OPEN ACCESS

Journal of Agricultural Extension and Rural Development

May 2018
ISSN 2141-2170
DOI: 10.5897/JAERD
www.academicjournals.org

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Vol.10(5), pp. 84-88, May 2018
DOI: 10.5897/JAERD2018.0952
Articles Number: D2032A056860
ISSN 2141-2170

http://www.academicjournals.org/JAERD

Journal of Agricultural Extension and Rural Development

Review

Impact of productive safety net program in rural community of Ethiopia: A review study

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Received 9 March, 2018; Accepted 28 March, 2018

Ethiopia lunched Productive Safety Net Program (PSNP) as social protection program since 2005 to tackle the causes of food insecurity. Even though, the country lunched the PSNP there are different challenges that hinder proper implementation of program for attaining intended impact on rural community. This paper seeks to review the impact of Ethiopia's PSNP and its implementation challenges through qualitative approach. Different literatures were reviewed on PSNP, which were done at national, regional and district level. The literatures were obtained through internet search from Google, Google scholar and database. Among 84 papers retrieved, only 28 of the published and unpublished organization reports, research reports and policy briefs were reviewed based on their relevance to the topic. According to the review, there are irreconcilable results regarding to the impacts of PSNP. Accordingly, PSNP has both positive and negative impact on beneficiaries' social, economic and environmental development. Thus, before implementation, the government should consider social, economic, environmental issues and available resources. Therefore, concerned bodies should consider impact of the PSNP and family support on the beneficiaries' livelihood, and they should depend on panel data.

Key words: Challenges, Ethiopia, impact, Productive Safety Net Program (PSNP), social protection.

INTRODUCTION

Even if there is a success story in reduction of hunger and poverty in some countries of South Asia and sub-Saharan Africa, the overall prevalence of hunger and poverty progress has fallen slowly. Most of the people in these countries live in rural areas and rely on agriculture as the source of their income. Due to the prevalence of hunger and poverty, they become chronically food insecure (FAO, 2015).

To reduce and/or prevent poverty and hunger, many countries in the developing world increasingly recognized that social protection measures have paramount role. Many studies also support that social protection programs have been successful in reducing hunger and poverty. Social protection program has positive impacts on local communities and economies to increase and diversify their food consumption, child and maternal

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welfare as well as fosters more investment in the education and health of children, and reduces child labor (FAO, 2015).

In the developing world, there are different challenges that face rural community to be food secure (Anderson and Elisabeth, 2015; Wiseman et al., 2010). For the chronically food insecure people, social protection programs appear as innovative and radical solutions, even though they vary from place to place (Food Sovegnity Brief, 2013). The Social Safety Net (SSN) programs which are well designed and operational responds to natural hazard (World Bank, 2013).

In Ethiopia "the Food Security Program was launched in 2003, and the Productive Safety Net Program (PSNP) was formally launched in 2005" to tackle food insecurity by government and fund providers. The PSNP is social protection, which makes household and community responses to shock and stress more resilient and improves food security through provision of financial, literacy training, technical and business advice, and linkages to credit or livelihood transfers, as well as follow-up support (Anderson and Elisabeth, 2015). It is the largest social protection program in the world particularly in sub-Saharan Africa to address food insecurity. In the developing world like Ethiopia, the PSNP as social protection program is the most ambitious and comprehensive program to tackle food insecurity in the rural poor. However, a number of challenges were facing the program to achieve its objectives (Brown and Teshome, 2007).

The Ethiopian climate is multifaceted variability of rainfall and temperature. As a result, the country has a long history of large-scale famines triggered by an extreme drought, most notably in 1973-1974 and 1984-1985. To tackle such issues in the community, government ratified and implemented a number of social protection programs like PSNP. Currently, the government implements the fourth; 2015-2020 phase of the rural PSNP 4 as one major component of the government's strategy to address climate vulnerability (MOA, 2014). The main function of the PSNP is to provide timely and predictable transfers to chronically food insecure households. Nevertheless, the amounts of the transfer vary from region to region (Maier, 2014). The transfer may be in the three forms: cash, food, or a combination of both. Combination of food and cash does not transfer on the same time rather, households receive food for some months of the year and cash for the rest of the months (Devereux et al., 2008; MOA, 2014).

