

Adopting a National Innovation Approach for Agro-Sustainability : A Case Study

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Abstract

Nowadays, agro-firms are confronted with competition from global suppliers in both domestic and export markets. Such competition in sustainable agro-operations is expected to intensify. The survival of these firms in developing countries urgently requires a significant transformation to be competitive. This paper discusses the rationale of adopting a national innovation (NI) approach from an industry-wide perspective. In order to attain sustainable agro-operations in developing countries, the approach stresses appropriate scientific and technological applications and effective linkages of technology transfer via the network between public and private institutions, universities and other research institutions. Central to this approach is the development of the agro-industrial sector whereby agri-chains are formed. An illustrated case of the NI approach is presented with respect to a small island developing state, the Republic of Trinidad and Tobago.

Key Words: National Innovation Model, Technology Transfer, Developing Countries

1. Introduction

Nowadays, an estimated US\$4,000 billion is spent on food, worldwide: 73% in retail outlets and 27% in food service establishments. Over the last decade, the food and beverage industry has experienced a steady and healthy economic growth. This industry is one of the world's largest employers. For every job in the food and beverage sector, many additional jobs are created for retailers, suppliers and other business partners [1]. Further up the supply chain, manufacturing requires the purchase of energy and huge investments are made to buy equipment, technology and new products. This sector is also a major customer for the packaging industry and transport services, and invests in transport infrastructure, networks and vehicles. At the end of the supply chain, it is one of the largest spenders on advertising and plays an important role in supplying the retail industry.

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Consumers are demanding an increasingly wide variety of foods, retail formats and restaurant concepts. Agro-firms (such as food manufacturers, distributors, retailers and food service operators) are facing additional demands as they strive to profitably supply the large variety of goods and services on time and in the correct quantity. These firms are responding to the challenges by making innovative operational changes, reshaping how they work together with other members of the food supply chain and how they organise themselves as individual companies [2]. This paper discusses the need for attaining sustainable agro-operations in small island developing countries like Trinidad and Tobago. It underlines the growing importance of the agro-firms to adopt appropriate scientific and technological applications that suit local conditions.

2. Some Drivers of Sustainable Agro-Operations

In today's globalised world of rapidly changing technology, the ability to tap into other countries' technology is critical. Agro-firms can gain access to technology through technology transfer and endogenous development. Trade is a vehicle for technology transfer whereby the exchange of technological know-how is performed. It allows firms to learn and to adopt production techniques from trading partners. This path requires the ability of firms to form cooperative arrangements with owners of foreign technology, who includes home-owned firms with substantial receptor capacity. More commonly, small island developing countries have relied on foreign multinationals to bring technologies to them [3].

Agricultural products are shaped by technologies of growing complexity. Sustainable innovation options need to be examined to ensure the competitiveness of the sector. Another challenge is linked to the strengthening of interactions and the forging of cooperation with other industrial and service sectors including transport and distribution which are important in creating horizontal networks and coalition among sectors [4, 5].

It is sometimes assumed that large firms constitute the main drivers of economic activity in industrialised countries. However, in a sample of developed countries drawn from the database of World Bank [6], small and medium-sized enterprises (SMEs) accounted for about three-quarters of GDP and just over 60% of employment. The figures are generally much higher in the case of the developing countries, confirming the critical role of SMEs in the development process.

Small-business ownership encourages personal freedom and individual empowerment and contributes to social and political stability. In many countries, the SME sector has been the catalyst for product innovation and for productivity enhancement [7]. In addition, small companies are more flexible at both the organisational and production level, which results in them having a greater capacity for restructuring in the face of fluctuations in demand. These

circumstances have caused the SMEs to intensify their cooperation both with other companies and with government, universities and public research institutions for the purpose of carrying out innovation and technological development processes [8].

3. Adopting a National Innovation Approach

A national innovation (NI) approach has at its core the formation of clusters of firms forming a chain as the main feature driving the process of innovation. The formation of agri-chains involves a broad spectrum of society [9]. Several key stakeholders constitute an agro-knowledge cluster that include agro-firms (including farms, processors, operators and practitioners), knowledge institutions such as the universities, research and development and technology centres and the government, with the farmers being at the core of this structural network. It is necessary to have a flexible and responsive innovation network among these stakeholders.

