

Using ICT to reduce transaction costs in agriculture through better communication: A case-study from Sri Lanka

Harsha de Silva and Dimuthu Ratnadiwakara

Address

LIRNEasia

12 Balcombe Place, Colombo 00800, Sri Lanka

<http://www.lirneasia.net>

Author emails

desilva@lirne.net

ratnadiwakara@lirne.net

This work was carried out with the aid of a grant from the International Development Research Centre, Ottawa, Canada

Abstract

This paper considers the specific role of information and communication technologies [ICT] in reducing transaction costs in agriculture by enabling timely and affordable communication. Segmenting transaction costs into several components, the paper isolates the costs associated with information search as the specific costs that could be influenced through ICT. Analyzing the findings of a case study among a group of small-holder vegetable farmers in Sri Lanka the paper identifies the specific information needs of these farmers along the agriculture value chain starting with the decision on the crop to be planted and ending with the sale of produce at the wholesale market and measures the information search costs associated with this group of farmers. The paper concludes by indicating the possibility of dramatic reductions of transaction costs with the use of ICT to reduce information search costs to enable greater farmer participation in commercial agriculture as opposed to subsistence farming that continues to force so many farmers in developing countries into poverty.

1. Introduction

The recent surge in global food prices resulting in dramatic increases in poverty levels in the developing world has renewed the interest in finding ways in which agricultural output could be improved and agriculture based livelihoods enhanced. At a very broad level, the World Bank (2008) point out that growth in agriculture is on average at least twice as effective in reducing poverty as growth outside agriculture. The argument is that agricultural growth reduces poverty directly, by raising farm incomes, and indirectly, through generating employment and reducing food prices. The report contends that the objective of poverty reduction is served best if agricultural growth is centered on small-holder farmers, who are made more competitive and sustainable through, inter alia, technological innovations. At a more specific level, Pingali et. al. (2005, 2008) at the Food and Agriculture Organization emphasize that the principal challenge confronting governments and the international development community is to ensure that smallholder farmers benefit from commercialization in agriculture by participating in the market.¹ They point out that increased commercialization shifts farm households away from traditional self-sufficiency goals and toward profit and income oriented decision making. Substantial literature is available to show that this process naturally makes farm output more responsive to market needs [for instance McCollough, 2008]. It is in this context that the argument made by Pingali et. al. (2005) that increased transaction costs deter the entry of small farmers into the market becomes crucially important. Flowing from which, is that interventions aimed at reducing transaction costs would encourage increased farmer participation in competitive markets to meet the broader poverty reduction objectives. Building on this argument, this short paper considers the specific role of information and communication technologies [ICT] in reducing transaction costs by enabling better and more affordable communication in a limited segment of the value chain. Transactions costs exists in all economic exchanges from the first step of deciding to plant a certain crop to the point this produce in a value added format is purchased at a retail outlet either in the same country it was grown or in some other country. Along this chain various stakeholders

¹ Our view is that governments and donors should strive to create a well governed framework that ensures proper institutions, efficient infrastructure and contract enforceability etc., along with policy that avails opportunities for small-holder farmers to participate in the market.

are involved both vertically from farmers to wholesalers to processors to supermarkets or exporters etc., and horizontally from input suppliers to financiers and insurance companies to logistics providers etc. But the analysis in this paper is limited to the segment of the value chain starting from the decision to plant and ending at the sale of produce to the wholesaler.

The rest of the paper is structured as follows. An introduction to transaction costs in agriculture to isolate the information search cost component that can possibly be reduced using ICT; a case study of selected small-holder vegetable farmers in rural Sri Lanka to identify these information search costs along the agriculture value chain; the possibility of introducing ICT to reduce information search costs; and finally some concluding remarks.

