THE GROWING ROLE OF CONTRACT FARMING IN AGRI-FOOD SYSTEMS DEVELOPMENT: DRIVERS, THEORY AND PRACTICE

by

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The Growing Role of Contract Farming in Agri-food Systems Development: Drivers, Theory and Practice[1]

Carlos A. da Silva[2]

ABSTRACT

The interest in contract farming as a mechanism to coordinate linkages between farmers and agribusiness firms has increased considerably in the recent past. This paper reviews the changes in agri-food systems that are leading to tighter coordination of supply chains and discusses the theoretical basis for contract farming as a chain governance strategy. It is argued that the need to minimize transaction costs in light of increasing uncertainty, asset specificity and market failures associated with changes in agri-food systems will continue favouring the intensification of contracting in supply chain management in food and agriculture. The international experience reviewed suggests that, under appropriate enabling environments, the potential advantages of contracting for farmers and agribusiness firms tend to outweigh the potential disadvantages. Potential socio-economic benefits are a further incentive to the promotion of contracts as a component of agribusiness development strategies. Critical success factors for sustainable contract farming are pointed out and issues for additional reflection are suggested.

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[1] Draft resource paper prepared for the Asian Productivity Organization Meeting on "Sustainable Contract Farming for Increased Competitiveness", Colombo, Sri Lanka, July 2005.

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1. Introduction

In recent years, the interest of policy makers, researchers and development planners in contract farming as a mechanism to govern linkages between farmers and agribusiness firms has increased considerably. This surge of attention is well evidenced by the growing number of publications on the topic – a search in the conventional scientific abstracting databases will generate hundreds of journal articles, conference proceedings, books and other reports discussing theoretical concepts, case studies and research findings relating to technical, economic and social aspects of agricultural contracts. Reviews of this vast amount of literature are presented by authors such as Singh (2002), Kirsten and Sartorious (2002), Warning and Hoo (2000), Bauman (2000) and Rehber (2000), among others.

The interest in the topic crosses across multiple disciplinary borders, different commodities and varied regional areas of both the developed and developing world. Since contract farming is by no means a novel issue[3], there should then be a specific reason for such heightened awareness and this is most plausibly associated to the remarkable pattern of changes and trends affecting agri-food systems worldwide.

Spurred by drivers such as technological developments, demographic changes, changing consumer preferences, trade liberalization and financial capital mobility, food and agricultural systems are being forced to adapt and modernize. Increasingly, such systems are becoming organized into tightly aligned chains and networks, where the coordination of production, processing and distribution activities is closely managed. In these modernized systems, the once dominant role of spot markets as a mechanism to harmonize transactions is being replaced by alternative forms of vertical coordination, including strategic alliances, full ownership and contracts. As a consequence, supply chain management principles, which already impacted the organization and performance of manufacturing and retailing internationally, have found in the agri-food sector a new, fertile ground to be put into practice.

These transformations, and the organizational responses thereof, are creating challenges and opportunities for producers, processors, wholesalers, retailers and other supply chain actors. Small farmers in developing countries, in particular, are perceived to be especially vulnerable to the changes. As Chen et al. (2005) indicate, modern organizational arrangements in agri-food systems might promote the

[3] The rich, early agricultural economics literature on agricultural marketing in general and vertical coordination in particular also examines the issue of contracting at length. See, for instance, Helmberger et al. (1981).

emergence of power imbalances and unfavourable terms of trade in the transactions between smaller-scale chain actors and the larger players which typically exercise the leading coordination role in a managed supply chain. But these perceptions notwithstanding, contract farming is being promoted by governments and development agencies as a coordination mode that can facilitate the integration of small farmers into supply chains (Singh and Asokan, 2005; Singh, 2004; Ahn, 2004; Anon., 2003; Eaton and Shepherd, 2001). This also accounts for the rising interest, earlier pointed out, in the conceptual foundations and in the practical implications of contracting in food and agriculture.

This paper briefly reviews the changes in agri-food systems that are leading into the development of more tightly aligned supply chains, whereby the role of contract farming as a vertical coordination mechanism is reinforced. It then discusses the theoretical basis for contracting and points out the potential advantages and disadvantages for the contracting partners. Drawing from the international experience, critical success factors for effective contracting in developing countries are summarized and a number of questions for further investigation are proposed.

2. The nature and extent of recent changes in agri-food systems

Agri-food systems around the world are undergoing a distinctive transformation process. Changes are being observed in all segments of the production-distribution chains, as well as in the institutional environments in which they operate. We are witnessing a phenomenon that has been called by some as the "industrialisation" of world agriculture, a metaphor that highlights the departure from the traditional ways in which food and fibre were produced and marketed to a mode under which farms tend to increase in size (and reduce in numbers), adopt production processes akin to the practices of manufacturing enterprises and develop closer ties to processors, retailers and other partners in the supply chain (Boehlje, 1999; Reardon and Barret, 2000). We are also witnessing the "rapid rise of the supermarkets", a related development where consolidation at the retail level is influencing procurement practices and therefore impacting agri-food chains internationally (Reardon and Berdegué, 2002). At the institutional level, we are observing, *inter alia*, the enactment of stricter quality and safety regulations, the emergence of private grades and standards and the reduced role of the public sector in traditional supporting activities and services provision. These general trends, while more pervasive in the developed world, are also present in developing countries. Moreover, their effects are not bound by geography: in a globalized world, where supply chains and networks are intertwined across countries and continents, the consequences of the changes are far-reaching.

Why are these changes happening and what are their implications for system organization and performance? The general perception is that the reshaping of agri-food chains is being driven by a number of demographic, technological and economic related factors. These will be reviewed next.

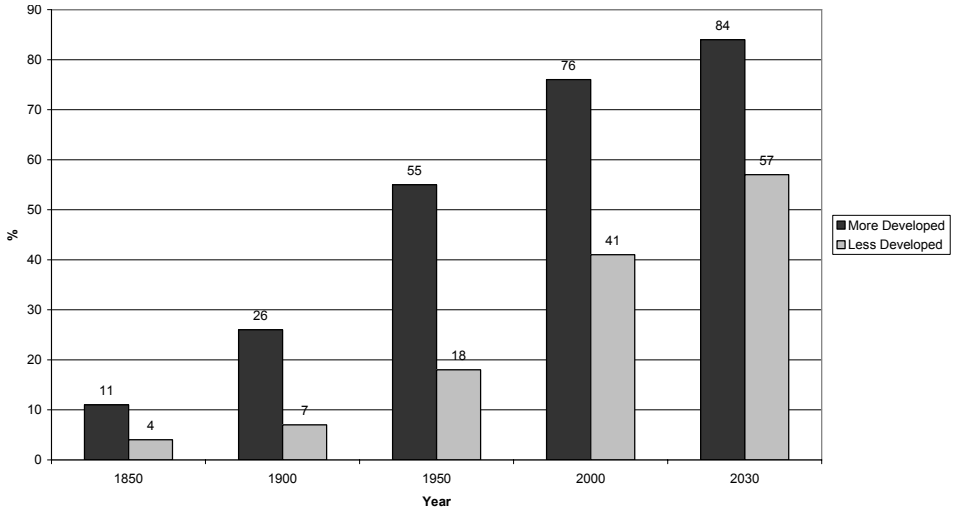
Population growth, urbanization and income growth

Population and income are the main factors affecting the demand for foods. The global population reached 6.4 billion in 2004 and grows by about 80 million every year, with fastest rates in Sub-Saharan Africa and West Asia and slower growth, even population decline, in most of the industrialized world (Ashford, 2004). These trends are expected to continue, particularly in the developing world, where the projected population growth rate is almost 2% per year until 2010 (Rabobank, 2005).