To the best of author's knowledge, only a few empirical studies have been done so far regarding impact of PSNP in the Ethiopian context. Generally, empirical evidence related to the impact of program on rural community provides incompatible results. Some of the studies are based on data collected soon after the implementation of the program or based on cross sectional data, and some of empirical studies and evaluation reports have focused on household-level investigation. Thus, the paper tried to review the different organizational reports and empirical studies to contribute knowledge on the challenges of PSNP's and its impact on rural community. The paper addresses the key questions like: What are the causes of food insecurity? What are the challenges that encounter PSNP implementations to attain intended objectives? What is impact of PSNP in Ethiopia? Therefore, the objectives of the review were to: (1) Identify the causes of food insecurity, (2) Review the impact of PSNP and, (3) Review the challenges that hinder PSNP implementation.

The information of the paper may be significant for the government, policy makers, donor organizations and researchers. The paper may help the government to take corrective measures and considerations for implementation of PSNP and give insight to recognize the gap of the policy and strategies on PSNP. Further, the review will be significant for policy makers to settle successful PSNP and food security enhancement practices. Besides, the result of the review will benefit fund providers that operate in the field of PSNP generally food security program by revealing the existing situation in the country. Lastly, the review paper may be important for researchers to indicate gaps that should be filled in future through their investigation.

METHODOLOGY

For this review, secondary information and study findings were utilized involving qualitative approach through narration. Secondary data were obtained through internet search from Google and Google scholar. The author search papers by providing directly the name of the title and with other related terms. Totally, 84 papers were obtained from Google and Google scholar. In addition to Google and Google scholar, the author also searches databases (Science direct, Scopus and Pubmed), but there are no additional literatures relevant to the topic. Subsequently, the author read the literatures collected from different sources. After thorough reading of the papers, only 28 of the published and unpublished organization reports, research reports and policy briefs were screened based on their relevance to review topic. Out of 28 papers, 9 of them were written before 2013 year, but the rest of them were written within 2013 year and after. Almost all papers were recent within five years later. The review study was made based on review of empirical studies and reports, which are done through analysis of cross sectional, panel and time series data.

RESULTS AND DISCUSSION

Causes of food insecurity in Ethiopia

Most people who live in rural areas and depend on agriculture as income generating activity were faced by food insecurity (FAO, 2015). Agriculture is the source of food and income for over 85% of the Ethiopian population, but drought becomes the main cause of livelihood crisis particularly for the rural community. As a result, most people are chronically food insecure and

around 10 million people, who are chronically food-insecure, are targeted to PSNP (FSIN, 2017). Failure to invest on the sufficient local food production and the collapse of pastoral livelihoods are the current food security crisis in Ethiopia. Some places of the Oromia, South Nations Nationalities and People and Somali regions have been threatened by the drought (FAO, 2017).

Even if the level of food-insecurity varies from one region to the other (Sewnet, 2015; FAO, 2017; FSIN, 2017), different scholars and organizations identify many causes of food insecurity which retard the development of the community in the rural area. The major causes of the food insecurity in Ethiopia are drought, volatile and record-high prices, population displacement, flood and localized insecurity (FSIN, 2017). According to Sewnet (2015), the major causes of food insecurity in Ethiopia are natural disasters (drought and climate change), population growth, land fragmentation and degradation and lack of infrastructure. The major causes of the food security according to the Welteji et al. (2017), are low rate of agricultural production, low access to food, the limited capacity of infrastructures and local markets, HIV/AIDS, investment power, finance gap, poor health, shortage of water and poor sanitation, environmental degradation, climate change and natural disasters, conflict and persecution.

