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People's perception on ecosystem services in organic agroecosystem at Gasa, Bhutan

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ABSTRACT: Organic agroecosystem strives for sustainability through enhancement of soil fertility and biological diversity while limiting the use of synthetic fertilizers and pesticides. It has the potential to provide varied ecosystem services (ES) apart from food. Bhutan started organic farming (OF) officially since 2004 declaring Gasa as 100% organic district. However, knowledge on people's perception on ES in organic agroecosystem is limited. Thus, study was conducted to assess people's perception on ES in organic agroecosystem for direct use value at Gasa district. The sampling for this study was conducted at two levels. Firstly, the district and the gewogs were purposively selected since Khatoe and Khamaed gewogs under Gasa employ OF. The households under selected gewog were sampled using systematic random sampling. A total sample of 52 (N=174) households were selected for this study. Two approaches were employed to examine direct use value: (1) assessed people's perceived value of provisioning and socio-cultural services, and (2) economic value from organic agroecosystem. The respondents perceived That OF has the potential to yield direct use values. Khatoed and Khamaed could avoid the cost of $38.62 and $130.35 respectively for not having to buy organically certified crops. Also, the willingness to accept monetary value on average were $ 1.02, $0.16 $ 0.84 for foreigners, students and visitors from other community respectively. This study would provide knowledge on the potential of OF on ES provision from the point of view of OF practitioner. Since this result is subject to vary overtime, such studies should be conducted at regular period to make precise decision to provide timely intervention.

Keywords: Economic valuation, provisioning services, socio-cultural services

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Introduction

Organic agroecosystem strives for sustainability through enhancement of soil fertility and biological diversity (McCrae-Hokenson, 2014). This strengthens the natural ecosystem and simultaneously enhances the productivity and sustainability (Department of Agriculture, 2006; McCrae-Hokenson, 2014). Bhutan's development ideas are shaped by the guiding principles of Gross National Happiness with the environmental conservation at its core. Since farming is considered as country's backbone of the economy, farming system in Bhutan is gearing towards green development policy. Organic farming (OF) is one such venture to boost economy while conserving natural environment.

Numerous benefits can be drawn from OF through interactions between natural and agroecosystems in the form of ecosystem services (ES) (Sandhu et al., 2007; Sandhu et al., 2010; Dou et al., 2018). OF also has the potential to provide both tangible and intangible benefits similar to natural ecosystems (Millennium Ecosystem Assessment, 2005; Brown et al., 2007; Ash et al., 2010; Sandhu et al., 2010; Crossman et al., 2013; Dou et al., 2018). The four broad categories of ES are (1) provisioning, (2) regulating, (3) supporting, and (4) socio-cultural (Ash et al., 2010). The direct use value yields from provisioning services and socio-cultural services including production of safe food, forage, fibers and raw materials (Chen et al., 2009). The socio-cultural services also helps in maintaining the human health and wellbeing through the provision of spiritual fulfilment, historical integrity, aesthetics and recreation, education, social relation, and inspiration (Millennium Ecosystem Assessment, 2005; Sandhu, 2007; Sandhu et al., 2010).

Bhutan started OF in Gasa district since 2004. While Bhutan implemented the concept of OF decades ago, no study has been conducted to assess people's perception on ES and OF. Such studies are deemed crucial for enhancing the ES obtained through shift in policy. Therefore, this study aims to assess the people's perception on ES in organic agroecosystem for direct use value in Gasa district, Bhutan.

Materials and methods

Study area

Study was conducted in Khatoed and Khamaed gewog (village blocked) in Gasa, Bhutan. Gasa is the first organic district in Bhutan (Duba et al., 2008), officially declared 100 % organic since 2004. The district consists of 572 households with total population of 3419 (Gasa Dzongkhag Administration, 2017). District has four gewogs: Khatoed, Khamaed, Laya and Lunana (National Statistics Bureau, 2017). Khatoed and Khamaed gewogs lies in the region having favorable climatic condition for crop production. Altitude ranges from 2300 to 2900 masl for Khatoe and 1500 to 2500 masl for Khamaed. Khamaed has 114 households and 60 for Khatoed (Dzongkhag Administration, 2018). Varieties of crops are grown in these two gewogs (Wangmo and Iwai, 2018).

