

# **E-Commerce Application Model for the Development of Rural Agriculture Sector and Empowerment of Farmers in Cambodia**

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## **Abstract**

Agriculture is a cross-cutting sector that produces 26.5% of GDP and employs 56% of the workforce in Cambodia. However, the unsustainable situation of traditional agriculture system contributes to low income capability and farmers are likely to remain below the poverty line. Therefore, we put forward a comprehensive e-commerce application model, a creative leverage of ICT-driven solution that could offer farmers up-to-date information, customized knowledge, input and services to enhance productivity and farm gate realization. This application model is tailored from e-commerce framework for rural agriculture sector which focuses on two main directions; of reshaping agriculture production and restructuring market orientation. There are six dynamic components in this application model mainly the e-commerce gateway, supply chain management, real-time info and search engine, multimedia and social network, knowledge based information system, and finally infrastructure and internet connection. This model will then become the basis for n-tier e-commerce application system requirements; from user-centered design principles, web development approach, client terminal and gateways, and infrastructure for internet connectivity. And lastly is the specific participatory approach for e-commerce application system that allows decision making among farmers towards rural development and empowerment.

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## 1 Introduction

Economic growth for Cambodia has been impressive with an average GDP growth of 9.5% per annum for the period of 1999-2008. It was mainly contributed by open economy policy, stable macroeconomic environment, exports, foreign direct investments (FDI) and low inflation rate of about 5.0%. Three main sectors contributing to the GDP of Cambodia are services, industry and agriculture. Table 1 shows that, in 2008, the services sector contributes 39.1% of GDP followed by industry sector at 27.5% and agriculture at 26.5%. Agriculture sector's share of GDP has been decreasing over time due to significant increase of industrial sector, but remains a crucial part of the economy. From 1999-2008, agriculture growth was around 4.5% per annum and contributes about 2% of GDP growth over the same period of time [1].

Table 1: Share of GDP (%), 2004-2008

Year	Service	Industry	Agriculture	Others
2004	38.6	26.9	28.8	5.7
2005	38.5	26.8	29.4	5.3
2006	38.3	28.6	28.0	5.1
2007	38.3	28.2	26.7	6.8
2008	39.1	27.5	26.5	6.9

*Source: Vuthy et.al (2010) "Review of Agriculture Policy and Policy Research". Original data was cited from NIS and National Account (2008).*

The philosophy of agricultural policy in Cambodia is articulated in Rectangular Strategy (RS); to improve agriculture productivity and diversification, thus enabling the agriculture sector to serve as the dynamic force for economic growth and poverty reduction. The RS is further complemented by agricultural reform and rural development policy such as National Strategic Development Plan (NSDP) 2006-2010, updated NSDP 2009-2013 and Strategy for Agriculture and Water (SAW) 2006-2010. The labor force in agriculture sector in 2007 was almost 56% of Cambodia's total work force, compare to 29% in service and 15% in industry sectors respectively [2]. However, the per capita contribution per unit of GDP growth as shown in Fig. 1 is unevenly distributed and agriculture is proportionally less productive than service and industry sectors [3].



Fig. 1: Per Capita Contribution per unit of GDP Growth by Sector

*Source: Consolidating Gains, Preparing for Change: Cambodia's Labor Force and Diversification (2011). Original data was cited from Cambodia Outlook Conference (2011).*

Therefore, the development of rural agriculture sector plays an important role towards Cambodia's economic and social growth; promoting livelihoods, food security and poverty reduction. There are several challenges to rural agriculture sector as highlighted by CDRI, CARD and IFPRI Roundtable Proceeding in 2011 [4]:

- Best way to promote and encourage farmers to adopt good production practices to intensify productivity and food security through appropriate technology and inputs
- Engaging the commune council, extension agencies and private institutions in technology transfer and capacity building to increase productivity
- Land planning, agricultural crops zoning, production expansion and effective management of agricultural risks factors (such as climate change and food insecurity) to increase agricultural growth and promote export
- Understanding market demand by identifying current and future markets with the emphasize of possible trade-offs between export and domestic demand
- Establishing data and information platform, and option for agriculture diversification by paying more attention to experience and lessons from other countries

This paper is organized into five sections including this introductory aspect of agriculture sector in Cambodia. Section 2 presents the background of agriculture sub-sectors, the unsustainable scenario, and the importance of e-commerce and its success indicators. While section 3 presents the e-commerce framework and the comprehensive application model for rural agriculture sector. This is followed by the e-commerce application system requirements, and appropriate participatory approach to implement e-commerce application system towards empowerment in section 4. Finally, section 5 brings this paper to a conclusion and suggestions.

## **2 Background**

### **2.1 Agriculture Sub-sector in Cambodia**

As shown in Table 2, crops are the biggest agriculture sub-sector with share value of 52.8% of agriculture GDP in 2008. The crops production growths due to increased market demand have reduced the share of other sub-sectors from 2004 to 2008. Rice is by far the largest crop and contributes about 27.9% of sectoral GDP with total planted area of 2.62 million hectares and production of 7.18 million tons in 2008. Other main crops consist of cassava, maize (and yellow maize), vegetables, sesame, soybean, sweet potato, mung bean, sugar cane, peanut, jute and tobacco. The following sub-sector, fisheries constituted 25.1% of GDP and the main production comes from inland fisheries, marine fisheries and aquaculture. The dynamism of other sub-sectors such as livestock and poultry, and forestry have also been slow but still play an important role in rural economy, making up 15.3% and 6.9% of GDP respectively in 2008 [2], [5].

Table 2: GDP by Agriculture Sub-sectors and Growth 2004-2008

	2004	2005	2006	2007	2008
Crops	46.1	50.9	50.8	52.3	52.8
(Rice)	(22.6)	(28.0)	(27.7)	(29.2)	(27.9)
Fisheries	28.8	26.3	25.9	24.9	25.1
Livestock and Poultry	16.9	15.4	15.8	15.6	15.3
Forestry	8.1	7.4	7.5	7.2	6.9

*Source: Vuthy et.al (2010) "Review of Agriculture Policy and Policy Research". Original data was cited from IMF (2004 & 2009) and NIS (2008).*

Agriculture is a multi-functional system in all 22 provinces and 2 main cities in Cambodia providing employment and income, stable fulfillment of domestic supply by reducing dependent on food and agriculture product imports from neighboring countries, and eventually moves towards promoting export. Exportable agriculture commodity with high potentials include rice, cassava, maize, sesame, soybean, mung bean, peanuts, pepper, rubber, fish products and livestock such as cattle and buffalo. Organic vegetables and fruits also have potentials as exportable items. Therefore, agriculture scheme for lucrative commodity, agro product processing and agro export is likely to intensify [6]. This scenario should benefit the farmers since the productivity have better market and indirectly improves the earning capability. However, the agriculture system in Cambodia is traditionally being unfair to farmers, and middlemen traders are well positioned to exploit both farmers and buyers through inefficient practices. Thus, the farmers remain underearning or financial performance below the real prospective.

## 2.2 Unsustainable Situation

In general, farmers have weak bargaining power and dependent on middlemen traders without any alternative marketing choice. The farmers cannot trade directly with the buyer or set the price of the agriculture commodity. They also don't have access to real-time information and purely based on rough ideas on price and price trends. With the weak infrastructure, information is difficult to access, time consuming and inconvenient. Farmers are dependent on mass media such as radio which has its own limitation. For example, information broadcasted in radio for five minutes in the evening can be inaccurate or too much to digest for an illiterate farmer. So the middlemen traders can exploit the market by setting a low price for agriculture commodity although the actual price might soar due to strong demand and future markets predictions.