The Ethiopia PSNP as social protection program

Social protection is a program with provision of cash or in-kind transfers to the poor as means of reducing poverty and economic and social vulnerability (FAO, 2015). In general, social protection has three components such as social assistance, social insurance and labor market protection. Social assistance programs are cash or in-kind transfers or public works programs. Programs that provide cover for designated contingencies affecting household welfare or income are called social insurance programs. However, labor market programs offer unemployment benefits to the workers through building skills. Hence, it increases workers' productivity and employability (FAO, 2015). The government of the Ethiopia implements the social protection program, that is, cash or in-kind transfers or public works programs for chronically food insecure community (Care, 2014). Such type of social protection program in Ethiopia is known as PSNP. It was launched 2005 to smooth consumption of chronically food insecure households by providing transfers of cash and/or food during lean months to address both the immediate and underlying causes of food insecurity (Brown and Teshome, 2007; Care, 2014). Like other world countries, Ethiopia is under taking PSNP to meet the need of vulnerable households and communities' to address food insecurity. The program provides cash or food for work and it benefits more than seven million people (Care, 2014). The PSNP aims are to reduce household vulnerability, protect household assets, improve household resilience and provide labor to create community assets (e.g. check dams and roads). In general, the target of the program is for graduate participants from food insecurity into sustainable food secure (Brown and Teshome, 2007).

Analysis of challenges of PSNP implementation

The government of Ethiopia and the donors were involved for the success of the program to attain its objectives. However, some factors affect the implementation of the program. The factors that hampered the program were capacity, ideologies of graduation and dependency and timeliness of transfers and donor funding (Brown and Teshome, 2007). The other problem or challenge that faces implantation of the program was inadequate financial resources. As result, a small number of beneficiaries were allowed to participate in the program (Fisseha, 2014). According to Mohamed (2017), accessibility of assets has influence on the government strategies to be under taken. Besides, study results indicate that geographical location, administrative (selection mechanism used for eligible household), and exclusion of poor with inclusion of rich, weak institutional linkages and lack of active community participation in the decision making process were the challenges for the program (Fekadu and Ignatius, 2009).

According to the Teshome (2013), some of the challenges of the program were targeting of beneficiaries and inability to distinguish between acute and chronic food insecurity at grassroots level, application of single wage rate at national level, lack of the capacity to manage, unprecedented amount of cash flowing into the district and linkage problem at grassroots level. The challenges that face PSNP implementation were inclusion and exclusion of beneficiaries, poor conservation, and limitation of awareness of beneficiaries, linkage problem of officials, lack of manpower in remote areas, lack of monitoring and evaluation of locally constructed infrastructures for their sustainability (Welteji et al., 2017).

Analysis of impacts of PSNP on rural community

A number of studies conducted show that PSNP has a positive impact on the rural community (Andersson et al., 2011; Debela and Holden, 2014; Gebresilassie, 2014; Mohamed, 2017; Welteji et al., 2017; Zoellick, 2014). According to Debela and Holden (2014), the PSNP has positive effect on children through providing short-term nutritional benefits. The finding of Zoellick (2014) indicates that PSNP has positive impact through preventing households from selling productive assets; facilitating

new investment, income increase, reductions in stunting and an increase in household food provisions, infrastructure as well as food security for households. Hence, it has improved food security, use of educational and health services and agricultural productivity. PSNP has positive effect on consumption, livestock holdings and productive assets of the household as indicated by Gebresilassie (2014). The participation of household in PSNP has positive and statistically significant effect on food consumption and on their livelihood (Mohamed, 2017). The PSNP has positive effect on the participant household. Therefore, that it helps beneficiaries for consumption smoothing and asset accumulation (Welteji et al., 2017).