As population grows, the share of inhabitants living in rural areas tends to decline sharply (Figure 1). It can be inferred from Figure 1 that by 2015 more than

half of the world's population is expected to be urban. Moreover, the UN estimates that in the next 25 years almost all of the world's population growth will be concentrated in urban areas of developing countries (FAO, 2005).

Figure 1: Urbanization Rates 1850-2030



Source: Population Reference Bureau (www.prb.org)

This shift of population from rural to urban areas is fuelled by economic development and as such stimulates income growth. In fact, the latest projections by the World Bank show income per person increasing in all regions of the world (Table 1), with particularly high rates in the Asia-Pacific area. With few regional exceptions, this is a trend that has been recurrent in the recent past: incomes have grown and will continue growing in the foreseeable future. In average, developing countries should experience a growth rate of 4.4% per year in GDP per capita between 2006 and 2015.

Table 1. Projected Growth in GDP per Capita (% per year)

Region	2005	2006	2006-2015
East Asia and Pacific	6.2	5.7	5.3
Europe and Central Asia	5.6	5	3.5
Latin America and Caribbean	2.3	2.3	2.4
Middle East and North Africa	2.8	2.5	2.6
South Asia	4.7	4.4	4.1
Sub-Saharan Africa	1.6	1.7	1.6

Source: The World Bank - Global Economic Prospects 2005

The combined effect of such income and demographic patterns in agri-food systems is already being manifested, mostly by quantitative and qualitative changes in the demand for agriculture and food products. FAO forecasts that the overall demand for foods will be approaching 3000 kcal/person/day in 2015 and will exceed 3000 by 2030, rising from 2803 kcal/person/day in 1997/1999. The diets are also changing,

with increases in the proportion of calorie intakes being derived from livestock, oil crops and sugar (FAO, 2005). Consumption of high value animal protein foods, for instance, has been rising steadily and is expected to increase by 5% yearly until 2007 and by 8% per year in the subsequent 5 years (Rabobank, 2005). In sum, there is a need to produce more food and to diversify the composition of the traditional food basket.

From the qualitative standpoint, consumers are also becoming more demanding and more concerned with non tangible attributes of foodstuffs. Consumers keep basing their choices on traditional food purchase drivers such as price, freshness and wholesomeness, but increasingly they demand information about and have their buying patterns influenced by aspects related to health and safety, environment conservation, animal welfare and social responsibility, to name a few. A shift from commoditization to product differentiation is thus being observed.

Finally, the impacts of the demographic and income trends are additionally being felt in the ways foods are being processed and distributed. More urban and affluent consumers are demanding foods that can be conveniently prepared, such as frozen, pre-cut, pre-cooked and ready-to-eat items. They are also spending greater shares of their budgets in the "food-away-from home" category. Processing and distribution systems have been adapting, as suggested by the growing importance of agro-processing and modern food retailing, especially in the developing world, in terms of contribution to growth of domestic product and employment generation.

TRADE LIBERALIZATION AND THE MOBILITY OF CAPITAL FLOWS

The globalization process is characterized by the free flow of goods, services, capital and knowledge among nations. Among its consequences are the increasing internationalization of firms and the integration of global markets, via trade mechanisms. Trade liberalization and the mobility of capital flows are at the root of these processes and have affected the organization and performance of agri-food systems worldwide.

Trade of agricultural products has not only been growing in absolute values, but with liberalization the composition of world agri-food exports has altered. By the end of the 1990s, the share of processed agricultural products trade in relation to commodities had increased from 24.7 % in 1970 to 58.2%, a trend that had similar patterns in developed and developing countries. Traditional export commodities, such as cocoa, coffee and sugar had their relative importance reduced, whereas increased trade occurred in fruits, vegetables and dairy products, a large portion of which in processed form (Senauer and Venturini, 2005; Wilkinson, 2004).

More trade and enlarged markets for higher valued products bring about intensified competition and the competitive pressures stemming from increased exposure to international markets affect food chains in diverse ways. A major one is the need for improved technical efficiency in producing, processing and distribution,

leading to reduced product costs and hence to potentially larger market shares. A further impact is the need for adaptations in the so-called enabling environment, which includes the set of norms and regulations that affect the way agri-food systems operates (e.g. health and safety regulations related to foods, norms governing industry entry and exit, labour laws, foreign exchange legislation, property rights, trade licensing, etc.) plus the set of support services (information, financing, insurance, research and development, etc) that facilitate transactions to take place. A third influence has to do with the organizational changes necessary to ensure that chain transactions are efficiently coordinated across firms locally and across borders, often calling for the adoption of supply chain management principles.

As to capital flow mobility, foreign direct investments in food and agriculture are considered as the strongest driver of globalization in this economic sector (Narayanan and Gulati, 2002). Agri-food chain assets are being acquired internationally by foreign investors in unprecedented numbers. Gopinath (2000) presents data from UNCTAD indicating that the food industry has the highest "transnationality index" of all industries. The index measures the degree to which a company is internationalized, by comparing foreign numbers to home country numbers for assets, sales and employment. Between 1990 and 1999, the index increased from 59 to 79%, a reflection of the fact that "...multinational activity is, therefore, a relevant and increasing phenomenon in food manufacturing" (Senauer and Venturini, 2005). Similar trends are also present in the retail sector, where global supermarkets such as Ahold, Carrefour and Wal-Mart are aggressively conquering market shares in the food retail business, particularly in Asia and Latin America (Reardon and Berdegué, 2002). Anecdotal evidence of growing direct investment in agricultural land is also mounting, with reports of Dutch farmers moving into Eastern Europe and East Africa, US vegetable growers expanding their holdings into Mexico and Central America and grain farmers and cattle ranchers from the US investing in the new agricultural frontiers of central-western Brazil. Though adapted to local idiosyncrasies, the business models of foreign investors tend to be reproduced in the host countries, thereby influencing systems organization and performance.

ADVANCES IN TRANSPORTATION AND LOGISTICS

A study published by the Worldwatch Institute called the attention to the fact that the distances between food suppliers and the consumer have been growing. In the US, food typically travels between 1,500 and 2,500 miles from farm to plate, as much as 25 percent farther than in 1980 (Halveil, 2002). The average distance travelled by the components of a typical meal in the UK is believed to be above 3000 km (Van der Vorst, 2005).