Agriculture production is driven by input supply and knowledge of farmers. In industry dominated market, the price of agriculture inputs such as seeds, fertilizers and pesticides is usually high. With high cost of input, weak farm subsidies, low yields due to inefficient use of input and low price for commodity; the farmers are losing in marketplace with little earning power. Sometimes the yield are gathered and auctioned by middlemen traders but this method of selling lacks transparency in pricing and weighing. There are also other critical issues such as irrigation, flood, land ownership, agriculture scheme (inter and mono-cropping) and credit facilities that lead to unsustainable situations for farmers [7].

### 2.3 E-Commerce and Success Indicators

E-Commerce is a creative leverage of Information and Communication Technology (ICT) and plays an important role in almost all aspects of modern society. For agriculture sector, e-commerce is a meta-market gateway for spectrum of commodities in support of rural farmers while addressing value-sapping problems that creates unsustainable situations. So, there will be significant step towards rural development and empowering farmers, which can be seen through e-commerce success indicators [8] such as:

- low cost of accessing and acquiring knowledge that leads to timely, accurate and reliable information
- shifting their agric scheme and plan production output according to price prediction and market demand for more profitable yield
- low transaction costs by cutting the procurement costs and lower price for input supply
- higher yield with enhanced farm productivity and quality output
- higher farm gate price
- higher income related to accurate weighing, faster processing time, prompt payment and higher profit margin
- capacity for risk management with bundling and customized knowledge
- larger investment, and creating business opportunities, identity and branding

The e-commerce application model is designed to suit the unique characteristics of rural agriculture sector in Cambodia. The interest of middlemen traders (small or medium) will be hurt due to disintermediation. So the role is redefined as local intermediaries to facilitate e-commerce process from procurement, to facilitation and information gathering. The trading commission is replaced by service charges paid through e-commerce application system. Besides, there are other challenges [7], [9], related to e-commerce as details below:

- readiness of traditional agriculture sector towards e-commerce (rural engagement) because rural society is structured around subsistence and unprepared modern services and products, isolation and, disparities of education and economic
- rural is a difficult business location due to inadequate electricity, transportation and telecommunication infrastructure, and mobile and internet coverage

## 3 E-Commerce Application Model

### 3.1 E-Commerce Framework

The e-commerce application model put forward in this study is based on the e-commerce framework for rural agriculture sector [10], [11], as shown in Fig. 2, which focuses on two main directions, and its' success factors as per details below:

- (i) Restructure Market Orientation
  - Alternative Trade Exchange Platform
  - Quality Input Supply
- (ii) Reshape the Agriculture Production
  - Promoting Farming Techniques and Extension Services
  - Greater Information Exchange

This framework is supported by the presence of two other important implementation (success) factors known as Rural Intelligent Information Centre (RIIC) and the Expert View. Besides that, incorporating Good Manufacturing Practice (GMP) and Food Safety (FS) mechanism in the framework will improve international market access and help to build trust among importing countries. Finally a feasible e-commerce application system can be an effective ICT tool to empower farmers based on the success indicators identified earlier.