2. Transaction Costs in Agriculture Markets

Before we go any further it is necessary that a working definition of transaction costs is specified. Singh (2008) captures the essence of the complexity of the problem of transaction costs stating that there is no standard definition of the term while proposing that transaction costs is broadly interpreted as costs associated with market exchange. This is important because it was seven decades ago that Coase (1937) introduced the concept of transaction costs associated with information, negotiation, monitoring, coordination, and enforcement of contracts. Based on these transaction costs faced by individual firms Coase theorized the natural emergence of intermediary firms to reduce these costs. Since then, a substantive volume of literature has been applied to transaction costs in agricultural markets. Building on Coase, Hobbs (1997) has classified the components of transactions costs in relation to the transaction: information costs as arising before the transaction; negotiation costs as the costs of physically carrying out the transaction; and monitoring costs as costs of ensuring that the terms of the transaction are adhered. There are others who have distinguished transaction costs in other, but related perspectives, some of which are discussed here.

Holloway et al. (2000) distinguish transaction costs between tangible [transportation costs, communication costs, legal costs, etc.] and intangible [uncertainty, moral hazard, etc.] costs. Pingali et. al., (2005) contextualize transaction costs from the point they occur. In this case as farmer specific, such as access to finance or the knowledge of market demand; location specific with the same cost for all farmers in a particular location, say road access to market; or even crop-specific, say perishables as opposed to grains. They go on to show that it is the aggregation of these transaction costs that farmers face that determines market participation, or commercialization. Elaborating, it is illustrated that from a farmer specific angle, transaction costs arise in both the input and output markets. On the input side these costs can vary, for instance, with the choice of financing. There is voluminous literature on the use of rural micro-finance houses, as opposed to formal banks, money lenders or commission traders, to bring down transaction costs in crop loans for small farmers in the developing world [for instance Ahmed, 1989]. On the output side, the use of brokers or collectors by farmers to search for market prices has been highlighted in an increasing volume of literature [for instance Gabre-Madhin, 1999]. In terms of location-specific transaction costs, differences can occur based on transport infrastructure. Aker (2008) having studied grain markets in Niger shows where road density and quality is low transaction costs associated with accessing markets tend to be high. Pingali (2005) has shown previously that poor road infrastructure increases transportation time and costs, resulting in the reduction in the final price that farmers receive reducing the incentive to enter commercial agriculture. In terms of crop-specific transaction costs, these vary by the produce to be grown. High-value crops, which are often perishable, such as vegetables, are usually associated with high transaction costs. Besides the above some have even considered transactions costs from a household-specific angle. Pingali (2005) describes a number of household-specific variables that are not so much transaction costs in themselves but have a significant impact on them, such as aversion to risk and uncertainty; social networks and organization; age, gender, and education etc. From yet a different perspective, Key et. al., (2000) define transactions costs as fixed and proportional [or variable] transactions costs. Here fixed transactions costs include the original search, negotiation and enforcement costs that are invariant to the volume of input as well as output. This is an

important point that we discuss later, as a farmer would incur the same search cost to sell either one ton or ten tons of produce. Proportional transactions costs on the other hand, include costs of transferring the input or produce being traded, such as transportation costs which is a per-unit cost of accessing markets.

While the foregoing discussion on transactions costs provides a macro perspective of the entire agriculture value chain from farm to plate our work is focused on the segment of transaction costs arising from the point of deciding what crop to grow to the point of selling the harvest to the wholesaler. Unless the farmer sells his or her produce to the wholesaler [or if an out-grower to the processor, which is not considered in this work] there is no entry in to the commercialization of agriculture. Given the now universal view that high transactions costs explain why some farmers participate in markets [commercialization] while others are simply self-sufficient [subsistence] understanding the transactions costs in this stage of the value chain is crucially important.

Having considered the many ways in which transactions costs can be defined and considering the ICT approach towards reducing the same, we in this paper adopt the widely used yet simple definition suggested by Staal et. al. (1997). This definition, building on the original work by Coase (1937) which incorporates a number of subsequent definitions discussed earlier; particularly in terms of tangible [Holloway et al., 2000] or proportional [Key et. al., 2000] transactions costs and intangible [Holloway et al., 2000] or fixed [Key et. al., 2000] transactions costs, classifies transaction costs into observable and unobservable transaction costs. Observable transaction costs include tangible or proportional costs such as transport, handling, packaging, storage, spoilage etc. that are visible when an economic exchange takes place. The unobservable transaction costs, on the other hand, include intangible or fixed transactions cost such as cost of information search, bargaining, and enforcement of contracts etc. Given the objective of this paper in understanding the possible role of ICT in reducing transactions costs, the subset of unobservable transaction costs dealing with information search that can potentially be reduced by applying ICT, forms the boundary of work.

