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Market linkage system for small-scale farmers

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Abstract The Least Developed Countries (LDCs) concerns the majority of the farmers as smallholders and they are confronted with numerous challenges in marketing their products. Although small-scale farmers have potential in reducing rural poverty and achieving global food sufficiency, it is dependent on their production potential and access to markets. Access to markets for small-scale farmers depended on reliable, time and relevant market information. Therefore, the challenges was identified for facing of small-scale farmers in markets of their products, developed a framework to design the electronic Market Linkage System (MLS) and validated the usefulness of the framework through an MLS survey. MLS was to link small-scale farmers with the market and these identified marketing challenges could be solved through features in MLS. The results indicated that farmers and extension agents had viewed that MLS is useful in solving common marketing challenges. However, over fifty percent of the vendors were positive that MLS would be useful, and almost forty percent were neutral in their opinion and ten percent was a negative view.

Keywords: Market linkage system, Market information system, Small-scale farmer

Introduction

The agriculture sector is the major employer for the world's workforce; there are over 2 billion people whose livelihood depends on agriculture (Nwanze, 2011). In the Least Developed Countries (LDCs) over 70 % of the workforce is employed in the agriculture sector (UN, 2011). Farms of less than 1 hectare (ha) and 1 to 2 hectares consist of 72% and 12 % of all farms in the world respectively, and they control 12% of the world's agricultural land (Food and Agriculture Organization, 2014). This indicates that majority are small-scale farmers. The small farms produced about 80% of the food consumed in Asia and sub-Sharan Africa (Nwanze, 2011). On the average, small farmers in Asia and sub-Saharan Africa owned less than 2 ha of land (Food and Agriculture Oorganization, 2012, 2014).

Despite their small size, these farms contributed to global food security (Jones, 2012; Magesa *et al.*, 2014, 2015) and rural poverty reduction is

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immensed (Thorp *et al.*, 2005). However, it is dependent on the production capacity and market access.

Small-scale farmers followed the traditional farming method, that was supply-driven production which had to be replaced by demand-driven production (Shepherd, 2007) and to ease their marketing challenges. The common marketing challenges are being faced by them as the limited market information (Delgado, 1999; King and Ortmann, 2007; Munyua, 2007; Bamiduro and Gbadeyan, 2011; Rehman *et al.*, 2012; Benfica and Mather, 2013; Vadivelu and Kiran, 2013; Matsane and Oyekale, 2014; Sylvester and Maponya, 2014; Magesa *et al.*, 2015), lack of market access (Delgado, 1999; King and Ortmann, 2007; Munyua, 2007; Rehman *et al.*, 2012; Benfica and Mather, 2013; Sylvester and Maponya, 2014; Magesa *et al*., 2015) insufficient production (Delgado, 1999; King and Ortmann, 2007; Munyua, 2007; Baliyan and Kgathi, 2009; Benfica and Mather, 2013; Matsane and Oyekale, 2014), inconsistent supply (Baliyan and Kgathi, 2009; Bamiduro and Gbadeyan, 2011), high transportation cost (King and Ortmann, 2007; Munyua, 2007; Baliyan and Kgathi, 2009; Bamiduro and Gbadeyan, 2011; Matsane and Oyekale, 2014) and poor market infrastructure (Munyua, 2007; Baliyan and Kgathi, 2009; Bamiduro and Gbadeyan, 2011; Rehman *et al.*, 2012; Matsane and Oyekale, 2014; Sylvester and Maponya, 2014).

Hence, to improve small-scale farmers marketing, those challenges are to be solved. The concept of Market Information System (MIS) has been practiced and promoted since the 1980's after market liberalization occurred in LDCs to improve farmers marketing (David-Benz *et al.*, 2011; Galtier *et al.*, 2014). Since, MIS has evolved and can be classified into first and second generation MIS (Galtier *et al.*, 2014, USAID, 2014, Chiatoh and Gyau, 2016, (Food and Agriculture Oorganization, 2017). Although first-generation MIS mainly focused on price information, the second-generation MIS offered information on production, policy measures, and marketing, such as storage facilities, credit lines, buyer and seller contacts, etc (Food and Agriculture Organization, 2017). Those MIS models followed a course such as collection of data, transmission of data to the central server, the analysis of those data and then the dissemination of the data to farmers through various medium. However, these models were expensive because of the human and financial resources required in the collection and dissemination of information.