These figures, while partially reflecting the growth of international food trade earlier discussed, also suggest that advances in transportation technologies are a further factor influencing the reshaping of food systems. Advances in containerization, reefers, controlled atmosphere, intermodalism, vessel sizes and speed, fuel efficiency and satellite navigation systems, among others, are contributing

to reductions in freight costs. Air shipment has become a standard international transportation mode for perishable products – loads of mangoes from Brazil, flowers from Kenya or fresh vegetables from Ghana, for instance, can be cost effectively sent overnight to Europe. In sum, transportation and other logistics advancements enabled long-distance sourcing and allowed the diversification of the supply base of food retailers and processors. It also favoured the growth of farming in sectors such as livestock rearing or others that depend on feeds or raw materials not locally available.

In domestic markets, improved transportation technologies are also favouring changes in food systems. An example is the dairy industry of Brazil, where after refrigerated bulk milk collection was introduced in the 1990's, the milk collection radius expanded from an average of 30 to 50 km to more than 300 km. The new logistic system promoted the intensification of competition among dairy firms and also displaced small farmers that could not make the investments required to adapt. Other examples can be drawn from retailing, where consumer mobility enabled by improved transportation has influenced the pattern of store location and sizes.

ADVANCES IN INFORMATION AND COMMUNICATION TECHNOLOGIES

The path of developments in information and communication technologies has been dramatic, affecting all segments of agri-food systems in both direct and indirect ways. In 1965, when the famous Moore's law was proposed[4], a single transistor cost more than one dollar. The first microprocessor had 2200 transistors. Today, a state-of-the-art computer chip has well above 1 billion transistors that cost less than 1/10000th of a cent per unit. Computers became much faster, smaller and less expensive and with this thrust information and communication technologies (ICTs) became widely adopted in all areas of economic activities.

For agri-food chains, ICTs allow fast and cost effective collection, storage and retrieval of data at its different stages. Information can then be readily exchanged among organizations and fed into managerial systems that permit better planning, control and decision making. Supply chain management in the agri-food industries is today heavily based in such information exchange processes. Consumer purchases, registered at the check-out counters of retail stores, immediately trigger inventory adjustments and replenishment orders from upstream suppliers. Supply chain efficiencies yielded by these systems are believed to be the major driver of the dominance of large retailers, such as Wal-Mart, in the food distribution business.

[4] The "law" states that "the number of transistors that can be fit onto a square inch of silicon doubles every 12 months"

Computer and communication technologies also allow better consumer responsiveness and compliance with food safety and quality regulations, as illustrated by the developments in bar codes and scanning that enabled product tracking and tracing. Veal consumers in Europe, for instance, can use the Internet to enter the bar code appearing in product packages and have immediate access to information on the production and processing steps followed from the farm to the supermarket. With bar codes and scanning, events of food contamination can be rapidly communicated down and upstream a chain, so as to isolate the source of the problem and ensure that consumers are not unduly exposed to health hazards.

Other significant developments are: the precision farming technologies that are contributing to gained efficiencies in farm productivity and input use; the automated devices used to improve controls in agricultural and post-harvest operations; the spread of mobile phones, which are contributing to increase market transparency and reduce transaction costs; the emergence of radio frequency identification systems (RFID), with the potential to further improve logistical management and the use of e-commerce in food and agricultural markets.

ADVANCES IN BIOTECHNOLOGY

Technological progresses in production and processing have historically allowed the growth of global food supplies to outpace that of population. Developments in fertilization methods, crop improvement and in animal genetics and nutrition have contributed to the increase of agri-food output per unit of land area, whereas improved post-harvest techniques permitted the conservation of products and their marketing under lower geographical and timing constraints. More recently, biotechnology is seen as the new step forward in the quest for food security. Notwithstanding the perceptions of potential risks, its development promises substantial benefits to all stakeholders of agri-food supply chains.

Biotechnology refers to the application of biological research techniques to the development of products that improve agriculture and human health. In agriculture, it involves the application of markers to assist in plant breeding, the techniques of tissue culture to allow the multiplication of plant materials and the genetic engineering, or manipulation of an organism's genome by introducing or eliminating specific genes (FAO, 2002).

With regard to agri-food systems organization and performance, biotechnology has the potential to negatively impact market structure. As illustrated by the recent experience in the US, in key segments such as crop seeds and chemical inputs, the high costs of research and development, the high regulatory costs and the time bound monopoly conferred to holders of property rights are leading to industry consolidation, via mergers and acquisitions (Fulton and Giannakas, 2001). Market power allows practices such as the requirement that farmers sign contracts impeding the reuse of seeds and limiting the type of herbicides they can use.

Another impact is related to the rapid spread of genetically modified (GM) crops in some areas of the world. According to the International Service for the Acquisition of Agro-Biotech Applications (ISAAA), the estimated area with GM crops in 2004 was 81 million hectares, up from 67.7 million hectares in 2003. These crops – mostly soybeans, maize, canola and cotton - were grown by 8.25 million farmers in 17 countries, most of which in the developing world.

GM based products, although widely accepted in the USA, are still a controversial issue for consumers in most areas of the world. Legislation regulating marketing of foods increasingly requires that special labelling is employed to inform consumers as to the presence of GM ingredients. Agri-food systems have to respond, by putting in place appropriate procedures and establishing chain wide standards to facilitate tracking and tracing. Clearly, the enactment of stringent traceability regulations is a factor that favours the development of tightly aligned supply chains.

In sum, as agri-food systems are reshaped in response to the trends here discussed, becoming more competitive and globalized, the ways in which supply chains are coordinated have to be adapted accordingly. Better synchronization of the vertical stages of agri-food value chains becomes necessary, as a way to lower costs by improving productivity, improve and ensure quality throughout the chain, control risks associated with markets and food safety and enhance responsiveness to demand (Tweeten and Flora, 2001). It is within this context of transformations that contract farming has resurged as a workable mechanism to govern transactions in supply chains.

3. The theoretical basis for contract farming

Some authors trace the principles of contract farming back to the 19th century, when the mechanism was used in the United States for processing crops such as sugar beets and peaches, and in Taiwan, for sugar production under the Japanese colonial rule (Runsten and Key, 1996; Rehber, 1998; Warning and Hoo, 2000). Its use later expanded into many food and fibre sectors, particularly in the US and in some Latin American countries supplying the US markets (Kirsten and Sartorius, 2002). Recently, contract farming became even more widespread. The United States Department of Agriculture revealed in a recent report that contracts now govern 36% of the value of US agriculture production, up from 12% in 1969 and are the primary means of vertical coordination in sectors such as hogs, broilers, pork, sugar beets, fruits and processing tomatoes (Mac Donald et al., 2004). In developing countries, contracts are also being increasingly used. In Brazil, 75% of poultry production is coordinated via contracts (UBA, 2005), whereas in Vietnam there are indications that 90% of cotton and fresh milk, 50% of tea and 40% of rice are being purchased by enterprises though contracts (Anh, 2004). Evidence on the recent emergence of contracting is also available from India (Singh and Asokan, 2005; Anon., 2003), China (Guo et al., 2005), Latin America (Santacoloma and Riveros, 2005; Key and Runsten, 1999) and in several African countries (Rottger, 2005; Woodend, 2003).