Sampling and sample size

Stage 1: Gasa district was purposively selected amongst the two organic districts in the country based on the duration of

the OF practice and certified crops availability. Since Laya and Lunana has unfavorable climatic conditions and few households depending on agriculture, these two gewogs were excluded. A systematic random sampling was then carried out to select the households. Stage 2: Sample size was calculated using the rule-of-thumb 30 % of the total population (Terwee et al., 2012) and the sample size deduced for analysis was 52 households (i.e 30 % of 114 and 60 households of Khamaed and Khatoed respectively). Stage 3: The total number of households was obtained from the district report (Gasa Dzongkhag Administration, 2017). After calculating the total sample size, respondent households were selected using systematic random sampling. Then the sampling interval (S.I) was calculated using the following equation (SMART Methodology, 2012);

$$S.I = \frac{\text{(Total number of Households)}}{\text{(30\% of the total households)}}$$

After calculating the S.I, the villages in the selected gewogs were approached for interview. A first random number was generated to select the first household and the subsequent households were selected by adding the value of S.I on the first household selected. The head of the households of the selected households were interviewed for the study.

Data collection

Primary data was collected using semi-structured questionnaire. Data collected for provisioning services were types of food and fodder crops grown. Data for SCES include education, recreation, social relation, aesthetic, inspiration and employment. The economic value was calculated for the farm gate price of the products (for provisioning services). SCES value was calculated using contingent valuation method (willingness to accept the value).

Data analysis

Descriptive analysis was performed using Microsoft excel 2016. Provisioning services analyzed include types food produced, and the fodder grown. The SCES were analyzed based on method used by Dou et al., (Dou et al., 2018) as shown in **Table 1**. The respondents who perceived the SCES from OF (that is respondents who agree and strongly agree with the statement divided by total respondents [N=52]) from the total respondents.

Results and Discussions

Demographic characteristics of respondents

The turnover of respondents was more female (88.89% in Khatoed and 67.65% in Khamaed) than the male (11.11% in Khatoed and 32.36% in Khamaed) **(Table 2)**. Majority were from the age category of 26-65. The extremes being 19 to 71. According to the National Statistics Bureau (2018), the age 15 to 65 years are considered productive population. The productive population is considered having maximum experience in farming, thus, study involved experienced respondents. Majority (88.89% from Khatoed and 50% from Khamaed) of the respondents were illiterate.

Table 1 Assignment rules for the presence/absence of each socio-cultural ecosystem service.

Description	SCES presence	Assigned value	Average value (0 to 2) and the corresponding assigned rank
Strongly disagree with/have no idea about the statement	No	0	No value
Agree with the statement	Yes	1	0-1 (Low value)
Strongly agree with the statement	Yes	2	1-2 (High value)

Table 2 Demographic characteristics of respondents

Traits	Description	Number of respondents	
		Khatoed	Khamaed
Age	16-25	0	2 (05.88%)
	26-35	2 (11.11%)	5 (14.71 %)
	36-45	4 (22.22%)	5 (14.71%)
	46-55	5 (27.78%)	8 (23.53%)
	56-65	5 (27.78%)	11 (32.36%)
	66-75	2 (11.11%)	3 (08.82%)
Gender	Male	2 (11.11%)	11 (32.36%)
	Female	16 (88.89%)	23 (67.65%)
Education	Primary	1 (05.56%)	2 (05.88%)
	Secondary	1 (05.56%)	4 (11.76%)
	Bachelor's degree	0	2 (05.88%)
	Monastic education	0	1 (02.94%)
	Non-formal education	0	8 (23.53%)
	Illiterate	16 (88.89%)	17 (50%)

Food

Food, the primary provisioning service of organic agroecosystem in the study area include mainly the vegetables **(Figure 1)**. As of now carrot, garlic and potato are given organic certification. Study showed that 100% of the respondents of Khatoed gewog grew all three certified vegetables. From Khamaed, 52.94%, 58.82% and 85.29 % of carrot, garlic and potato were grown respectively. It was found that the farmers in Khamaed grew more of cereals (especially rice) than vegetables (Wangchuk, 2018). It was also observed that Gasa is self-sufficient in terms of vegetable production. The trend in the production and diversity of organic crops in Gasa has been increasing as per the data of Department of Agriculture (Wangmo and Iwai, 2018).

The specialty of OF is its provision of a varied, nutritional and safe food (Das et al., 2017; Rundgren, 2002). Moreover, many studies stated the potential of OF in yield increase in the marginalized areas (Duba et al., 2008; Scialabba and Müller-Lindenlauf, 2010).