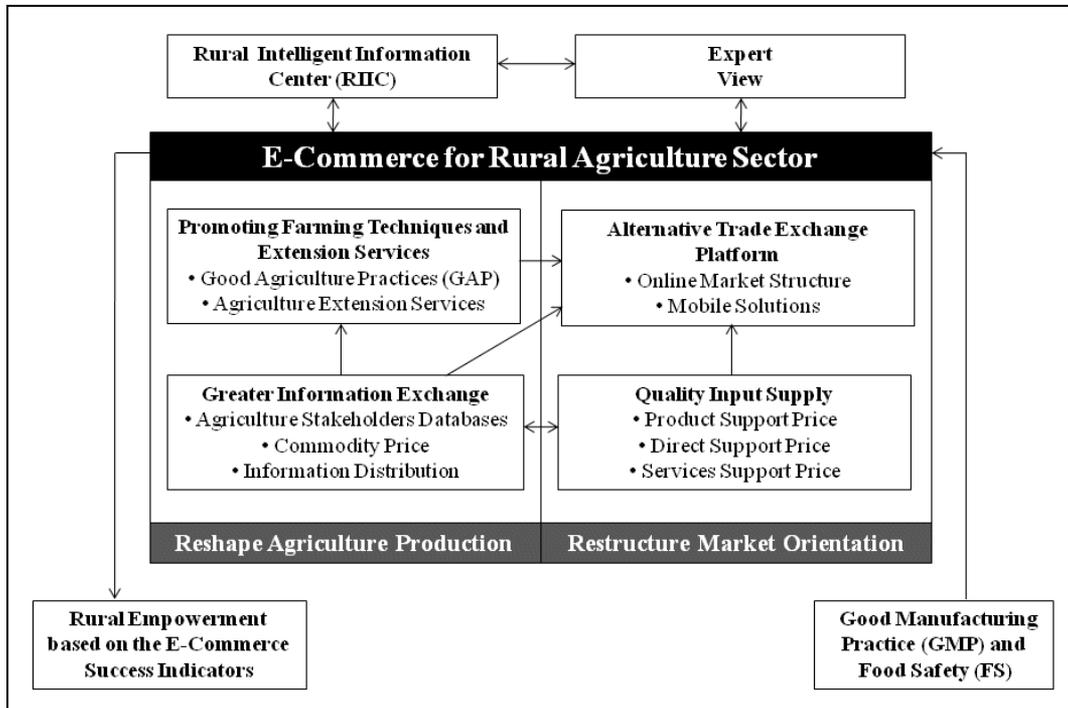


Fig. 2: E-Commerce Framework for Rural Agriculture Sector

Source: Adapted from "E-Commerce Framework to Improve Rural Agriculture Sector in Cambodia" (2011).

### 3.2 E-Commerce Application Model

The framework in Fig. 2 is then translated into more technical representation known as e-commerce application model as shown in Fig.3. The model has six dynamic components which actually signify the success factors mentioned earlier. These components are also essentials for developing the functional modules, integrating experts' know-how, and providing adequate infrastructure and technology to implement e-commerce application system in rural environment. The six components are:

- (i) E-Commerce Gateway (Alternative Trade Exchange Platform) – the conventional e-commerce platform that includes user access login and personalization, agriculture commodity and/or product catalogue, shopping cart and payment gateway
- (ii) Supply Chain Management (Quality Input Supply) – is the supply chain information sharing and trade of agricultural input supply and support services, that can be connected to the e-commerce gateway

- (iii) Multimedia and Social Media (Promoting Farming Techniques and Extension Services) – make the most of multimedia and/or animation content and social networking tools for communication and information dissemination
- (iv) Real-time Info and Search Engine (Greater Information Exchange) – the is no delay in timeliness of agriculture-related data and information, and the importance of search capability and links
- (v) Knowledge-based Information (Expert View) – one-stop agro-advisory and professional opinion from subject matter experts
- (vi) Infrastructure and Internet Connection (Rural Intelligent Information Center or RIIC) – setting-up the infrastructure and internet connectivity to access the e-commerce application system in rural and isolated areas