So, the research finding was to explore an alternative model through electronic Market Linkage System (MLS) that can be used as a medium to link farmers and vendors by providing market information to both parties. For example, farmers can get the demand information, and plan on what and when to produce, where to market, how much to produce, and for whom to produce

which would be helpful in solving common challenges faced by the small-scale farmers. This study aimed to develop a general guide for designing Market Linkage System (MLS) incorporated with MIS functionality to promote small-scale farmers marketing and validate the design guide through a potential MLS users' survey.

Materials and method

Population, sampling, and data collection

For qualitative data (secondary research): The review was conducted on secondary data from peer-reviewed articles and international organization publications. Peer-reviewed articles consisted of conference proceedings and journals, and the international organization publications were comprised of books, discussion papers, consultancy reports, proceedings of expert meetings, and annual reports.

An online manual search was adopted. The online databases searched were IEEE Xplore Digital Library, ACM Digital Library, Elsevier Science Direct, ResearchGate and Google Scholar for the peer-reviewed articles. For international publication related to agriculture, telecommunications and ICTs, websites of international organizations such as Food and Agriculture Organization (FAO) of United Nation, International Fund for Agriculture Development (IFAD), World Bank, Technical Centre for Agricultural Rural Cooperation (CTA) and International Telecommunication Union (ITU) were searched.

For the survey (questionnaire), main MLS users were identified as the farmers, vendors, and extension agents. In order to validate the usefulness of MLS design, a survey was conducted. The study used a purposive sampling method to identify farmers, agriculture vendors, and extension agents, among various farmers, vendors and extension agents. The survey was conducted using convenience sampling method with a sample size of 30 each for the farmers, agriculture vendors, and extension agents. The sample consisted of farmers and agriculture extension agents from the western, eastern, central and southern regions of Bhutan and vendors from the capital city and western region of Bhutan; Bhutan is an LDC in South East Asia with 43.9% of the population dependent on agriculture (NSB, 2018).

For qualitative data, online databases were explored, relevant literature was collected to understand the phenomenon and theories on the topic, and then the theoretical framework was prepared.

For quantitative data analysis, the main purpose was to capture farmers', vendors' and extension agents' views towards the MLS design, so descriptive analysis was conducted. While conducting descriptive analysis, literature pointed out that mean and standard deviation were not recommended for central tendency and variance in the dataset for Likert item questions. Therefore, the median and Inter Quartile Range (IRQ) were analyzed to present dispersion in the dataset. SPSS was used for statistical analysis.

Operational definition

The terms vendor, extension agent, farmer group and contract farming are also used in the study frequently. In this study, the vendors are defined as those who purchase agriculture products from farmers. The vendors here could be retailers, educational institutes, hotels and restaurants, military organizations, central monastic bodies, charitable organizations, hospitals, etc. Linkage with a spot markets, commodity exchanges, and auction activities are not included in this study. As per definition of the Food and Agriculture Organization of the United Nations, the term extension refers to an informal educational process directed toward the rural population; the extension is a process of working with rural people in order to improve their livelihood. This involves helping farmers to improve their productivity and abilities to direct their own future development (Food and Agriculture Organization, 2018).

The collective action as individual farmers working in-group to fulfill a common objective which defined by Stockbridge *et al.* (2003. Small-scale farmers forming a group and working collectively supported them in participating in the market more effectively as modified from Markelova *et al*., 2009). Contract farming has been defined as a legal understanding between a producer and buyer where the quantity, quality, timing, and price are agreed before production starts refered from Eaton and Shepherd (2001) and Ton *et al*. (2018). The practice of contract farming is considered as a device to link small-scale farmers to domestic markets which ultimately reduces poverty as referred from IFAD (2003) and World Bank (2007).

Proposed guide for designing market linkage system

MLS is considered as an electronic system with a component for each: the vendor, farmer, extension agent, and policymaker (Table 1). Its aim was to ease the marketing challenges which faced by small-scale farmers through market information. Production information such as product type, estimated

quantity, quality in image form, and estimated time of harvest, were available for MLS users' right from the production stage in a near real-time basis.

