can play in reducing the extremely high prevalence of CVD in the country. The government and business climate is supportive of companies investing in functional foods.

Russian consumers read product labels carefully and are ready to pay more for branded products (Taybakhtina 2005a). The concept of functional foods is best understood in the dairy sector, while some product segments, such as high fiber foods, suffer from low consumer awareness (Taybakhtina 2005a). In addition to still lagging consumer awareness in some aspects, challenges for the sector are the limited retail distribution, especially in rural areas, and lack of quality ingredients and technology from domestic suppliers. Expansion of functional foods market is likely to remain urban based for years (Benkouider 2005).

Summary

There is an increasing demand of functional foods in developed countries. The rapidly growing market of functional or health-enhancing foods has emerged as a response to demographics, patterns of health and disease, innovation in food and health related research, and globalization. The ageing population, increasing prevalence of lifestyle related diseases, and the generally improving nutritional status has shifted the focus from nutrition issues to using diet to reach and maintain optimal health. This sizeable demand of functional foods provides important export opportunities for developing countries.

Demand for functional foods in the developing countries is small but growing and is an opportunity to develop local markets to supply this demand. Key concerns that may require public support include: underdeveloped infrastructure; unorganized and fragmented retail network; lack of resources for research and little cooperation between academic research and the industry; emphasis on low-level processing of bulk commodities; the high cost of ingredients, and the high costs in meeting food safety and quality regulations. The future of functional food markets will depend on how these concerns will be addressed by governments and how international organizations and the private sector can participate and facilitate this process.

4. Supply Chains in Functional Foods

Functional foods sell at higher prices and carry larger profit margins than conventional foods. Despite the higher initial research and development (R&D) costs, this makes it an attractive sector for all: from raw material producers to retailers. Price premiums for functional foods over similar conventional products are reported between around 30 percent and over 500 percent, depending on the product (Hilliard 1998; Heasman & Mellentin 2001; Menrad 2003). The main question, however, is who captures the price premium and how it affects the primary producer, especially the more marginalized ones. Despite limited research on quantifying the net benefit to primary producers and other actors along the supply chain, there are a number of studies that show how poor communities would benefit from having a viable alternative source of income.

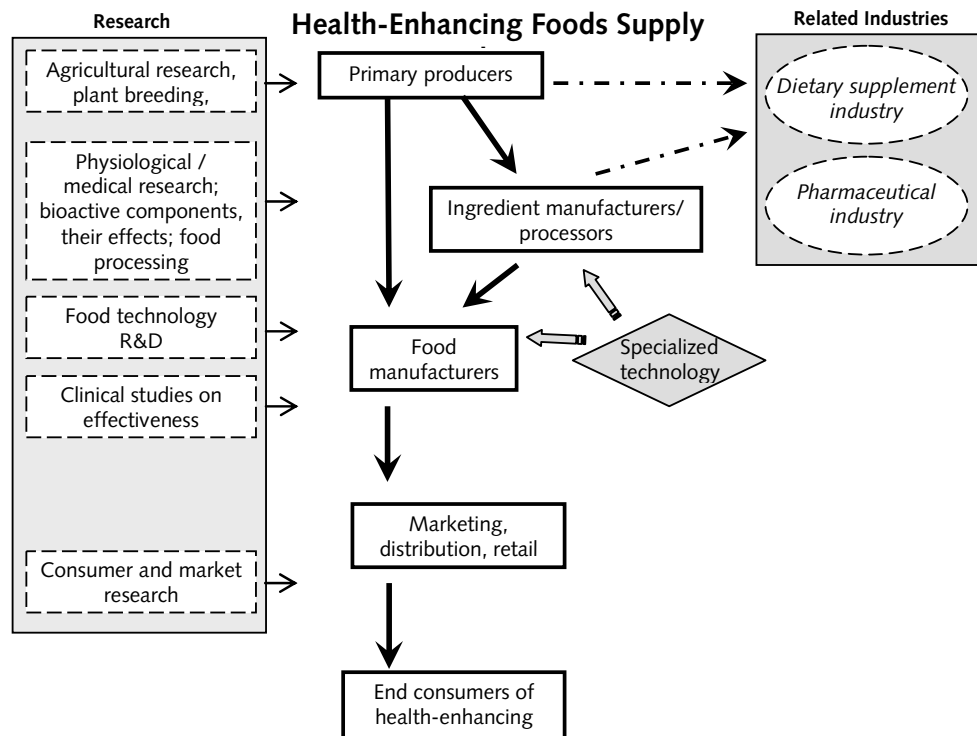
Figure 4.1 illustrates the main stages involved in the functional foods supply chain from primary producers of raw materials to the end consumers. This generic supply chain representation does not factor in the various specific characteristics of different markets, nor the differences between the numerous types of functional foods. The detailed form of an individual supply chain may be very different from this representation.

The individual steps in Figure 4.1 can be contained within the same company or can be conducted by separate parties, or even broken down into several sub-steps. In international markets, trade across national borders may take place at any stage of the chain. The ultimate destination (domestic versus foreign market) could dictate how the activities from the very beginning (raw material cultivation or collection) are conducted.

The role of research distinguishes functional foods from the general food sector. Both basic and applied research can occur in public institutions, in private in-house research centers or through collaboration in various partnership arrangements. It is often incorporated into other supply chain activities and holds an integral place in the entire concept of functional foods, although in Figure 4.1 shown as a separate group of activities. The top two research areas have applications in many related industries. Integral areas of research include basic biochemical and physiological research, combined with food technology. Research required for market development involves clinical studies on safety and efficacy and consumer research.¹¹

Developing countries, from the primary producers to retailers and consumers, can potentially benefit from developing functional foods for domestic consumption. The main challenge is producing affordable products for the poorer population (see Section 3). Functional foods for export markets can benefit mainly the primary producers and processors depending on the level of participation among supply chain actors in developing countries. There is, however, a need to assess the competitiveness of individual developing countries to ascertain the level of involvement (for example, primary production and/or processing) and the most economically attractive

Figure 4.1 Supply Chains in Functional Foods



Source: Authors.

Note: The bold black arrows indicate material flows (dashed lines flows into related industries). Small arrows from the research section indicate places in the supply chain where this type of activity is most used. Levels of research in product development have also been included.

products for developing countries to participate in the growing demand for functional foods.

Primary Producers

The functional foods sector has the potential to provide product diversification for producers and an alternative source of income. Primary agriculture is traditionally viewed as a bulk products industry, and competition based mainly on price and quality. Product differentiation is a key feature of successful competition in today's food industry. Health benefit claims are an example of an adding value to a product in order to differentiate this product from other similar products. Product differentiation affects production and often at the beginning of the supply chain with production of raw materials of improved quality and meeting strict buyer specifications. Such functional foods can result in higher value primary products, both plant- and livestock-based. Developing countries' poorer communities may benefit from growing functional foods which include sustainable harvesting and or production of wild plants; enhanced links to the private sector, for example, through contract farming; employment or business opportunities from processing ingredients or producing high-value products for functional foods; and employment in plantation farming.

Crops grown specifically for the functional food industry may include those with especially high content of applicable nutrients or bioactive non-nutrient components such as specific fatty acids, insoluble fiber, and so forth. These crops might include non-traditional plants with beneficial nutrient composition or improved varieties of traditional crops. Crops may be used naturally in non-processed form as functional foods or may only be used after processing.

Medicinal plants for functional foods, dietary supplements, pharmaceuticals and cosmetics, are a growing export sector for developing countries. In 2000, the leading developing country suppliers of medicinal and aromatic plants to the EU were China, India, Egypt, Morocco, Chile, Turkey, and Albania (UNCTAD (Peru) 2004). Almost two thirds of the EU imports of medicinal and vegetable saps and extracts originated in Madagascar, China, and Congo and more than 80 percent of vegetable alkaloids from Congo, Turkey, China and Brazil (UNCTAD (Peru), 2004). Trade activity in Uganda in dried/ground leaf/bark/root plant materials to the domestic and regional markets for food, cosmetics and pharmaceutical use increased and while its export market is relatively small, with a few companies transforming the plant material into powders, extracts and essential oils, the potential exists for further development (Biotrade Uganda website).

In addition to agricultural production, raw materials functional foods can be harvested wild, as is the case with many medicinal plants. However, the inability to standardize the concentration of active ingredients in wild-collected plants may present a problem in their commercial use (FAO 2005). If sufficient demand exists, systematic cultivation of these species could be a viable option (De Silva 1997). There are examples of where harvesting plants from forests for processing of healthy food products have benefited ethnic groups in some developing countries including the Philippines (see Box 4.1). Moreover, health-enhancing properties increase the value of otherwise marginal crops and their potential use, if carefully managed, can aid in sustainable biodiversity conservation.

Functional foods can also be based on animal products. For example, eggs have been promoted as nature's own functional foods and eggs with added

Box 4.1 Philippines: Processing of Healthy Food Products from Indigenous Forest Species by Ethnic Groups

Since 1994, the Ikalahans in the northern Philippines have been processing jams and jellies labeled as healthy food products from indigenous forest species. Their first products were guava jelly, guava jam and guava butter and their commitment to quality and good taste attracted people from outside the reserve to buy their products. Leading supermarkets in Manila also took notice. Their products were entirely natural with no chemical additives. Quality control measures ensure proper cooking and sterilization. To prolong the shelf life of the preserved products marketed under the "Mountain Fresh" label, jars are sealed airtight.

Encouraged by the favorable acceptance of their first products, the Ikalahans started processing other products from indigenous plants in 1980. These products include dagwey (*Saurauia subglabra*) preserves, dagwey jelly and spread; dikay (*Embelia philippinensis*) jelly; ginger (*Zingiber officinale*) jelly; passion fruit (*Passiflora edulis*) jelly; roselle (*Hibiscus sabdariffa*) jelly; and santol (*Sandoricum koetjape*) jelly and spread. Today, their products are sold in 10 major shopping centers in Manila and are exported to the United States of America, Japan and Australia.

Source: Dolom and Serrano 2005.

benefits from increased omega-3 fatty acid content have been developed and marketed. A recent study on the supply chain of the value-added Omega-3 eggs in Canada found the return to egg farmers was 45 percent while the egg processor/concept marketer return was 29 percent (SWMI, 2002). Other potential animal sources for functional foods include fish oil due to its high omega-3 content. Dairy products in health-enhancing forms of kefir and drinking yogurts in Russia and camel milk in Kenya are leading functional foods (see Box 4.2).

The rich biodiversity and traditional knowledge in developing countries of the health effects of certain indigenous plant species provide good potential cost competitive sources as primary producers for raw materials for functional foods (see Box 4.3).

To date, however, the promoted health effects of many local plants typically lack substantial scientific validation. In Peru, farmers are too far away from the functional food market and are mostly unaware of how their crops are finally sold or the health claims made by processors and concept marketers and sometimes these claims match with their traditional knowledge (personal

Box 4.2 Russia and Kenya: Dairy-Based Functional Foods

Dairy industry in Russia has taken the lead in the functional foods movement and the largest growth is expected in this sector (Spiridovitch 2005). Probiotic products currently hold a noteworthy 35 percent market share in kefir and 25 percent in drinking yogurts (Drujinina 2005c). The leading functional food company in Russia is the dairy and juice manufacturer Wimm-Bill-Dann (WBD). WBD together with Danone are the market leaders. Fifteen percent of Danone's products belong in the Activia® health-enhancing product family (Drujinina 2005b). Local firms Ochakovo and Petmol have also launched probiotic product lines, although research and development costs as well as production and marketing investments are significantly higher than in traditional products, representing a barrier to entry into this sector (Drujinina 2005b). Still, most dairy processing companies have probiotic products in their product line (Spiridovitch 2005).

In Kenya, there is a potential to develop the camel milk sector to respond to the demand from South America. Camel milk has medicinal properties, especially in management of diseases such as diabetes, high blood pressure, heart disease, allergy and peptic ulcers. A Peruvian hospital that specializes in allergy-related conditions has placed a large order for camel milk from a Kenyan company. Vital Camel Milk Ltd, which has been retailing the commodity in some selected outlets in Nairobi, says the clinic wants a supply of 1,000 liters of camel milk per week. The company's main marketing approach has been the fact that camels feed exclusively on diverse vegetation in the virgin savannah, far from pollution of urban centers. The animals browse more than 200 different plant species that make camel milk a unique organic product, according to Vital Camel Milk (VCM) Managing Director, Holger Marbach. Stakeholders from the Kenya Dairy Board Kenya Bureau of Standards and VCM are currently working on quality standards for camel milk. A cooling plant was inaugurated for camel milk in Isiolo town, where residents will be selling their milk and being paid promptly for milk deliveries at the rate of Sh40 a liter. VCM handles 6,000 liters per day from some selected herders who meet its hygienic and herd management standards. There is an estimated one million camels in Kenya, and camels and dairy goats account for 16 per cent of the total milk production. Camel milk was a non-commercial commodity until VCM started processing it mid-2005. Since then, the commodity is found in some supermarkets (Gitonga 2006).

Sources: Spiridovitch, 2005; Drujinina 2005c; Gitonga 2006.

communications with Thomas Bernet of the International Potato Center (CIP). Scientific substantiation of health effects would be necessary for gaining a stronger foothold in mature markets as illustrated by the Brazil and Peru cases (see Box 4.3). In other parts of the world, increasing research activities have been undertaken for substantial scientific validation of several local species including green tea in the Himalayan region in India, and various medicinal plants in Chattisgarh, India and Chiloe, Chile (Durst, 2005). Moreover, as conservation and sustainability issues are included in the efforts to increase the cultivation and export of some of the non-traditional commodities (BioTrade Peru 2004) functional foods market development warrants further research.

In addition to the rich reservoir of wild and exotic plants, developing countries may offer cost advantage in crop production as raw materials for functional foods due to generally lower labor and land costs. For instance, a recent study indicates that China and India have cost advantage over U.S. in soybean production (see Box 4.4).

The distribution of value added benefits along the supply chain varies greatly among product types. The health-enhancing property that differentiates a

Box 4.3 Peru and Brazil: Growing Production and Export Activities for Functional Foods

The vast biodiversity of Brazil, Peru and of the Amazon and the Andes holds remarkable potential for the discoveries of new health-enhancing ingredient.

In Brazil, manufacturers in Japan and the U.S. obtain plant-based physiologically active ingredients such as antioxidant compounds. Of these, acai-berry, guarana, and yacon have received global media attention. Currently products are mainly focused on micronutrient fortification, probiotic products, and cholesterol lowering spreads. The Brazilian functional food market is currently a small niche market that, however, has been forecasted to reach a sales value of US\$1.9 billion by 2009. However, the growth of 29 percent in per capita spending on functional foods during this period is considerably lower than forecasts for some other emerging markets (Benkouider 2005). Investments in biodiversity related research have been described as inadequate. The Brazilian Agricultural Research Corporation (EMPRABA) investigates numerous plants with potential uses in this sector, including tubers, tropical fruits and medicinal plants (EMPRABA web site). Overall, functional foods related research is primarily conducted in public institutions.

