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Poor Farmer, Entrepreneurs and ICT Relation in Production & Marketing of Quality Vegetables in Bangladesh

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Bangladesh is a country where people mostly depend on agriculture. The crop sub-sector of agriculture mainly depends on extensive agrochemicals to increase production and to ensure the national food security. Although, farmers have been using agrochemicals, the production was still found not to increase significantly due to the lack of knowledge about proper and modern cultivation technology. In addition, farmers are getting less income from agriculture compared to another profession, because of the inconsistent price of agricultural produces between the rural and urban area. In order to improve the situation, Kyushu University has conducted JICA (Japan International Cooperation Agency) grassroots technical cooperation project which aims at income generation for BOP (Bottom of Pyramid) farmers by producing and marketing the chemical free quality vegetables using ICT (Information and Communication Technology). The project has been conducted in five rural areas in Bangladesh. Here, the farmers are producing vegetables under a quality vegetable management center (QVMC) which is well equipped with ICT tools, and a quality vegetable entrepreneur (QVE) is helping them regularly to get the desired production and also ensuring the marketing of such vegetables. The project has targeted 100 farmers for producing chemical free vegetables and already got 42 interested farmers in 1.5 years of time. It is observed that farmers get better production under this QVMC in the winter season (called “Rabi” in Bangladesh) than summer season (called “Kharif-1” in Bangladesh).

Key words: Chemical Free Production, Income Generation, Quality Vegetable Management Center

INTRODUCTION

Bangladesh is a developing country with a large number of population. About 77% of the population is living in the villages (Hossain, A. and M. Rahman, 2012). Among them, about 35.2% people of the rural is living under poverty line (Hossain *et al.*, 2010). Here, Agriculture is the main source of food, nutrition, employment and income generation for the majority of rural people. The sector contributes 19.1% to GDP and employs 50.3% of the labor force and crop sub-sector alone accounts for 60.8% share of agricultural GDP (Mondal, 2010). The performance of the agriculture sector regulates the GDP growth rate in Bangladesh. The loss of crop production is a regular phenomenon in Bangladesh due to climate change and natural calamities like flood, cyclone, drought etc.

The soil of Bangladesh is not rich in organic matter. A fertile soil should have at least 2.5% organic matter for better production (Rahman *et al.*, 2014). The soil of about 45% of the net cultivable area in Bangladesh has less than 1% of organic matter (Okonwu, K. and S. I. Menash, 2012). However, rural people of Bangladesh are not aware of this soil condition. Farmers have no knowledge about improving the soil condition by adding organic matter.

The way of proper agricultural information flow in rural areas is very poor in Bangladesh. Farmers are getting quite less agricultural knowledge from government source due to lack of manpower. Different foreign and local NGO's are working on it, but the support is quite limited. Private sector investment in the development of agriculture is so low in Bangladesh. For this reason, our agricultural production is not satisfactory enough. To fill up this production gap, the farmers have mainly depended on agrochemicals. However, they are not getting profit from it due to more production cost and less sale price of products due to lack of proper marketing. This scenario is hindering the economic development of the rural people in Bangladesh. The alarming situation is that people are facing different health problems due to excessive use of chemical based fertilizer and pesticides.

In order to give appropriate information about the modern technology of cultivation and proper marketing of farmer's products, Kyushu University proposed a grass-root cooperation project named “Support to establish a new society of BOP farmers by using the power of ICT (SENSE)”. The goal is to generate income for BOP farmers by providing the knowledge of chemical free farming technology through ICT (Information and Communication Technology) and ensuring proper marketing of farming products. The project is supported by JICA's grass root funding, implemented by Kyushu University, Japan.

The main goal of the project is to establish quality vegetable management center (QVMC) where quality vegetable entrepreneur (QVE) can provide farming and marketing information among rural farmers. The center also can help the farmers to sell their products in the urban

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and local area to generate more income.

METHODS OF THE PROJECT

About SENSE project

SENSE project is three-year project proposed by Kyushu University, Japan and funded by JICA. The project has started in January 2014 and will be ended in December 2016. The project has established in five model villages; Ekhlaspur (Chandpur), Kapasia (Gazipur), Manohardi (Narshingdi), Mirzapur (Tangail) and Basundia (Jessore). Information of these model villages is shown in Fig. 1. The objective of the project is to assist the BOP farmers to produce quality vegetables by using organic compost and organic pesticides. The project supports the whole marketing of the products to generate more income of the farmers by using different tools of ICT. The project is collaborated with four local partners; WIN-incorporate,

Grameen Communications, Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU) and Bangladesh Agricultural Research Institute (BARI). The outline and the role of each collaborative partner are shown in Table 1. The project equipped with its main office in Dhaka (capital of Bangladesh) and local offices in each model villages. The office in Dhaka got 6 regular employees: one coordinator (a role of a general manager and to coordinate with the partnering organizations), one marketing manager (to create marketplace for farming products), two marketing officer (to assist the marketing manager), one technical manager (to answer the farmer's queries by using ICT) and one technical administrator (to maintain the ICT setup in main office and local quality vegetable management center). In the field i.e. in each project site there is one QVE. QVE has monitored farmers' activity, advised the farmers and assisted the marketing of farming products. Detail organization of SENSE is shown in Fig. 2.