Contract farming can take different formats and some typologies for it have been proposed. Minot (1986) cites R. Mighel and L. Jones as originators, in 1963, of the widely used classification of contracts into three kinds, namely "market specification", "resource providing" and "production management". In the first modality, the transaction between growers and buyers is agreed on terms of *what* to be produced (product and quality attributes) and *what* are the commitments for future sale (timing, location and price). The second modality adds the provision of farming inputs to the former contract type. Beyond specifying what to produce and what the conditions for marketing are, in-kind credit is offered via the provision of key inputs, often with cost recovery upon farm product delivery. Finally, under production management contracts growers agree to follow precise technological guidance on *how* to produce. But regardless of the typology, the general term "contract farming" refers to a particular form of supply chain governance adopted by firms to secure access to agricultural products, raw materials and supplies meeting desired quality, quantity, location and timing specifications. In this context, contract farming is seen as one of the alternative forms of vertical coordination in which firms can engage, which can also be spot markets, full vertical integration and different forms of vertical alliances.

Spot markets, or open markets, are the simplest form of vertical coordination. Transactions are coordinated by prices only and there is no continuing obligations among those engaging in them. For markets where the conditions resemble perfect competition (i.e. many buyers and sellers, homogenous products, perfect information, etc.) spot markets can be efficient coordination mechanisms. The chains for agricultural commodities are typically governed by spot markets.

Situated in the opposite extreme of the vertical coordination choice continuum, full vertical integration refers to cases where a firm exercises centralized ownership control over two or more different stages in a chain. Ownership, of course, ensures complete power over decisions regarding product attributes, location and timing of delivery. The supply of agricultural ingredients to the pharmaceutical industry is often cited as an example of transactions where vertical integration tends to be the governance norm.

Contracting is an intermediate mode of coordination, whereby the conditions of exchange are specifically set among transaction partners by some form of legally enforceable, binding agreement. The specifications can be more or less detailed, covering provisions regarding production technology, price discovery, risk sharing and other product and transaction attributes.

Assuming that a firm is not bound to any particular form of vertical coordination, what would then be the rationale for its choice of governance? The answer to this question is still subject to much academic debate, with contributions being drawn from diverse areas such as agency theory, transaction cost theory, strategic management and resource based theory, among others (Peterson and Wysocki, 1998).

It would be beyond the scope of this paper to delve into an extended discussion of the alternative theoretical bases for the choice of a governance structure. The interested reader is referred to Rehber (2000) and Trienekens at al. (1998), for good treatments of this topic. Instead, focus is given here on the contributions of transaction cost economics, which is perceived as particularly significant to the case of contract farming.

Simply stated, transaction costs are the costs incurred when a firm engages in an exchange process. They include the costs occurring before a transaction takes place, such as obtaining information and negotiating the exchange conditions, and the ex-post costs of monitoring and enforcing the transaction terms. When choosing a governance mode, firms seek to minimize transaction costs and in this process they have to examine the characteristics of transactions related to asset specificity, uncertainty and frequency (Hobbs, 1996).

Asset specificity refers to the degree in which an asset can be economically transferred to alternative uses. Land, for instance is a non specific *physical* asset, whereas a milk parlour is a highly specific one. *Site* specificity, on the other hand, exists when buyers and sellers base their location decisions on the need to reduce

transportation costs in their exchanges – the location cost advantage is lost if the commercial bond that motivated it is broken. *Time* specificity is associated to the timing of delivery and its effect on product value – more perishable products, for instance, lose value if not timely marketed. *Human capital specificity* arises as a consequence of accumulated knowledge by participants in production processes. The specific skills acquired might have lower value in alternative uses. The higher the degree of asset specificity, the higher will be the exposure of the transaction partner who holds the asset to exploitative or opportunistic behaviour from his counterparts. Hence, a high degree of asset specificity drives transactions away from spot markets, towards tighter alignments in the supply chains.

Uncertainty in transactions arises from three main sources. One is the behaviour of those engaged in the exchange, which can be influenced by opportunism. Reneging on previously agreed terms, nondisclosure of undesirable attributions or distortion of information are some characteristics of opportunistic behaviour that generate uncertainty on a transaction. The second has to do with uncontrollable factors, such as technological changes, acts of nature or consumer preferences. Finally, a third source is related to the inability to control decisions and plans made by others, which may affect attributes such as product quality and timing of delivery. As uncertainty increases, firms have more incentive to seek control over the transactions, thus moving from spot markets to more vertically coordinated governance modes.

The frequency of transactions is directly correlated with the incentive to opt for spot markets. When transactions are frequently performed, buyers and sellers tend to engage in longer term - but not necessarily exclusive - business linkages, thus reducing the scope for opportunistic behaviour. Information about buyers and sellers tends to be disseminated by the repeat transactions, reinforcing the motivation for the continuance of the open market transactions. Note that *frequency of transactions* is a different concept from *frequency of production*. The latter refers to an internal operation, being related to production costs, rather than transaction costs. Obviously, when a firm produces a certain type of product only sporadically, it will have little incentive to engage in close coordination modes with partners in the supply chain.

Table 2 summarizes the theoretical basis for the selection of a mode of governance, in accordance with transactions cost theory. Negative and positive signs are used to denote the relationship between the characteristic and the likelihood of adoption in the respective governance mode.

Table 2 - Choice of the governance – A summary

Characteristic	Open Markets	Tightly Aligned Chains
Asset specificity	-	+
Uncertainty	-	+
Frequency of transactions	+	-

Although this theoretical base is useful to discuss the observed expansion in the utilization of contract farming and the movement towards the development of more

tightly aligned supply chains in light of the changes taking place in agri-food systems, it is at best an incomplete framework in terms of its explanatory and predictive power in empirical analyses[5]. This vulnerability was illustrated in a study conducted by Bando (1998) with the Brazilian fruit industry. Even though the transaction characteristics he examined were such that contractual integration would be predicted by transactions cost theory, the actual governance structures observed in his analysis were mostly open markets. This author attributed the lack of agreement among his empirical evidence and the theoretical prescription to institutional failures associated with contractual enforcement. His hypothesis was that, in the absence of effective contractual enforcement laws, mutual perceptions about opportunistic behaviour precluded fruit producers and processors to use farming contracts, thus favouring open market transactions. The contractual instrument, in principle desirable to reduce the degree of uncertainty caused by opportunistic behaviour, was deemed ineffective because of an institutional failure.