However, some scholars conclude that PSNP has negative impact on the rural community (Mamo, 2011; Hayalu, 2014; Beshir, 2011; Gilligan et al., 2009; Sabates-Wheeler and Devereux, 2010; Adimassu and Kessler, 2013). Some of the negative consequences of the PSNP program were developing sense of dependency syndrome (Hayalu, 2014). According to Mamo (2011), household failed to enhance asset accumulation if they are incorporated under PSNP. According to the earlier researchers (Beshir, 2011; Gilligan et al., 2009; Sabates-Wheeler and Devereux, 2010), PSNP has negative effect on welfare/asset building and consumption. Adimassu and Kessler (2013) reported that PSNP has also negative effect on soil erosion control measures.

Conclusion

The causes of the rural community for the food insecurity are many and varied. Some of the major causes of the food insecurity are low level of agricultural production, drought, environmental degradation, limited capacity of infrastructures and disease. Different scholars have come up with different challenges that face rural community. The challenges that face implementation of the PSNP were different in different places. In Ethiopia, different empirical studies have been conducted in different parts of the country and impacts of the PSNP vary according to the study area. Some of the studies have shown that PSNP has been enhancing infrastructure, increased asset creation, environmental transformation, increased utilization of education and health services and improved agricultural productivity. However, some studies show that PSNP has negative impact on beneficiaries such as developing sense of dependency syndrome, consumption smoothing, asset accumulation and soil erosion control measures. Impacts of PSNP implementation were indicated to be multi-dimensional, which vary from place to place. The studies conducted have also their own limitations such as being area and variable specific, depending only on cross sectional data and unable to show presence or absence of family support to examine impact of program. Therefore, the government and other concerned bodies like researchers have to conduct researches that consider social, economic, environmental issues and resource availability of the beneficiaries in each region, that enable them to obtain baseline information regarding the root cause of their food security, before further PSNP implementation in Ethiopia. Researchers should consider overall impact of the PSNP and family support on the beneficiaries' livelihood, and they should depend on panel data to investigate the impact of PSNP at national level.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

ACKNOWLEDGEMENTS

The author special thanks go to Mr. Kindie Fentahun Muchie (Assistant professor) and Mr. Awoke Worku Dessie (lecturer) for their technical assistance provided during review of different literature.

ABBREVIATIONS

PSNP, Productive Safety Net Program; **FAO,** Food and Agriculture Organization; **SSN,** Social Safety Net; **MOA,** Ministry of Agriculture; **FSIN,** Food Security Information Network; **HIV,** Human Immune Deficiency Virus; **AIDS,** Acquired Immune Deficiency Syndrome.

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Vol.10(5), pp. 89-98, May 2018
DOI: 10.5897/JAERD2018.0953
Articles Number: 572CBC856866
ISSN 2141-2170

http://www.academicjournals.org/JAERD

Journal of Agricultural Extension and Rural Development

Full Length Research Paper

Pollinator habitat: A cooperative project between the landfill industry and blueberry growers

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Received 10 March, 2018; Accepted 6 April, 2018

Bee decline is a threat worldwide. An extension project was initiated to make the general public, industry, and municipalities aware of this problem. This study demonstrated pollinator habitat suitable for Maine farms by developing cooperation between the Maine wild blueberry industry and a regional commercial waste landfill. The reason for involving the landfill industry was to demonstrate and encourage non-farm enterprises to become involved in pollinator conservation. This project arose from previous research of ours on pollinator reservoirs in the Maine (USA) wild blueberry agro-ecosystem with the objectives of: (1) comparing three seed mixes, (2) providing demonstration areas where farmers and the general public can see such gardens, and (3) encouraging others to plant for pollinators. The methods involved planting two types of gardens in 2015, one that contained three different commercially available pollinator forage seed mixes, and one that contained shrubs and some perennials that are visited by pollinators early and late in the season, but that are not readily grown in a wildflower meadow. For all three seed mixes, at least some plant species produced flowers that were visited by bees, but there were also gaps in flowering and some species on which we saw few bees. We observed more bees coming to flowers of corn poppy, tall yellow clover, oxeye daisy, black-eyed Susan, anise hyssop, and bergamot. Ox-eye daisy and black-eyed Susan were not in any of the seed mixes but were allowed to grow among the sown plants. More than 600 people came through the booth or toured the gardens at four open houses in 2015 and 2016, and many people know of the project through presentations we have given. The stakeholders and public learned about bees and floral resources. Several municipalities and farmers have planted pollinator reservoirs since this project was initiated.