3. Case Study in Rural Sri Lanka

Having discussed the theoretical issues of transactions costs and how they are spread along the agriculture value chain, this section considers the results of a case study of group of selected small-holder vegetable farmers in rural Sri Lanka to identify and measure the unobservable transaction costs dealing with information search. Issues related to bargaining and contract enforcement it is not considered, but would be a later extension to this work. Additionally, the value chain in this case is limited to the segment starting with the decision to grow and ending with the sale of the produce at the wholesale market.

The setting

The logical starting point in understanding the total information related transaction costs faced by the farmer is to understand the demand for information at each point of exchange by disaggregating the agricultural value chain to a series of activities. A simplifying assumption is that the relevant information is available in some format, as opposed to the extreme case of missing information. This is a realistic assumption in the case study as the geographic location provides for the availability of information.

The selected group of farmers is those who have the option of growing a given set of vegetable varieties and has the option of selling either at the Dambulla Dedicated Economic Centre [DDEC], Sri Lanka's primary wholesale produce market, which is situated in the same geographic area as the small-holder farmers, or selling the produce at any of the smaller local markets. The DDEC, located at almost the island's geographic center is situated on 12 acre plot with 144 trade commission-based trader operated stalls that attracts farmers or their agents [sellers] and buyers from all over the country. They arrive early in the evening on trucks and tractors and trading goes on till late night. Nearly 1,200 trucks go through the market daily during the peak season with sales estimated to average around USD 0.5 million. An additional piece of relevant information is that a simple price collection and dissemination system operates at the DDEC. Named "Govi Gnana Seva" [GGS] to mean Farmer Knowledge Service, walking investigators collect prices of vegetables and fruits and disseminates them via a price

board at the market on a continuous basis [de Silva, 2005]. These prices are also updated on a website during trading hours and made available via radio and newspapers the next day.²

The situation with input markets are also the same, in that, information is available and the farmers have options to purchase the same from several suppliers; particularly in the vicinity of the DDEC. Thus the location-specific transaction costs and crop-specific transaction costs [Pingali, 2005] remain fairly constant. A point of interest however is that under the current agriculture policy of Sri Lanka, paddy [rice] farmers and certain other plantation small holders [but not vegetable farmers] can obtain fertilizer at a dramatically subsidized price through government controlled distribution system. This situation has created a perverse incentive for vegetable farmers to spend money and time searching for opportunities to 'purchase' subsidized fertilizer for their vegetable small-holdings.

Selected farmers

In this background, the farmers were selected from the immediate feeder area to the DDEC and the produce limited the four mostly traded vegetables at the market by volume. A questionnaire-based survey was conducted among a sample of these farmers. In the first stage of sampling, 10 farmer associations out of the total 89 farmer associations in the DDEC feeder were selected using a simple random sampling technique. Then from each selected farmer association at least 30 farmers who grew one of the above crops in the last season were selected. Measures were taken to ensure that there was an equal distribution of farmers for all the crops as follows: tomato 78 farmers; onion 76 farmers; brinjal [eggplant or aubergine] 85 farmers; and chili 75 farmers.³ It is estimated that about 8,000 farmers belong to all the farmer associations in the area resulting in a sampling error for of 5.4 percent.

² <http://www.ggs.lirneasia.org>

³ Chili is not strictly a vegetable and is not as perishable and may have biased some of the results. However, the inclusion of similar number of farmers would have reduced any bias.