Market and institutional failures, such as the one identified by Bando (1998), can affect the transaction characteristics summarized in Table 2 in positive and negative ways. Hence, authors such as Minot (1986), Key and Rusten (1999) and Kirsten and Sartorious (2002), have focused their discussion of the theoretical basis for contract farming on the examination of such failures. They discussed asymmetries in production and marketing information, as well as the imperfection in markets for credit, inputs and agricultural support services and indicated that these failures account for increases in transaction costs and thus provide incentives to increased coordination in the transactions, leading to contracting or to full vertical integration. Minot (1986) goes further to indicate that scale complementarities would influence the choice between contracts and full integration – if economies of scale, location and or scope are complementary in adjoining links in a supply chain, then a motive exists for integration. His example is the integration observed in the US among feed and livestock operations. The bulkiness of feeds favours location of processing plants closer to livestock operations, which in turn are more efficiently operated on large scale. Hence, vertical integration is favoured by both location and scale complementarities.

In sum, the study of vertical coordination in agri-food systems provides the backdrop for our understanding of supply chain organization and performance. Within this general setting, and in spite of known shortcomings, transaction cost theory is the conceptual framework of choice in recent analyses of contracting farming issues. We turn now to examine the potential advantages and disadvantages of this mode of governance for the actors involved in the transactions.

[5] The theory has also been criticized because of its perceived overemphasis on transaction costs (Rehber, 2000). Empirical problems in measuring transaction costs are another limitation (Hobbs, 1996).

4. Potential Advantages and Disadvantages of Contracting for Agri-Food Chain Actors

A useful instrument for public policy design is offered by stakeholder analysis, which among other things tries to identify who stands to win or lose from a policy choice and assess what is the extent of their potential gains and losses. Private decisions on strategic choices, on the other hand, are primarily based on cost benefit analysis of the consequences of the decision options. For both public and private decision making regarding the promotion or adoption of contract farming, it helps to follow principles of stakeholder and cost-benefit analyses in an attempt to enumerate the potential advantages and disadvantages of this mode of governance. In the ensuing review of pros and cons of contract farming, two main stakeholder groups will be considered, namely farmers and agribusiness firms (processors, retailers, etc.). The review draws from and extends the discussions presented by Eaton and Shepherd (2001) and Kirsten and Sartorious (2002).

4.1. Advantages for Farmers

Farmers find in contract farming a means to manage risks in production and marketing. Indeed, as concisely put by Glover (1994), contracting is fundamentally a way of allocating risks between a company and its growers. For farmers, production and marketing risks are reduced because of the following reasons:

- inputs can be provided by agribusiness firms, thereby reducing the uncertainties associated with input availability, quality and costs. Failures in input markets are circumvented by such direct provision and the economies of scale allowed by the larger purchases of inputs by agribusiness firms can be passed on to farmers, via reduced costs. Input quality and adequacy to the crop or livestock activity contracted is ensured and translated into higher productivity and higher returns. services, such as mechanization and transportation, can be provided by agribusiness firms. In the absence of a contractual link, cost effective access to mechanized land preparation, sowing and harvest might be unfeasible to an individual farmer

- technological assistance can be offered by the contracting firm, favouring the production of higher valued, often riskier crops and livestock. Without technical assistance, the tendency is for farmers to avoid venturing into less known crop

and livestock enterprises. A related benefit is the facilitation of the conversion path from subsistence to commercial farming.

- farm production and management skills are enhanced by the technical assistance provision, and spill-over effects might happen if farmers also engage in non-contracted crops and livestock enterprise activities. Such positive externalities of contracts have been observed in cases where subsistence crops are produced alongside cash crops grown under contractual arrangements.

- a market outlet is secured for the contracted production, such that the uncertainty and the transaction costs involved in the search for markets are reduced. Small-scale farmers in particular benefit from the reduction of marketing risks, as they often have more limited market access

- the uncertainty about sales price is often reduced, since contracts typically specify at the beginning of the growing cycle the prices to be paid at product delivery. Although price formulas used in some types of contracts may specify a relationship with uncertain, future prices prevailing in international or domestic markets, this is not the norm but rather an exception.

- with the reduction of product and market risks, income stability is favoured. If the contract has a long term continuation, farmers can benefit from the more foreseeable and stable income streams, especially via better planning of consumption and investment decisions

- access to credit is enhanced. Under a resource provision contract, working capital credit is typically supplied in kind, via input provision, by the contracting firm. The contract firms, or the banking system, may also offer investment credit for the acquisition of machinery, buildings, etc. These transactions are guaranteed by the commercial commitment between the borrower and the agribusiness firm. By the same token, credit access for both working and fixed capital is enhanced in the case of market specification contracts, because banks accept the contractual commitment as a sufficient guarantee for the granting of loans.

- by-products and residues from the contracted farming activity can be used in complementary farm enterprises. Poultry manure and sugar beet leaves are two examples that can illustrate this potential benefit. The former can be used by farmers in vegetable production for cash or subsistence products while the latter can be used as animal feed.

4.2 Disadvantages for Farmers

Even though farming risks can be reduced by contracting, the contracts themselves represent a risk source in the farm operation, thus leading to potential disadvantages for farmers. As we will see, most of these negative aspects come

from the fact that the relationship between individual farmers and the agribusiness firm is uneven, the latter being often in a position to exercise power and non-competitive conduct in the definition of the terms of the transactions. The potential disadvantages are:

- firms might renege on contractual terms if market circumstances change or if other conditions for opportunistic behaviour arise. Since prices specified in contracts are based on expectations about future market behaviour, substantial variations in the realization of the expectations can lead firms to force renegotiation or to engage in contractual hold-up. Causes for such variations might be a bountiful supply depressing market prices, a change in government policy that allows imports of competitive products and a variation in exchange rates that significantly raises input prices, to name a few. A disguised form of hold-up is the rejection of products delivered, under pretext of non-conformity to quality regulations – firms might refuse to receive products as a strategy to transfer to farmers the financial losses arising from unexpected market turns. In the absence of effective enforcement mechanisms, there is little that a farmer can do to avoid the negative impact of contractual hold-ups.

- the dependency on a prescribed technology package makes farmers vulnerable to output and productivity manipulation by agribusiness firms. Manipulation, in this hypothesis, can be seen as an indirect, sophisticated means to control payments to farmers. An animal feed supplied by a firm, for instance, might be formulated so as to delay the growth cycle or decrease the daily weight gain, thus reducing productivity and the final prices paid to farmers. Technology control can thus be used as a conduit to shift market pressures from firms to producers.

- delivery schedules might be set by firms so as to influence prices paid to farmers. This strategy can happen when prices are rapidly changing and firms adjust the delivery schedule to benefit from the market volatility. It may also happen because of asset specificity related to timing of delivery. In the case of sugar cane, for instance, the delay might depress prices received if these are based on the degree of sucrose, which falls rapidly after harvest.