Table 1. MLS components

Component on MLS	Purpose	Marketing challenges that will be solved
Vendors Interface	For vendors to order products (upload their requirement)	Lack of market information and market access
Farmers interface	For farmers to respond to vendors' needs(requirements) and advertise their products	Lack of market information and market access
Extension Agents interface	For extension agents to upload or help illiterate farmers to use the system	Digital gap
Policymakers interface	For the government to view production reports so that necessary intervention can be planned.	Market infrastructure intervention and food security status.
Search option	For vendors to search for the right farmers, aggregate products, and to plan transportation.	Inconsistent supply, insufficient production and high transportation costs.

Vendor interface

Consists of features to upload/order demand information (product type, quantity, quality, time and price) before production season begins. This information would help farmers to plan what to produce, when to produce and how much to produce.

Farmer interface

Interface for farmers was to respond the vendors demands/orders. Farmers would be able to specify what they can produce in relation to the vendors' requirements (product type, quantity, quality, time and price), which would be helpful in creating a vendor and farmer linkage. An additional feature would be advertised the product directly from the farm. These processes recorded to help the farmers in marketing their products later.

Extension agent interface

Feature to upload respond on behalf of farmers who were digitally illiterated to enhance the adoption rate of the system and reduced the exclusion of illiterate small-scale farmers from using the system.

Policymaker interface

The view reports of actual production information entered in MLS. Product-wise, production information can be filtered down to the sub-district level, which helped the government in providing marketing infrastructure intervention based on production information. Also, the system provided an idea on the early warning for food security, as the information would be available on the system when production started.

Search option

Where the user was filtered their search using product type, estimated date of harvest, and production area. It helped the vendors aggregate the same product from the same area with the same estimated date of harvest, and to overcome the economy of scale (insufficient production). Similarly, they searched for a product from different areas produced at different periods of time in advance for a consistent supply.

With these interfaces and features, common challenges that small-scale farmers were faced such as the lack of access to market information, lack of access to markets, inconsistent supply, insufficient production, high transportation and transaction costs, and the lack of market infrastructure that solved directly or indirectly problems.

For the survey, the main purpose was recorded to capture farmers', vendors' and extension agents' views towards the MLS system design which based on the MLS framework. The survey was conducted using convenience sampling method on a sample size of 30 farmers, 30 agriculture vendors and 30 extension agents, using five scale Likert item questions.

Farmers' perspective: the usefulness of the "farmers interface" on MLS from the farmers' point of view was analyzed. A survey was recorded by Likert item questions with the scale of 1 – 5 (1. Strongly disagree, 2. Disagree, 3. Neutral, 4. Agree, and 5. Strongly agree) in order to collect the opinion of the respondents. The Median and Inter-Quartile Range (IQR) were used. IQR values within the range of 1 to 2 and lower indicated that respondents are polarized towards the similar view, whereas inter-quartile range greater than 2 indicated that respondents deviate from similar views (Table 2).

Results

The median value of 4, Q3 value of 5, and IQR value of 1 for the quantity required and time showed that the majority of the respondents are polarized towards the positive view in terms of MLS providing market information on quantity and time (when required). The median value of 4, Q3 value of 4, and IQR value of 0 for quality and price showed 75% of the respondent had agreed that MLS provided them with quality requirements and expected good price from the vendor.

Similarly, Q3 value of 5 and Q1 value of 4 indicated that 75% of the farmers were optimistic (agree and strongly agree) that the MLS solved their challenges regarding lack of access to markets, inconsistent supply and insufficient production.

Furthermore, the scale was reduced to positive, neutral and negative for analytical purposes. The percentage of respondents with positive, neutral and negative views towards MLS in solving their respective challenges are shown in Figs 1 and 2.