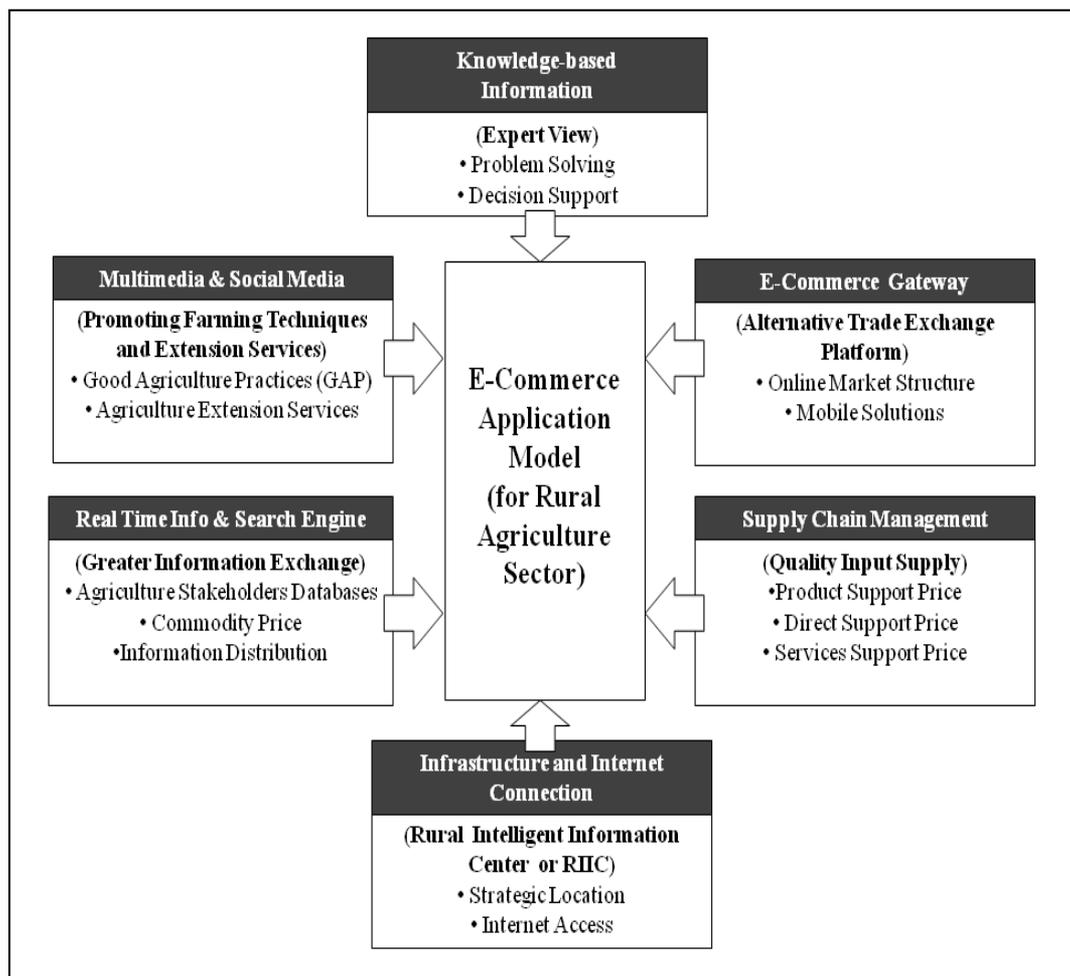


Fig. 3: E-Commerce Application Model for Rural Agriculture Sector

Each of the six components in Table 3 can be further expended into sub-components, details and challenges [12], [13], [14], [15], as shown below:

Table 3: E-Commerce Application's Sub-Components, Details and Challenges

Main Components	Sub-components	Details	Challenges
1. E-Commerce Gateway	1.1 Online Market Structure	<ul style="list-style-type: none"> <li>• E-Marketplace (neutral e-hub)</li> <li>• Trade exchange between farmers and buyers (B2C) and farmers and input supplier (B2B)</li> <li>• Distribution channel that doesn't alienate anyone including the traders</li> </ul>	<ul style="list-style-type: none"> <li>• Physical obstacles</li> <li>• Perishable and easily spoilage items</li> <li>• Food safety, quality and standards, regulations and certification</li> <li>• Establishment of rural supermarket for fast moving consumer goods (FMCG)</li> </ul>
	1.2 Mobile Solutions	<ul style="list-style-type: none"> <li>• Mobile gateways to support e-commerce; SMS and MMS</li> </ul>	
2. Supply Chain Management	2.1 Product Support Price	<ul style="list-style-type: none"> <li>• Seed and seedlings</li> <li>• Pesticide and fertilizers</li> <li>• Machinery, tools and parts</li> <li>• Crop and animal health</li> </ul>	<ul style="list-style-type: none"> <li>• Standard price lists (by location)</li> <li>• Purchase volume versus competitive price</li> <li>• Support processes can be tedious and time consuming</li> <li>• Availability and scale-down services to accommodate small farmers</li> <li>• Readily available tools that is not costly</li> </ul>
	2.2 Direct Support Price	<ul style="list-style-type: none"> <li>• Transport and logistics</li> <li>• Warehouse and cold storage</li> <li>• Product tracking</li> </ul>	
	2.3 Services Support Price	<ul style="list-style-type: none"> <li>• Financial loans</li> <li>• Insurance</li> <li>• Legal aspects</li> <li>• Management Tools – calculator and info tracking</li> </ul>	
3. Multimedia and Social Media	3.1 Good Agriculture Practices (GAP)	<ul style="list-style-type: none"> <li>• Agriculture best practices</li> <li>• Scientific farming</li> </ul>	<ul style="list-style-type: none"> <li>• Developing multimedia and animation-based content can be time consuming and costly</li> </ul>
	3.2 Agriculture Extension	<ul style="list-style-type: none"> <li>• E-Government – government services,</li> </ul>	

	Services	<p>schemes and support</p> <ul style="list-style-type: none"> <li>• E-Training –vocational training for educating farmers and family</li> <li>• E-Awareness – creating awareness and understanding issues</li> <li>• E-Counseling – farmers welfare and wellbeing support services</li> </ul>	<ul style="list-style-type: none"> <li>• Content in local language</li> <li>• Well trained and skilled agriculture extension personnel</li> <li>• Promoting all the e- services</li> </ul>
4. Real-time Info and Search Engine	4.1 Agriculture Stakeholders Databases	<ul style="list-style-type: none"> <li>• Farmers, villages, communes, farmers' cooperative and association</li> <li>• Buyers, traders, business entity and traders association</li> <li>• Relevant departments and agencies</li> </ul>	<ul style="list-style-type: none"> <li>• Attract agriculture stakeholders to subscribe to the e-commerce (need to set some target/year)</li> <li>• Need to appoint lead farmer or commune leader to guide rest of the farmers</li> <li>• Live data, up-to-date date and historical data</li> <li>• Market analysis</li> <li>• R&amp;D information from university and research institute</li> </ul>
	4.2 Commodity Price	<ul style="list-style-type: none"> <li>• Real-time price list by grade, quantity and location</li> <li>• Price comparison between markets</li> <li>• Future market quote and price prediction</li> <li>• Global price trend</li> </ul>	
	4.3 Information Distribution	<ul style="list-style-type: none"> <li>• Weather report, irrigation and oil price</li> <li>• Vacancy or manpower need</li> <li>• Research outcome</li> </ul>	
5. Knowledge-based Information	5.1 Problem Solving	<ul style="list-style-type: none"> <li>• Use of pesticide and fertilizer</li> <li>• Crop disease and pest incidence</li> <li>• Diagnosis, advice and follow up</li> </ul>	<ul style="list-style-type: none"> <li>• Background and expertise</li> <li>• Availability and fee imposed</li> <li>• Cost of integrating into e-commerce system</li> </ul>
	5.2 Decision Making	<ul style="list-style-type: none"> <li>• Validate new method or technology</li> </ul>	