Research question

In order to understand the possible role of ICT in reducing transactions costs the study had to first identify and then estimate the cost of unobservable transaction costs dealing with information search. This was structured as a percentage of the total cost incurred by the selected small-holder vegetable farmers. For the purpose of this study, the unobservable transaction costs dealing with information search is defined as those costs that could be reduced by the use of alternative sources of obtaining the same information. For example, farmers can reduce the costs incurred in unsuccessful visits to purchase fertilizer if they make telephone calls to first obtain information on its availability on the day of the visit. Such costs are classified in this section as 'information search costs'. However, the cost associated with the visit to purchase the fertilizer is not part of the 'information search costs', but forms a part of the observable transaction costs. Prior to the survey, two focus-group discussions were conducted with ten farmers to obtain an in depth understanding of the agriculture value chain in the area. Based on input from the focus groups the agricultural value chain was conceptualized as being made up of six stages. Note the limitation of this study in that the segment of the value chain considered stops at the wholesaler and does not include processors, packagers, supermarkets etc.

The agriculture value chain: From planting decision to sale at wholesale market

Figure 1: The limited agriculture value chain



The first stage is "Deciding". This is the stage where farmers decide on what crop to grow, how much land to allocate for each crop and also arrange working capital financing. The second stage is "Seeding". This is when farmers either purchase seeds or prepare their own seeds based on the crop they have earlier decided to grow. They might also prepare a seed bed during this stage. The third stage is "Preparing and planting". During this stage, farmers prepare the land using own or hired labour or land preparation machinery and subsequently planting the seeds. The fourth stage is

“Growing” where application of water, fertilizer and pesticides take place. It is during this stage that farmers look for subsidized fertilizer that they are not actually eligible for; the perverse incentive that was discussed earlier. The fifth stage is “Harvesting, packing and storing”. During this stage, farmers have to find labour for harvesting and locations for storage if at all. Packing, again, if at all, take place during this stage. The final and sixth stage is “Selling”. In this stage [some] farmers check prices at the various markets find a method of transporting and transport the packed produce to the selected market to sell. If the price has not been found or if the price has changed since it was last known, farmers, who have arrived at DDEC have to find the best price from the large number of wholesalers. The questionnaire covered all the above stages and attempted to capture costs incurred during the previous season. Interviews were conducted mostly at the homes of farmers by trained enumerators recruited from the Dambulla Agriculture Technical College and supervised by GGS staff.

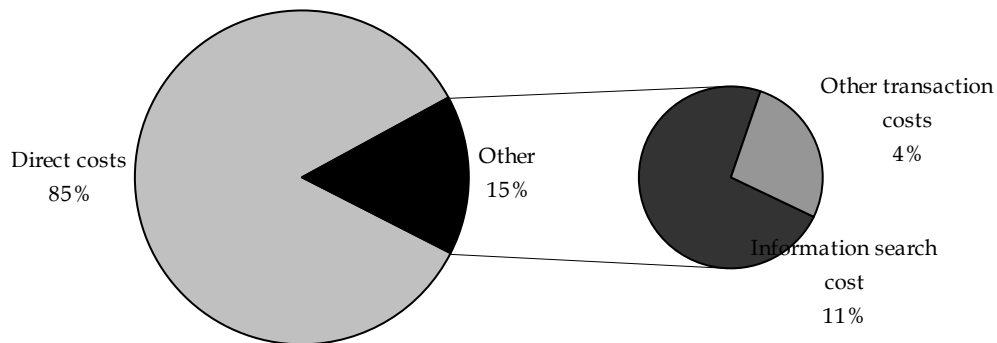
Transaction costs classification

The costs incurred by farmers throughout the process were categorized in to two exclusive groups; transaction costs and direct costs. Transaction costs were then segmented to information search costs and costs unrelated to information. The first component; information search costs, are costs that can be reduced by using alternative, cheaper means of obtaining the same information. For example; cost of finding availability of fertilizer by telephone as opposed to going to the fertilizer distributor to find out the same information. The second component is costs that are unrelated to information: These are the costs of facilitating transactions, e.g., cost of transporting produce to market etc. Outside of transaction costs are direct costs; the costs that are unavoidable and directly associated with the farming process, e.g., cost of fertilizer, labour, seeds, etc.