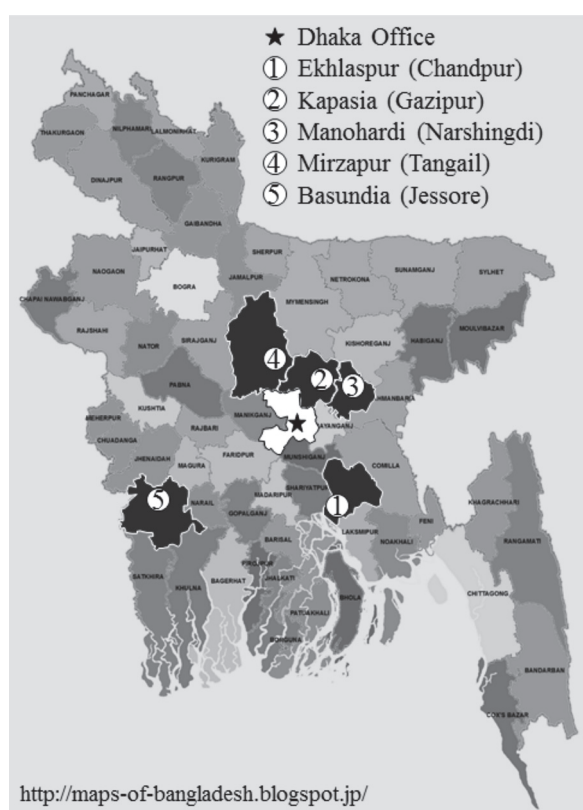


Fig. 1. Model Village of SENSE.

Quality Vegetable Management Center as connecting hub

A quality vegetable management center (QVMC) has been established in each villages. The QVMC is the gathering point of the farmers and a QVE is regularly there to help the farmers. A monthly meeting has been arranged in the QVMC about recent and upcoming farming activities. The farmers have got the following help from the QVMC:

1. Modern cultivation information about vegetables
2. Fertilizer and manure management information
3. Crop and variety selection
4. Diseases and insects control measure
5. Sale information of products
6. Selling the farming products

ACHIEVEMENTS OF THE PROJECT



ICT activities

ICT applications

ICT applications have been used as information platform for cultivation and marketing of the products. Mainly five ICT applications have been used by both farmers and QVE. Features and usage of five ICT applications are described below (Fig. 4).

- (1) "E-agriculture" is a medium where the QVE upload farming activities in both English and Bengali lan-

Table 1. Information of collaborative partner

Collaborative partner	 BSMRAU	 Grameen Communications	 Win-Incorporate	 BARI
Outline for Organization	BSMRAU aims to contribute to agricultural research system and dissemination of agricultural technique and knowledge thorough research, training and field activity.	Grameen communications is a core organization of ICT in Grameen family and develop ICT infrastructure including tele-center network in Bangladesh.	Win-Incorporate provide agricultural technical knowledge and marketing information through internet and contribution to development of farming business.	BARI is the largest multi-crop research institute conducting research on a wide variety of crops and management of crop, soil water etc.
Role of SENSE	provision and teaching if agricultural technique	Construction for ICT environment	Development of ICT contents	Providing soil & product testing and certification