Functional food activities in Peru focus strongly on the possibilities of utilizing its exceptionally rich biodiversity. In these efforts, functional foods are one sector among others including dietary supplements, cosmetics, and pharmaceuticals, all of which use natural ingredients. A natural ingredients sector assessment from 2004 identified ten species for further analysis on the basis of their potential in world markets. Of these, at least maca, camu camu, maize morado (purple corn), and yacon have health-enhancing applications. The value of exports of health-enhancing plants purple corn and yacon have boomed, growing an average of 467 percent and 335 percent annually, respectively, in the years 1998-2002 (BioTrade Peru 2004). The website of Peruvian Institute of Natural Products (IPPN), lists 16 plants under investigation for commercial use, some of which are at this stage more suitable for dietary supplements and natural medicines than functional foods. The main export destinations for maca and cat's claw, for which statistics are provided, are Japan and the United States, with 52 percent and 19 percent share of maca exports, respectively (2002 statistics). Dozens of companies are involved in export.

Source: Biotrade Peru 2004; IPPN website; Lima 2006; Benkouider 2005; EMPRABA website; Authors.

Box 4.4 Soybean Farming Cost Comparison between China, India, and United States

Soybean has now become one of the world's most valuable agro-products and by some estimates it is the most valuable crop in international trade. Soybeans are rich in edible oil and protein - around 60 percent of the protein food consumed in the world is provided by soybeans. Soybeans are the most nutritious food among all the beans and some even call it the "king of beans." A dry soybean is 38 percent protein, which is twice the protein average of pork, three times more than an egg and 12 times more than milk. It has an 18.4 percent fat content, which is basically unsaturated fatty acid. Soybean byproducts include soy meal, which is the most valuable, and range from 50-75 percent of its value (depending on relative prices of soybean oil and meal). According to the United States Department of Agriculture (USDA) soybean meal is the world's most important protein feed, accounting for nearly 65 percent of world supplies.

Today, China is the fourth largest producer of soybeans in the world and after Argentina and Brazil. Based on a recent study by Japan Development Institute (2006), soybeans are 10 percent less costly to produce in China's northeast region and 2 percent less costly to produce in India than in mid-west U.S. As cost-efficient producers of soybeans, China and India have the potential to develop their soy-based processing industry to cater to the increasing demand in the domestic and export markets for soy-based functional foods.

Source: Japan Development Institute, 2006.

food product may reside in the raw ingredient composition, for example oats or soy, or be entirely created in specialized processing, for example fermenting bacteria for yogurts. In the latter case, most of the value added benefits beyond a conventional product accrues to the company responsible for processing and market development. With a naturally health-enhancing product, a larger share of the profit could be expected to return to the primary producer, although in this category basic research and market development play an equally prominent role. A value-added chain analysis of functional foods and nutraceuticals in Canada more closely resembles that for highly processed foods with the share of value received by agricultural producers estimated between 5 percent and 25 percent of total value added, in comparison to 10 to 70 percent in the conventional food sector (SWMI, 2002). Because functional foods return a higher value than conventional foods, the reduced percentage received by raw material suppliers reflects the other value added components in the value chain. Despite the fact that most functional foods provide higher price, there may be no additional value in chain for suppliers of raw materials than there is under the conventional food model (SWMI, 2002). While these circumstances may also be true for some supply chains in developing countries, the untapped demand (discussed in Section 3) may offer a potential source of income especially for those communities that are struggling to earn a living.

There is a growing literature on the success stories of developing countries tapping the export markets for high-value products, which have been the source of economic development in many poor communities. These range from fruits and vegetables in Kenya and Zimbabwe; and fish in Bangladesh to farmers' organizations supplying supermarkets in Brazil, Argentina and Chile.¹² Farmers' associations have been effective in helping smallholders participate directly in supply chains through a variety of contractual arrangements to market their products and to access inputs at better terms as

illustrated by the case of tea production in Vietnam initiated by the Making Markets Work for the Poor (MMW4P) project (ADB 2004). Moreover, the same study suggested strategic orientations for the tea value chain with emphasis on strong private sector and foreign direct investment (FDI), diversification into new products and markets, strengthening partnership with research bodies for improved quality, and strengthening linkages within the supply chain which could potentially make higher contribution to overall income, given that the current tea sector income, US\$100 million, is far below its potential (ADB 2004).

Associations can also help organize producers, negotiate contracts, improve market information systems, promote products, coordinate research, enforce quality standards, and pool risks as in the case of medicinal plants cultivation in India (see Box 4.5). These functions have become increasingly important with the rise of global sourcing of products and private or company grades and standards.

Additional trends in the area of raw materials, applying also to ingredients, include the value-added from ecologically friendly and ethical production, for which demand has been growing. Marketing advantage may be gained further from functional foods by offering, for example, products that are “certified organic” (Brinkmann 2003). These innovations through differentiated strategies and certification can be crucial to some developing countries to enable them to gain niche markets internationally as in the case of Ecuador’s medicinal plant sector (see Box 4.6).

International donor organizations, including the World Bank, have supported several schemes to foster small-scale farmers’ participation in global supply chains, especially for higher value products. Despite these successes, small-scale farmers’ organizations for high-value exports are still very challenging to scale up and sustain. The case of the Asumpal farmers’ cooperative in Guatemala is a good example. Farmers received technical assistance, technology, and market access, but they eventually failed in the market because they could not sustain the quality of the produce, supply it regularly, or resolve conflicts over side-selling (Dugger 2004). In Kenya and Zimbabwe, smallholders grew nearly 75 percent of fruits and vegetables in 1992, but by 1998 four of the largest exporters were sourcing only 18 percent of produce from smallholders (Dolan and Humphrey 2000). Where markets are not competitive, contract farming and vertical integration (in which the same entity controls some or all of the steps in the supply chain, for example, from the seed and other inputs used to grow a crop to the processing and sale of the final product) threaten to make farmers overly dependent on one agribusiness company.

Simultaneous increases in production and exports in several countries can drive down world prices, posing a major risk for new suppliers into the markets. Price trends for avocados, green beans, green peas, mangoes, and pineapples already demonstrate this risk (FAO 2004). Similar to other high value crops, functional foods may run the risk of a “price crash” as many producers may simultaneously shift production as a result of strong government or non governmental organization (NGO) support as a result of media attention to these crops with praise for their nutritional and health benefit. This is already creating some concerns in Peru’s functional food market where producers are potentially on the losing side when

Box 4.5 India: Farmers Quickly Respond to New Market Opportunities

The Agricultural Technology Management Agency (ATMA), through a World Bank-financed National Agricultural Technology Project established in the Patna District of Bihar, became the lead agency that orchestrated and facilitated a series of development activities resulting in a sustainable supply chain being established for selected medicinal plants in that district. The lead crop and focus of this case study, is Vinca Rosa, the most common flowering plant in India. Studies have shown that this plant contains about 65 alkaloids, of which Indol, Robesin and Serpentine are most prominent. The leaves of Vinca Rosa contain alkaloids, like Vincristine and Vinblastine, which are used to treat certain types of cancers. The roots of Vinca Rosa also have alkaloids, like Azmalicine and Risprine, which can help reduce high blood pressure.

The first company to enter into a formal contract with producer groups to produce Vinca Rosa was M/s Ayurveda Shri Herbals Ltd. This firm had recently established a traditional drug manufacturing facility in the state of Gujarat, with a subsidiary office situated in Patna. The second company identified by the ATMA during its initial assessment of potential markets for medicinal plants was Baidyanath Ayurved Bhawan. This firm has four factories and produces over different 86 products requiring a significant range of herbs and medicinal plants.

When this activity was launched in 2000, there were five Farmer Interest Groups (FIGs) with a combined membership of about 60 farmers who began with the cultivation of Vinca Rosa in Patna district. By April 2003, the ATMA had established a network of 50 FIGs who were pursuing medicinal plants cultivation. The number of new members and FIGs in this network is expected to increase rapidly as farmers become interested in medicinal plant cultivation. At the state level, there is already a farmer association that is promoting medicinal plants cultivation as a means to increase farm income and to enhance rural livelihoods. Based on a cost-benefit analysis, estimated net income per hectare per annum is US\$1,516.

The ATMA was instrumental in helping these farmers get organized and in learning how to produce and market Vinca Rosa and other medicinal and aromatic crops to buyers' specifications. In addition, the ATMA played a central role in coordinating and mobilizing the expertise of other organizations, including scientists from universities and research organizations, private sector firms, banks and nongovernmental organizations to develop and test the production technologies, to train the farmers and farm leaders, to arrange for the needed inputs and so forth.

As a result of these extension activities, the participating farm families substantially increased their farm income, which improved their rural livelihoods through better nutrition and expanded schooling for their children, especially girls; in addition, rural employment was generated due to the need for post-harvest handling and processing of these crops.

Source: Singh and others, 2005.

underutilized crops take off because of evidence related to health benefits (personal communications with Thomas Bernet). This provides a case for strengthening market intelligence to small-scale producers to aid them in decision-making and encouraging contract farming and private sector linkages to reduce the risk for small-scale producers by providing them a certain level of assurance for the market of their products. It also points to the importance of continuous innovation and diversification among producers and processors in order to be competitive in the market. The public sector also has a role in supporting the overall development of the functional foods sector as developing the sector as a whole limits the risk of 'picking winners'

Box 4.6 Ecuador: Differentiated Strategy Based on More Exotic and Innovative Products for Competitiveness

Most of plant species for functional foods demanded in EU markets are not commercially produced in Ecuador or the entry barriers or competitiveness requirements are too high to warrant consideration in the country's development strategy. Based on expert opinion, a late entry by Ecuador into the functional foods and pharmaceutical products market in EU would be a mistake. Instead, Peru needs to concentrate on a differentiated strategy based on more exotic, rare, innovative plant products. In some cases, exporters have proved successful with non-native products such as cardamom, where the competitive edge is based on the competitiveness of the sustainable supply chain, its efficiency and the quality of the extraction process that makes Peru a global competitor.

In some cases, it is not sufficient to offer new and innovative products, as ecological and/organic certifications are important. Ecuador could develop a competitive edge, positioning itself as a reliable supplier of biodiversity-based products (from extraction or domesticated harvests), with a system of sustainable supply chains organized around networks of small businesses or community based enterprises as long as these obtain sustainability and fair trade certification, and work with global quality standards.

Source: UNCTAD (Ecuador), 2004.

and provides conditions for functional food innovations to develop and thus expand farmers food production choices.

The experiences of many producer organizations that successfully participated in these export markets have demonstrated the importance of the private sector's role otherwise private entities will not invest in functional food production (World Bank 2005). As noted above, public support remains critical, however, for establishing a conducive legal, regulatory, and policy framework for example, in contract law and grades and standards; for promoting the organization of small-scale producers with good leadership which understands market requirements; and for helping to provide training, technology, and quality control systems (World Bank 2005). Moreover, there is need to promote interaction and strengthen linkages among producers, traders and processors.

In addition to the potential direct linkage of smallholder farmers to markets, there can be a significant employment effect from agribusiness, especially for women, and often at higher wages than traditional agriculture can offer (Dolan and Sorby 2003; Minot and Ngigi 2003, Singh and others 2005). These backward and forward linkages from the development of functional food markets potentially create opportunities for employment and additional income for producers of inputs, (middlemen, retailers, and exporters and service providers (private laboratory services, training, scientific and market researches, and other related services).

Processors (food ingredients and end products)

Low-level processing at or near the production site could offer a feasible means to add value to raw materials with processing limited to general initial processing such as milling or involve specialized value-added processing. The output of initial processing could be channelled into further processing, or directly serve as health-enhancing ingredient for the industry. In developing countries, most innovations come from the low-level processing (for example extracts, ingredients, and so forth.) whereas high-level processing often remains a constraint as in case of Brazil and Peru (see Box 4.7).

Box 4.7 Brazil and Peru: Limited High-Level Processing of Functional Foods

In Brazil, most innovation in the food industry is occurring incrementally at the ingredient level. Processing equipment suppliers are not flexible enough to generate innovative solutions for the evolving food industry needs (Lima 2006). From food industry point of view, the still low awareness of functional foods among Brazilian consumers limits the market. Research on consumer attitudes and behavior with respect to functional foods presents a research gap (Lima 2006). High cost of obtaining functional ingredients and scientific substantiation also present barriers for expanding markets. Other market challenges to manufacturers are posed by regulations on the use of certain ingredients and strict health claim regulations. Because of the regulatory hurdles concerning labelling, products may be launched under alternative names instead of as functional foods (Lima 2006), or by relying on consumers' previous knowledge of ingredients, which can be listed in packaging. Laboratory capacity is described as a barrier for development of functional food markets in this region. A major task of food laboratories in recent years has been creating a food composition database for Brazil. This task was necessary to enable companies to comply with the mandatory nutritional label legislation.

In Peru, biotrade-related activities often involve low level processing. Higher processing and the technology required for it are concentrated in Lima. The natural ingredients sector as a whole involves approximately 170 companies, out of which 80 companies are involved in exporting extracts for functional foods. Natural ingredients producers, mainly private, total around 20,000. (UNCTAD Peru 2004). For local consumer markets, some of the native functional fruits and vegetables are sold fresh, but also processed. Especially tubers maca and yacon are available in various forms (flours, extracts, syrups, chips, juices, and so forth), and also used as additives in many types of foods (Hermann & Heller 1997; interviews). Statistics on how much of these consumer-ready products are exported or whether the export market is mainly at the ingredient level were not available. Dietary supplements, such as capsules containing these functional ingredients, are exported as end-products (IPPN website).

Sources: Lima 2006; IPPN website; UNCTAD (Peru) 2004; Hermann & Heller 1997; key informants' interviews.

Medicinal plants are primarily processed into extracts, which can be used in the production of health foods, drinks, and dietary supplements. Ecuador, Columbia, Peru and Brazil have established and are expanding activities for harvesting and production of medicinal plants. While private companies are involved in the processing into extracts, the supply chain is dependent on business support services and technical assistance from international organizations. For instance, developing the medicinal plant industry in Ecuador with the aim of providing a source of livelihood and improving the quality of life of poor communities have been supported by international organizations for financial and technical assistance (see Box 4.8).

Functional ingredients for food fortification are a rapidly growing market within the functional food sector. Staple foods have traditionally been fortified with vitamins and minerals in an effort to combat and alleviate nutrient deficiencies on a population-wide level such as the iodization of table salt. Much of this basic fortification is no longer considered "health-enhancing" but new possibilities for functional food fortification to help attain optimal health and reduce the chronic disease burden have emerged. Extraction of new functional ingredients for fortification may be highly specialized and the core innovation can in certain cases reside at this level.