Findings

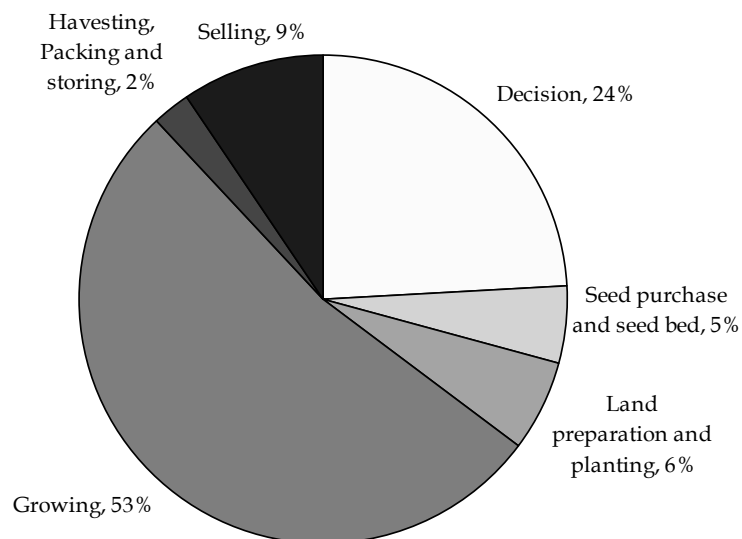
The first key finding is that for the group of small-holder farmers in the DDEC feeder area of Sri Lanka growing tomatoes, onions, brinjals and chilies, total transaction costs; including observable and unobservable costs, are 15.2 percent of the total cost incurred by them during the entire process; encompassing the six stage value chain.

Figure 2: Transaction costs; information search costs



The second key finding is that the information search costs amount to 69.8 percent of total transaction costs, i.e., 11.0 percent of the total costs incurred by the farmers in the six stage process. When the total information search costs in different stages of the agricultural value chain is considered, we find that the highest percentage of cost of information is incurred during the growth stage, followed by the decision stage and selling stage as depicted in Figure 3.

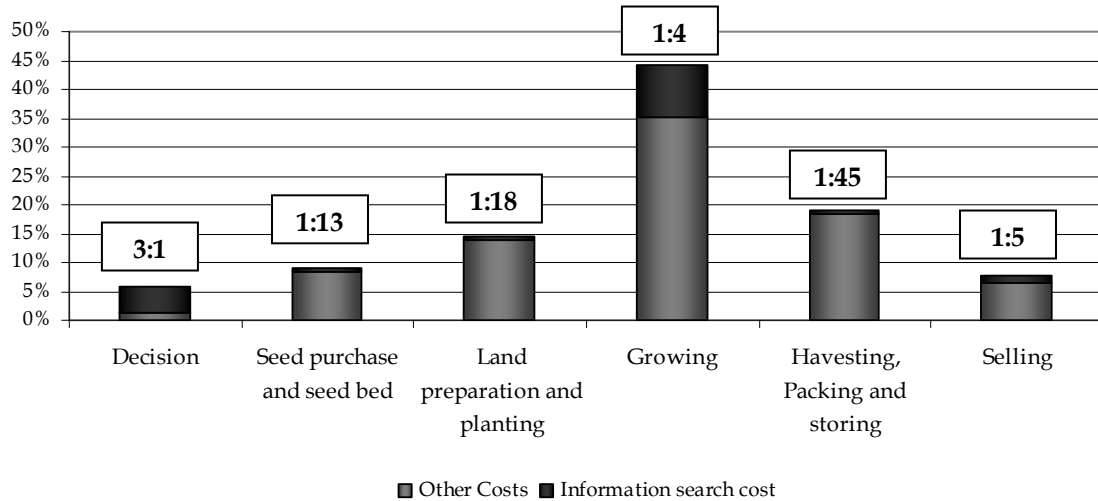
Figure 3: Information search costs by stage