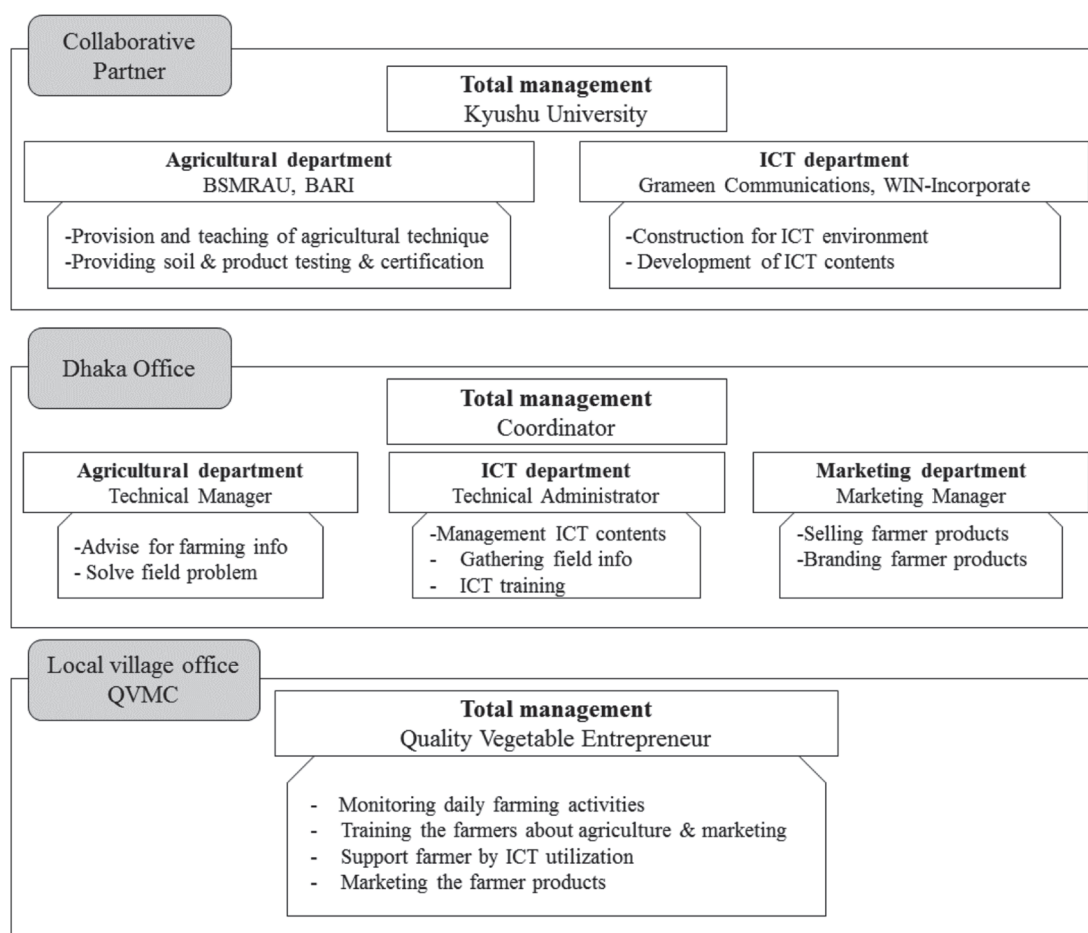


Fig. 2. Organization of SENSE.



Fig. 3. QVMC of Mirzapur, Tangail.

guage (for better understanding of the farmers). It is also communication hub among the farmers, expert and market agent. By using E-agriculture farmers can get immediate solutions of their problems from agriculture experts (Fig. 5).

- (2) "Digital content of learning" is supporting contents of chemical free cultivation method of different seasonal vegetables. The contents have been prepared and updated by our agriculture experts. The cultivation knowledge from the digital contents of learning is used by QVE to teach the farmer about proper cultivation. Farmers are also getting updated information from this content.
- (3) E-commerce is a marketplace of quality vegetable

where the consumer can purchase the products. In addition consumers can see the farming activities and ensure the products safety. It can reduce the intermediaries' activities as this result it can increase the income of farmers.

- (4) Agri-eye is a farm environment monitoring system which can provide decision-making information in farming. The data from the Agri-eye can be used to predict the harvesting time of vegetables and the pattern of different insect pest infestation. Fig. 6 shows example temperature and humidity data obtained at Ekhlaspur in Kharif-1 season.
- (5) Android information gathering system is a smart-phone based application which is used for gathering farming information by text (both English and Bengali) and images. In addition, a real time alert option is available in the application to tell the farmers about weather and market conditions. Android information gathering system is the data entry point of farming activities and a portable learning medium of agriculture and marketing information. Through this system, the farmers can easily send their problems for knowing the solutions immediately. In addition, farmers are getting some alert message through this application (Fig. 7). An android based Tab is being used by QVE to gather the information of farming activities.