		<ul style="list-style-type: none"> <li>• Agriculture scheme and production planning</li> <li>• Expect opinion on price and market trend</li> </ul>	
6. Infrastructure and Internet Connection	6.1 Strategic Location	<ul style="list-style-type: none"> <li>• Identifying commune, villages and farmers</li> <li>• setting-up e-commerce kiosks</li> </ul>	<ul style="list-style-type: none"> <li>• Power source and other basic infrastructure</li> <li>• Internet access</li> <li>• Cost</li> <li>• Community participation</li> <li>• Multi-platform support</li> </ul>
	6.2 Internet Access	<ul style="list-style-type: none"> <li>• Infrastructure and technology available</li> <li>• Internet connectivity</li> </ul>	

## 4 E-Commerce Application System

### 4.1 System Requirements

The framework must then be translated into the working e-commerce application system and experimented to evaluate the success indicators towards empowering the farmers. Firstly, the e-commerce application system must be designed based on user-centered principles that focus on target users characteristics and behavior, tasks and procedures, their capability and expectation. Although targeting naïve farmers in the rural environment, the system must be built to highest design standards and include leading-edge technology. Four design principles in the development and implementation of e-commerce application system are [16]:

- Local user need – content and system functionality
- Dialogue and personalization –building relationship with users through dialogues and information preference
- Sophisticated system - will be easily and effectively used
- Lowest common denominator – in order to be robust in most demanding rural circumstances, the e-commerce has minimum infra and internet connectivity requirements

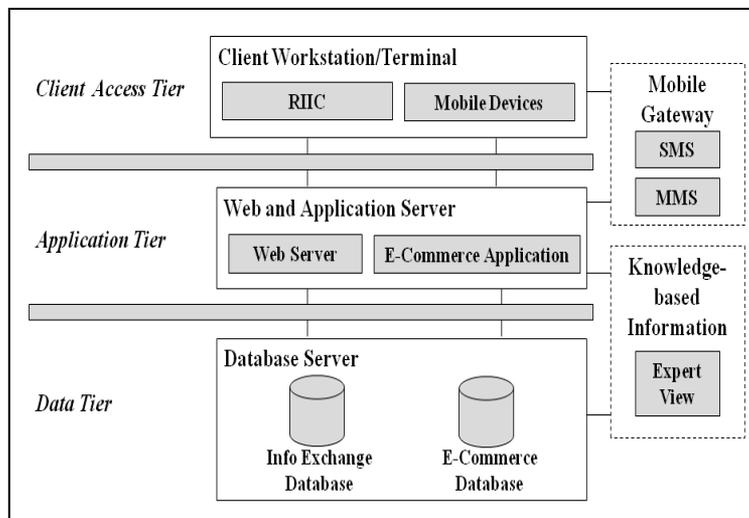


Fig. 4: E-Commerce Application System based on N-tier Architecture

As shown in Fig. 4, the e-commerce application system development will be an n-tiered software system and the architecture is based around central databases and application server with each test ground having client workstation or terminal. An open source web development approach will be adopted; using PHP to design the server-side program functions, and MySQL database language to create the relational databases for the applications. Meanwhile, Dynamic HTML or DHTML which combines XHTML, CSS and JavaScript scripting languages will be used to design the Web Portal, which will be the main client-side interface for this system. This portal must have dual language support; one for English and the other for Khmer. All the features and functionality of e-commerce will be available through this portal.

Mobile gateway are a key scale-up element of the e-commerce system as they can provide access to services from anywhere with mobile network connectivity. The Short Message Services (SMS) and Multimedia Messaging Services (MMS) gateways will allow the system to penetrate further in rural community and the main constraint is cost of mobile phone and SMS/MMS subscription fee. However, with a basic mobile phone, the access is limited to text only despite getting fast and reliable information such as price list by location of market places nearby the farm. Therefore, priority to access the e-commerce must be desktop-based and the option of setting-up internet kiosk or RIIC becomes vital for each village.