Box 4.8 Ecuador: The Jambi Kiwa Project

This project started in 1998 as a pilot project for the Guayabamba community in the Chimborazo province of Ecuador. Its legal status is similar to a community-based company with the objective of improving the quality of life of the families through income generated by the production of the medicinal plants, and improving their knowledge of alternative medicine and management of their natural environment. The final goal of this project is to allow Jambi Kiwa to enter international markets. Jambi Kawa brings together 600 families of 62 related-communities of the province, with 80 percent of the women included. The company regularly supplies a product mix of about 44 different herbs, spices, medicinal plants and aromatic plants. Depending on the customer, it delivers the products as fresh, dried or processed. In some cases, it produces formulated mixes, each with a particular health claim: expectorant, digestive, carminative, fat burners, parasite control, and so forth.

Typical income for a partner family, of Jambi Kiwa is about US\$60 per month, which is significant for these families living below poverty conditions. The income depends on the size of the plots of land assigned to the program; however on average a partner's income has increased by approximately 25 percent.

This project has received international support at different stages since its conception. Today, Canadian Centre for International Studies and Cooperation; International Solidarity Center Alma Quebec, Canadian International Development Agency, and the Dioceses of Riobamba are supporting the organization with technical and managerial services, constant technical assistance, financial support and infrastructure. Other previous supporters have included German Technical Cooperation, Comart Foundation and United Nations Development Programme. Recently, Export and Investment Promotion Corporation (CORPEI) joined with Jambi Kiwa to present a project to the Organization of American States, which has been accepted for a second round of support and should be the subject of final decisions in July 2006. This project requests funding for organizational, managerial and commercial support. It also includes some funds for infrastructure and equipment.

CORPEI is already helping Jambi Kiwa with its competitive funding (matching grants) for organic certification of 300 producers, commercial contacts and market information. For instance, Jambi Kiwa will need additional services from the B T F P such as joint venture formation, additional certification requirements, quality assurance, technical support, packaging design, export audit and integral business plan definition. The current goal is to increase average family income to at least US\$200 per annum.

Source: UNCTAD (Ecuador) 2004.

The better-established functional ingredients for food product fortification include dietary fibers, plant stanols and sterols and probiotics. In addition, active research is conducted on other components including, but not limited to, fatty acids, various antioxidant compounds, and phytoestrogens. These compounds could be ingested naturally in, for example, fresh fruits, berries and vegetables, but are increasingly also processed for the ingredient market.

Genetic engineering has also been applied to modify plant metabolism to enhance nutritional or health enhancing properties. A famous case is Golden rice containing the Pro-vitamin A. Biotechnology offers opportunities for functional foods sector, however, none of the genetically modified products with health-enhancing food properties have, reached large-scale production yet (see Box 4.9).

Box 4.9 Genetic Engineering and Functional Foods

Genetic engineering of crops through gene transfer offers great potential for developing health-enhancing properties in foods. Research on these enhancements has included improving fatty acid profiles in oil seed crops, in modification of protein quality in potato, and anti-oxidant content in different crops, to mention a few (see table below).

Examples of Genetically Modified Crops with Health-Promoting Properties

Substance	Benefit	Crop	Transgene
Provitamin A	Anti-oxidant vitamin A supplement	Rice	Phytoene synthase (daffodil); Phytoene desaturase (Erwinia); Lycopene cyclase (daffodil)
Vitamin E	Anti-oxidant	Canola	γ -tocopherol methyl transferase (Arabidopsis)
Flavonoids	Anti-oxidant	Tomato	Chalcone isomerase (Petunia)
Fructans (indigestible polysaccharide)	Low calorie	Sugarbeet	1-sucrose:sucrose fructosyl transferase (Helianthus tuberosus)
Iron	Iron supplement	Rice	Ferritin (Phaseolus); Metallothionein (rice); Phytase (mutant, Aspergillus)

A famous case in nutritional enhancement is 'Golden Rice' in which pro-vitamin A pathway has been engineered into rice, which does not naturally have it. However, a distinction is made here between health-enhancing properties inherently in a crop species and in biofortification applications, where a totally new metabolic pathway has been engineered into a crop. Thus, Golden rice, while an interesting example of the potential of agricultural biotechnology, falls into the latter category and is not included in this study. In addition to engineering specific nutritional and functional traits, where the genes governing the different properties are already known, there is also a new systems biology community applying genomics to explore bioactive properties of crops called nutrigenomics (Nutrigenomics is the application of the sciences of genomics, transcriptomics, proteomics and metabolomics to human nutrition, especially the relationship between nutrition and health wikipedia (Ruth and Wrick, 2005)). It is evident that there is much dynamism and interest in applying the tools of molecular biology to identify new nutritional and functional foods properties in foods, and it is important for the development community to be informed on these developments. However, none of the genetically modified organism crops with functional foods properties have reached large-scale production. It is also worth noting, that engineered foods are more complicated from the regulatory point of view and require significant research to ensure the necessary approvals associated with food safety risk assessments and this is likely to delay their approvals for large scale production in developing countries.

Sources: Kleter, 2001(Table above); Ruth and Wrick, 2005; Authors.

Basic research aims to identify physiologically active components and investigate their effect on human health and disease, and discoveries may benefit several related industries (dietary supplements, pharmaceuticals and cosmetics). Additional research on product-specific applications must also be conducted. Economic analysis of the profits from producing for the functional food industry in comparison to dietary supplements or pharmaceuticals has not been presented in this report, but it would offer valuable insight into the potential and the associated tradeoffs in each segment of the industry.

While developing countries are the main source of raw materials due to vast biodiversity and cost advantage in crop production, developing a high-value

processing of these materials may pose barriers to these countries. Because functional foods are conceptually defined at the consumption level, the development of suitable food solutions to deliver the health benefit to its ultimate target function is critical. On the other hand, functional foods are first and foremost foods and beverages, and in addition to health benefits, consumers expect to derive pleasure from consuming them (Goldberg 1994; Sloan 2000). Therefore, the task faced by food technology is to transfer biological discoveries into organoleptically and conceptually acceptable consumer products, while ensuring that the health-enhancing properties are maintained throughout the process.

Building consumer awareness is critical in the case of new functional foods or ingredients or newly found health benefits of functional foods. Acceptance of products is linked to prior knowledge and understanding of the health-enhancing ingredients and the associated health benefits (Menrad 2003). Typically the product and its marketing must be adjusted to meet both the local regulatory environment (standards, scientific support for health claims when applicable) and deliver preferences to local consumer. Thus, the costs of bringing a new product on the market can be significant, and especially the magnitude of transaction costs associated with exporting (information search, registrations, meeting regulatory demands, consumer research, public relations and so forth) can present a barrier. The R&D and marketing costs of Nestle's probiotic LC1 product and Becel Proactive spread have been estimated at over US\$ 50 million each (Menrad 2003).

Because of these challenges in developing functional food end-products, intermediate products and raw materials may present a more easily approachable area in international trade, especially for companies with limited resources (at least at the entry level to the market). Once capacity (for example, physical and market infrastructure, and institutional and regulatory framework including standards and certification) of developing countries is improved, high-level processing could be expected to start. Especially for smaller producers and processors, there is a need for public support to deal with the regulatory system through time-limited technical and market assistance, especially at the entry level (see World Bank 2005).

There are a few examples of producers' organizations that successfully found a niche in producing and processing functional foods such as the case of yacon products in Peru (see Box 4.10). International research organizations have also been active in providing technical assistance to producers' organizations as in the case in Peru. The biggest challenge still remains on how to sustain and scale up these few ventures of small-scale producers and processors involved in functional foods.

At present, even in processing functional foods for domestic consumption, several developing countries face difficulties in supplying demand and in face competition with imported products. For instance, a recent study indicates that the growing demand of functional foods in China face strong competition from imports (see Box 4.11).

In Brazil, the lack of research on food processing and lack of institutional and physical infrastructure are barriers to strengthening the high-value processing sector (see Annex 4). Moreover, the development of functional foods for domestic consumption is threatened by the high costs of imported specialized raw materials, which is bulk of the components of the end-

Box 4.10 Peru: Processed Yacon Products by a Producers' Association

Asociación de Productores de Yacon de Oxapampa (APYEDO) is a producers' association of limited economic resources, located in the eastern Andean foothills, which acquired legal status in 2002, with International Potato Center's (CIP) technical assistance. In order to generate greater and better income opportunities from the association, CIP promoted and co-financed research on a processing technology to produce yacon syrup. This product is similar to maple syrup, and other natural sweeteners. It is made up of oligofructose, a sugar with fewer calories that does not increase the blood glucose level. For this reason, it can be positioned well in market niches for people who suffer from diabetes and wish to lose weight.

In 2004, three new products, using yacon roots as raw material, were developed at CIP: juice, marmalade and dehydrated flakes. At present, the juice and the marmalade are produced in APYEDO. CIP has co-financed the development of labels and legal transactions, required to obtain the licenses for marketing of the products in order to obtain greater market opportunities. The Dirección General de Salud Ambiental, entity of the Ministry of Health, which authorizes the marketing of beverages and processed food in Peru, has assigned to APYEDO several marks to authorize the marketing of their products.

Because of the high perishability of the roots, processed yacon products provide an alternative to the traditional marketing of fresh roots. Since 2003 several supermarkets in Peru have offered syrup, juice, marmalade and tea leaves made of yacon. Although small-scale production predominates, exports of yacon products have been exported to Japan, the European Union and the U.S. High demand for information on yacon indicates that there is considerable interest in this crop in various parts of the world.

Source: CIP 2004.

product processing in Brazil and Russia (see Box 4.12). Soymilk processing in India shows a negative benefit to processors compared to processing loose milk (Japan Development Institute, 2006).

It is important for developing countries to devise strategies to find niches in functional food markets. Proper targeting of consumer segments combined

Box 4.11 China: Strong Competition of Local and Imported Products

China has a growing demand of functional foods and with a huge population base, the country has a strong economic incentive to develop the market for functional foods. In its current stage, however, the production and processing of functional foods face strong international competition. With the attractiveness of the market, there has been an increased number of participants. Depending on the source of statistics, domestic competitors in the functional foods industry number anywhere from "more than 3,000" to "some 4,000." Although the market is growing rapidly, bankruptcies among domestic manufacturers have occurred due to a lack of a variety of products, short product lifecycles for certain approved brands, and the low level of investment in research and development. Data also show that foreign functional food products occupy over 40 percent of market share. It is estimated that sales of foreign products have grown 12 percent per annum over the last five years and the prospect for their continued growth and expansion is positive. Foreign companies compete on the basis of strong management, financial resources, investment in research and development, and marketing techniques. Additionally, many consumers believe that foreign products are of higher quality than the domestic products; thus, they are more willing to try foreign products and to pay high prices for them.

Source: Japan Development Institute, 2006.

Box 4.12 Brazil and Russia: Dependence on Imported Materials for Processing Functional Foods

Multinational companies are dominant in the sector in functional foods production (Nutraceuticals World 2005). In the food ingredients sector in general, importers hold an important position as Brazilian manufacturers depend on foreign ingredients especially in special products such as colorings, flavorings, vitamins, (Hirata 2004) and functional food ingredients. According to a local source, an informal survey in 2004 suggested that approximately 80 percent of ingredients for functional foods are imported. The high prices of special ingredients drive up the prices of end products; health foods and organic foods are sold at prices 40-300 percent over comparable conventional products (Fonseca 2005).

The expanding food industry in Russia relies on imports of special ingredients. Multinationals and domestic food processors source food ingredients from foreign suppliers in order to provide competitive quality products. At this stage, local suppliers are not able to match foreign quality ingredients (Evdokimova 2005; EIU 2005). Similarly, domestic food processing equipment does not meet modern criteria in terms of quality, but is competitively priced (U.S. Commercial Service 2006c).

Source: Nutraceuticals World, 2005; Hirata, 2004; Fonseca, 2005; U.S. Commercial Service 2006c.

with adequate investment in R&D to meet the needs of these targeted segments will contribute to continued industry growth and this will provide more opportunities, including foreign joint ventures. In China, for example, based on an interview done by Japan Development Institute (2006), one of the world's leading natural food ingredients suppliers (Chr. Hansen) has formed a strategic alliance with Mengniu Dairy, China's leading milk producer, to promote probiotics, and the concept of healthy bacteria in the dairy market (Japan Development Institute, 2006). There is a crucial need to assess the competitive advantage of developing countries participation in the functional food market especially in the functional food processing and value adding sectors.

Summary

There are numerous examples of activities related to the development of functional foods in developing countries. All studies refer to a strong potential in the market with primary producers, middlemen, retailers, processors and exporters directly benefiting from the development of functional foods markets. The backward and forward linkages potentially create opportunities for employment and additional income for the population from production and supply chain activities and may increase demands for private laboratory services, training, scientific and market researches.

Production of certain raw materials for functional foods can have a cost competitive advantage in developing countries as their rich biodiversity and traditional knowledge of the health effects of certain indigenous plant species offer good source for raw materials for functional foods. In addition to the rich reservoir of wild and exotic plants, developing countries offer cost advantages in crop production due to lower labor and land costs. Poorer communities can benefit from growing functional foods through sustainable harvesting and or production of wild plants; enhanced links to the private sector, for example, through contract farming; employment or business

opportunities from processing ingredients or high-value processing for functional foods; and employment on plantation farming.

While developing countries are the main source of raw materials due to vast biodiversity and have cost advantages in crop production, developing a functional foods industry producing high-value food products face significant barriers. The costs of bringing a new product on the market can be significant, and especially the magnitude of transaction costs associated with exporting (information search, registrations, meeting regulatory demands, consumer research and public relations) can present a barrier. Because of these challenges in developing health-enhancing food products, intermediate products and raw materials may present more opportunities in international trade, especially for companies with limited resources (at least at the entry stage to the export markets). The public sector role relates to building infrastructure, establishing regulatory frameworks and developing research capacities to take advantage of the emerging functional food sector. The experiences of many producer organizations that have successfully participated in exporting functional foods into high value markets offer lessons in developing the functional products and markets and improving links to primary producers especially the more marginalized ones. The importance of having the private sector fully involved was critical investment by private entities. Public support for functional foods remains critical, for establishing a legal, regulatory, and policy framework (for example, contract law and grades and standards); for promoting the organization of small-scale producers with good leadership and understanding of market requirements; and for helping to provide training, technology, and quality control systems. In addition, there is need to promote interaction and strengthen linkages between producers, traders and processors.

The participation of developing countries in the development of functional foods and the benefits obtained vary depending on the geographical, socio-cultural, economic, and resource endowment of each country. There is, however, a need to assess the competitiveness of individual developing countries to ascertain their level of involvement (for example, primary production and/or processing) in the growing demand for functional foods.