The reason for the unusually high percentage of information search costs during the growing stage [53%] we found is caused by the previously mentioned idiosyncratic government procedure on fertilizer subsidy to farmers in that area. Vegetable farmers often visit the distribution centre multiple times before purchasing the subsidized fertilizer earmarked, not for vegetable farmers, but for paddy farmers. We expect the growing stage to be less pertinent in countries without such inefficient fertilizer subsidy policies and hence it is not analyzed further. The next important stage is the decision stage [24%]. Here information search costs included visits to meet farmer association officials and other neighboring farmers etc. to decide on a crop to grow; costs of arranging finance where the farmers had to pay multiple visits to banks and other rural finance institutions obtain application forms, completing them and finding guarantors etc. Some farmers we found had leased the land from others and this process also had involved quite a search for information. The selling stage is the next most important in terms of information search [9%]. Here it was found that costs of comparing prices of different markets and traders accounted for the most costs while finding transport to physically carry the produce to the selling market also incurred a fair share of information search costs. Land preparation and planting come next in importance of information search costs with finding labour and arranging the hiring of agricultural equipment to prepare land accounting for bulk of the costs [6%]. Information search costs in the stage of seeding comes in next [5%] with costs of finding particular types of seed and the cost of unsuccessful visits to purchase seed being the most significant. Harvesting packing and storing embedded the least information search costs [2%] with costs associated with finding labour and storage being the main costs.

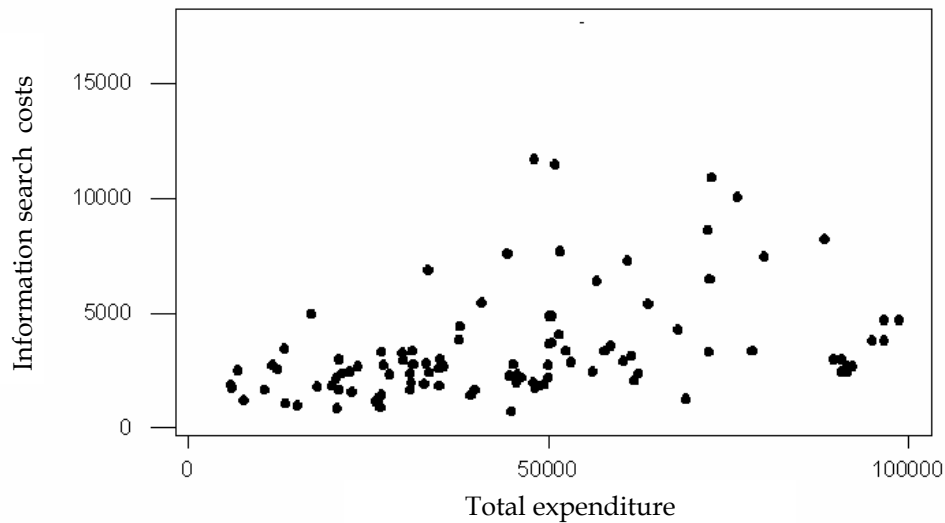
In terms of proportion of cost of information in each stage in the agricultural value chain, the decision stage comes first with the cost of information search to total cost ratio being 3:1, followed by growing stage with a ratio of 1:4 and the selling stage with a ratio of 1:5.

Figure 4: Relative cost of information by stage



Another significant finding is that the cost of information is relatively fixed; that is the cost incurred in obtaining information is not necessarily associated with the total cost. Stemming from this finding is that the smaller farmers have to bear a larger proportion of total costs as information search costs as shown in Figure 4. This finding reiterates the earlier discussed findings of Key et. al., (2000), where fixed transaction costs were categorized as search [and also negotiation and enforcement] costs that are invariant to the volume of input as well as output.

Figure 5 : Information search costs vs. total cost [in Sri Lanka Rupees, LKR]



4. Use of ICT in Reducing Information Search Costs

Having considered transaction costs in agricultural markets and subsequently having analyzed the findings of a case study on the information search costs component in transaction costs this section looks at the specific role ICT can play in reducing these information search costs within the considered component of the agriculture value chain. The final objective is to reducing total transaction costs to increase the incentives for small-holder farmers to participate in commercial agriculture as opposed to being stuck in subsistence farming. The evidence is unambiguous that a positive correlation exists between commercial agriculture and poverty reduction.