Extension agent perspective

Opinions from extension agents were collected concerning three broad areas, namely a) the information through MLS helped to provide the market infrastructure intervention, b) it was useful in providing early warning for food security and c) the feature in MLS was useful for them to assist illiterate farmers in overcoming the digital gap. Thirty extension agents from the western, eastern, central and southern regions of Bhutan were surveyed. The median value of 4 and 4.5 with IQR value of 1 is shown in Table 3. It indicated that responses were skewed towards "agree and strongly agree". Furthermore, Q1 value of 4 which was the next to the highest possible value which corroborated that at least 75% of the respondents agreed with the statements.

The percentage of participants' responses in terms of positive, neutral and negative views is shown in Figure 3. 90% and 80% of the extension surveyed agents had a positive view on MLS providing information on early warning for food security and market infrastructure respectively. Furthermore, none of the respondents had negative viewed on the feature in MLS that they assisted illiterate farmers (Figure 4).

Vendors' perspective

The gathered data on the vegetable vendors' perspective based on the operational definition of vegetable vendors for this study, the survey was

conducted on 10 vegetable retailers, 10 hotel and restaurant managers and 10 educational institute food managers. The Q1, Q2, Q3 and IQR values of the survey data were shown in Table 4.

The median value of 4 with IQR value 1 indicated that 50% of the respondents viewed that the search feature in MLS helped them in finding the right farmer to solve insufficient supply and inconsistent supply issues. Whereas the median value of 3.5 and IQR value of 2 with Q1 value of 2 indicated that 25% of the respondents had a negative view towards signing a contract with farmers based on the information from MLS (Figure 5).

Furthermore, the scale was reduced to positive, neutral and negative views to understand their opinions (Figure 6). Nearly 40% of the surveyed participants were neutral in their viewed that the search feature in MLS helped them in finding the right farmer and solved insufficient supply and inconsistent supply issues. Whereas, 26.7% of the vendors were reluctant in signing a contract agreement with farmers based on the information provided by MLS.

Therefore, in summary, farmers and extension agents viewed that the MLS used to solve the small-scale farmer in common marketing and digital inclusion challenges. On the other hand, over 50% of the vendors were positive that MLS would be useful, almost 40% were neutral in their opinion and the rest had a negative view.

To further elaborate, MLS design is compared with any e-commerce and social media platform. MLS is a combination of social media and e-commerce platforms. The concept of linkage is e-commerce where customers are linked to a product through an electronic platform. And the concepts of users' profile (farmers, vendors, and products) like the social media models where contact details could be obtained in the form of images and text, which helped the users in contacting each other. Therefore, it can be concluded that with this MLS design showed the system to be able to link small-scale farmers to markets, which promoted their marketing.

This study showed a two-way information flow model by providing a platform where respective stakeholders interacted and shared information. (Figure 8). The model showed the vendors' demand-information stimulated farmers' supply plans, matching demand and supply even before production started. With this approach, there were no recurrent costs for data collection, analysis, dissemination. Moreover, the government can use the information exchanged through the system as the input for planning and intervention purposes.

Furthermore, the user surveys, farmers', vendors' and extension agents' perspectives were recorded to validate the usefulness and helpfulness of the system for various system users. From the market surveyed data, information

on production and how much to produce had significantly positive viewed when compared to the production cost which signifieed that market information on production had and more important to farmers than the production cost. From the vendors' perspective revealed over 50% which positively viewed on MLS solving insufficient production and inconsistent supply, over 40% were neutral. It showed that the respondents neither agreed nor disagreed which indicated that they were least concerned about the importance of MLSs.

The small-scale farmers marketing to vitalize rural communities using Information, Communication and Technology for Development (ICT4D) in Agriculture were recorded. The small-scale farmers' marketing had positive impact on achieving global food security, reducing rural poverty and unemployment. In general, small-scale farmers' marketing was dependent on production potential, the capacity to innovate and having access to the markets. Therefore, using ICT improved the agriculture sector through broader Agriculture Information System (AIS) with production information (PI) and marketing information (MI) was a greater impact on agricultural development (Figure 9).

The production information consisted of information on agriculture inputs and machineries, production technologies, pest and diseases occurrence and control, post-harvest technology, agro-metrology, credit information, etc. The availability of all the information related to agriculture through a single source of information, the system showed beneficial to agriculture stakeholders at large in terms of access to information, which had a positive impact on improving production.