5. Conclusions and Recommendations

As indicated by this report, the countries studied showed that consumers everywhere are increasingly interested in using specific foods for enhancing health and performance; that the use of local natural resources in value-added functional food production is a research interest; and that there are possibilities for economic gains, in addition to the health benefits. However, there are challenges in developing this rapidly evolving sector, which are demanding. A special problem in assessing the development of this sector is the widely varying definitions for functional foods.¹³

Functional foods present a broad and heterogeneous sector. The role of different supply chain members depends on the type of product and the characteristics that render it physiologically beneficial to health. Cultural and regulatory factors influence the potential of each type of product in different markets. More detailed assessments at the country level or with specific production systems are needed to clearly identify specific opportunities and the associated challenges.

While there should be awareness of the differences in both functional food product characteristics and cultural perspectives, there are many common issues relating to: the production-related capacity; the demand and market development in home markets; the demand in export markets, and the associated regulatory requirements and marketing needs; and the need for research on product effectiveness. In domestic markets, market development involves increasing consumer awareness and demand for functional foods, providing infrastructure (which also influences the development of other processed or value-added food products), and on the supply side, supporting product development that targets the most pressing health needs, and establishing a clear regulatory environment for this product. For international markets, market development could focus on areas of potential competitive advantage, such as native plants, local traditional knowledge of health effects, and unique food applications and the need to comply with international food safety standards.

The five target countries are in different evolutionary stages with respect to the above-mentioned factors. China and Brazil have advanced regulatory frameworks for the approval of functional foods and their advertising, although these differ somewhat in the specifics. Russia has recently introduced regulations, while in Peru and India there is still a need to formulate and clarify the regulatory frameworks. Consumer demand for functional foods tends to be high in all of the countries as foods have traditionally been used for health-enhancement purposes and increasing levels of disposable income enable the purchase of new value-added products. However, the lack of organized retail chains and the poor physical infrastructure in some countries limits both the domestic market penetration of functional foods and export capacity.

New market opportunities exist in capitalizing on local knowledge to aid scientific investigations and the local biodiversity is a potential target for

development of functional foods in many developing countries (including transition economies). However, the increased benefits for farmers and food manufacturers from this sector need to be assessed on product-by-product basis and with specific export markets in mind to find the most promising opportunities. Regulations and consumer demand are product and/or ingredient specific and largely dictate the possibilities.

Due to the limited published literature and the small number of interviewees, this study was not able to comprehensively describe the situation in target countries. It would be necessary to examine these issues more closely to better identify specific opportunities and constraints. In further research, a key issue is the varying definition for functional foods. In many developed countries the definition between foods and medicine is clear; there is less clarity on whether a product is considered a functional food, a dietary supplement, or a drug. For practical purposes, “functional foods” is primarily a marketing term and its meaning becomes relatively less clear going closer to the producers along the value. For the World Bank purposes, it might be beneficial to create one definition for “functional food” or “health-enhancing foods” that would be used consistently in further studies.

More country-to-country studies on the competitive and comparative advantage in functional foods would assist in understanding the potential for participation in the functional foods product development. Benefits will vary depending on the geographical, socio-cultural, economic, and resource endowment of each country. There is, a need to assess the competitiveness of individual developing countries by ascertaining the level of involvement (for example, primary production and or processing) and the products that can participate in the growing demand for functional foods.

There is a need to further assess the role of private and public sector in assisting the sector. A growing literature on experiences in the development of high value products, including functional foods, suggest some potential forms of public support in assisting supply chain development, especially for the small-scale producers, in these high value markets. Possible entry points for public sector support include:

- a. **Creating a regulatory atmosphere to ensure product safety and support the industry:** Legislative aspects of functional foods are complex, as the product group can be considered to display properties of both food and drugs. Food labelling is an important tool in the market success of functional foods. A clear regulatory system for nutrition and health claim use and its enforcement are critical factors in building consumer trust in functional foods. They also help provide a level playing field to foster competition within the industry and encourage innovation. In many developing countries, legislation and regulatory frameworks require further clarification and strengthening.
- b. **Building institutional capacity of sector participants:** Capacity to meet higher regulatory requirements may present a bottleneck in the market development for functional foods. Assistance to build this capacity could be made available to producers, processors as well as the government regulatory bodies, as necessary. Support to producers and processors could include technical assistance on potential technologies, improved understanding of quality standards, establishment of producer organizations that are often better capable of meeting complex quality

requirements and provide economies of scale, or enhanced access to financial services. Specific needs for each should be identified in further assessments.

- c. **Research and innovation:** Biodiversity in many developing regions and the beneficial health effects of food crops have been traditionally recognized, but very few of the foods or bioactive compounds have been scientifically studied to the extent required for functional food uses in the markets. This lack of scientific evidence for proposed health effects presents a major challenge for the countries in this study; scientific evidence for safety and functional effectiveness of these compounds is essential in order to realize their potential in the production of high market valued products. New value-added components could also come from local food crops, medicinal plants or non-food sources.

- d. **Providing information and support for strategic decision-making:** For raw materials and ingredient providers, the target markets of functional foods, dietary supplements, and sometimes natural medicines are closely related. It would be important to assess the relative profitability of each possible sector, case by case, and select the most promising areas for intensive functional foods programs. The possibility to diversify activities to reach all these sectors could expand the potential markets. The public sector could encourage this by facilitating the interaction between the various disciplines and participants, including public and private research, industry, primary producers, and so forth.

Regulations in export markets have been identified as a challenge for the functional foods industry that is aiming at export activities. Both novel food legislation and the strength of scientific support for health benefits are involved in this. It could be useful to consider the likelihood of market acceptance and the resource intensiveness of the process in advance, on a market-by-market basis, when product and/or ingredient decisions are made. To this end, market and regulatory information could be made available to the entire supply chain, so that each member has the opportunity to make informed decisions.

At primary producer level, domestication of selected wild plants with functional properties and promotion of their cultivation could be encouraged, if a closer assessment indicates that they present benefits for farmers. Well coordinated value chains could also be included as a goal, as these would help to reduce uncertainty related to returns in this sector, increase commitment by all parties involved and maximize the proportion of value added received by the farmers.

In addition to health enhancement, other market value properties, such as “certified organic” could be promoted for both ingredients and end products. Assistance to upgrade facilities to meet standards or to certify products or processes could be provided, as necessary and appropriate.

- e. **Emphasizing and supporting marketing, both domestic and export markets:** Market intelligence, especially on export markets, is critical for producers, processors and exporters to create successful strategies. The lack of market information was indicated as a challenge in the supply chain in some countries studied. Market demand and associated regulations are diverse between major market areas, and the transaction costs in engaging in export are consequently significant, thus suggesting a

need for export promotion services, particularly for smaller companies. Other supporting activities related to market development include marketing and consumer education, when applicable. Collaboration in these areas could be fruitful, as many stakeholder groups stand to benefit from them.

- f. **Other considerations:** Although not emphasized here, factors critical in broader general areas must be considered. These relate to processed food markets in general, food exports, and the use of natural resources for botanical ingredients. With respect to the latter, ecological issues, environmental sustainability, intellectual property rights protection should be considerations with respect to primary production of raw materials for functional foods. In general, level of organization in food retail and infrastructure development need to be at a sufficient level for domestic market to grow.

The preceding success factors for the sector, common challenges in developing countries, and possible actions to address these challenges, as necessary, are summarized in Table 5.1.

Table 5.1 Recommendations to Strengthen the Functional Foods Sector in Developing Countries

Target area	Critical success factors	Actions to overcome potential challenges
Institutional capacity and competitiveness of sector participants	<p>Sufficient information on market demand and regulatory requirements.</p> <p>Sufficient information on technical aspects of production.</p> <p>Technical know-how and capacity of producers to meet standards and certification requirements.</p> <p>Availability of supporting services, such as laboratory capacity for food analysis and export assistance.</p>	<p>Provide information and assistance in strategic decision making; select crops / components /products based on assessment of possibility to meet regulatory and market demand requirements in targeted markets in reasonable amount of time.</p> <p>Support publicly funded research to scientifically establish safety and functional effects of food components / products.</p> <p>Arrange technical assistance to improve production capacity or introduce new production, handling, processing, and storage technologies.</p> <p>Organize and arrange financing for market development services.</p> <p>Support collaboration between different actors in supply chains.</p>
Regulatory environment	<p>Clear regulatory environment regarding health claims and advertising. Enforcement of regulations.</p> <p>For export focused products, regulations harmonized with international standards.</p>	<p>Establish clear regulations and enforcement - where these are already in place, monitor the effects on dietary intakes and respond if new scientific results indicate a need.</p> <p>Ensure coherence of regulations with national dietary guidelines.</p> <p>Harmonize regulations with international / foreign standards.</p>
Research and innovation	<p>Capacity to conduct necessary research to generate scientific substantiation for specific functional foods effects of foods.</p> <p>To achieve full potential in this sector: Awareness of and focus on areas of competitive advantage (or comparative advantage early on).</p>	<p>Assistance to build human and institutional capacity in research.</p> <p>Emphasize utilization of local natural resources, local foods and local knowledge to create new products.</p> <p>Foster a competitive atmosphere, encourage innovation.</p>
Other considerations	<p>Sufficiently organized retail sector.</p> <p>Sufficiently developed physical infrastructure.</p>	<p>For sustainable operations:</p> <p>Provide assistance in immaterial property protection issues.</p> <p>Ensure environmental sustainability in farming, harvesting, and production.</p>

Source: Authors.

Appendix 1. List of Organizations Contacted during This Review

FinPro, Finland

FoodFiles Oy, Finland

Raisio Oy, Finland

Sitra, Finland

SGS Finland

Teknia, Finland

University of Turku, Finland

University of Saskatchewan, Canada

International Potato Center (CIP), Peru

IPPN, Peru

La Molina University, Peru

ABIA, Brazil

EMBRAPA, Brazil

The University of Campinas, Brazil

University of Sao Paulo, Brazil

Moscow University of Food Technology, Russia

Rostest-Moscow, Russia

Russian Food Producers' Association, Russia

The Russian Union of Dairy Enterprises, Russia

Appendix 2. Regulation and Labelling of Functional Foods

The approach to regulating functional foods and their marketing is notably heterogeneous on the global level. This is largely due to the challenges in classifying these products, as explored in Section 3 and Annex 4, but there are also varying views on what is considered sufficient scientific substantiation to conclude functionality (Verschuren 2002).

Common concerns behind all legislation involve ensuring product safety and public health implications. In most countries, general agreement exists that functional foods are first and foremost foods and must be safe (Hasler 2002; Diplock et al 1999). Food safety and quality demands may influence this market even more than conventional foods, as often the innovative aspects of products include novel and/or non-traditional ingredients or new processes. As an example of the challenges posed by novel food regulations, a Finnish baking company, Fazer, obtained an approval to market rye bread fortified with plant sterols in 2006, after an application process that spanned more than five years (Kehittyvä Elintarvike 2006). Both rye bread and plant sterols have been in the market before, in other combinations. By one estimation, the cost of registering a dietary supplement for the Chinese market is around \$US 70,000 to US\$100,000 and for a functional food product US\$2,500 to US\$10,000. The time demanded by this process is up to one year and up to six months for supplements and functional foods, respectively (Habiger 2005). In the less developed countries, with often rather ambiguous or non-existent regulatory systems, the approval processes might take even longer time, and thereby, pose significant challenges and/or bottlenecks for product development and marketing.

Regulation of functional foods differs from that of conventional foods mainly with respect to labelling and advertising. In Japan and China, a manufacturer can apply for product approval and a “functional food” symbol can be displayed on the food label. Elsewhere, for example in some European countries and the U.S., a health benefit can be conveyed to the consumer using “nutrient-function claims” or “health claims” when specified conditions are met¹⁴. As outlined in the International Codex Alimentarius Guidelines for Use of Nutrition and Health Claims (CAC 2004), any reference to cure or prevention of a disease state should not be permitted. Approved health claims must be based on sound science, typically including clinical studies, and the role of these products in total diet must be understood. The required scientific testing can be expensive enough to exclude smaller companies from the sector.

Food labelling is a central tool in the market success of functional foods, as the value added (the health benefit) is usually not readily apparent to the consumer at the point of purchase, at consumption, or even afterwards. Appropriate messages placed on packaging offer a direct channel to deliver the information of

product properties to the buyer. Industry participants have indicated appropriate labelling regulations as a priority area in market development (Hilliard 1998; Functional Foods in Europe, 1998; Verschuren 2002).

The flipside of the health claim legislation is the responsibility of governments to protect consumers from false or misleading advertising. There is also a business argument for strict regulations; even though labelling regulations are often stricter than industry would desire and may restrict marketing efforts, allowing misleading messages would erode consumer trust and could be equally damaging to market development. Finding the balance between protecting consumers from false advertising without overly restricting food companies' operations poses a challenge that governments worldwide are grappling with. The regulations are evolving even in mature markets. Despite the good intentions behind regulatory systems, the process is often slow to respond to this rapidly developing market.

At the global level, the regulatory situation is fragmented. A Food and Agriculture Organization survey found that 35 of the 74 countries covered had no regulations in place regarding health claims (including many countries in Latin America and Eastern Europe). Another thirty had regulations forbidding curative, therapeutic, or preventative claims or any reference to a disease. As of 2004, specified disease risk-reduction claims were permitted in Brazil, Canada, China, Indonesia, Philippines, Sweden and the United States. A framework for evaluating product-specific claims existed in Japan, the Netherlands and Sweden. (Hawkes 2004) The process of obtaining approval for using claims varies. In international markets, the diverse and often ambiguous health claim regulations can pose a trade barrier for end consumer products. (Hawkes 2004)

Consumer use and understanding of food labels differs significantly by geographic region. An internet-based survey indicated that 35 percent of Latin Americans always check nutrition information on food packaging. In Europe, the proportion of consumers reading labels was only half of this. (ACNielsen 2005b) The actual influence of health claims on food selection and commercial success of functional foods has been studied, but the findings have been mixed (Hawkes 2004). Health claims are only one factor among many in determining food selection and socio-cultural factors and personal preferences may play an even stronger role.

Appendix 3. Market Environment Favorable for Functional Foods

Key determinants for the maturity of functional foods markets discussed in the preceding sections relate to consumer characteristics, general market properties, and general business environment including government policies. Success in domestic markets has certain prerequisite conditions, some of which are outside the direct influence of manufacturers and even marketers. These requirements for individual products include but are not limited to:

- Consumer need and awareness of health benefits;
- Consumer acceptance of a food solution and non-traditional taste;
- Acceptable price level;
- Optimal convenience, adequate retail or out-of-home availability;
- Proven safety and efficacy;
- A clear regulatory framework for making health claims;
- Assurance and support from different sources, including scientific opinion leaders.