Key words: Pollinator reservoirs, wildflower seed mix, demonstration, landfill, wild blueberry.

INTRODUCTION

Pollinator decline is a major problem worldwide (Potts et al., 2010, Lever et al., 2014), especially for the most important pollinators, the bees (Garibaldi et al., 2009). Decline of pollinators has significant implications not just for crop pollination, but for the reproduction of most wild angiosperm plants that are the basis of natural

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landscapes (Dibble et al., 2017). They could be impacted by pesticides, natural enemies, diseases, habitat degradation (through invasive plant encroachment), habitat fragmentation, and climate change (Brown and Paxton, 2009; Goulson et al., 2015; Kerr et al., 2015). In the northeastern United States, there is evidence that most species of bees have maintained their historical abundances over several decades, or even increased, although some species have declined (Bartomeus et al., 2013). Therefore, in Maine where a large economically significant obligate bee pollinated crop is grown, wild blueberry, there is much concern.

Many believe that conservation and enhancement of bee habitat is one strategy that might reduce risk to threatened bee species in the northeastern U.S. (Dibble et al., 2018). Pollinator habitat improvements have been an emphasis supported by the USDA Natural Resources Conservation Service (NRCS) as of the 1990s and early 2000s. Over the past ten years, several studies have shown that habitat modification (Venturini and Drummond, 2018) and pollinator plantings or reservoirs can increase bee community abundance for both crop and native wild flower pollination (Venturini et al., 2017a; Dibble et al., 2018). We have been researching plantings to enhance pollinators in Maine wild blueberry (*Vaccinium angustifolium* Aiton) production. Native bees are an important component of blueberry pollination (Drummond, 2016; Asare et al., 2017; Qu and Drummond, 2017) and bee communities respond to planting of floral resources adjacent to wild blueberry fields and wildflower field edges with the result of increased yield (Venturini et al., 2017b; Drummond et al., 2017). The seed mix that we have tested in wild blueberry is described in a Maine Cooperative Extension factsheet (Venturini et al., 2015). Improving pollinator habitat has many benefits, not least of which is to improve pollinator services for crops, and to meet habitat requirements for the 268 species of native bees documented for Maine (Dibble et al., 2017). For most of these bee species, specific habitat requirements are incompletely known, but geographic areas with poor floral resources have low bee diversity and abundance (Groff et al., 2016; Dibble et al., 2018). To aid wild blueberry growers in determining if their fields are in need of higher bee abundance via pollinator plantings we have provided a video tutorial on estimating wild blueberry fruit set and bee pollinator strength (Skinner et al., 2014) and a tool (BeeMapper, https://umaine.edu/beemapper/, Du Clos et al., 2017) for them to locate their field and obtain estimates of native bee abundance.

To increase habitat for native bees beyond the neighborhood of wild blueberry fields, we obtained funding through a USDA/NRCS Conservation Innovation Grant to engage the landfill industry in a cooperative effort with blueberry growers to enhance flowering resources needed by bees. Our project was designed to demonstrate potential for pollinator habitat on a large scale, e.g., larger than a single farm. The project duration was 3 years, September 1, 2014 - August 31, 2017.

MATERIALS AND METHODS

Sites

In 2015, two types of plantings were installed at each of two sites, and in 2016 another garden was established at a third site. We were hosted by our cooperators, Casella Waste Systems in 2015 at the Pine Tree Landfill (hereafter "PTLF"), in Hampden, ME and in 2016 at Juniper Ridge Landfill (hereafter, "JRLF") in Alton, ME, and by G. M. Allen and Son, Wild Blueberries Inc., on Rte 15 in Orland, ME (headquarters unit), hereafter "GMAS", in both years.