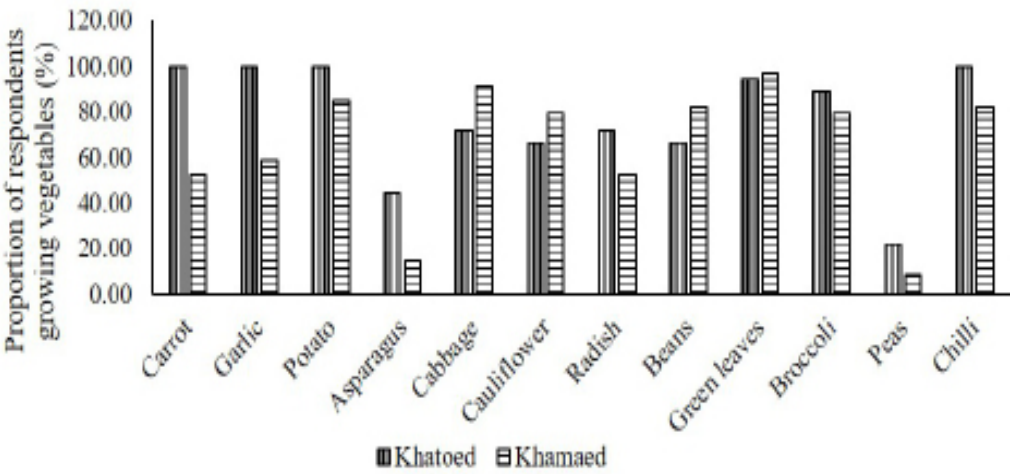

Figure 1 Respondents growing different vegetables in Khatoe and Khamae.

Fodder

Farmers grow fodder for their cattle on cropland for use during the lean season. Around 87% of the respondents mentioned that they collect fodder from their field. Farmers who collect crop residuals such as maize stalk, beans plant, radish and turnip for their cattle were 89% and 85% from Khatoed and Khamaed respectively **(Figure 2)**. Besides cattle feed, fodder also improves the better management of the environment (Horne and Stür, 1999; Daily, 2000; de Groot et al., 2002; Sandhu et al., 2010) and are safe due to pesticide free (Baker et al., 2002). Growing fodder restores vegetation and control erosion because crops rehabilitate the landscape and improve biodiversity in addition to enhancing livestock nutrition and productivity (Food and Agriculture Organization, 2016).

Socio-cultural services

Result showed that farmers perceived all six Socio-cultural services (SCES) (**Table 3**). The relevant factors that contributed to each services were similar to that identified by Sandhu et al. (2007) and Millennium Ecosystem Assessment (2005). They stated that SCES provide human health and well-being through recreation, aesthetics and education, spiritual fulfilment, historical integrity, recreation and aesthetics, education, social relation, and inspiration (Millennium Ecosystem Assessment, 2005).

The mean perceived value was highest value (mean=0.88) perceived were that OF creates scenic beauty, sense of joy and provide recreational services **(Table 3)**. It was observed that the scenic beauty was created by planting diverse crops and hedges. And farming was considered a recreational services. Dou et al. (2018) stated that agriculture landscape provides recreational services through outdoor activities.

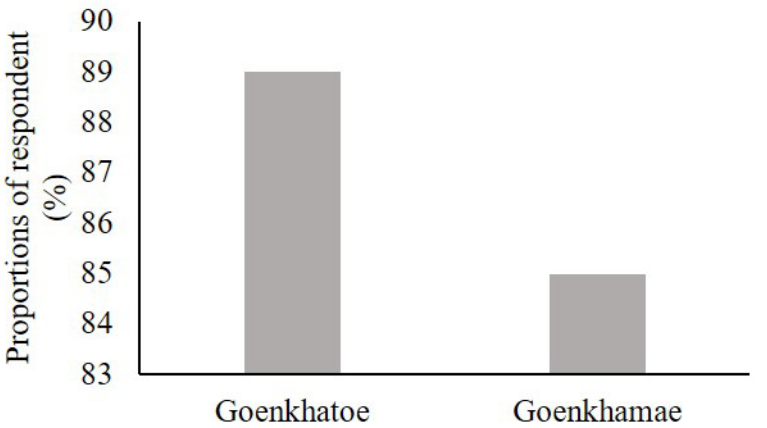

Figure 2 Proportions of respondents growing fodder crops on farm in two study areas.

Educational service

The respondent perceived that highest SCES was educational services which scored 35.65%. And out of five factors under educational service, the highest perceived value was "OF helped understand the importance of native crop conservation" which scored 84.6%. According to IFOAM (2005), OF is a system which inculcates the wholesome education. OF can provide educational services by uncovering the inherent values of OF (de Groot et al., 2002; Millennium Ecosystem Assessment, 2005; Sandhu et al., 2010). OF is not just about management of farm and production of food but also considers environment, health of the producer and consumers in a chain of food production (IFOAM, 2012).