(Weststrate et al 2002)

Consumer interest in health maintenance and awareness of the role of functional foods in this are key factors generating demand. Public health statistics reveal that a need for functional foods exists in nearly any market but specific characteristics of consumer response to health problems and/or risks vary across cultures; in Asian cultures, for example, it is natural to use food for health purposes (FAO 2004). Also, acceptance of processed or “manipulated” foods varies. In general, northern Europeans tend to be more open to engineered foods than southern Europeans (Benkouider 2004). Cultures with a strong belief that people can and ought to take control of their own health, view functional food innovations favorably (Bech-Larssen & Gruneth 2003).

In most markets, functional foods are mainly seen as food products and the factors influencing food selection are multiple; socio-cultural factors like local cuisine, ideology, religion and other beliefs, rituals, economic situation, group values, emotions, status, communications, and so forth. (Fieldhouse 1996) Thus, acceptance of individual food solutions for health reasons is highly culture-specific.

Education of consumers is complicated. Foods that are functional from a nutrition science point of view are not all marketed using this competitive advantage. Some consumers may purchase them as conventional products, others in mature markets may base purchase decisions on prior knowledge and/or beliefs of certain ingredients or other properties and may purchase products as functional, even in the absence of such marketing claims. Consumers

may not see the difference between regulated health claims and other clever marketing information based on ingredients and non-health related statements: they may purchase products as functional foods even when scientifically the product does not meet the requirements. Consumers also require sufficient disposable income, as functional foods are typically priced significantly above comparable conventional products.

Innovation in the industry is driven by sophisticated demand and business atmosphere and benefits from a supportive regulatory environment. Government regulations must be compatible with the direction of the industry and the level of sophistication of demand. Public sector can play a role in innovation, but the resources and capacity are often limited and these limitations stress the role of private sector.

Priority areas in market development for industry participants include appropriate labelling regulations, consumer education, taste parity with regular products, and proof of efficacy. (Fogliano 2005) Consumer education, national regulation on functional foods and harmonizing regulations with international standards, have been emphasized in many contexts as the key developments still needed to strengthen this sector, particularly in the currently less developed markets and countries (Tee et al 2002; Fogliano 2005; Lajolo 2002).

Sector development thus requires collaboration in the fields of: nutrition, medicine, food chemistry and technology, education and government (Fogliano 2005) and for an extensive discussion on stakeholder interactions related to functional foods, see McConnon et al 2002). Consequently, there is a great need to facilitate multidisciplinary research and collaboration in market development efforts. Developing countries are at different stages of evolution with respect to the factors discussed above, as will be explored in Annex 4.

Table A3.1 Summary: Factors Affecting Market Success in Functional Foods
<ul style="list-style-type: none"> • Consumer awareness of health issues and the role of diet in human well-being • Consumer acceptance of functional components and food solutions • Sufficient disposable income level • Clear regulatory environment • Organized retail sector
<p><i>Source: Authors.</i></p>

Appendix 4. Functional and/or Health-Enhancing Foods in Developing Countries

This Annex examines functional foods in countries in Asia, Latin America and Eastern Europe: China, India, Brazil, Peru, and Russia. These countries were selected to represent different regions, different food and health related traditions, and different stages in the development of functional foods markets. Markets and the market environment have been assessed on the basis of general factors required for a successful functional foods market such as consumer awareness and acceptance, sufficient income levels, regulatory environment, organized retail sector, and so forth. Activities at in the supply chain including research, certification, marketing, and education are assessed based on existing literature, interviews and e-mail contacts with local or foreign experts. Challenges for both domestic and international market development are discussed. As this review was based on limited data, country level assessments should be considered preliminary. However, the brief country overviews illustrate the national differences and the issues involved in the functional foods sector.

1 Asia

Japan, described earlier in this report, is a leading global producer of and market for functional foods. In other Asian countries, the markets and the regulatory situations are diverse and evolving. Generally Asian cultures see a close connection between food and medicine, which are believed to come from the same origin (FAO 2004).

There numerous functional food products include fresh and/or natural and processed products. A regional concern expressed by consumer groups is the lack of specific labelling regulations, especially the lack of scientific support for health claims and the lack of enforcement of safety standards. Proceedings from an FAO workshop indicate that some research is being conducted to validate health effects of some functional foods and/or ingredients and other research activity is mainly focused on product development (FAO 2004).

China and India are covered in more detail in the following section.

China

Population:	1.3 billion ^a
Number of metropolitan areas:	174 ^b
Urban population:	40 percent ^c
Population under poverty level:	5 percent ^c
GDP / capita (PPP-adjusted):	US\$6,300 ^a
a) CIA World Factbook b) GAIN files c) World Bank data	

Background

Food processing has been one of the fastest growing segments in the Chinese economy in recent years. The industry is fragmented and estimates of the total number of food processing companies vary considerably. The underdeveloped agricultural and distribution system exacerbated by long distances, present problems. (Bean 2005; Taylor 2006).

Chinese consumers spend nearly half their disposable income on food and beverages, although the proportion has decreased significantly over the past decade. Currently only 30 percent of Chinese food consumption is processed foods compared with 80 percent in developed countries (Taylor 2006; Bean 2005). Trends visible in the food industry are consumer demands for convenience products and for healthier and fortified products as reflected in an increasing demand for high quality foreign food ingredients for the industry (Taylor 2006; Bean 2006). With a population of over 1.3 billion, the minority high-income group is large, providing a market for value-added food items.

Food and beverages, increasingly purchased at supermarkets and hypermarkets, currently account for 46percent of all food sales. In 2004, the number of supermarkets increased by 17percent, although mainly in urban areas (Taylor 2006). Concurrently, the traditional outdoor markets are decreasing in number.

Functional Foods

Concept

In Chinese philosophy food and medicine have the same origin. Traditional Chinese medicine has always used foods in health care, and to some extent, consumers still use foods based on the inherited knowledge of their properties, in addition to modern information on packaging. Traditionally, many conventional foods are believed to have therapeutic properties for example cold or cool or warm or hot, five tastes, and other properties. (Dang 2002; Weng & Chen 1996). Since 1995,with western-type functional foods entering the market, food regulations have recognized a special “health foods” category for foods with a proven physiological effect.

According to the regulations, functional foods are *foods with a special health function, suitable for consumption by defined special groups of people*. These foods exert effects on specific body functions and should not be confused with drugs, which are used for therapeutic purposes (FAO 2004; Xie 2005). Functional food (or “health food”) products also include non-food forms such as extracts or tablets. The main differences compared to regular foods include a specific functional effect, a narrowly specified user group, and a recommended daily dosage (Xie 2005).

Raw materials and functional ingredients for these “health foods” often come from traditional foods or traditional Chinese medicine. Products include whole fruits, teas and herbal extracts, ginseng, walnut, honey, and powder of spirulina (Arai 2002; FAO 2004). Despite the distinct category for functional foods, it is sometimes difficult to distinguish among conventional foods, functional foods, dietary supplements and even drugs. In regulations, 87 substances are classified for use both as food and medicine (Xie 2005).

Market Description

China's "health food" industry experienced rapid growth from late 1980s to late 1990s, with the fastest increase among the urban higher income population. Continued expansion in the functional foods market is predicted as per capita spending on functional foods is expected to grow two-fold or more between 2004 and 2010. (Benkouider 2005; U.S. Commercial Service 2006) Currently, it still remains a fraction of that in the developed markets.

Factors driving the health food market include: economic growth, nutrition awareness, efforts to extend health food markets to rural areas, and traditional use in herbal medicine. (U.S. Commercial Service 2006a) Increasing costs of modern health care may be an incentive for increasing the consumption of health foods.

Between 1995 and late 2005, the government had given approximately 7000 domestic and 500 imported products functional food approval (Xie 2005). According to a locally conducted survey (not an original report), 89 percent of all health foods are functional foods, while 11 percent are in a supplement form. Imports account for 40 percent of health food (including supplements) sales, although imported products fall mainly in the dietary supplement category. Approved products primarily target enhancement of the immune system (34 percent), combating fatigue (18 percent) and regulating cholesterol levels (16 percent) (U.S. Commercial Service 2006a)

Short product life cycles in the market (3 to 5 years) are a notable characteristic. Advertising is conducted aggressively, although the recent regulatory changes have a stricter approach (see next section). (U.S. Commercial Service 2006a). Functional foods are available through similar retail outlets as other foods (Arai 2002).

Functional foods supply the necessary nutrients that are lacking in Chinese diets. Supplementary calcium is an example of a growing market opportunity as it is estimated that approximately one-third of the population has less than the required daily calcium intake. The number of calcium supplements and ingredients is substantial with the annual national market for calcium supplements estimated at more than a half billion U.S. dollars. The functional foods market has responded by producing high-calcium milks, noodles, biscuits, candy and flour (fortified with other vitamins and minerals). The increased variety of calcium fortified functional foods is expected to take market share from calcium supplements. Other supplements in high demand are iron, iodine (now obligatory in salt) and selenium (Japan Development Institute, 2006).

Regulation and Labelling of Functional Foods

New interim measures for functional food registration were enacted in 2005. The changes in the legislation aimed to standardize the approval process and the review of supporting scientific evidence (U.S. Commercial Service 2006a; Bugang 2005). Product efficacy and safety must be demonstrated in clinical studies conducted in government-designated testing laboratories in order to gain product approval. This provision also applies to foreign products. The new regulations set out detailed guidelines on these safety and efficacy requirements

and standards for manufacturing facilities. To gain market approval, testing is required for safety toxicology, physiological function (animal or human tests), effective ingredient or marker ingredient content, and hygiene (Bugang 2005). Either animal testing, tests on humans, or both are required depending on the type of functional claim (Xie 2005).

Stricter regulations on advertising were also established in 2005. Health food labels must clearly state product name, ingredients, effective and marker ingredient content, functions, suitable user group, instructions of use, standards, best- used before date, storage methods and other important notes (Bugang 2005). Misleading product description and labeling of health foods is prohibited and a prior approval system on the contents of health food advertisements is required. Health food production enterprises using illegal advertisements had been highly prominent problem prior to the new legislation (U.S. Dept of Commerce 2006a).

Opportunities and Challenges

Industry challenges include a limited variety of products in some domestic production, short product lifecycles for some approved brands, low level of R&D investment, old and inefficient equipment, and the unwillingness to source newer raw materials for ingredients. Problems also include poor quality control and management. (U.S. Commercial Service 2006a). The Chinese research community is interested in processing herbal ingredients for the global functional foods industry (Peverelli 2003). However, the stringent requirements for scientific evidence from costly clinical studies, which differ from the domestic approval process in major ways, is a barrier.

As illustrated by the recent changes in the regulatory system, quality problems and illegal advertising have plagued this sector. Problems have included untruthful or exaggerated marketing, use of banned chemicals in products, unapproved production and sale of functional foods, and failure to meet GMP requirements (HKTDC 9/2002).

Functional foods related research is actively conducted in several institutions. Adequate clinical and other investigations are crucial if Chinese health products (functional foods or otherwise) are to enter western markets. The knowledge of traditional Chinese medicine is based on ancient literature and tradition of use, but specific scientific evidence to substantiate the claims is lacking. Many products are combinations of potentially active ingredients, in which the active compounds and their physiological mechanisms are unknown (Dai & Luo 1996; Weng & Chen 1996).

Although some clinical studies on the effectiveness of traditional ingredients and products are being conducted in China and overseas, the ability for these studies meeting the required standards may be limited. In addition, requiring the identification of the active ingredients and explaining their effective mechanisms demands a complete change in scientific paradigm (Kan 1996).

China—Summary

- The Chinese functional food market is still heavily influenced by traditional Chinese medicine, even though western influences are increasing. All types

of functional foods are increasing in popularity and the number of consumers who can afford to use them are increasing.

- Functional foods or “health foods” form a separate regulatory category with standards for product testing and approval; manufacturers must follow GMPs, and safety and efficacy of products are tested in government-designated laboratories prior to market approval.
- Challenges in the domestic market include poor infrastructure, lack of resources, and still small and fragmented pockets of higher income potential users.
- Lack of internationally recognized scientific substantiation for effectiveness of traditional health products slows down expansion into foreign markets.

India

Population:	1.1 billion ^a
Number of metropolitan areas: (population greater than 1 million) ^b	27
Urban population:	29 percent ^c
Population under poverty level:	29 percent ^c
GDP / capita (PPP-adjusted):	US\$3,400 ^a
a) CIA World Factbook b) GAIN files c) World Bank data	

Background

India is the world’s second largest producer of fruits and vegetables but only a very small amount of perishable agricultural products are processed approximately 2percent in comparison to 80percent in the U.S. (Rabo India Finance 2005). The food industry sector is small scale, and even in segments where processing is more common, this rarely represents adding value to products. Barriers to faster growth in the food sector include poor infrastructure and logistics, and tight food regulations (on especially on fake products). (Govindan 2005b; U.S. Commercial Service 2006b). Food imports are relatively limited except in the food additives sector.

Small companies account for over 70 percent of food industry’s output. Until now, foreign direct investment (FDI) into food processing industry has been limited, totalling only 4 percent since 1991 (Govindan 2005b). Multinational companies are now entering the market.

Most consumers still shop in traditional shops and markets, with supermarkets found only in major cities. Food retail development has been hindered until very recently by strict regulations (for example prohibiting FDI in this sector). The organized retail sector has less than a one percent market share and the presence of an unorganized and unbranded section is strong. Most traditional food retailers compete on price (Govindan 2005b; PWC 2005/2006).

India’s middle class is significant, estimated at 280 million (U.S. Commercial Service 2006b). Consumer spending has grown at an annual rate of more than ten percent in the past decade. Expenditures on food as a percentage of income are

proportionately high, around 50 percent, as is typical for developing countries (PWC 2005/2006). Although consumers generally prefer fresh products, demand for processed food is increasing (Govindan 2005b).

Functional Foods

Market Description

India has a long tradition in using foods for their health-promoting or functional properties, influenced, for example, by Ayurvedic medicine. These functional foods can include herbal extracts, spices, fruits, and nutritionally improved foods or foods products with added functional ingredients. Common ailments are often treated primarily with foods (FAO 2004). Increasing health-awareness of functional foods is further raising the demand for diet foods and fortified natural foods (Govindan 2005b; cee-foodindustry.com 1/4/2005). Nine out of ten urban Indian consumers have been reported to generally choose foods based on health and wellness benefits (Ciocca 2003).