Planting herbaceous plants

The first planting type was a pollinator strip or wildflower meadow about 30 m long and 10 m wide, for which we purchased seed mixes available from Applewood (the blueberry pollinator seed mix for Maine; Venturini et al., 2015, 2017b), Ernst Conservation Seeds (mix for Northeastern Pollinators, minus tall lupine, which is invasive in Maine), and Johnny's Selected Seeds (pollinator mix). We divided the total length of the pollinator strip into three sections, each about 10 m long by 10 m wide. The second planting type was a perennial/shrub border about 10 m by 5 m, with plants grown at the University of Maine or purchased from local nurseries. Plant species for the pollinator strip are listed in Appendix A, and purchase information and site preparation notes are in Appendix B. Species grown in the perennial/shrub border at three sites are listed in Appendix C.

Perennial shrub planting

In the perennial/shrub border we demonstrated plants not suitable for a seed mix, but that contribute important floral resources from early spring (willow) to late in the growing season. In June 2015, we installed two perennial/shrub borders. At GMAS, this second planting was located near the gift shop. At PTLF, it was located near the railroad track as no woody plants can be planted on the landfill where they might compromise the water-proof cap beneath a layer of soil. The third site, JRLF in Alton, Maine, was planted in July 2016 in a planting ringed with boulders and filled with compost; this was about 15 m × 5 m in area. Plants are listed in Appendix C.

Site preparation

Site preparation for the pollinator strip was in October 2014 at GMAS, continued in June 2015, and at PTLF in June 2015 (Figure 1). This consisted of rototilling by tractor, application of commercial compost (at GMAS), and raking by hand. At PTLF, a tractor was used to prepare the site at the top of the landfill. At GMAS, a tractor was used to spread a commercial compost mix contributed by Casella Waste Systems. In June 2015, at both sites, seed was mixed with Vermiculite and applied by hand broadcasting, then the seedbed was rolled with a water-filled roller, and a layer of straw was applied. The number of people who worked on raking, sowing, rolling, and spreading straw varied from seven at PTLF to nine at GMAS, and took about 5 h at each site (35 - 45 person-hours, not including machinery operations).

Measures of floral and bee abundance

In 2016, we made repeated observations and photos from the same

Figure 1. Site preparation at one of the GMAS blueberry fields. Photo shows delivery of Casella Organics GroMax® and Nutrimulch® at the pollinator strip site, which was roto-tilled in mid October and again in June the following year before planting.

vantage points to track changes in abundance of flowers and bees in the three seed mixes. We also inventoried bees on flowers starting in September 2014 and throughout the growing season in 2015 using insect sweep nets and small cups. We continued to collect bees and had their identifications confirmed by bee taxonomists. The specimens are housed at the Maine State Museum.

RESULTS AND DISCUSSION

Year 1: Plant response

At GMAS, rainy weather in June and early July 2015 led to a surge of weeds from the soil seed bank that overtook all three seed mixes despite an application of Poast© by Judith Collins of the University of Maine in early July. Lamb's quarters or pigweed (*Chenopodiium album*), common ragweed (*Ambrosia artemisiifolia*), and witch grass or quack grass (*Elymus repens*), grew densely and as tall as five feet in some parts of the pollinator strip, but sunflowers in the Applewood flower mix offered important floral resources to bees. Perennials emerged in sufficient abundance that it seemed worthwhile to hand weed the following season to create openings for the perennials. The pollinator strip was mowed by GMAS to a height of less than 20 cm in October 2015.

At PTLF, the pollinator strip was overtaken by Canada thistle (*Cirsium canadense*), lamb's quarters (*C. album*), and quack grass (*E. repens*). No herbicides can be used on the capped landfill. During the growing season in 2015 we weeded by hand with help from students but the weeds quickly grew back. The pollinator strip at this site was abandoned, though the perennial/shrub border was successful, producing an abundance of flowers all season, and allowed documentation of a European wool-carder bee that frequented flowers of anise hyssop (Table 1).