Table 2. Median and IQR values

Variables	**Min**	**Q1**	**Q2**	**Q3**	**IQR**	**Max**
1.Provide market information on						
a) Quantity required	3	4	**4**	5	**1**	5
b) Quality required	2	4	**4**	4	**0**	5
c) Time (when required)	2	4	**4**	5	**1**	5
d) Price (at what price)	2	4	**4**	4	**0**	5
2) Improve access to the market	2	4	**4**	5	**1**	5
3) Solve inconsistent supply	2	4	**4**	5	**1**	5
4) Solve insufficient supply	2	4	**4**	5	**1**	5

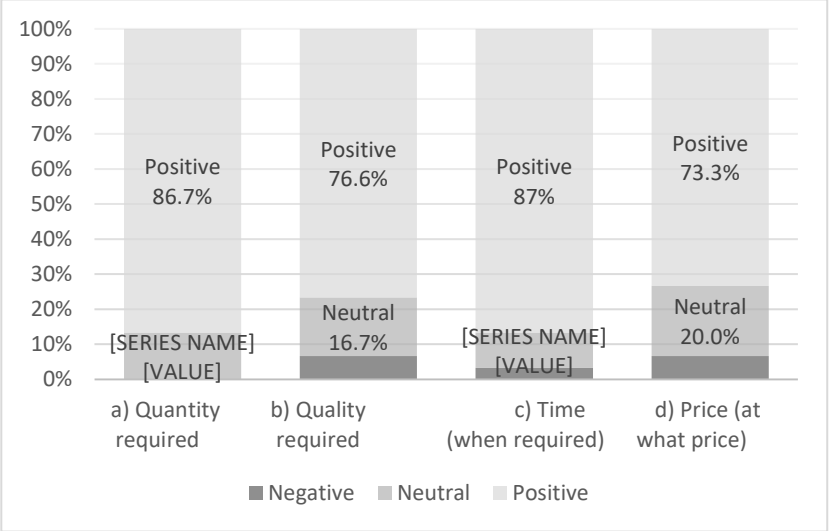

Figure 1. Respondents' views on MLS providing market information

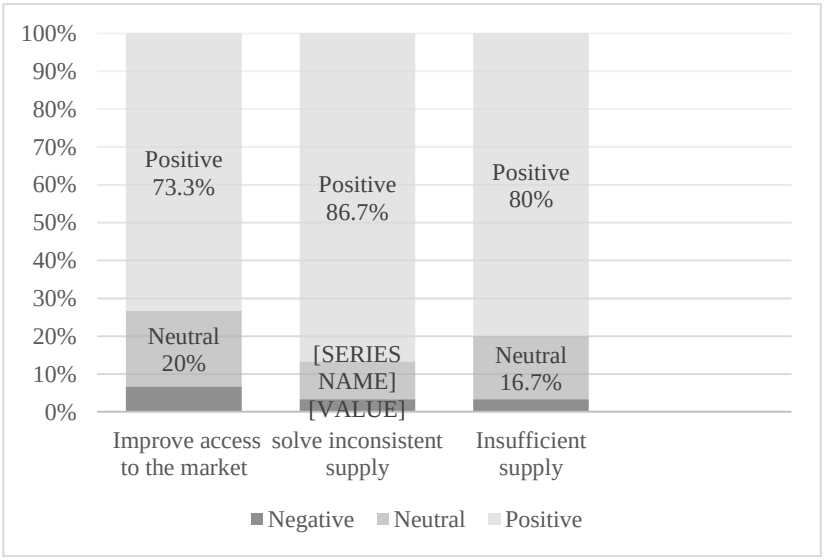

Figure 2. Respondents' views on various challenges

Table 3. Extension agents' perspective

Variable	Min	Q1	Q2	Q3	IQR	Max
Marketing infrastructure intervention	2	4	**4**	5	**1**	5
Early warning for food security	2	4	**4.5**	5	**1**	5
Help illiterate farmers in using the system	3	4	**4**	5	**1**	5