The government is active in the development of the functional foods industry. According to Ministry of Food Processing Industries representative, the Ministry is mandated to develop and promote throughout the country the food-processing sector including functional foods. It conducts seminars, workshops and training programs; and runs a financing scheme, providing grants-in-aid to the food processing companies that want their manufacturing/processing units certified to meet safety standards such as HACCP and ISO (Japan Development Institute, 2006). In addition to the substantial government support, the functional foods industry is thriving in the private sector. According to the Frost and Sullivan marketing study, consumer goods giants in India understand their consumer targets well and are successfully positioned in both mass-market and higher value- products (Japan Development Institute. 2006). In India, as many suffer from deficiencies of iron, iodine and Vitamin A, fortified foods include wheat flour, iodized salt, calcium, vitamin-enriched jams and soft drinks. To deal with Vitamin A deficiency, prevalent in rural areas, food companies have introduced specific products with high vitamin A at affordable prices. For the high value market, companies have launched products such as low-sodium salt, catering to blood pressure patients (Nutraingredients.com).

Robust industry growth is expected to continue in the functional foods industry with productivity expected to grow by 68 percent in the five years from 2005 to 2010. Based on this productivity growth, the size of the nutrition industry will nearly double to US\$13.5 billion by 2010 (Ismail 2005). Additionally, India's population is large and predominantly young. With 516 million people between the ages of 20 and 55, this number is expected to increase to 800 million within the next 40 years. As the younger generation moves toward middle age and disposable income increases¹⁵, the need to maintain and/or establish a healthy diet will increase functional food consumption.

For processed foods in general, affordability limits domestic demand. Price difference between fresh and processed foods is great relative to the value added provided, and consumers are price sensitive (Rabo India Finance 2005).

Regulation and Labelling of Functional Foods

In 2003, a Ministry of Health expert group report indicated a need, under food laws, to create new categories for regulating functional foods and dietary supplements. This category would include products intended to supplement the diet with nutrients, those with an established structure-function property and those marketed with health claims. It recommended that there should be mandatory safety testing for these products (Ministry of Health 2003). The lack of a suitable regulatory category results in problems in misleading advertising and sales of these products.

In India, voluntary standards are developed by the Bureau of Indian Standards, the national standards body, which comprises representatives from various food sector stakeholder groups. In addition to developing national standards, the Bureau is involved in product certification, quality system certifications and testing, and consumer affairs. A network of testing organizations conducts conformity testing against relevant standards. Efforts are made to match Indian standards with international ones. (U.S. Commercial Service 2006b)

According to key informants' interviews, several major bottlenecks are created by the current regulation (Japan Development Institute, 2006):

- The Prevention of Food Adulteration (PFA) Act has specific definitions for every food preparation sold in the country and as such, it does not provide flexibility to the food manufacturers to produce new recipes without violating the law. To complicate matters, there are seven or eight different laws and resultant regulations governing genetically modified foods, drugs and pharmaceuticals respectively.
- It is difficult for manufacturers to quickly bring out new food preparations. In cases where scientific evidence requires amending the standards, the producers can appeal to have the PFA Rules amended. Under the PFA, the Central Committee for Food Standards, chaired by the Director General of Health Services, is responsible for the final decision regarding PFA rules.
- Since many of these recipes are classified as proprietary foods, manufacturers are reluctant to share data with the authorities, fearing this data might be shared with competitors.
- The process of launching a new food product is difficult as the application process can be cumbersome.

Production of Functional Foods

Indian foods traditionally used for health-enhancement purposes have commercial potential if sufficient investments in R&D are made. However, R&D is mainly conducted in academic institutions and the transfer to the industry is not well developed (Rabo India Finance 2005). At farm level, most production for the food industry is not efficient as agriculture is fragmented, and suffers from low technology use, lack of information for appropriate decisions, and logistical issues (Rabo India Finance 2005).

According to a 2005 report, there were approximately 140 government-owned and 50 private laboratories for food testing. This network is considered clearly

inadequate, especially as many of these laboratories lack facilities meeting international standards (Rabo India Finance 2005).

Although China is seen as the major competitor, Indian research technology in areas such as fermentation processes, plant extraction and even chemical synthesis are more developed than their Chinese counterparts. There is a growing conviction among researchers, government, and private sector that 4000-year-old Ayurvedic medicine and philosophy offers India several advantages. However, it is also recognized that for functional food products to be successfully exported, must be standardized, or at minimum, their potency must be measurable (Japan Development Institute 2006).

Recognizing the favorable government attitude and support, and the research friendly environment and available qualified human resources, several multinational firms have located in India including Herbalife, DuPont, GlaxoSmith Kline, Akzo Nobel Chemicals, Hindust Lever, Heinz, Novartis and Roche (Japan Development Institute 2006). A growing number of Indian companies are working internationally such as the Associated Capsules Group (the third most important company), Solae (an alliance between DuPont and Bunge), Avesthagen, RSA Vitamins, Zytex and MM Activ. These companies export a range of products including raw materials, formulated supplements, enzyme preparations, and immunological and diagnostic products (Ismail 2003).

Functional Food Constraints and Opportunities in the Indian Market

The market environment for functional foods in India can be considered as cooperative and relatively advanced. This is not to suggest that the market for functional foods in India is without constraints, however. Among the constraints, challenges and opportunities faced by the industry are the following: (see Japan Development Institute for more details)

1. Low income of vast majority of the population;
2. Existence of unscrupulous manufacturers;
3. Lack of testing infrastructure to validate manufacturers' claims;
4. Lack of physical infrastructure;
5. Lack of regulatory framework for functional foods; and
6. Some resistance to genetically modified foods.

As indicated in the section regarding the trends in the industry, there are many opportunities for growth in the functional foods industry. Most opportunities relate to the need to curb malnutrition. As previously stated, according to Dr Rajesh Kapur, Director Department of Biotechnology, 60 percent of children in India below 14 years of age are malnourished (Japan Development Institute 2006). The Biotechnology Department's development of high protein biscuits is now in the commercial stage with the government planning to distribute the biscuits through the mid-day meal schemes run in the government schools across the country (Japan Development Institute 2006).

India—Summary

- The functional food industry is growing with a government interest of becoming a major force in the international health foods market.

- Culturally, the connection between foods and health has been always recognized, but many of the traditional foods lack scientific substantiation for functionality. The Indian biodiversity holds potential for new functional foods and/or ingredients.
- Problems within the food industry include low level of organization in retail, inadequate infrastructure, and lack of capacity in value-added processing.
- The Central Food Technological Research Institute in Mysore has extensive research facilities and activity in this sector. Elsewhere, food laboratory capacity is currently insufficient for the industry needs especially considering the need to adhere to international standards.
- As indicated in the section regarding the trends in the industry, there are many opportunities for growth in the functional foods industry. Most of these opportunities relate to the need to curb malnutrition, a particularly pertinent issue in India.

2 Latin America

Latin American cultures have a tradition of using foods, particularly many native plants, for specific functional foods purposes. The general consumer attitude towards health-promoting foods is positive. An internet-based study covering 38 nations worldwide found that consumers in Mexico, Brazil and Peru along with South Africa were the most convinced that food can offer health benefits as addition value to food products (Anonymous, Nutraceuticals International, 2005). In addition, 35 percent of Latin Americans say they always check nutrition information on food packaging, compared to only half of this percentage in Europe. Most often-checked label information includes calories, and fat and sugar content.¹⁶ (ACNielsen 2005b) High price is indicated as a barrier for using health-promoting foods much more often than in other regions (ACNielsen 2005a).

Overall, the markets for processed functional foods are relatively undeveloped. More traditional health-enhancing plants or foods are sold through informal channels where the extent of this trade is not known (Lajolo 2002). In the region, product health claims are generally not allowed and in many countries they are not regulated at all, allowing a range of products to be sold with functional or even curative claims (Hawkins 2004; Lajolo 2002). Currently, only the Brazilian legislation contains health and function claim regulations that are conform to international standards.

The Amazon region is estimated to host approximately 50,000 plant species, but there is very little data available on their nutrient and non-nutrient composition and many may contain components of interest in the health field. Some examples of these plants of interest are listed in Table A4.1. Many of them are already cultivated industrially (Lajolo 2002).

South American botanicals already established in the U.S. market include cat's claw, cayenne fruit, guarana, maca, mate leaf, pau d'arco bark, and stevia (Brinckmann 2003). Some of these are used to manufacture functional foods, although many are channelled into other product categories. In export related activities, Latin American companies have expressed their concern about trade

barriers posed by the novel food regulations in place or proposed in the EU area (BioTrade documents) .

Source	Component/function of interest
Guava	lycopene, anthocyanins
Palm fruits like acai	lycopene, anthocyanins
Camu-camu fruit	ascorbic acid
Brazil nuts	Selenium
Maca, guarana, mate	energy giving properties
Various roots and tubers	oligosaccharides, polysaccharides, oils, sterols, saponins
<i>Source: Lajolo 2002.</i>	

There is limited laboratory capacity related to food analysis. Constraints to achieving a desired level of quality and laboratory accreditation indicated in a 2003 Inter-American Network of Food Analysis Laboratories¹⁷ (INFAL) workshop were in the areas of: human resources (lack of awareness, motivation, and commitment); financial issues (high costs of equipment, low salaries and training budgets); material resources; methodology; and cumbersome accreditation procedures (INFAL 2003).

The rest of this chapter provides a closer look into two countries, Brazil and Peru.

Brazil

Population:	188 million ^a
Number of metropolitan areas:	9 ^b
Urban population:	83 percent (146 million) ^c
Population under poverty line:	rural 51percent, urban 15 percent ^c
GDP / capita (PPP-adjusted):	US\$8,400 ^a
a) CIA World Factbook.	
b) GAIN files.	
c) World Bank data.	

Background

Brazil has a sizable agricultural production sector supported by its large land area and favorable climate. As a result, the nation is largely self sufficient in food and is the world's fourth largest agricultural exporter. Agricultural production and processing together account for approximately one fourth of gross domestic product (GDP) (EIU 2005; Fonseca 2005a).

Despite the large agricultural production, a relatively small amount of production is processed into higher value products. Unprocessed agricultural products, particularly soya and coffee, amount to 24 percent of exports, while processed agricultural products contribute 17 percent. Bulk agricultural products and low processed foods together account for over 60 percent of agro-food

exports (Brooks & Lucatelli 2004). The food industry still depends on foreign sources for special ingredients, such as food additives (Hirata 2004).

Food processing is the second-largest sector in the Brazilian economy representing 10 percent of national GDP in 2003. A large proportion of food industry production is consumed domestically; approximately 90 percent of sales revenue comes from the domestic market (Hirata 2004). The sector consists of around 40,000 to 45,000 food processing companies. These include major multinational corporations like Unilever and Nestle, but a large majority of firms are local small and medium enterprises (SMEs) (EIU 2005; Hirata 2004). Despite the large total number of companies, the food market is heavily consolidated. In 2003, the top ten food and beverage companies represented 45 percent of sales, of which five largest companies contributed 32 percent of sales (EIU 2005; Fonseca 2005a).

Retailers are the major food and beverage distribution channel in Brazil. Supermarkets control 75 percent of the food market, which represents a significantly higher proportion than in other large countries in the region. The top five supermarkets control close to half of food sales (Fonseca 2005a; Brooks & Lucatelli 2004).

The income gap in Brazil is large, but even with only 2.4 percent defined as affluent, this amounts to 1.16 million families, creating a sizable target market for value-added foods, including functional foods. The size of the middle class is estimated at a significant 61.9 million. More than half of wealthy families are concentrated in Sao Paulo state. These affluent consumers follow international trends and are demanding in their purchase decisions (Fonseca 2005a; Fonseca 2005b).

Functional Foods

Market Description

As with other developing countries, factors driving future growth in functional foods include the demographic shift with aging population, rising disposable income levels, and an increasing awareness of the role of diet in preventing chronic diseases. Increasing media coverage of scientific research related to healthy eating and visible government health education campaigns assist in this (Nutraceuticals World 2005; Lima 2006). Demand trends among the wealthier population segment tend to follow those in the rest of the world: recently the focus has been on food quality, environmental conservation, convenience and practicality of products. Factors influencing dietary behavior also include social pressures; aesthetics and the desire to preserve youth (Lima 2006; interviews). Culturally, appearance is in an important consideration.

Regardless of the needs, health foods have a limited presence in the Brazilian market but the sector is relatively young, growing rapidly and has significant room for further growth. The small size of domestic target market has discouraged local companies from stronger market development efforts (Fonseca 2005). The Brazilian functional foods market is currently a small niche market, which, however, has been forecasted to reach value sales of US\$1.9 billion by 2009. However, the growth of 29 percent in per capita spending on functional

foods during this period is considerably lower than forecasts for some other emerging markets (Benkouider 2005).

Dairy products present clearly the largest category of Brazilian functional foods sales. Functional dairy¹⁸ accounts for 73 percent of total functional foods sales, and 11 percent of all dairy sales in Brazil (Nutraceuticals World 2005). From a functional ingredient point of view, the currently available functional foods are most commonly products fortified with vitamins and minerals, dietary fibers or probiotics. Cholesterol-lowering spreads are also available; the first product with an approved health claim in the Brazilian market was in this category. Supermarkets are becoming the main distribution channel for functional food products (Benkouider 2005).

Regulation and Labelling of Functional Foods

Brazil has advanced regulations in place for the market entry and marketing of functional foods, and these are well harmonized with international standards. Before 1999, a whole array of products with unproved safety and undemonstrated health claims were found in the market. The regulations have been successful in weeding out many of those (Lajolo 2002).

Since 1999, all functional food products, both domestic and imported, must pre-register with the Ministry of Health to gain permission to use structure-function or health claims in marketing. Mandatory registration also applies to similar food categories: foods with added essential nutrients, food for weight control, food with dietary restrictions of nutrients, foods for diets with controlled sweeteners, foods for special diets, new foods and or new food ingredients (Silva 2005). Scientific support for the proposed health claims must be presented for review in order to gain approval. In using health claims, the role of healthy overall diet and lifestyle must be indicated (ANVISA 1999 No18 and No19). The regulations also apply to advertising and marketing in addition to food labels.

Since 1999, over 200 products with labelling claims have been approved with 14 different functional property claims (see Table A4.2). There are 25 types of substances or micro-organisms to which these functions have been attributed. To date, no products with a disease risk reduction claim has been approved (ANVISA 2005; Bellaglia 2006; Cleber Ferreira dos Santos 2006).

As in all markets, the regulations are evolving. In 2005, a group of previously approved claims were revoked, because the products were not considered consistent with general dietary guidelines. In addition, as of early 2006, the use of nutrient-function claims has been temporarily put on hold, due to concerns regarding the total dietary intake of some nutrients. More research will be conducted before approvals continue (Bellaglia 2006).

Government Involvement

The government has taken an active role in improving the nutritional status of the population, which impacts the functional foods industry. Government regulations cover nutrition labelling and education, and the health claims. Such regulations offer consumers information to make wiser dietary choices. Consumer reception to the government's nutrition campaign has been positive – labelling is found useful and consumers demand more information about their

foods (Coitinho et al 2002). In an international survey, over 50 percent of Brazilian respondents reported always checking nutrition information on food packaging (ACNielsen 2005b), although their full understanding of the information was not reported. This area currently presents a clear research gap. In addition to labelling regulations, the government nutrition awareness project has included other components increasing general understanding of foods and health through public media, schools, and by training teachers and health workers in the principles of healthy diets (Coitinho et al 2002).