In the case of the earlier case study we found that small-holders hardly used phones to find information related to their crop. The costs incurred on phone calls were found to be negligible at only 0.2 percent of the total cost of information search. It was found that farmers mostly traveled to markets looking for fertilizer, or looking to get a good price for their produce because they did not have prior accurate and timely information.⁴ The

⁴ Some argue that it is not possible to estimate the cost of information accurately since farmers do other things or do multiple things when they travel to town. Special attention was paid to this possibility in the

study found that on average a farmer made 24 visits during the six stage process incurring an average cost LKR 195 [\approx USD 1.80] per visit. This cost includes traveling costs, food costs and other related costs that they incur during travel. Thus on average the total cost of information for a farmer was LKR 5,571 [\approx USD 52] of which LKR 4,680 [\approx USD 44] was cost of traveling. It is plausible to assume that if some of these visits are replaced by simple phone calls, the information search costs would reduce substantially. For instance, if half of the visits are replaced with phone calls and assuming a phone call cost LKR 40 [\approx USD 0.37] the total information search costs would reduce to LKR 3,714 [\approx USD 35]. This is a 33.0 percent reduction in information search costs even without accounting for time saved.

A number of recent studies have shown robust positive results between use of ICT [mainly mobile phones] for information search and increased income among fishermen and farmers. Jensen (2007) is perhaps the most convincing thus on the role that mobile phones can play in increasing efficiencies in markets where information is limited or costly. The paper presents the results of a four-year study on fishery markets in Kerala, India, where the adoption of mobile phones by fishermen and buyers resulted in a “dramatic reduction of price dispersion, the complete elimination of waste and a near perfect adherence to the Law of One Price”. This, Jensen (2007) shows, was because prior to the availability of mobile phones the cost of information was so high that agents were not able to engage in optimal arbitrage; before phones, fish was sold in home markets of the fishermen where they did not get the best possible price, whereas after phones, they found out the prices in nearby markets that enabled them to sell their fish at the market with the highest price. This improved the welfare of fishermen as well as fish consumers. More recently, Aker (2008) has shown that mobile phone use among grain sellers led to significant reductions in grain-price dispersion net of transport costs across markets in Niger.

survey and only the costs incurred during visits that are primarily related to the farming process were included.

However, the results are not always as expected. Alene (2008) studying the maize market in Kenya found that access to communication assets had turned out to have positive but insignificant effects on market participation. This, the author postulates could be because access to a mobile phone is less useful in accessing market information and in facilitating transactions if there is no viable market information service, which was the case within the study area. It was found that during the period of study price information was published only in newspapers and only for the major markets that are not accessible to the majority of farmers. In the study area, farmers had to go physically to the local assembly markets to gather such information as found in the case of Sri Lanka in the case study. De Silva (forthcoming), taking dozens of examples in the South Asia region, provides a detailed discussion on the appropriate use of ICT in agriculture specifically focusing on the importance of choice of technology in ensuring relevant information is made available to farmers when they need it. A classic example is a project in Maharashtra, India named "Warana Unwired" where the transfer of small but relevant pieces of information to sugarcane farmers via text messages on mobile phones [as opposed to the original "Warana Wired" project which attempted to use PC kiosks to do the same thing but failed] have created a significant change in the incomes of the sugar cane farmers in the area. Soysa (2007) in a study on traceability in the agriculture value chains show how gherkin farmers in Sri Lanka were able to improve their incomes by using a simple mobile phone application to reduce waste through a simple feedback system. Here text messages were sent to the farmers on a daily basis giving details of amount of gherkins rejected and the reasons for same in order to take immediate action to rectify the issue [here mainly melon fly disease easily reversible in less than 3 days]. The information search costs of this activity prior to the use of mobile phones were prohibitively high and resulted in significant losses both to the processor and the farmer.