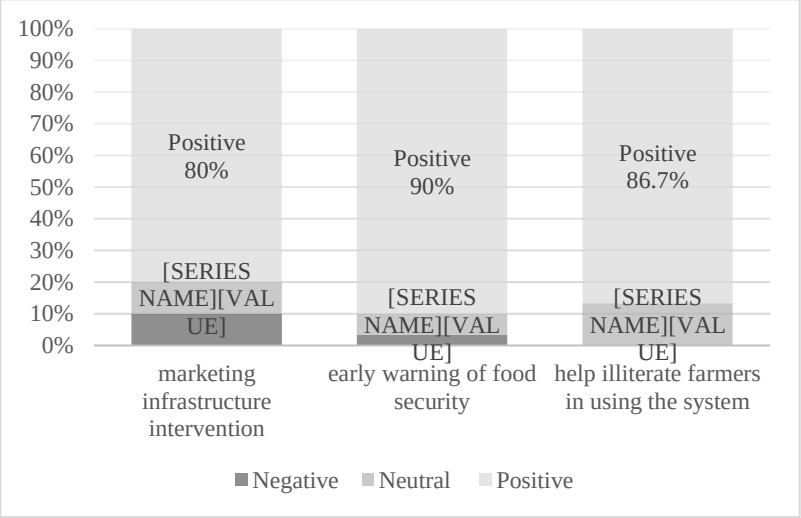

Figure 3. Extension agents perspective

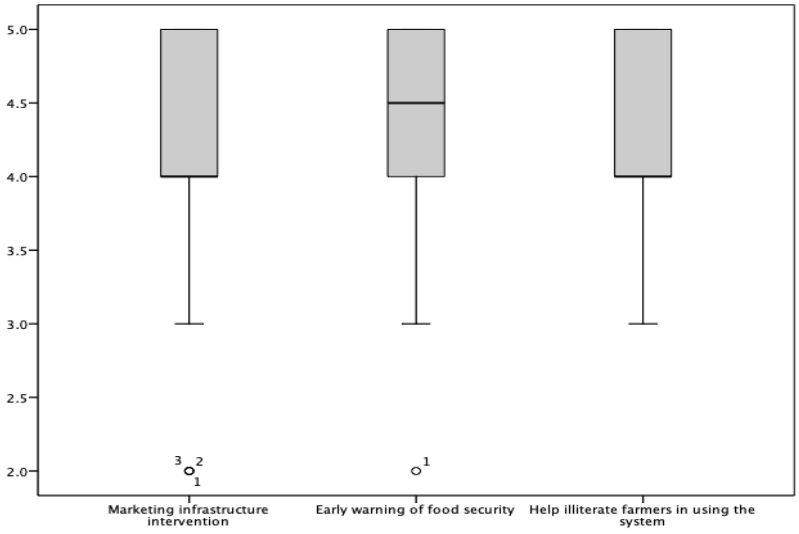

Figure 4. Box plot for extension agents' perspective

Table 4. Vendors' perspective

Variables	Min	Q1	Q2	Q3	IQR	Max
Solve insufficient supply	2	3	**4**	4	**1**	5
Solve inconsistent supply	2	3	**4**	4	**1**	5
Contract production.	1	2	**3.5**	4	**2**	5