- firms might intentionally avoid transparency in the price determination mechanism of the contract, utilizing complex formulas or quantity and quality measurements not well understood by farmers. Formula prices related to quality attributes such as fat content, somatic cell counts, sucrose content, bacterial counts and other criteria that require laboratory measurement lend themselves to fraud and manipulation. Quantity determination based on tare measurement is another example of contractual practice over which farmers can exercise little or no control.

- farmers lose flexibility in enterprise choice. Bound to a crop or livestock enterprise by a contract, farmers can not adjust production mixes so as to benefit from market opportunities

- long term contracts might lead to gradually decreasing real prices received by farmers. As asset specificity is built in the farm operation, firms might use this constraint as a way to establish and reinforce monopsonistic power and thus gradually impose lower prices on farmers.

- farmers may lose linkages with former transaction partners. Long-term business relationships with intermediaries, lenders and input providers might have been developed by farmers prior to engaging in a contractual relationship. These linkages are broken and can be difficult to re-establish if the event of exit from the contractual relationship.

- farmers may abandon traditional cultivation methods and products. Age old patterns of cultivation and animal rearing are disrupted by the innovations introduced in a contractual relationship. Patterns that emerged from the optimal utilization of locally available resources might be irreversibly lost, as farmers become used to different technologies. Again, in the case of exit, it might be difficult to re-establish the traditional ways.

- the risks that are normally associated with monoculture practices are increased. Intensified production of single agricultural crops, or the concentration of animal herds, increases the chances of diseases. Disease control requires the use of plant protection and veterinary inputs that might have undesirable environmental and human health effects.

- socio-cultural structures in the family or farming community might be disrupted. In societies where the division of labour and family responsibilities are shared by genders in distinctive ways, contracts can introduce threats to the cultural pattern. This can happen when farm labour is mostly performed by one gender, but cash payments by firms are made to the spouse. Social tensions might arise, in such cases.

- the risk of indebtedness grows. The downside of easy access to credit is the possibility to incur mounting debts. As farmers find fewer restrictions to access credit, they might find an incentive to borrow, even to finance consumption and other non-commercial needs.

- there is a tendency for the development of a gradual reliance on the contracting company for non-farm-related matters. With their dominant position, agribusiness firms might become a last resort benefactor in areas where public services are weak or non-existent. Firms may provide some social services and do small favours to farmers, such as the provision of free transportation rides or the distribution of promotional gifts (t-shirts, caps, pencils, etc.). The reliance on the firm to provide such services and favours weakens a farmer's bargaining position and reinforces the firm's ability to exercise monopsonistic conduct.

4.3. Advantages for Agribusiness Firms

The theoretical hypothesis is that agribusiness firms find in contract farming a strategy to minimize transaction costs, primarily the ones related to asset specificity and uncertainty. The main potential advantages are as follows:

- greater regularity of agricultural product supplies to the firm is ensured. With contracts, firms can schedule the deliveries so as to optimally utilize their processing capacity and / or distribution infrastructure. They can also better coordinate product delivery with the timing of the demands from their own clients.

- greater conformity to desirable product quality attributes and to safety standards is promoted. Since contracts specify quality attributes and since most also allow control of farming technology processes, firms are in a better position to meet consumer requirements and mandatory quality and safety standards.

- access to land is facilitated. Access to the large land areas needed by agribusiness enterprises may be precluded by legislation that caps farm sizes or exclude private companies from land ownership. Moreover, even where legislation is not restrictive, land can be costly to purchase. Contracting allows circumventing these limitations.

- input costs per unit are reduced. Economies of scale in purchasing can be attained by firms that acquire large quantities of farm inputs. These economies can stem from reasons such as the greater bargaining power of the firms, the reduced costs of bulk transportation, the sharing of fixed purchasing costs into a large number of purchased units and the possibility to access financing under more favourable conditions. Lower input costs imply lower production costs and thus permit that farmers maintain a given margin even when product prices are set at competitively lower levels.

- access to agricultural credit and eventual financial incentives and subsidies is facilitated. The reduction of risks in the firm's supply chain and the economies of scale associated with contracting operations are conditions that in principle increase a financing institution's willingness to lend. As earlier suggested, not only access is improved, but financing conditions tend to be more favourable to the firm. As to government incentives and subsidies, countries that promote contracting often use such instruments in their agribusiness development policies. They might be expressed in the form of tax breaks, foreign exchange quotas, profit repatriation flexibility, tariff reduction for imported inputs, etc.

- labour costs are reduced. Compared to full vertical integration, where the firm must hire and manage its own labour force, in contract farming these administrative responsibilities are transferred to farmers. Labour costs, including wages, social benefits, supervision and training, can represent a significant share of production costs in labour intensive farming operations. Farmers will use

family labour and when hiring, they may not be bound to the same labour laws as agribusiness firms. Hence, labour costs tend to be lower under contracting schemes.

- expansion and contraction of production is facilitated. Without fixed assets in land or specialized housing for animals, for instance, agribusiness firms have greater flexibility to expand or reduce operations. This allows better adjustment to market developments.

- for high value, labour intensive agricultural enterprises, managerial efficiency in farming may be favoured. Under contracting schemes, there is evidence indicating that family farming units tend to achieve comparable or even better productivity, when compared with larger, commercially managed units. The main reasons are the invested commitment and the comparative advantage in micro-managing farming operations. An example is the production efficiency competitions among contracting farmers, regularly promoted by a poultry processor in south-eastern Brazil. In such comparisons, small farms were frequently in the top ranks.

4.4. Disadvantages for Agribusiness Firms

As for farmers, agribusiness firms incorporate new risk sources in their operations, when opting for contractual arrangements as a governance mode in their supply chains. These risks bring disadvantages for the use of contracts. Classic disadvantages are:

- risk of contractual hold-ups. Just as a firm may be prone to renege on contractual terms when market conditions change, a farmer may be compelled to sell all, or part of his or her production, to a third party, when prices are perceived to be higher outside the contractual bond. This is especially problematic where alternative markets for the crop or livestock grown under contracts are easily accessible and where contractual enforcement is weak. Contractual hold-ups by farmers are known to be the reason for the failure of contract farming in many such schemes.

- transaction costs of dealing with large numbers of farmers are high. A contracting firm will typically be linked to a sizeable number of farmers, scattered over wide regional areas. Managing a commercial relationship with a myriad of partners is a complex task, requiring investments in personnel, in controls and in monitoring systems. The logistical costs tend also to be high when inputs must be distributed and production assembled by the contracting firm. For these reasons, some evidence in the literature of contract farming suggests that firms prefer to work with larger, rather than smaller farmers.

- risk of misuse or deviation of supplied inputs and of final products. In resource provision contracts, a known problem is the potential use of the distributed inputs in alternative crop and livestock enterprises. Farmers may use fertilizers

in their subsistence crops or may feed domestic herds or flocks with feedstuffs provided for the contracted animal rearing. Farmers may also consume part of the production or, as we have already seen, simply sell to third parties. Firms tend to avoid this problem by closer monitoring and control and by relating prices paid to the efficiency of input use. In poultry growing contracts, formula prices take into account the feed conversion rate and the percentage mortality rate of the flock, among other performance indicators. If inputs or outputs are deviated, these figures should reflect it.