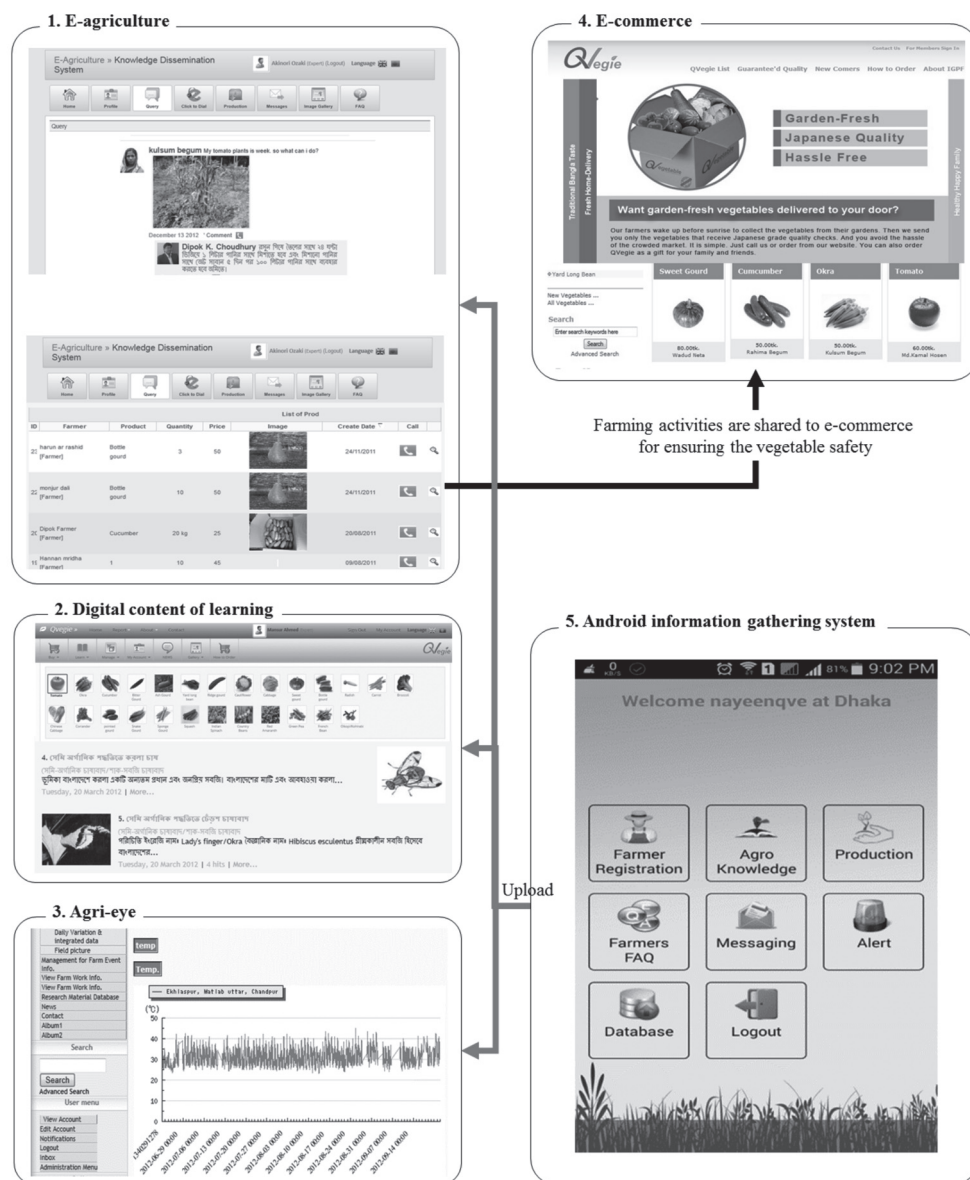


Fig. 4. ICT applications of SENSE.



Fig. 5. Answer farmers' problem by experts.

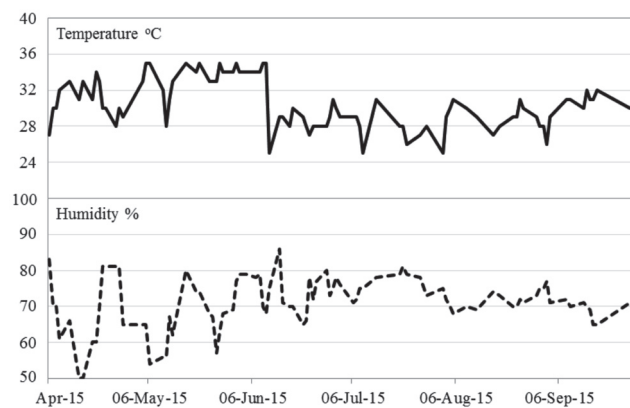


Fig. 6. Temperature and humidity data obtained at Ekhlaspur in Kharif-1 season.



Fig. 7. Android application for farmers.

Agricultural activities

Agriculture training and courtyard meeting

SENSE project has informed the farmers about artificial agrochemical free modern cultivation method and asked their participation in the project. The project has designed to facilitate 100 model farmers from 5 model villages in which 20 farmers should join from each village. After explanation of our activities, about 72 farmers have agreed to cultivate agricultural produces following the project model. Two leader farmers has been selected in each site based on their ability to motivate others. Within the project, a training program has been arranged at BSMRAU to train the farmers about the proper way of cultivation. After that, QVE and leader

farmers have arranged follow up training programs at their respective sites. Leader farmers and QVE shared their learning of modern way of cultivation to farmers who were interested in modern cultivation methods. The table shows the previous training information (Table 2).

A courtyard meeting has been regularly arranged in every month by QVE and leader farmers in each site. QVE and leader farmers have shared the recent and forthcoming information related to cultivation in the meeting. Sometimes, local government agricultural staffs also volunteered to train the farmers. QVE has regularly visited the farming fields, solved the farmers' problems and advised the farming activities.