Table A4.2 Food Components and Related Functions Approved for Health Claims in Brazil

- Omega 3 and the maintenance of healthy blood triglyceride levels
- Lutein and the protection against cellular damage from free radicals
- Lycopene and the protection against cellular damage from free radicals
- Dietary fiber and intestinal function
- Lactulose and intestinal function
- Bifidobacter animalis and intestinal function
- Fructo-oligosaccharides and balanced intestinal flora
- Inulin and balanced intestinal flora
- Probiotics (9 species specified) and balanced intestinal flora
- Beta-glucan—helps reduce absorption of cholesterol
- Psyllium—reduces the absorption of fats
- Chitosan—reduces the absorption of fats and cholesterol
- Plant sterols—reduce the absorption of cholesterol
- Soy protein and reduction of cholesterol

Source: ANVISA 2005

Production of Functional Foods

Multinational companies are dominant in the sector in functional food production (Nutraceuticals World 2005). In the food ingredients sector in general, Brazilian manufacturers depend on foreign ingredients especially in special products such as colorings, flavorings, vitamins, (Hirata 2004) and functional ingredients. According to a local source, an informal survey in 2004 suggested that approximately 80 percent of ingredients for functional foods are imported. The high prices of special ingredients drive up the prices of end products; health foods and/organic foods are sold at prices 40 to 300 percent over comparable conventional products (Fonseca 2005).

Opportunities and Challenges

Brazil's vast biodiversity holds remarkable potential for new functional ingredient discoveries. Various antioxidant compounds have been under much interest lately. Manufacturers in Japan and the U.S. obtain plant-based physiologically active ingredients from Brazil. Of these, acai-berry, guarana, and yacon have received global media attention. Investments in biodiversity related research have been described as inadequate.

The Brazilian Agricultural Research Corporation (EMPRABA) investigates numerous plants with potential uses in this sector, including tubers, tropical fruits and medicinal plants (EMBRAPA web site). Overall, functional foods related research is primarily conducted in public institutions. Currently, most innovation in the food industry is occurring incrementally at the ingredient level. Processing equipment suppliers are not flexible enough to generate innovative solutions for the evolving food industry needs (Lima 2006).

From food industry point of view, the still low awareness of functional foods among Brazilian consumers limits the market. Research on consumer attitudes and behavior with respect to functional foods presents a research gap (Lima 2006). High cost of obtaining functional ingredients and scientific substantiation also represent barriers for expanding markets.

Other market challenges to manufacturers are posed by regulations on the use of certain ingredients and strict health claim regulations. Because of the regulations concerning labelling, products may be launched under alternative titles instead of as functional products (Lima 2006), or rely on consumers' previous knowledge of ingredients, which can be listed in packaging.

Laboratory capacity is described as a barrier for development of functional foods markets in this region. A major task of food laboratories in recent years has been creating a food composition database to enable companies to comply with the mandatory nutritional label legislation.

Brazil—Summary

- The market for functional foods is relatively young, but growing. Despite the small consumer segment, the total population size, the developed retail network and local demand increase the attractiveness of this market. Currently products are mainly focused micronutrient fortification, probiotic products, and cholesterol lowering spreads.
- The Brazilian government has been active in creating functional foods regulations that conform to international standards. These regulations are still evolving.
- Functional foods are an area of strong interest for science and industry; numerous events around this topic have been organized for example by ILSI Brazil. Increased media attention has helped generate growing consumer interest.
- Vast biodiversity with potential in the functional foods industry present a research interest. More resources could be invested in this area to realize the potential.
- The resources needed to meet regulations (scientific substantiation) and high cost of functional ingredients creates constraints for manufacturers.
- Collaboration between various fields of research is crucial in order to develop the sector; the process should draw from the expertise of agronomy, human nutrition, food technology, and so forth, as the issues are multidisciplinary in nature. In addition, enhanced interaction among industry components, including public and private sector R&D, governance, processors, and producers, is important to develop the sector.

Peru

Population:	28.3 million ^a
Number of metropolitan areas:	1 ^c
Urban population:	74 percent (20.1 million) ^c
Population below poverty level:	Rural 65 percent, urban 40 percent ^c
GDP / capita (PPP-adjusted):	US\$ 6,100 ^a
a) CIA World Factbook	
b) GAIN files	
c) World Bank data	

Background

In Peru, the majority of locally consumed food is domestically processed. Even multinational companies tend to process through local subsidiaries, and imports contribute only 8 percent of food sales. Imports by the major food processor companies represented nearly half of all food imports in 2001 (EIU 2005; Gutierrez 2003).

Food processors are concentrated in 86 companies, which make up 75 percent of total sales. Largest food companies are multinational corporations or have major foreign investment, while purely domestic enterprises tend to be smaller (Gutierrez 2003).

A notable characteristic in food retailing is the lack of consolidation. Three quarters or more of food sales continue to occur through small grocery stores and traditional markets, although the share of supermarkets and hypermarkets is increasing (EIU 2005). In 2004, of the total food retail market, 80 percent was concentrated in Lima, and major supermarket chains do not have outlets outside of Lima (Gutierrez 2004).

Much of the population lives in poverty and 76 percent of the population are considered low income. High and middle-income populations only amount to approximately 1.6 million consumers (Gutierrez 2004), which limits the market for high value-added products. Overall, the proportion of disposable income spent on food, beverage and tobacco in Peru is around one third, which is typical of a low-income country (EIU 2005).

One third of the population of Peru and 60 percent of national income are concentrated in the capital, Lima (Gutierrez 2003). In urban wealthier areas a shift away from locally produced staples toward branded products and packaged processed foods is taking place (EIU 2005). However, there are cultural challenges for processed foods as most Peruvians prefer fresh products and shopping for food at traditional markets (Gutierrez 2004).

Functional Foods

Market Description

The market for healthy eating, in general, is still in early stages, but it has potential for growth. As in the entire region, demand for better-for-you type of low-fat and sugar-free products is increasing, but mainly among high-income consumers who are increasingly health conscious (Gutierrez 2004; EIU 2005).

Local demand for more specific functional food products seems to be directed at products made with local edible plants traditionally believed to have functional or even therapeutic properties, even though the effects have often not been substantiated by human studies. These fruits and vegetables can be purchased and used raw, home cooked, or processed (Source: interviews).

Processed functional or health-enhancing foods are also sold by local branches of the largest multinational companies¹⁹. Research on consumer attitudes regarding functional foods in Peru represents a research gap.

Regulation and Labelling of Functional Foods

Functional foods and their marketing and advertising in Peru are not clearly regulated and the existing fragmented regulations are not strongly enforced. Claims for health effects, usually without scientific backing, are prevalent in product packaging and advertising (Source: interviews).

Food and beverages in general are regulated for sanitation, where special diet food and additives have their own categories. Food label contents must comply with Peruvian standards for packaged products. The Peruvian food additives regulation is, in general aspects, based on the Codex or the U.S. regulations: additives not permitted by the Codex are prohibited and flavorings accepted by the U.S. FDA and the Peruvian Flavor and Extractive Manufacturing Association are allowed (Gutierrez & Arellano 2005).

Production of Functional Foods

Peru hosts innumerable native plant species that, according to traditional knowledge in Peru and elsewhere, are believed to promote health or improve specific physiological functions. The growing conditions in the Andes are unique and produce unique varieties. However, at this stage, the suggested health effects of these local plants typically lack substantial scientific validation. Conservation and sustainability issues are included in the efforts to increase the cultivation and export of some of the non-traditional commodities (BioTrade Peru 2004).

For local consumer markets, some of the native health-enhancing fruits and vegetables are sold fresh, but are also processed. Tubers maca and yacon²⁰ are available in various forms (flours, extracts, syrups, chips, juices, and so forth), and also used as additives in many types of foods (Hermann & Heller 1997; interviews). Statistics on how much of these consumer-ready products are exported or whether the export market is mainly at the ingredient level were not available. Dietary supplements, such as capsules containing these functional ingredients, are exported as end-products (IPPN materials; trade literature).

Functional food activities focus strongly on the possibilities of utilizing the country's exceptionally rich biodiversity. In these efforts, functional or health-enhancing foods are one sector among others including dietary supplements, cosmetics, and pharmaceuticals that use natural ingredients. A natural ingredients sector assessment from 2004 identified ten species for further analysis, on the basis of their potential in world markets. Of these, at least maca, camu camu, maize morado (purple corn), and yacon have functional foods

applications. The value of exports of functional food plants especially purple corn and yacon have boomed, growing an average of 467 percent and 335 percent annually, respectively, in the years 1998 to 2002 (BioTrade Peru 2004).

The web site of Peruvian Institute of Natural Products (IPPN)²¹, lists 16 plants under investigation for commercial use, some of which, however, are at this stage more suitable for dietary supplements and natural medicines than functional foods. The main export destinations for maca and cat's claw, for which statistics are provided, are Japan and the United States, with 52percent and 19percent share of maca exports, respectively (2002 statistics). Dozens of companies are involved in exporting.

Biotrade-related activities often involve low level processing. Higher processing and the technology required for it are concentrated in Lima. The natural ingredients sector as a whole involves approximately 170 companies, out of which 80 companies export. Natural ingredients producers, mainly private, total around 20,000 (BioTrade Peru 2004).

Basic agricultural and biological research on native Andean plants and their potential for use in functional foods is conducted in universities and other research centers including La Molina Agricultural University in Lima and at the CIP Potato Research Center. Research on the physiological effects of some crops has been conducted also in Japan and the United States.

Certification

As one segment of the natural ingredients industry aims heavily at export, the role of various standards and certifications is important. Organic certifications are widely used in Peruvian export-oriented agro-business and this is seen as a significant competitive advantage. Over 10,000 organic farmers have been certified in Peru since 1997. A national ecological certifying system was established in 1994 and is recognized in major foreign markets (BioTrade Peru 2004).

Many export-oriented ingredient or food companies have obtained GMP and HACCP. (Source: company websites, IPPN materials). Voluntary certifications such as a biotrade certificate have been used by some companies to improve their position in international markets.

Another approach to improving export opportunities has been cooperation in lobbying for changes in regulations in foreign target markets. The EU novel food regulations have especially been identified as an unreasonable trade barrier for ingredients with a long tradition of use in the country of origin (BioTrade.org web-site). Problems in trade of natural products include patent issues, novel food regulations in the EU, and requirement for GMPs for the United States supplement market (BioTrade Peru 2004) .

Limited research restricts the value-added processing sector; there is a shortage of scientific and technological information, as well as information on clinical trials. Chemical analysis, research on functional and/or therapeutic value, and food-safety analysis are all areas where the needs are not being met. These types of studies are especially important for the export-oriented companies, as they are often demanded by overseas purchasers (BioTrade Peru 2004). Clinical trials to

record efficacy of foods are mainly described as beyond the financial resources of the Peruvian companies.

Opportunities and Challenges

The opportunities in Peru are largely focused on local biodiversity. Involvement in functional foods sector can, in turn, strengthen the position of lesser-known native plants and help conserve biodiversity. Challenges for the functional foods sector and/or biotrade in a larger sense have been indicated in the following areas:

- The supply sources are dispersed; crops are mainly grown on small farms in remote areas.
 - Storage and transportation problems
 - Inability to cover demand in large quantities
- Poor linkages and mistrust in the value chain
 - Understanding of the entire value chain and target market is missing
- Inadequate laboratory capacity
 - Few specialized laboratories of chemical composition analysis
 - Limited equipment and methods available for research
- Certification issues
 - Most producers are not using GMP and HACCP
 - Lack of training in quality control standards
 - High cost of organic certification
 - Inconsistent quality of raw materials
- Incomplete legislation
 - Lack of enforcement of proper production and sales practices
- Capacity at farm level
 - Production technology, storage, and handling require improvement
- Lack of information
 - Difficult access to technical and scientific information, information of scientific studies relate to crop value as functional ingredient
 - Limited knowledge on how to start exporting
 - Inaccessible information about markets and consumers
- Small domestic market for value-added products
- Lack of integrated research and development strategies
- Lack of organization among farmers

Sources: BioTrade Peru 2004; interviews.

Peru—Summary

- Opportunities in the sector are presented by the rich biodiversity and interest in both benefiting from and protecting this resource.

- Domestic functional foods market is not highly developed; barriers for growth include low income level of consumers, lack of organized retailing, and the absence of clear regulations.
- Numerous functional products are available, both originating from the local traditional knowledge and those manufactured by the multinational food companies. In the absence of labeling regulations, products are frequently advertised with strong, sometimes unsubstantiated health claims.
- Functional food development activities are mainly focused on the potential of native plants. Internationally well-known crops with functional food applications include yacon, purple corn, and maca and these are exported. Scientific substantiation of health effects would be necessary for gaining a stronger foothold in mature markets.
- Lack of analytical laboratory capacity is a problem, and meeting stringent quality demands for export would require more resources.

3 Eastern Europe

The functional foods market in Eastern Europe is relatively underdeveloped. Although health problems such as obesity are prevalent (Benkouider 2005), and death rates from heart disease in Central and Eastern Europe are significantly above the global average (Anonymous CEE 2004), consumer awareness of nutrition and understanding of functional foods is still low (Ciocca 2003; Sofroniou 2005).

The availability of health and wellness products in this region is limited; functional dairy products are present, but there is little development in other segments. The better-for-you reduced fat foods are expected to gain popularity with the growing obesity problem. (Patton 2005a).

Generally, no clear regulations for functional foods are in place in Eastern European countries, and incorrect and unregulated advertising may exacerbate consumer confusion. Overall, this sector is still in its infancy and little representative information is available in the literature on functional foods. The following section offers a more in-depth assessment of Russia.

Russia

Population:	143 million ^a
Number of metropolitan areas:	13 (population >1M) ^b
Urban population:	70 percent ^b
Population below poverty level:	17.8 percent ^a
GDP / capita (PPP-adjusted):	10,700 \$ ^a
a) CIA World Factbook b) GAIN files	

Background

Russia has experienced significant growth in GDP in the past years and consumer incomes have been growing rapidly. Disposable incomes grew by 19 percent in 2004 and consumer spending by 22 percent. (Evdokimova 2005; PWC 2005/2006). In this geographically vast nation, however, regional differences are

remarkable. Nearly 20 million consumers, 30 percent of retail trade and 40 percent of FDI is concentrated in the Moscow region. Per capita income in Moscow is three times the national average (Taybakhtina 2004).

The food processing sector is one of the leading industries. Factors driving rapid growth include the large population, rising incomes and consumer demand for new products. (U.S. Commercial Service 2006c) Accordingly, the strongest growth in the food and beverage sector has been in companies, which focus on the higher-end products and emphasize quality (PWC 2005/2006). Growing categories in food domestic food processing include health foods and special diet foods (EIU 2005).