Year 2: Plant response

We maintained the three seed mixes by hand weeding once every two weeks, and fertilizing them once (June) with Osmocote™, a slow-release fertilizer. Several plant species that were visited by pollinators, including oxeye daisy, yarrow, and black-eyed-Susan, were not in the seed mixes. To replace the demonstration at PTLF, Casella Waste Systems chose to install a new garden next to the landfill at JRLF. The new garden was successful at having an abundance of ironweed, Joe pye-weed, oregano, white borage, and other plants in flower into early October 2016.

Bee abundance

At both sites there were already many bees present

Table 1. Thirty bee species documented at GMAS (blueberry field) and PTLF (landfill) from September 2014 through October 2015, 1 denotes presence.

Family	Species	GMAS	PTLF
Andrenidae	*Andrena wilkella*	1	1
Andrenidae	*Andrena carlini*	1	
Andrenidae	*Andrena crataegi*		1
Andrenidae	*Andrena milwaukeensis**		1
Andrenidae	*Andrena miserabilis*		1
Andrenidae	*Andrena sigmundi*		1
Andrenidae	*Andrena virginiana*	1	
Andrenidae	*Andrena wheeleri*		1
Andrenidae	*Andrena wilkella†*	1	1
Andrenidae	*Pseudopanurgus andrenoides*	1	
Apidae	*Apis mellifera†*	1	1
Apidae	*Bombus bimaculatus*	1	
Apidae	*Bombus impatiens*		1
Apidae	*Bombus sandersoni**		1
Apidae	*Bombus ternarius*	1	
Apidae	*Bombus vagans*	1	
Apidae	*Ceratina calcarata*		1
Apidae	*Ceratina dupla**		1
Apidae	*Melissodes illata**		1
Apidae	*Nomada luteoloides**	1	
Colletidae	*Colletes simulans*		1
Colletidae	*Hylaeus affinis**	1	
Halictidae	*Halictus confusus*		1
Halictidae	*Halictus ligatus*		1
Halictidae	*Lasioglossum leucocomum**	1	
Halictidae	*Lasioglossum nigroviride**		1
Halictidae	*Lasioglossum versans**		1
Megachilidae	*Anthidium manicatum†*		1
Megachilidae	*Coelioxys rufitarsus**		1
Megachilidae	*Megachile latimanus*	1	1
Totals		**13**	**21**

† denotes exotic bee species (n=3); * denotes unusual in context to other bee collecting sites in Maine, 2000 – 2015 (Dibble et al., 2017) (n=10).

before we began the habitat improvement activities, and this could reflect lack of pesticides and relative abundance of bees under existing conditions. During 2014 and 2015 we documented 30 bee species total, with 13 species at GMAS and 21 species at PTLF (Table 1). Eleven of these are somewhat unusual compared to historical data and our other recent collections (Dibble et al., 2017; Bushmann and Drummond, 2015; Drummond et al., 2017), though none are known to be truly rare and might be temporarily less abundant than they have been in the past. Half of the diversity was comprised of digger bees (Andrenidae) and sweat bees (Halictidae). This was consistent with Bushmann and Drummond (2015). One of the most noteworthy is Sanderson's bumble bee (*Bombus sandersoni*).

Assessing seed mixes, based on the pollinator planting at GMAS

Photo documentation provided adequate information for assigning ranks according to the abundance of flowers in the three seed mixes (Figure 2). We also had sufficient observations on plants to rank relative visitation rate by bees (Figure 3). We documented flowering periods of the most visited plants (Figure 4). Each seed mix had strengths and weaknesses through the flowering season. All were successful in that pollinators were observed visiting each of the plots. Many other insect pollinators and beneficial insects were observed (Figure 5), suggesting that these pollinator plantings play a multifaceted role near crops.