Farming activities

The farmers have produced vegetables mainly in two seasons named Kharif-1 (16 March to 15 July) and Rabi (16 October to 15 March). The cultivation season is shown in Table 3. The season wise vegetable list is shown in Table 4. The farmers have followed different companion cultivation method to produce quality vegetables. Some cultivation activities of the project are shown in Fig. 8.

Results of harvesting

During the first 1.5 years of implementation term,

Table 2. SENSE agricultural training

Training	Date	Contents	Participants
Explanatory meeting at Ekhlaspur	1–4 April 2014	Introduction of basic concepts of SENSE	SENSE staff: 8
BSMRAU training	25–27 August 2014	Training of cultivation technology, pest management and post-harvest management of summer and winter vegetables	Representative model farmer: 10 SENSE staff: 9
Local training at Ekhlaspur	10 Nov 2014	Training of cultivation technology, pest management and post-harvest management of summer and winter vegetables	Ekhlaspur model farmer: 11 SENSE staff: 1
Local training at Kapasia	10 Nov 2014	Training of cultivation technology, pest management and post-harvest management of summer and winter vegetables	Kapasias model farmer: 15 SENSE staff: 1
Local training at Manohardi	10 Nov 2014	Training of cultivation technology, pest management and post-harvest management of summer and winter vegetables	Manohardi model farmer: 6 SENSE staff: 1
Local training at Basundia	10 Nov 2014	Training of cultivation technology, pest management and post-harvest management of summer and winter vegetables	Basundia model farmer: 20 SENSE staff: 1
Local training at Mirzapur	10 Nov 2014	Training of cultivation technology, pest management and post-harvest management of summer and winter vegetables	Mirzapur model farmer: 20 SENSE staff: 1

Table 3. Cultivation seasons for SENSE

Season	Status	Duration
Winter season (Rabi)	Cropping	15 Oct 2014–15 Nov 2014
	Harvesting	16 Nov 2014–15 March 2015
Kharif season (Kharif-1)	Cropping	10 March 2015–20 April 2015
	Harvesting	21 April 2015–15 July 2015

Table 4. Season wise cultivated vegetables

Cropping Season	Vegetables
Summer (Kharif-1)	Snake gourd, Ridge gourd, Bottle gourd, Sweet gourd, Pointed gourd, Coriander gourd, Sponge gourd, Okra, Yard long bean, Spinach, Cucumber, Bitter gourd
Winter (Rabi)	Cabbage, Cauliflower, Tomato, Lettuce, Broccoli, Chinese cabbage, Carrot, Radish, Coriander, Sweet gourd, Bottle gourd

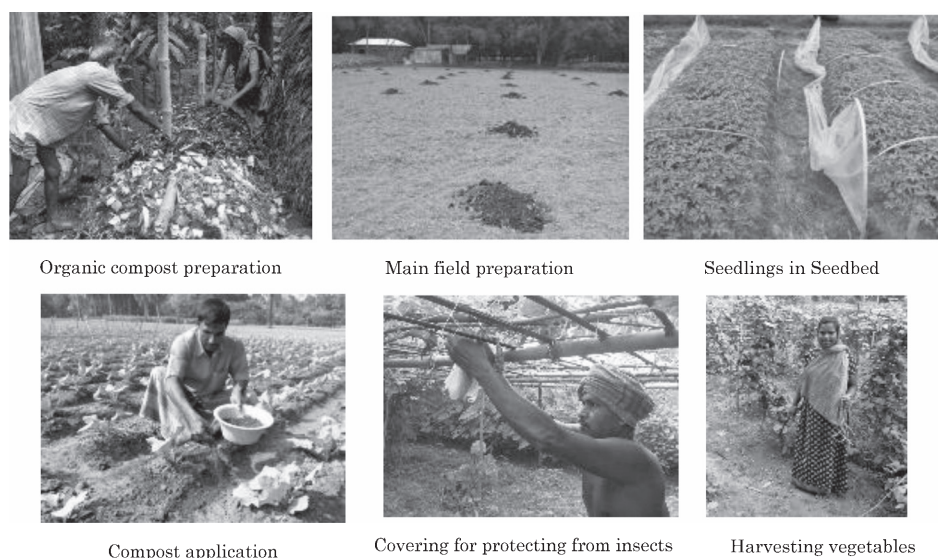


Fig. 8. Cultivation activities by using organic compost and organic pesticides.