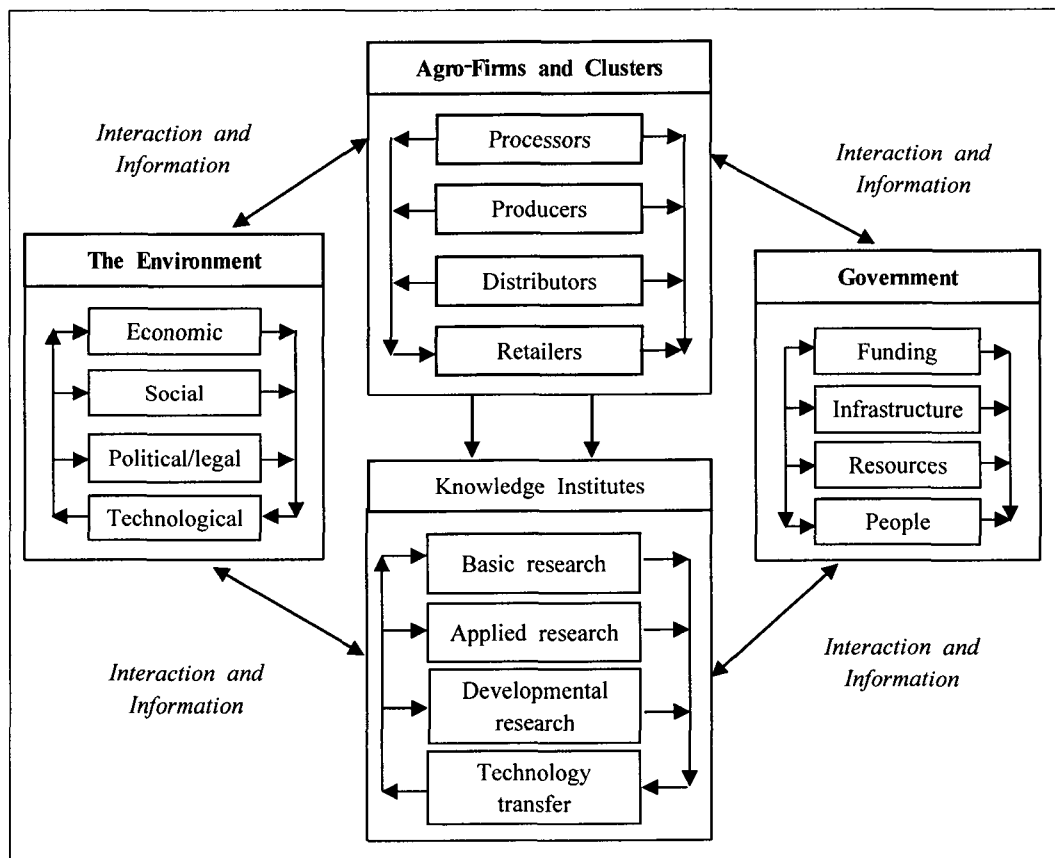
The rationale of the NI approach rests on the premise that developing linkages among the stakeholders are the key to improving technological performance in the innovation process. It focuses on the flows of knowledge within the network which is increasingly directed to improving performance in 'knowledge-based economies' [10]. Expenditure on R&D is an investment in the organisation's absorptive capacity and the organisation's ability to evaluate and utilise external knowledge related to its prior knowledge and expertise and that this prior knowledge is in turn driven by prior R&D investment [11]. These clusters generate a number of externalities based on the flow of information and the knowledge shared on the basis of the network of relations established by all members.

Through adopting the NI approach, firms can map knowledge flows as a complement to measuring knowledge investments, and can compare the main channels for knowledge flows at the firm level or the national level. This helps identify bottlenecks and suggest various mechanisms or strategies to be implemented to improve their fluidity. Therefore, it involves tracing the links and relationships among industry, government and academia in the pursuit of developing a scientific and technological environment. The approach is also a reflection of the rise of systemic approaches to technology development since ideas of innovation emerge from many sources and at any stage of research, development, marketing and diffusion. This can also take many forms including adaptations of products and incremental improvements to processes. It is the result of the complex interaction among various stakeholders (see figure 1).

The NI approach stresses the interaction and interdependence between elements in the system, where innovations are thought to be determined not only by the elements in the system, but also by the relations among them [12]. Among these elements are key stakeholders

including both firms and non-firms such as universities, research institutions, government agencies and venture capital organisations. The relations between different organisations and between organisations and institutions are extremely complex and characterised by reciprocity, interactivity and feedback mechanisms in several loops [5]. The innovative firm is seen as operating within a heterogeneous complex network of cooperating and competing firms and other institutions, building on a range of joint ventures and close linkages with suppliers and customers.