In 2003, approximately 22,000 companies were involved in food-processing, but the sector is gradually consolidating (U.S. Commercial Service 2006c). The presence of multinational corporations is strong and domestic companies are primarily SMEs (PWC 2005/2006). Moscow and St. Petersburg areas dominate the food industry with 35 to 40 percent of food products are manufactured in these two areas (U.S. Commercial Service 2006c). Approximately 40 percent of total food consumption is imported (EIU 2005).

The expanding food industry relies on imports of special ingredients. Multinationals and domestic food processors source food ingredients from foreign suppliers in order to provide competitive quality products. Local suppliers are not able to match foreign quality ingredients at this stage (Evdokimova 2005; EIU 2005). Similarly, domestic food processing equipment does not meet modern criteria in terms of quality, but it is competitively priced (U.S. Commercial Service 2006c).

Food retail channels in Russia remain fragmented; close to half of food purchases in large cities and 70 percent or more in the outer regions are made in open markets or traditional stores (Taybakhtina 2004).

Diet-related issues have recently gained publicity as the most prominent public health problem is cardiovascular disease (CVD), which accounts for over 50 percent of deaths. Largely due to CVD²², life-expectancy in Russia is 12 years lower than in the U.S., and 5 years lower than in China. Inappropriate diet is a major factor in determining CVD risk²³. About 60 percent of Russian adults have blood cholesterol levels above the recommendation and 20 percent need medical attention. Overall, death rates from non-communicable diseases are three times higher in Russia compared with the EU average (World Bank 2005).

Functional Foods

Market Description

Although the Russian functional foods market is still undeveloped, numerous new products have been introduced in the past few years, and the demand for functional foods is high among the higher income population where a trend towards healthy lifestyle and healthier eating is evident (Spiridovitch 2005; Taybakhtina 2005b).

The value of Russian functional foods market was estimated at US\$75 million in 2004, and annual growth of 20 percent is expected (Patton 2005). However, the

definition for functional foods for this figure was not indicated. Growth in certain sectors, such as enriched products has been extremely rapid (Drujinina 2005c).

Dairy industry has taken the lead in developing functional foods and largest growth is expected in this sector (Spiridovitch 2005). Probiotic products currently hold a noteworthy 35 percent market share in kefir and 25 percent in drinking yogurts (Drujinina 2005c). Functional properties are also becoming popular in the bakery and beverage sectors and functional foods differentiation strategies are used in oils, dietary fats and confectionery, and even in spirits. (Drujinina 2005a). The main reason for developments in the functional foods market is consumer demand: rising affluence and increasing health awareness, partly induced by public health education efforts and aggressive advertising of functional foods. In the dairy sector, 80 percent of advertising expenses in 2004 went into marketing functional products. (Spiridovitch 2005). Consumer awareness has improved particularly about the role diet can play in reducing the extremely high prevalence of CVD in the country. The atmosphere is supportive towards companies investing in functional foods.

Russian consumers read product labels carefully and are ready to pay more for branded products (Taybakhtina 2005a). The concept of functional foods is best understood in the dairy sector, while some product segments, such as high fiber foods, suffer from low consumer awareness (Taybakhtina 2005a). In addition to still lagging consumer awareness, challenges for the sector are presented by the limited retail distribution, especially in rural areas. Expansion of functional foods market is likely to remain urban based for years (Benkouider 2005).

Regulation and Labelling of Functional Foods

Russia has been harmonizing its food labelling regulations to better match those by the Codex and the EU. The new regulations, established at the end of 2004, include mandatory nutrient labelling for macro- and micronutrients, as well as specifically worded statements to use on organic products. Certain health claims are also permitted and scientific support for them is required (Drujinina 2004). Products have to be tested in the national testing center for clinical efficacy. (Details for this process were not available for this review.) In terms of quality standards, regulators have started to move away from detailed government standards toward producer responsibility (Hager 2005).

Production of Functional Foods

The leading functional foods company in Russia is the dairy and juice manufacturer Wimm-Bill-Dann (WBD). WBD together with Danone hold market leadership in functional dairy products, the most prominent sector in functional foods. Fifteen percent of Danone's products belong in the Activia® functional product family (Drujinina 2005b). Local firms Ochakovo and Petmol have also launched probiotic product lines, although R&D costs as well as production and marketing investments are stated to be significantly higher than with traditional products, and this is a barrier to entry into this sector. (Drujinina 2005b). Still, most dairy processing companies have probiotic products in their product line (Spiridovitch 2005).

Information was not found on the possible involvement of the agricultural sector in value-added production aiming at functional foods industry. This gap should be addressed for complete understanding of the possibilities of this industry in the near future.

Opportunities and Challenges

The growing domestic market concentrated in major urban centers presents a potential for new value-added products. Significant challenges to local food manufacturers result from the need for new machinery, technology, and functional ingredients, all of which must be imported as local supply is insufficient and of poor quality. (Spiridovitch 2005). Natural ingredients are particularly difficult to obtain from domestic markets (Drujinina 2005c).

Russia—Summary

- The Russian functional foods market is still relatively small but shows promise; improving nutrition awareness combined with the large population with rising incomes result in an increasing demand for health-promoting foods.
- The current market is mainly concentrated in the functional dairy sector. The leading company is Russian, with significant representation from foreign companies.
- Regulations related to functional foods have recently been revised and are now conform to international standards; government pre-approval process and clinical efficacy trials are required for products to carry health claims. The regulations are recent and their effectiveness cannot yet be assessed.
- Problems faced by the general food industry could be expected to limit the sales in the functional foods. These include lack of quality ingredients and technology for domestic suppliers, geographic fragmentation, and low level of the organized food retail sector.
- Lack of information about the involvement of farmers in the functional foods sector results in an incomplete picture of the sector.

Table A4.3 Summary of the Country Case Studies

Country	General awareness, atmosphere, demand	Legislation	Domestic market	Agriculture, processing, manufacturing activities	Supporting activities	Challenges	Opportunities
China	<ul style="list-style-type: none"> • Tradition of using food as therapeutic agent (TCM) • Public health problems, such as obesity and related conditions becoming more prevalent 	<ul style="list-style-type: none"> • Elaborate legislation in place for “health foods”; includes government testing • Advertising controlled 	<ul style="list-style-type: none"> • Traditional products mixed with western-type science-based functional foods • Growing local demand 	<ul style="list-style-type: none"> • Manufacturers need GMP certification to gain government approval for products 	<ul style="list-style-type: none"> • Research in local institutions and overseas 	<ul style="list-style-type: none"> • Markets are urban-based • Underdeveloped infrastructure 	<ul style="list-style-type: none"> • Raw materials and active ingredients from traditional functional foods; need internationally acknowledged research
India	<ul style="list-style-type: none"> • Tradition of using food as therapeutic agent based on for example ayurvedic philosophy • Malnutrition 	<ul style="list-style-type: none"> • Bureau of Indian Standards is involved in product certification, quality systems, and consumer affairs • Lack of suitable regulatory category results in misleading advertising and sales of functional foods 	<ul style="list-style-type: none"> • Growing functional food market 	<ul style="list-style-type: none"> • Until recently, these were severely restricted by government policies • Medicinal plants and ingredients for related industries are an active area, potential for functional foods as well. 	<ul style="list-style-type: none"> • Active academic research institutions 	<ul style="list-style-type: none"> • Retail network unorganized and fragmented • Even general value-added food processing is rare • Little cooperation between academic research and the industry 	<ul style="list-style-type: none"> • Biodiversity • Based on traditional knowledge, potential in local foods and ingredients
Brazil	<ul style="list-style-type: none"> • Traditional knowledge of functional foods properties of local plants • Rising incomes, western influences; new 	<ul style="list-style-type: none"> • Regulations are well in line with international standards, but are still evolving • Since 1999, products with health claims 	<ul style="list-style-type: none"> • Large income disparity, but sizable middle/high income segment interested in functional foods 	<ul style="list-style-type: none"> • Specialized/ high quality ingredients are imported and expensive • Some local botanical ingredients 	<ul style="list-style-type: none"> • Functional foods gaining attention through many activities (workshops, lecture) 	<ul style="list-style-type: none"> • Most functional ingredients must be imported • Previously emphasis on low-level processing of 	<ul style="list-style-type: none"> • Biodiversity • Growing local demand and increasing media attention • Alleviating public health problems by

Table A4.3 Summary of the Country Case Studies

Country	General awareness, atmosphere, demand	Legislation	Domestic market	Agriculture, processing, manufacturing activities	Supporting activities	Challenges	Opportunities
	<p>products are welcomed</p> <ul style="list-style-type: none"> • Government promotes healthy diets as public health effort • For consumers, well-being and appearance are important 	<p>must be pre-approved by the government; scientific support for product specific health claims is required</p>	<ul style="list-style-type: none"> • Better-for-you low-fat, low-sugar and fortified products are common. • Probiotics gaining popularity 	<p>exported for dietary supplement and food industries</p> <ul style="list-style-type: none"> • Great potential in local biodiversity 		<p>bulk commodities</p> <ul style="list-style-type: none"> • High cost of ingredients and meeting regulations 	<p>dietary means</p> <ul style="list-style-type: none"> •
Peru	<ul style="list-style-type: none"> • Traditional knowledge of health properties of local foods and plants • Interest in finding new value-added uses for native plants in international markets • Undernutrition still a major problem 	<ul style="list-style-type: none"> • No clear regulations for functional foods 	<ul style="list-style-type: none"> • Mainly traditional local products: maca, yacon in various forms • Multinationals also sell probiotic drinks and fortified products 	<ul style="list-style-type: none"> • Small scale and fragmented agriculture • Primary production and low-level processing for export often targets other related industries along with functional foods 		<ul style="list-style-type: none"> • Lack of regulation • Lack of resources for research, especially for efficacy trials • Poor coordination along the supply chain • Unorganized retail sector • Low local demand 	<ul style="list-style-type: none"> • Biodiversity • Utilizing local less-known crops for economic gain • Functional foods could help in improving sustainability of agriculture and environmental preservation
Russia	<ul style="list-style-type: none"> • Demand growing rapidly among urban, wealthier population • Public health problems, especially CVD, are recognized and the role of 	<ul style="list-style-type: none"> • Amendments in 2005 to harmonize legislation with Codex and EU • Must run clinical trials through national 	<ul style="list-style-type: none"> • Domestic demand is urban-based • Dairy sector most popular, others suffer from lack of consumer awareness 	<ul style="list-style-type: none"> • Local companies produce functional dairy products for local market • Specialized or high quality ingredients are 	<ul style="list-style-type: none"> • Large investments in advertising by the industry 	<ul style="list-style-type: none"> • Insufficient infrastructure • Ingredients, value added inputs must be sourced from foreign sources • Lack of consumer 	<ul style="list-style-type: none"> • Growing local demand

Table A4.3 Summary of the Country Case Studies

Country	General awareness, atmosphere, demand	Legislation	Domestic market	Agriculture, processing, manufacturing activities	Supporting activities	Challenges	Opportunities
	diet is acknowledged • Good nutrition awareness and interest by the public (in some categories)	institution and get their approval for a health claim		imported		awareness in some product categories	

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Endnotes

¹ Developing countries referred to in the report include economies in transition.

² Estimate of market in 2004.

³ Estimate of market in 2003. In this report Datamonitor used the term “nutraceutical,” but its definition was similar to the one for functional foods in this report, that is nutraceuticals is the same as “food products providing medical or health benefits beyond basic nutrition or foods with added biologically active components that impart these benefits”.

⁴ The figures should be considered as suggestive. The confusing classification and terminology related to functional foods makes accurate estimation of the overall market size difficult. Some estimates only include products using a health claim on packaging, which defines a clear scope, but excludes entire markets where health claims in marketing are prohibited. Others include everything sold over-the-counter to consumers for self-help purposes, including dietary supplements, herbal extracts and the like⁴. A striking illustration of the impact of varying inclusion criteria is from 1999 when the estimate of the global market value was more than US\$33 billion using a broader definition for functional foods. With the strictest definition including only products making health claims on packaging, the global market was estimated at about US\$6 billion (Arai et al 2002)—less than one fifth of the more encompassing figure.

⁵ Minimum amounts for certain protective components and maximum amounts for risk-related components.

⁶ Current disposable income per head in India, in \$ purchasing price parity terms, is \$2,303, but is expected to grow to \$3,033 by 2008 (Ismail 2005).

⁷ Functional dairy here includes vitamin and mineral fortified dairy drinks.

⁸ Company web site information.

⁹ The other major risk factors are alcohol abuse, traffic accidents, and HIV/AIDS.

¹⁰ The main risk factors for CVD are hypertension, high cholesterol, diabetes, obesity, and smoking.

¹¹ For a comprehensive look at the complex areas of health-enhancing food -related research see Diplock et al 1999 or MacAulay et al 2005.

¹² See examples in Narayanan and Gulati. 2002. “Globalization and the Smallholders: A Review of Issues, Approaches, and Tentative Conclusions.” Paper presented at IFPRI on June 12, 2002 and World Bank on July 18, 2002; and Rondot, et al. 2004. “Rural Economic Organizations and Market Restructuring: What Challenges, What Opportunities for Small farmers? A Global Issue Paper.”

¹³ For the purposes of this report, functional or health-enhancing foods were defined as food or beverage-type products that influence specific physiological functions in the body, thereby providing benefits to health, well-being or performance, beyond regular nutrition, and are marketed and consumed for this value added property. This definition thus excluded simply nutritionally enhanced products, such as foods fortified with essential nutrients used to alleviate and prevent nutrient deficiencies. Also excluded are products marketed with a generally healthier image, if a specific effect on a specific physiological function and a concomitant benefit is not perceived from a nutritional science point-of-view (that is organic foods, free-range chicken, and so forth).

¹⁴ These have been part of the Japanese regulation as well since 2005.

¹⁵ Current disposable income per head in India, in US\$ purchasing price parity terms, is US\$2,303, but is expected to grow to US\$3,033 by 2008 (ibid).

¹⁶ In contrast, Europeans and Asians tend to focus more on information on preservatives and additives.

¹⁷ INFAL website: <http://www.panalimentos.org/rilaa/ingles/index.asp>.

¹⁸ Functional dairy here includes vitamin and mineral fortified dairy drinks.

¹⁹ Company web site information

²⁰ More detail on the use of maca and yacon in Hermann 1997

²¹ www.ippn.org.pe IPPN, founded in 1999, aims to research and develop possibilities to utilize native plants in order to provide value added for the country in a sustainable manner.

²² The other major risk factors are alcohol abuse, traffic accidents, and HIV / AIDS.

²³ The main risk factors for CDV are hypertension, high cholesterol, diabetes, obesity, and smoking.