Table 5. Yield amount of winter season (Rabi) 2014–15

Location	Cropping term	Products	Yield amount	No. of farmers	Land area (m ²)
Ekhlaspur	Winter (Rabi) 2014–15	Cabbage (Pcs)	1852	11	3702.09
		Cauliflower (Pcs)	1744		
		Tomato (kg)	3109		
		Carrot (kg)	120		
		Radish (kg)	360		
		Bottle gourd (pcs)	590		
		Chinese Cabbage (Pcs)	750		
		Broccoli (Pcs)	490		
		Lettuce (Pcs)	300		
Kapasasia		Cabbage (Pcs)	2227	15	3115.42
		Cauliflower (Pcs)	2082		
		Tomato (kg)	1080		
		Bottle gourd (pcs)	680		
Manohardi		Cabbage (Pcs)	225	6	669.61
		Cauliflower (Pcs)	200		
		Tomato (kg)	120		
		Carrot (kg)	48		
		Radish (kg)	110		
		Bottle gourd (pcs)	195		
		Sweet gourd (Pcs)	90		
Mirzapur		Cabbage (Pcs)	394	20	3924.62
		Cauliflower (Pcs)	2284		
		Tomato (kg)	205		
		Carrot (kg)	105		
		Radish (kg)	1237		
		Bottle gourd (pcs)	862		
Basundia		Sweet gourd (Pcs)	166	20	4248.30
		Cabbage (Pcs)	574		
		Cauliflower (Pcs)	6057		
		Tomato (kg)	1760		
		Bottle gourd (pcs)	416		

the farmers cultivated two seasons. The yield data of Rabi and Kharif-1 is shown in Table 5 & 6, respectively. The yield was decreased in the Kharif-1 season due to frequent heavy rain. The production in Mirzapur (Tangail) was more satisfactory although heavy rain and insect infestation were the major problems. The main reason was the farmers of Mirzapur were very cooperative with QVE to execute his instructions.

Marketing activities

Grading and packaging

SENSE project has emphasized to generate more income for the BOP farmers by selling quality vegetables. A training session for the farmers on grading and packaging has been arranged at BSMRAU. A grading manual was made to teach the farmers about saleable grades. Three-way of grading has been followed during product purchase from the farmers to selling the products in the

Table 6. Yield amount of summer season (Kharif-1) 2015

Location	Cropping term	Products	Yield amount	No. of farmers	Land area (m ²)
Ekhlaspur	Summer (Kharif-1) 2015	Bitter gourd (kg)	62.5	9	1820.70
		Cucumber (kg)	160		
		Okra (kg)	136		
		Yard ling beam (kg)	133.9		
		Ash gourd (kg)	230		
		Ridge gourd (kg)	12		
		Sponge gourd (kg)	130		
Kapasia		Bitter gourd (kg)	40	6	1254.26
		Cucumber (kg)	88		
		Okra (kg)	86.5		
		Ridge gourd (kg)	14		
		Sponge gourd (kg)	61.9		
Manohardi		Bitter gourd (kg)	15.1	6	1335.18
		Cucumber (kg)	32.9		
		Okra (kg)	76		
		Yard ling beam (kg)	164.4		
		Ash gourd (kg)	62.5		
		Snake gourd (kg)	65.8		
		Indian spinach (kg)	74.6		
Mirzapur		Bitter gourd (kg)	490	10	2023
		Cucumber (kg)	154.5		
		Okra (kg)	252		
		Yard ling beam (kg)	187.3		
		Ash gourd (kg)	140		
		Ridge gourd (kg)	136.5		
		Sponge gourd (kg)	291		
		Sweet gourd	504		
Basundia		Cucumber (kg)	20	7	2023
		Okra (kg)	139.75		
		Yard ling beam (kg)	61		
		Ridge gourd (kg)	60.5		
		Pointed gourd (kg)	123		
		Snake gourd (kg)	44		
		Sponge gourd (kg)	227		

market. Initially, the farmers have graded their own product and then QVE has made another grade for sending the product to Dhaka. Finally, an ultimate grading has been done in Dhaka by marketing personnel of the project. Through these three-way the products have been divided into three grade namely rejected, standard

and premium. The rejected graded products has been using for composting and also using as animal feed. The premium and standard graded products have being sold in Dhaka by marketing team. Also, some quantity of the premium and standard graded products has being sold in local market of the villages by farmers. Table 7 shows

Table 7. Product grading information of Dhaka marketing

Cropping term	Vegetable	Before Grading (kg)	Local Grading Passed (kg)	Dhaka Grading Passed (kg)
Winter (Rabi) 2014-15	Radish	290	229	195
	Bottle Gourd	195	171	156
	Sweet gourd	36	35	33
	Cabbage	795	721	651
	Cauliflower	638	582	462
	Tomato	1044	921.5	829
	Broccoli	433	382	334
	Chinese cabbage	612	540	470
	Lettuce	77	65	62
	Carrot	92	73	59
Summer (Kharif-1) 2015	Ash gourd	139	100	96
	Bitter gourd	163	101	82
	Cucumber	211	138	102
	Indian Spinach	49	44	43
	Okra	270	210	174
	Pointed gourd	126	118	112
	Ridge gourd	99	72	52
	Snake gourd	72	62	60
	Sponge gourd	213	155	127
	Sweet gourd	388	388	380
	yard long bean	227	161	132