- internalization of support service costs. In the absence of contracts, farmers seek support services with external providers, public or non public (private firms, NGO's etc). With contracts instead, extension services, transportation services, financing, quality monitoring and other services are transferred to the responsibility of the agribusiness firms. Such new costs must be internalized and reckoned in the decision to contract or not.

- loss of flexibility to seek alternative supply sources. Bound by a contract, a firm is precluded from sourcing from alternative suppliers when economic conditions would so advise. As previously commented, in situations of over supply in domestic markets or in cases of favourable movements of exchange rates that reduce import costs, contracting firms must still honour the contractual commitments and may lose competitiveness

- risk of undermining the corporate image. Firms with strong brand image are particularly affected by this potential risk. Contract farming is still seen in some circles as an exploitative relationship, where farmers become simply an outsourced labour force to rent-seeking companies. Moreover, conflicts with farmers may arise, or negative impacts of the contracted operations on the environment or in animal welfare, for instance, might exist. The association of a corporate image to these negative aspects is clearly undesirable.

In brief, there are potential costs and benefits and there are less tangible rewards and shortcomings in contract farming, for all partners involved in it. The recent resurgence of contracting in agri-food systems suggests that the balance has been favourable to the participants. Successful contracting, nonetheless, demands some pre-conditions to be in place and these are reviewed in the next section.

5. Critical Success Factors

As a preamble to the discussion of success factors for contract farming, a basic tenet might be enunciated as follows: contractual relationships will only be sustainable if partners perceive that they are better off by engaging in it. Both have to see the partnership as a source of gains - financial or otherwise - that could not be matched in the next best alternative. The corollary of this proposition is that contract farming will fail if parties do not develop mutual trust and reciprocal dependency rooted in the systems principle of synergy, whereby the whole becomes greater than the sum of its parts. As such, the critical factors for successful contract farming are primarily those that address the set of potential disadvantages that can countervail the sources of synergies.

Needless to say, a fundamental prerequisite is an *appropriate enabling environment*. No successful contracting scheme can exist or remain sustainable where the institutional and political setting is not conducive to it. We have already mentioned some of the areas where laws, regulations and policies can create advantages and disadvantages for contracting parties. They include themes such as labour relations, land tenure, taxes, foreign exchange, international trade, property rights, anti-trust measures, and commercial licensing. The importance of this normative and policy framework can not be overemphasized - governments wishing to promote farm-agribusiness linkages via contracts should start by assessing, streamlining and expunging the framework from restrictive features.

The normative framework must also deal explicitly with the issue of contractual hold-up. The obligations of parties involved in formal agreements on commercial transactions have to be enforceable, and legislation to that end should be in place. Most importantly, enforcement has to be operationally and financially feasible. If the judicial system is such that the cost of litigation becomes greater than its potential benefit, no legislation protecting the rights of contractual partners can be effectively enforced.

Since the *minimization of contractual hold-ups* is considered as a critical success factor, strategies towards accomplishing this objective can be pursued by firms and farmers as complementary measures to legal enforcement. From the farmer's perspective, enhancement of bargaining power via collective action is a standard approach, for that matter. Through their associations, farmers can have stronger voices in negotiation processes and in this way better protect their interests. Firms, on the other hand, can reduce farmer defaults by group lending, by good communication and close monitoring, by the range and quality of services they offer and by treating defaulters strictly (Coulter et al, 2000). Providing credit and distributing inputs through groups reinforces peer pressure processes and in this way discourages non-

compliance with the obligations individually assumed. Good communication fosters non-adversarial relationships between farmers and firms, whereas monitoring allows preventive actions when default is likely. Good quality and ample scope of services provided, of course, increase the opportunity cost of a farmer's default. Strict treatment of defaulters comprises the exclusion from the contractual scheme, asset seizure, charging of interest in payments due, or taking legal action – they are harsh, but nonetheless mostly effective measures that are ultimately beneficial to the group as a whole. Finally, a further way to reduce hold-up is to extend the contractual duration, as long term contracts in principle encourage investments in specific assets which, in turn, reduce the motivation for defaults.

The organization of farmers in groups or other associative form is a strategy that can address two other success factors identified in this work. They are *the need to countervail the unevenness in bargaining power* and *the need to reduce the transaction costs of dealing with multiple contracting parties*.

In the first case, the concern with unfair conduct by contracting firms is justified by empirical evidence that imbalanced power in contractual relations can lead to non-competitive behaviour by the dominant party. In the case of contracting agribusiness firms, this can be expressed, *inter alia,* by the imposition of low prices, by deductions of highly set input costs, by early termination of contracts, by the manipulation of quality attributes or by the design of biased contractual clauses (Roth, 1992; Singh, 2002; Guo et al., 2005). Whereas farmers' group action per se does not impede such practices, it does reduce the scope for their imposition. Besides with their strengthened power for financial negotiations, associations are better positioned to find support from government, NGO's or private advisors in order to monitor compliance with contractual clauses, double check product quality measurements, mediate litigations and provide information on prices and costs. In a work with poultry farmers operating under contracting in Brazil, Lopes and Da Silva (1992) provided the growers' association with detailed information on the financial impact of risks affecting the performance variables that defined prices received. This helped the association to negotiate favourable revisions in the payment criteria utilized by the contracting company.

In the second case, when dealing with farmers' groups agribusiness firms can reduce transaction costs in activities like contract negotiations, which can be done collectively, extension services, which might be delivered to groups, and group lending, which as we saw can reduce the likelihood of default. FAO is presently executing a project to rehabilitate a sugar factory in Afghanistan that will contract sugar beet growing with 2000 small farmers. The factory managers explicitly indicated their desire to work with farmer's groups, as opposed to individual growers. Other ways to reduce transaction costs include a preference by firms to work with larger farms, a strategy that can be socially undesirable, if contract farming is promoted within the scope of agribusiness development programs.

A further critical success factor is the *appropriate consideration of production risks in the contract design*. Some risk sources can be known *a priori* and their sharing among

transaction parties can be negotiated. Yet, risk sources can never be completely foreseen nor can they be fully covered by contractual clauses. For both of these scenarios, strategies are needed, so as to avoid unexpected events that undermine the contractual relationship. In the case of known risks, or even in the case of so called "force-majeure" events, insurance mechanisms might be designed to provide the needed compensations. In the sugar factory above referred to, such an insurance scheme is being created with FAO assistance. For circumstances that can not be foreseen and not classified as "force-majeure", arbitration mechanisms can be proposed to resolve ensuing disputes. Third parties, such as NGO's, might function as conflict arbitrators, for that matter.