Based on the case studies in similar rural agriculture conditions, the best place to setup RIIC is in commune leader house and linked to internet via phone line (cable and/or wireless) or by satellite. Each RIIC can serve farmers in surrounding villages within the same commune inside 5km radius. The costs of setting-up of one RIIC could reach a minimum amount of USD3,000; which includes initial site preparation, electrification, furniture, telephone, modem, computer, printer and essential software. Additional cost is also needed to maintain the kiosk which comprises of electricity charges, telephone bill, training and printing [17]. The concept of 'intelligent' in the RIIC is actual refers to the connectivity to the knowledge-based information for expert view through the e-commerce application.

In general, the infrastructure is still lacking from the standard needed to provide internet services to the rural community. In order to support transactional and rich web content such as multimedia, a reliable connectivity with better throughput is required. A wireless local loop (WLL) and/or very-small-aperture terminal (VSAT) may help in this situation. But WLL is only suitable if the village is close to the city or town because it can be connected to the existing infrastructure. For the rural areas, a VSAT is probably the best alternative to connect to the internet. VSAT is a telecommunication system based on wireless satellite technology and can be configured to support variety of protocols. It is used for data, voice and video signals, as well as internet functionality for wireless e-commerce services [18].

## **4.2 Participatory Approach**

It is important to understand how to use participatory approaches to introduce e-commerce application system, and the related ICT technology and infrastructure such as VSAT, internet and RIIC to the intended users (or participants); including farmers, buyers, traders, suppliers and even extension staffs. Participatory approach for introducing e-commerce application system can be in different stages; from collaborating with the community, through increasing awareness of the e-commerce, providing views on how community coped without e-commerce and distributing the benefit of using e-commerce back to the communities. There might be a need to have a ‘training team’ who can determine the e-commerce needs of the community through collaboration. The training team can consist of lead farmers, extension staffs and even NGOs, which will lead to wider adoption of e-commerce [19].

One of the approaches is Participatory Information and Communication Technology Development (PICTD) which is divided into four aspects [20]:

- Participatory Video (PV) - best medium to disseminate information related to e-commerce application and its features when farmers (especially women) are reluctant to participate in group discussions and gatherings; video can provide a feedback mechanism and motivate the participating communities
- Participatory Communication (PC) – various mode of communication such as SMS, MMS, email, teleconferencing and telephone to exchange information between the participants and system administrator; to improve web portal and communication methods; to make agricultural queries and training programs
- Participatory Learning and Action Research (PLAR) – participation with the rural farming community is crucial to understand their socio-economic system and observe changes when this community adopts e-commerce system; the farmers can analyze own practice, discover problems and seek solutions; innovative training skills is needed
- Farmer Participatory Research (FPR) – shared process that will address farming issues and get more control over the results and allow decision making in the hands of farmers; crucial for community involvement and rural development; also leads to empowerment; one excellent method is Participatory Rural Appraisal (PRA) which has been used in the Cambodian agriculture assessment

## 5 Conclusion

Despite the views on priority to basic needs of food security, and clean water and electricity, the government has always highlighted the role of ICT in social and economic transformation of rural community, such as Government Administration Information System (GAIS), one of the leading e-government projects in Cambodia. The initial success of GAIS despite the critical challenges [21], [22], can be used as motivation for bigger projects such as e-commerce application system. In this study, the e-commerce application model is centered at network of information centers equipped with computer, connected to internet and located in rural farming villages. Connectivity to the internet and access to the information determine the wealth and quality of life, greater social participation and awareness, informed decision making and business opportunities.

The model also provides the guiding principles for the development and implementation of e-commerce application system, which includes the concept of re-engineering rather than reconstructing or reinventing, capability to address the whole situation, more dynamic features and functionality, engaging all members of rural landscape and widening network. There is a need to have extensive partnership with technology provider, private sector as business investors, government agencies and extension services, and research institutes. However, it is also important that any e-commerce initiative must be sanctioned by the MAFF and relevant authority to avoid monopolistic control by technology providers and business entities; and provide a win-win solution for farmers and other agriculture stakeholders.

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