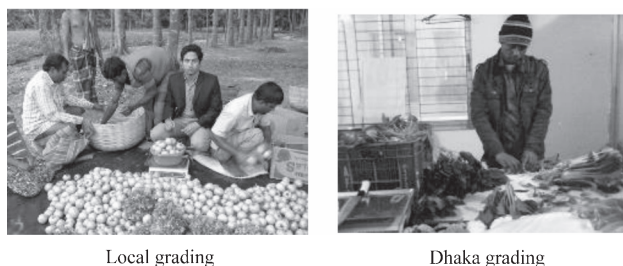


Fig. 9. Grading of vegetables.

Table 8. Transport cost from local site to Dhaka office

Cropping term	Location	Quantity (kg/Pcs)	Transport cost (Tk)
Winter (Rabi) 2014–15	Ekhlaspur	2,029	8,720
	Kapasia	513	4,650
	Manohardi	158	1,250
	Mirzapur	541	4,121
	Basundia	405	4,230
Summer (Kharif–1) 2015	Ekhlaspur	249	4,425
	Kapasia	135	2,660
	Manohardi	190	2,790
	Mirzapur	640	7,662
	Basundia	344	8,121

the grading difference between the local and Dhaka.

Regarding the method of package, bamboo or paper bags have been used for packaging the products in local. While plastic crates have been used to bring the products from the local site to Dhaka. Final delivery packaging have been done by plastic bag or wrapping paper in Dhaka.

Supply chain

The project has been functioning well in terms of selling the product in the rural areas due to less transportation cost and it was found more expensive while selling them in Dhaka because of high transportation cost. The



Fig. 11. Q-Veggie leaflet, Portable stand banner, sticker & product catalog.

project is still trying to find an efficient way to sale the product in Dhaka at lower transportation cost which should help the farmers getting more benefits. The way of the supply chain is shown in Fig. 10.

Branding of products

The project has created own branding name Q-Veggie i.e. Quality Vegetable, a unique brand which provides the

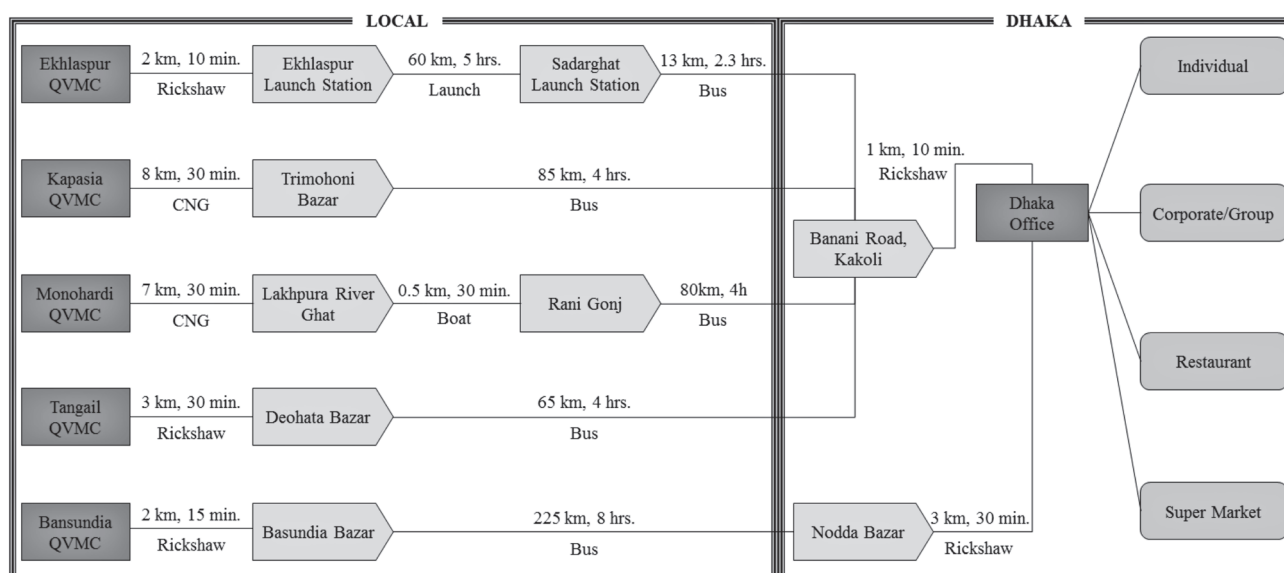


Fig. 10. Supply chain of SENSE.