Moreover, OF considers the traditional knowledge coupling with modern methods invaluable for development (Department of Agriculture, 2006). Thus, the practice of OF as per its definition and principles provide deeper and comprehensive educational services about multiple dimensions (Department of Agriculture, 2006; Tashi, 2015). OF system opens the space for more innovations for better system (De Bruin and Ensor, 2018). A better understanding of how multiple ES respond to socio-economic drivers can help to restore multiple ES which requires better education (Chen et al., 2018). All these studies reveal that organic farming imbibes education inherently and no OF is possible without farmers having better education on the system. OF provides holistic education to multiple stakeholders.

Table 3 SCES perceived by respondent and the interpretations of the meanings of each SCES

SCES and proportion of values (%)	Relevant factors for each service (Organic farming has helped the following):	Proportion of total respondents who perceived the SCES (%)	Mean perceived value
Education (35.65)	Understand the environmentally friendly agriculture practices	78.8	0.85
	Understand the importance of native crop conservation	84.6	0.85
	Understand the importance of nature conservation	80.8	0.81
	Understand more about nutrition	78.8	0.79
	Understand consequences of chemicals	76.9	0.77
Social relation (17.17)	Increases the involvement with multiple stakeholders	48.1	0.35
	Strengthen community bond	86.6	0.87
	Gain customer trust	57.9	0.58
Inspiration (10.98)	Inspired other communities	59.6	0.60
	Inspired youth to take up agriculture	63.5	0.63
Aesthetic (22.14)	Scenic beauty is created	88.5	0.88
	Create sense of joy	71.2	0.71
	Sense of touch by the diversity of crops	88.6	0.88
Recreational (7.89)	Provide recreational exercises	88.4	0.88
Employment (6.17)	Provide employment opportunity	69.2	0.69

Social relation

Social relation showed the third highest contributor to SCES with the proportion of 17.17%. It was found that three factors (1) Increase in involvement with multiple stakeholders, (2) Strengthening of community bond, and (3) Gain in customer trust were present.

As inscribed in National Framework of Organic Farming in Bhutan (NFOFB), "Integration of traditional knowledge, joint problem solving, and farmer to farmer exchange can improve community relations and lead to greater involvement and commitment of producers" (Department of Agriculture, 2006). It can also provide the space for the growers to get together in the process of farming (Duba et al., 2008; McCrae-Hokenson, 2014). OF enables actors of different social backgrounds to share their knowledge and build trust and contribute to the cohesion of a network, to its progressive structuring, and this interaction is the necessary platform to produce innovation and local change (Favilli et al., 2015).

There is a fundamental significance of social learning (SL) to agricultural innovation, which can be operationalized by framing agricultural innovation as changes in understanding, practices and relationships (De Bruin and Ensor, 2018). OF system is the system that encourages SL by integrating multi-stakeholders (Department of Agriculture, 2006). Similarly, OF in Khatoed and Khamaed involved farmers of different age group and gender, extension officers and Department of Agriculture. The SL supports the emergence of agricultural innovations that bring equitable benefits are sustainable and are innovative in context (De Bruin and Ensor, 2018).

Inspiration

The proportion of contribution to socio-cultural ecosystem services (SCES) in the form of inspiration was 10.98%. The factors contributing to these services were (1) OF inspired other communities, and (2) OF inspired youths to take up agriculture.

OF has the potential to provide source of inspiration as one of the important services (Millennium Ecosystem Assessment, 2005). This is supported by the fact that organic certification actually brings the producers and consumers closer to each other, through its mediating process that is based on trust which can be a source of inspiration for the global players on the market (Luttikholt, 2007). OF can be a source of inspiration for the ecological civilization for development of society (Løes, 2015; Tiejun et al., 2012).

According to Barton (2018), OF drew inspiration from the past in which the millions of people, institutions and governments turned the gaze backward to look at the past as a source of guidance and wisdom. The inspiration seemed to be perpetual as it has come from the past and is continuing to inspire the present and future. In fact, the term organic is getting more popular around the world. This shows the spatio-temporal factors contributing to sustainable quality. Having sustainable quality that has minimum impacts on social and environment without compromising the economic benefits is one the main factors that inspire the governments and institutions.