Through the promotion of a technological cluster as a structure of cooperation in relation to technological development, firms including SMEs can gain access to innovations and seek collective adaptation to the environment. The channels through which knowledge flows among the actors in the NI approach can occur either through: 1) interactions among enterprises; 2) interactions among enterprises, universities and public research laboratories; 3) diffusion of knowledge and technology to the firms; and 4) movement of personnel [13].



Source: Modified from [5]

Figure 1. Components of the NI Approach

4. An Illustrated Case of Trinidad and Tobago

4.1 Situational Analysis

Trinidad and Tobago is a twin island democratic republic located at the southern end of the Caribbean archipelago, approximately seven miles off the Venezuelan coast. It is one of the most diversified and industrialised economy in the English-speaking Caribbean. There are large reserves of petroleum and natural gas, and well-developed heavy industries-iron and steel, methanol and nitrogenous fertilizers and petroleum products. Air, sea and land transportation links are excellent, and telecommunications links with the Americas and Europe are completely modern. Trinidad and Tobago experienced its tenth straight year of economic growth in 2004. Gross domestic product (GDP) for Trinidad and Tobago was US\$11.48 billion in 2004 – a 5.7% increase from 2003 [14].

Unlike most of its Caribbean neighbours, Trinidad has a large industrial sector, which is primarily based on petroleum and natural gas production and processing. The agricultural sector remains a small but vital part of the national economy. The non-energy sector grew at a slower pace in 2004. Output in this sector increased by 2.9% in 2004 compared to 3.8% in 2003 with the impetus coming from the manufacturing and services sectors. The rate of growth in 2004 in the manufacturing sector was 6.6% which was attributed to the food and beverage industry and assembly-type industries [14].

The food and beverage industry is very important to this country from the perspective of being a major user of indigenous inputs, employment generation and its potential for generating foreign exchange earnings and improving this country's food security. The food and beverage sub-sector contributes 3% of the GDP of the Trinidad and Tobago economy. More importantly, the sector represents roughly 36.5% of total value added of the manufacturing sector [14]. To meet consumer desires and obtain the ingredients needed by a thriving food processing industry, Trinidad and Tobago is heavily dependent on agricultural imports. Food and beverage imports and exports for the period 1999 to 2003 on an annual basis are shown in Table 1.

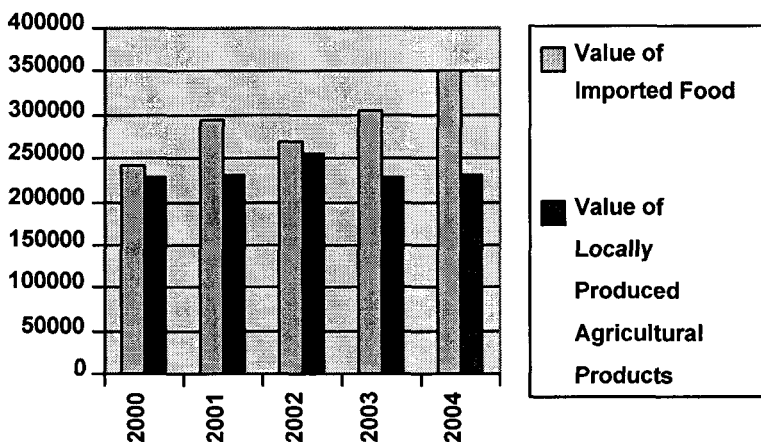
Table 1. Imports and Exports of Food and Beverage Products, 1999 - 2003

<i>Item*</i> (TT\$ million)	Year	1999	2000	2001	2002	2003
Imports		1,496.6	1,370.9	1,689.6	1,536.6	1,919.0
Exports		912.1	902.7	813.6	808.7	1,174.0
Trade Imbalance		(584.5)	(468.2)	(876.0)	(727.9)	(745.0)

Source: Abstracted from [14] (*Remark : US\$1 = TT\$ 6.30)

The trade imbalance is high in Trinidad and Tobago. In the period 1999 to 2003, imports have increased by 28% and exports increased by 27%. Over 50% of this country’s food exports are within the CARICOM region. Figure 2 shows the value of imported food versus the value of domestic food products. In 2004, Trinidad and Tobago’s agricultural imports totaled US\$ 352 million. Consumer-oriented agricultural products comprised roughly 57% of all agricultural exports to Trinidad and Tobago. The United States is the country’s main trading partner in terms of food and beverage products. Over 40% of food imports are from the US. In 2004, the US exported US\$ 163 million in agricultural fish, and forestry products to Trinidad and Tobago, of which US\$ 51 million were consumer-oriented agricultural products, and US\$ 1 million were edible fish and seafood products. Approximately, 30% of all imported consumer foods are destined for the food service sector and the remainder for the retail sector [15]. Moreover, the agricultural sector which provides raw materials for many food processors continues to be characterised by low productivity (see Table 2).