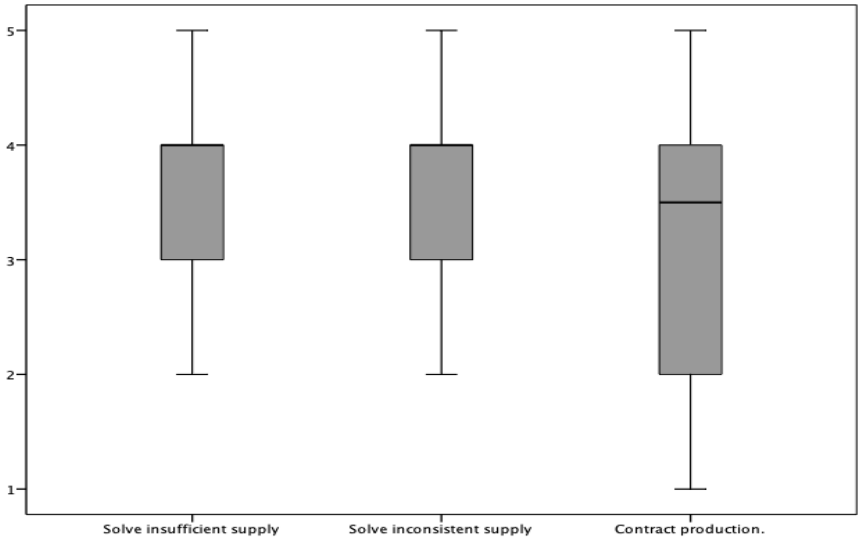

Figure 5. Box plot for vendors' perspective

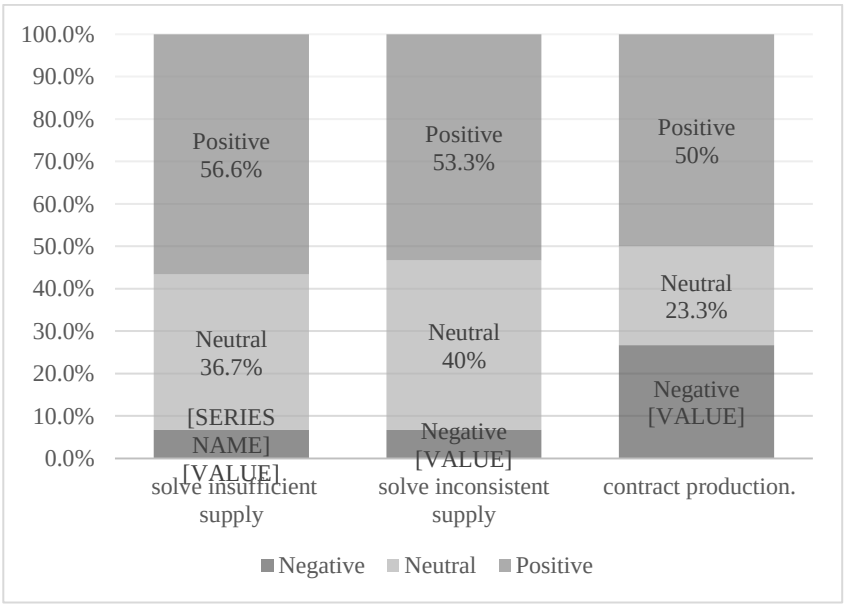

Figure 6. Vendors' perspective

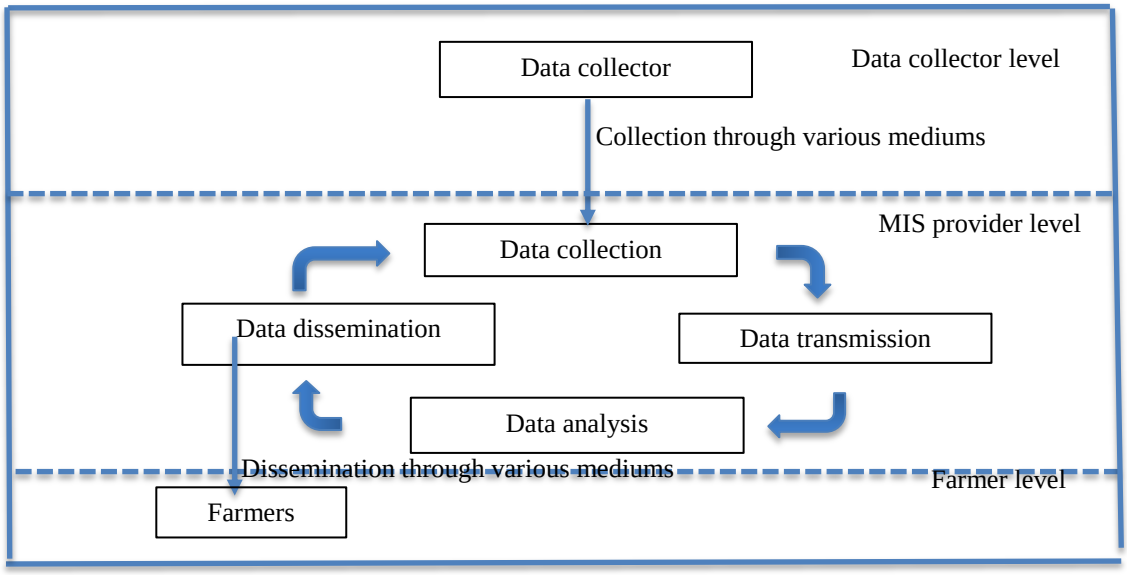

Figure 7. Practiced model of AIMS

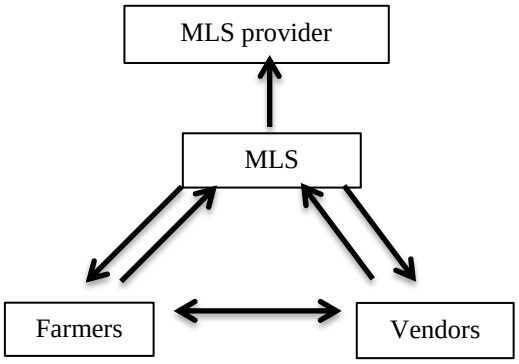

Figure 8. Proposed model for MLS

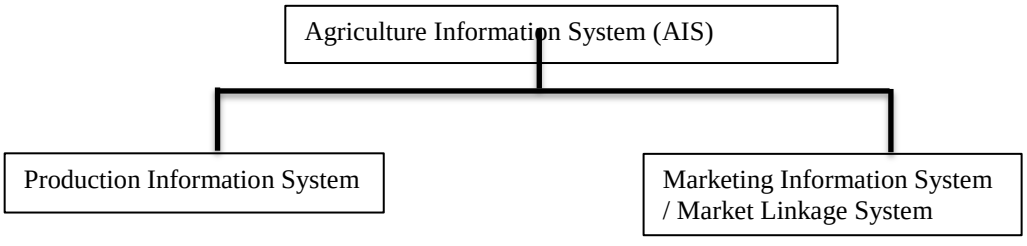

Figure 9. ICT4D in agriculture

Discussion

The small-scale farmers marketing through Market Linkage System (MLS) was improved with positive impact in achieving global food security as described by Jones (2012) and Magesa *et al.* (2014, 2015) and reducing rural poverty as stated by Thorp *et al*. (2005). Agriculture Market Information System (MIS), a well-established concept was developed and implemented for almost a century in developed countries as stated by Magesa *et al.* (2014) and Food and Agriculture Organization,(2017).

Whereas, in the least developed countries the concept was promoted in the 1980s (David-Benz *et al.*, 2011*)* and adopted in LDCs for its sustainability and effectiveness possessed some challenges to the most of the small-scale farmers. It is in consistyent with the study that focused on developing a guide for designing an electronic MLS by reviewing. The challenges was faced by small-scale farmers in marketing and digital inclusion. The trends of existing agriculture MIS were found. The information needed and implemented the plan and sustainability goal. The guide for designing MLS helped MIS designers and MIS which provided in developing effective MIS/MLS with various components to solve small-scale farmers marketing challenges through a farmers and vendors linkage system. These were similar to several designs (Shepherd, 1997; Poon, 2011; Technical Center for Agricultural and Rural cooperation 2015a, 2015b, 2015c, 2015d; Food and Agriculture Organization, 2017) which adopted to the solutions that focused on the vertical integration of MIS activities, where the MIS providers initially recorded data, and transmited them to a central database to analyze and disseminated the data to the farmers through various media. The model was expensive for the dedicated human resources which required in data collection and analysis. Furthermore, it faced difficulty in providing information on quantity and quality in advance as stated by Binayee (2005) and Katengeza (2012). The provided information was either in the past or the present prices, and quantity of product reached to the market.

It is recommended that forming farmers' groups/cooperatives including that contract farms, low cost storage with market information can be resolved insufficient production, inconsistent supply, and good price which also stated by Jama and Pizarro (2008), Baliyan and Kgathi (2009), Jari and Fraser (2009), Rehman *et al*. (2012), Benfica and Mather (2013), Vadivelu and Kiran (2013), Matsane and Oyekale (2014). These helped the digitally illiterate farmer to use of MLS. Moreover, the agriculture extension agents would be helped the illiterated farmers for using the system for extending the adoption rate of MLS.

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