Aesthetic

Aesthetic services accounts for 22.14% of the total SCES. Amongst the factors under aesthetics, 88.6% and 88.5% of the respondents agree that OF increases sense of touch seeing hedgerows and trees around and sense of touch by the diversity of crops.

According to Hansen et al. (2006); and Nemes (2009), OF has the potential to contribute to aesthetic value. OF holds a special position and potential in nature and landscape values owing to the incorporation of the nature protection as its central principle for farming and also serve as a tool to improve the natural habitat (Hansen et al., 2006). The system provides aesthetic services through the plantation of hedgerows, shelterbelts or trees (Sandhu et al., 2010).

Recreational

Recreational service accounts for less than 1/10 (7.89%) of the total SCES. However, 88.4% of the respondents reported that OF has provided recreational services.

OF provide recreational services such as accommodation and recreational activities for the visitors (de Groot et al., 2002; Hansen et al., 2006; Nemes, 2009).

For instance, the Druk Organic Farm in Toktokha under Punakha district, an Integrated Agriculture Technology farming Wang Sisina farm was designed for the purpose to offer "recreational exercise" to the government employees (McCrae-Hokenson, 2014).

Employment

Result showed that employment creation was found least contributor to SCES (6.17%) in proportion to the other identified services. This could be due to the preferences of majority on white collar jobs.

However, Gasa district employed the total population of 2077 on agriculture sector as of 2015 (National Statistics Bureau, 2016). Several studies shows that OA has the potential to create employment opportunity. (Dabbert et al., 2004; Knudsen et al., 2006; Badgley et al., 2007; Gross National Happiness Commission, 2013;). Millstone and Lang (2003) as cited in Sandhu et al. (2010) stated that agriculture is the single largest employer in the world.

Economic values from provisioning services

Khatoed and Khamaed could avoid the cost of $38.62 and 130.35 respectively for not having to buy carrot, garlic and potato **(Table 4)**. The production is solely for self-consumption except for the farmers group who produce as cash crop. They sell only the surplus; thus, few quantities of products were sold in 2017.

The net income from the sale of the certified crops were $85.35 and 186.50 for Khamaed and Khatoed respectively. The income is expected to increase over time as the production is increasing in consecutive years (Wangmo and Iwai, 2018). According to Department of Agriculture (2016), the estimated average income for Bhutan from carrot, garlic and potato were $ 24.63 (calculated from million ngultrum 38, 797 and 32 respectively, total population depending on agriculture). Certifeid crops from Khatoed and Khamaed fetched higher income than the average national income.

Economic value from socio-cultural services

Study found that the willingness to accept monetary value were on average $ 1.02, $0.16 and $ 0.84 for foreigners, students and visitors from other community respectively. According to Dou et al. (2018), cultivated land was perceived as more important than forest for SCES provision. In addition, residential areas were perceived as providing significant SCES because of local traditions that produce close and highly social neighborhood bonds in agricultural landscapes. However, farmers of Gasa perceived that their farm has the potential to provide wholesome education, aesthetic value, social relation and inspirations.

Table 4 Income statement of the farmer

Cash inflow	Khatoed		Khamaed	
	Cost avoided (USD)	Amount earned (USD)	Cost avoided (USD)	Amount earned (USD)
Carrot	30.64	34.29	27.86	25.71
Garlic	171.43	139.29	171.43	98.57
Potato	77.14	196.43	77.14	107.14
Gross profit	279.21	370	276.43	231.43
Expenditure				
Seed	57.73	0.64	1.08	1.08
Labour	134.29	134.29	105.00	105.00
Powertiller	5.71	5.71	5.71	5.71
Oxen	42.86	42.86	34.29	34.29
Total expenditure	240.59	183.50	146.08	146.08
Net income	38.62	186.50	130.35	85.35

Farmers practice ecological intensification by maintaining the traditional way of farming practices as an approach for organic farming. Similarly, Sandhu et al. (2007) agriculture provides these services as farmers conserve field-boundary vegetation or enhance landscapes by planting hedgerows, shelterbelts or native trees. For instance, arable farms in Canterbury are characterized by highly managed shelterbelts which resulted in earning high cultural ecosystem services.

Conclusions

Study found that OF practitioners in Gasa perceived the potentiality of OF in providing varied ecosystem services. It was found that OF not only for food provision but also provides varied ES. This finding is in line with many studies that OF has potential to provide ES similar to natural ecosystem. Therefore, this study would help multi-stakeholders broaden the opinion on OF. Also, this study justifies the need for incentive requirement for producers to encourage more OF. However, more such studies need to be conducted to determine the contextual factors which are subject to change.

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