5. Concluding Remarks

This study found that there are significant costs attached to information search and hence transaction costs associated with all six stages of the agricultural value chain starting with the decision to grow and ending with sale of produce at the wholesale market. The relative proportion of information search costs was found to be highest in the decision stage and selling stages among the farmer group in the case study of small-holder vegetable farmers in rural Sri Lanka. The study also found that these farmers hardly used any ICT for obtaining information and demonstrated that if farmers had used the phone at various points in the agricultural value chain their information search costs could have been reduced significantly creating greater incentives for commercialization of their agriculture. Therefore it is plausible to suggest an integrated system using a mobile phone platform that addresses the total information needs from the decision making stage to selling stages of agricultural produce to help farmers significantly reduce information search costs and thus transaction costs associated with the agriculture value chain.

6. References

- Ahmed, Z.U. (1989). Effective Costs of Rural Loans in Bangladesh. *World Development* 17 (3): 357-63
- Aker, J. C. (2008). Does Digital Divide or Provide? The Impact of Cell Phones on Grain Markets in Niger. Job Market Paper.
- Alenea, A. D., Manyongb, V. M., Omanyac, G., Mignounac, M. B., and Odhiambod, G. (2008). Smallholder market participation under transactions costs: Maize supply and fertilizer demand in Kenya. *Food Policy* Volume 33, Issue 4, August 2008, Pages 318-328
- Central Bank of Sri Lanka. (2007). Annual Report, Retrieved on 30 May 2008 from http://www.cbsl.gov.lk/pics_n_docs/10_publication/_docs/efr/annual_report/Ar2007/content.htm
- Coase, R. H., The Nature of the Firm, *Economica* 4, pp 386-405, 1937.
- de Silva, H. (2005). An Innovative Fruit and Vegetable Market Information System in Sri Lanka: The Govi Gnana (Farmer Knowledge) Service
- de Silva H. (forthcoming). Scoping Study: ICT and rural livelihoods South Asia Component, Draft ICT4L Research Scoping Report
- Ellen B., McCullough, P. L. and Pingali, K. G. S. (2008). The Transformation of Agri-Food Systems: Globalization, Supply Chains and Smallholder Farmers, Earthscan, ISBN 1844075680, 9781844075683
- Gabre-Madhin, E.Z. (1999). Transaction Costs and Market Institutions: Grain Brokers in Ethiopia. Discussion Paper No. 31, Market and Structural Studies Division, International Food Policy Research Institute, Washington, D.C

Hobbs, J.E. (1997), Measuring the Importance of Transaction Costs in Cattle Marketing. American Journal of Agriculture Economics. Vol 79, November: 1083-1095

Holloway, G., Nicholson, C., Delgado, C., Staal, S. and Ehui, (2000). Agro-industrialization through institutional innovations: Transaction costs, cooperatives and milk market development in the east African highlands. Agricultural Economics, Vol. 23: 279-288

Jensen, R. (2007). The Digital Divide: Information (Technology), Market Performance, and Welfare in the South Indian Fisheries Sector. Quarterly Journal of Economics. Vol. CXXII, Issue 3: 879-924

Key, N., Sadoulet, E. and de Janvry, A. (2000). Transaction Costs and Agricultural Household Response. American Journal of Agricultural Economics, Vol. 82 (2): 245-259.

Pingali, P., Khwaja, Y., and Meijer, M. (2005), Commercializing Small Farms: Reducing Transaction Costs, ESA Working Paper No. 05-08. Agricultural and Development Economics Division, The Food and Agriculture Organization of the United Nations

Soyza, S. (2008). Traceability In Agricultural Markets: Using ICTs to improve traceability of Gherkins: presentation of initial learnings

Staal, S., Delgado, C. & Nicholson, C. (1997). Smallholder Dairy under Transactions Costs in East Africa. World Development. Vol. 25, No. 5: 779-794.

Singh, N. (2008). Transaction Costs, Information Technology and Development
University of California, OnlineMPRA Paper No. 9095, posted 11. June 2008 /
09:29

World Bank, World Development Report. (2008). Retrieved on 30 May 2008 from
[http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/
EXTWDRS/EXTWDR2008/0,,menuPK:2795178~pagePK:64167702~piPK:6416767
6~theSitePK:2795143,00.html](http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTWDRS/EXTWDR2008/0,,menuPK:2795178~pagePK:64167702~piPK:64167676~theSitePK:2795143,00.html)