There are certainly other success factors to which the literature draws attention. Yet, they tend to deal with regional specific situations or are basically portions of the traditional check-lists for successful implementation of any agroindustrial development project, regardless of the mode of governance. Hence, assuming that the critical aspects here discussed have been properly dealt with by those wishing to promote contracting, a final question remains to be answered: are all farm enterprises suitable for contract farming? In principle we can not rule out any, but some characteristics make some enterprises more suitable than others. In this respect, the literature here reviewed and the author's experiences suggest that high valued crops and livestock, destined to processing or to export markets, seem to be the better candidates for contracting[6]. These characteristics either generate mutual asset specificity or require close control over production and delivery processes, so as to ensure adherence to the intended quality and safety attributes and to facilitate logistical scheduling.

[6] A list of agri-food enterprises for which contracting farming has been reported has been compiled and is presented in Annex 1.

6. Conclusions

We have seen that changes in agri-food systems internationally are creating a renewed interest in contract farming as a supply chain governance strategy. We also saw that the theoretical framework of transaction cost economics helps to explain the growing role of contracts in vertical coordination in food and agriculture. To the extent that the changes in agri-food systems favour the creation of asset specificity and increase the uncertainty in transactions, the increased adoption of contracting worldwide can be regarded as a rational response of supply chain actors seeking to minimize their transaction costs.

The evidence gathered in this review pointed out this growing adoption of contracts and also hinted at its promotion in the developing world as an instrument for agribusiness development. Indeed, contracts can be a conduit for private sector involvement in the provision of inputs, credit, farming technology, information and access to markets. This becomes a particularly suitable strategy to be followed in the aftermath of structural adjustments programs, where the capacity of the public sector to provide such services has been curtailed. Moreover, contract farming can also have a role as a catalyser of income growth in the rural sector - the possibilities offered for small farmer participation in managed supply chains are known to result in potential income enhancement in rural areas. Nonetheless, contracting should not be seen as a one-size-fits-all solution for the improvement of agri-food systems performance and organization in developing countries. Critical success factors for adoption and sustainability have to be assessed, as without doubt there will be situations and settings for which the strategy would be ill-advised.

When contract farming is promoted within the scope of a development strategy, mechanisms to lessen the potential disadvantages for the contracting parties should be put in place. This review has suggested a number of options to be considered in this context, among which the role of third parties in facilitating the initiation of contracts and in acting as conflict mediators deserves special consideration. The experiences of NGO's and other organizations functioning as brokers in linkages between farmers and agribusinesses have been highlighted by FAO in a number of case studies (Rottger, 2005; Santacoloma and Riveros, 2005). Yet, these are mostly recent experiences - research is still needed to provide a better understanding of their modes of operation and on the sustainability of their involvement as the contractual relationship matures. Research is also needed in a related issue, namely the role of private-public partnerships in promoting and sustaining contract farming. Is there a role for public funding of NGO's and organizations that act as brokers in farm agribusiness linkages?

Another facilitation role that deserves further consideration is that of information provision. Information on contracting in general and on contract designs in particular, can be provided by governments, development agencies, research institutions and NGO's, as a way to disseminate best practices and reduce the uncertainty in decision processes regarding this form of supply chain governance. FAO has published a book on contract farming and has started an initiative to promote farm-agribusiness linkages, which has already generated the case studies earlier mentioned. New cases are being collected and are being disseminated in FAO's web-site (http://www.fao.org/ag/ags/subjects/en/agmarket/linkages/index.html). In the future, there are plans to also collect and publicize model contracts for different commodities. It is hoped that these initiatives can continue raising awareness on the subject.

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Annex

Annex 1 - Crops and Livestock Enterprises Produced under Contracts[7]

Enterprise	Countries	Sources
Asparagus	Lesotho, Philippines	Minot, Rottger
Acquaculture	China, Brazil	Guo et al., author's observations
Baby Corn	Thailand	Eaton and Shepherd
Banana	Philippines, Costa Rica, Guatemala, Honduras, Panama, Ecuador	Minot
Barley	India, Bolivia	SPICE, Minot
Blackberry	India	Eaton and Shepherd
Cassava	Thailand	Eaton and Shepherd
Coffee	Sudan, El Slavador	Minot
Corn	USA, Philippines, Brazil	McDonald et al, Eaton and Shepherd, author's observations
Cotton	USA, Zimbabwe, India, Ghana, Vietnam	McDonald et al.; Woodend; SPICE; Eaton and Shepherd, Ahn
Cucumber	Guatemala	Minot
Eggs	USA	McDonald et al
Flowers	Thailand	Eaton and Shepherd
Fruits*	Several	Several
Green Beans	Thailand	Eaton and Shepherd
Hogs	Brazil, USA, Philippines	McDonald et al., author's observations, Rottger
Honey	China, El Slavador	Guo et al., Minot
Melon	Dominican Republic	Minot
Milk	USA, China, India, Turkey, Honduras, Mexico, Croatia, Kenya, Vietnam	Ahn, Minot, McDonald et al., Guo et al., Birthal et al., Minot, Eaton and Shepherd, Rottger
Oil Palm	Ghana, Cameroon, Ivory Coast, Malaysia, Indonesia, Papua New Guinea, Nigeria	Minot, Huddleston, Eaton and Shepherd
Papaya	Fiji, Colombia	Eaton and Shepherd
Passion Fruit	India	Eaton and Shepherd
Peaches	Guatemala	Minot
Peanuts	USA, Senegal	McDonald et al; Warning and Key
Pineapple	Ivory coast, Brazil, Thailand	Minot, author's observations
Poultry	Brazil, USA, Zimbabwe, India, Kenya, Bolivia, Jamaica, Peru	McDonald, Bando, Woodend, Borthal et al.
Rice	Vietnam, Guatemala, Costa Rica, Honduras	Minot, Ahn
Rubber	Cameroon, Ivory Coast, Nigeria, Malaysia, Indonesia	Minot
Seeds	Brazil, India	NABARD, author's observations
Silkworm	Brazil, China	Bando, Guo et al.
Soybeans	USA, Thailand, Philippines	Eaton and Shepherd, McDonald et al.
Spices	Kenya, Malaysia	Minot, Rottger
Strawberry	India, Mexico	Minot
Sugar beets	Afghanistan, Germany, USA	Author's observations, McDonald et al.
Sugarcane	Kennya, Swaziland, Uganda, Thailand, South Africa	Eaton and Shepherd, Minot, Rottger
Sunflower	Kenya	Minot
Tea	Zimbabwe, Kenya, Uganda, Malawi	Minot; Woodend
Tobacco	USA, Kenya, Brazil, Nigeria, Tanzania, Sudan, Jamaica, Thailand	McDonald et al, Minot, author's observations
Tomato	Brazil, Dominican Republic, Nigeria, Nigeria, Nicaragua, Indonesia	Minot, Raylnods, Eaton and Shepherd, author's observations
Vegetables*	Several	Several
Wheat	USA	McDonald et al.

7 This table adapts and expands the one originally prepared by Minot (1986)

* General categories with too many entries for the table. Where possible, the information was broken down by enterprise type