Table 9. Customer segment of SENSE

Cropping term	Customer Type	Customer Number
Winter (Rabi) 2014–15	Individual	54
	Group/Corporate	4
	Restaurant	2
	Super Store	1
Summer (Kharif–1) 2015	Individual	43
	Group/Corporate	3
	Restaurant	0
	Super Store	2

farmer details and location in its sticker. It indicates expiry date of the products to taste the real taste of the products. In addition, different promotion material such as leaflets, product catalogue, sticker and banner have been used for promotion of the Q–Vegie brand. An e–commerce site has been promoting and selling the products in Dhaka. By doing this, the project can increase the farmer's sales and income as well as sales.

Consumer of the products

The consumers are divided into four segments namely individuals, group/corporate, superstore and restaurant. Now, the project has worked to increase the customers from each segment. Some of the local village people have purchased Q–vegie products from the farmer directly.

OUTCOMES OF THE PROJECT

Farmer

Participant farmers have been able to increase their income gradually through Q–Vegie selling. In Rabi season, we got 72 farmers but in the Kharif–1 season, it was only 42 model farmers for producing quality vegetables. The reasons of decreasing the number of farmers in Kharif–1 were difficulties of pest control, heavy rainfall and needed more labor to produce quality vegetables compared to conventional vegetables.

Production

It was found that the quantity of production was different between Kharif–1 and Rabi season. The production was satisfactory in Rabi season, but it was deficient in Kharif–1 season. The primary reason of the good production in Rabi season was less intervene of natural calamities and pest infestation. In the case of the Kharif–1 season, the natural calamities were the main cause for low production, and pest infestations play a vital role. In the Kharif–1 season, the country was frequently affected by heavy rain, uneven temperature and natural calamities.

Marketing

Marketing of quality vegetables have been tough in local village due to lack of awareness about healthy vegetables among local consumers. Local consumers have not been ready to pay the additional price than the conventional price for quality vegetables. However, foreign

consumers are willing to give a reasonable price. Foreign consumers and some of the rich consumers are willing to pay higher price because they are well–known about chemical free vegetables as well as health conscious.

Transportation

Transportation is a considerable problem for selling the products in Dhaka market. Bangladesh has no available refrigerator van service to transport vegetables from the local site to Dhaka. We have to depend on public transports for bringing products to Dhaka. For this reason, the quality of products has been decreased and damaged significant percentage of the products. In addition, the cost of transportation is high which is accountable for the less profit of the farmers. Now the project has been trying to select the site–specific and high–value vegetables to generate more income for the farmers.

Certification of products

In Bangladesh, there are no facilities to certify raw vegetable products. Consumers have been demanding certification for quality products. The superstores are also interested in quality vegetables, but they want regular supply and certification. A certificate of the quality vegetables is under way which will be the joint effort of BARI and BSMRAU. This certification will create a path to establish a proper system to certify the vegetables.

Seed Sourcing

Good quality seed is the primary demand from the farmer to produce quality vegetables in the rural area since there is no good source of quality seeds in the rural area. The farmers have to depend on the local vendor for seeds. Those seeds are not always good in quality. The project has been trying to establish a link to seed supplier in local area via QVE to ensure the availability of the good quality seeds in the local area. In addition, the project has been encouraging the local seller to collect quality seeds from the authentic source.

Composting

The resources for composting have been decreasing in the rural area. The farmers have to depend on limited natural resources to produce compost. The cow dung is not available in all sites to produce compost. The farmers have to depend on poultry manure to produce compost, but it is not safe for quality vegetable cultivation. The model farmers are facing serious problem to collect resources to produce compost for using in the field. The good quality compost was not possible to prepare due to lack of proper composting resources. The project has been trying to increase the production by incorporating vermicompost (the product of composting different decomposable materials by using worms) and organic compost which is prepared by farmers.

Information source

The good source of information is rare in the rural area. Farmers mainly depend on the local seller of pesticide and fertilizer for their information. The project has

been helping the farmers to get proper information and introduce them with modern cultivation technologies by using the power of ICT. But the ignorance is the main obstacle to accepting the deliveries from the project. QVE has been working to minimize this ignorance obstacle by helping farmers regularly and showing the benefits of modern technologies.

CONCLUSION

SENSE project has disseminated the agricultural and marketing information by taking help from QVE and ICT applications in QVMC. Farmers can acquire right information to increase production and protect their products from different problems by using the ICT tools. The farmers have produced quality vegetables based on consumer interest and sells their products at good price. Currently, the project has been working for identifying the delivery mechanism of the products among consumers, the alternative of poor quality compost due to lack of composting materials and the good source of seeds for the farmer in the rural area. Also, the project has been planning to adopt the high profitable vegetables to hold the interest of the farmers despite of different problems such as heavy rain and pest infestation. The project has

been trying to develop a certification process to ensure the safety of the farmer products by testing the products in the laboratory of BSMRAU and BARI.

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