Value of Imported Food VS. Value of Domestic Products
(in thousands of Dollars - U.S.)



Source: Abstracted from [14]

Figure 2. Value of imported food versus value of domestic products

Table 2. Agriculture’s Contribution to Gross Domestic Product, 1999 ~ 2003

Year	1999	2000	2001	2002	2003
Agricultural Sector	1.9%	1.4%	1.3%	1.2%	1.1%

Source: Abstracted from [14]

Recognising the fact that energy plays an important role in the economy of Trinidad and Tobago, the Government needs to diversify the economy and reduce its dependence on the energy sector to achieve self-sustaining growth. Agriculture, both in terms of the domestic as well as the export markets, is today confronted with competition from global suppliers which is expected to increase in the near future. The survival of the agricultural sector in Trinidad and Tobago urgently requires significant and rapid transformation.

4.2 Discussion

In Trinidad and Tobago, to promote the growth of domestic food production requires a massive investment in agriculture and agro-processing industries to make farming productive and to increase the purchasing power of farmers and those employed in the agricultural sector. The food and beverage industry is very important to this country from the perspective of being a major user of indigenous inputs, employment generation and its potential for generating foreign exchange earnings and improving the Country's food security base.

However, the local/domestic market of Trinidad and Tobago is relatively small and does not provide the market base to support the business activities in the agricultural sector that requires significant capital for product development, marketing, distribution and sales. Weak linkages exist with the domestic farm sector accompanied by a low rate of technology adaptation, lack of access to affordable technological support and inadequate capacity of the companies to develop new, high-value added, innovative products. To achieve sustainable agro-operations, quality product development is required. Another challenge facing the food industry is the lack of regulatory enforcement and/or financial resources to establish the infrastructure and systems for ensuring food safety [16].

In Trinidad and Tobago, agro-firms have largely focused on food products and condiments. Linkages with the other industries need to be developed and enhanced such that the manufacture of agrochemicals for example as downstream activities from the petrochemical sector needs to be encouraged and explored. Networks of production linkages can no longer be domestic; such networks need to be both domestic and international for long-term sustainability of the sector. These networks depend on information flows, the transport of goods and specification. Prices as determined by comparative cost advantages based on labour, intermediate inputs and the cost of capital are also important.

Outward oriented strategies need to be adopted such as seeking export opportunities or finding ways to participate in production chains with large producers abroad. The emphasis must be on the development of a collaborative effort to produce innovation and increase productivity and competitiveness. While most SMEs remain focused on the local market, those that are likely to thrive and expand are the ones that embrace the export challenge and are prepared to adopt new technology, develop new information systems and devise in-

novative products that are globally competitive.

As part of its diversification effort, the Government also needs to act as a catalyst and enabler of the process by investing in the development of a cluster of technology industries linked to the university sector in Trinidad and Tobago and other key stakeholders. This cluster is expected to develop a range of innovative products that can compete at the global level.

At the upstream part of the chain, partnerships with the suppliers of agricultural raw materials and packaging inputs are essential to maintain competitive prices and high environmental standards. Many companies should form partnerships with farmers and growers - offering appropriate technical advice, training and contributing to relevant research projects so as to improve the quality, efficiency and productivity of agricultural production. The relationship between manufacturers and retailers is more collaborative and cross-functional to create genuine partnerships - joint project teams, staff placements into each other's businesses and common initiatives, etc. The management of the relationship with these actors in the supply chain would have a great influence on the food and beverage industry's road to sustainability.

5. Conclusion

Sustainable agro-operation development has increasingly become a concern for the international community. The growth of the agro-food system will be increasingly determined by the greater efficiency of the components within the supply chain and by the competitiveness of the system as a whole. Producers, processors, retailers and foodservice operators will increasingly need to work in partnership to more efficiently and effectively meet market demands. This is a key factor since vertical integration of agricultural producers and food processors varies considerably, depending on geographic regions and companies. Aside from the leverage that distributors could apply to processors' margins, processors are also faced with the adoption of new methods of doing business and adapting it to suit local conditions. The NI approach advocates the formation of agro-knowledge clusters and linkages to facilitate the transfer of technology and viable management practices within the network. Adopting it could assist developing countries especially in the agricultural industry to identify leverage points for enhancing innovative performance and competitiveness that promote sustainability.

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