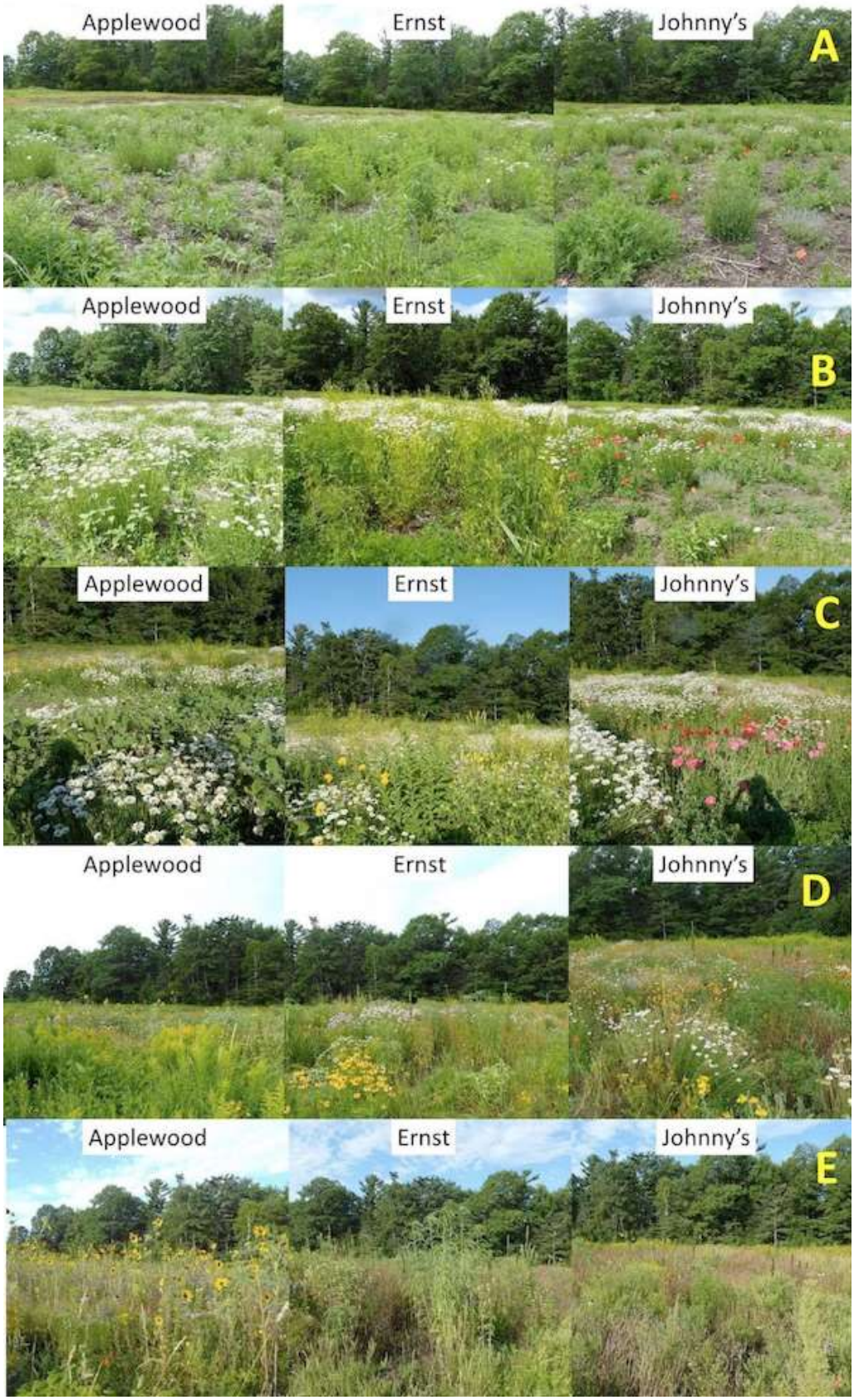

Figure 2. Views of 2016 GMAS (blueberry field pollinator planting) three pollinator seed mixes on 5 dates: A) 14 June, B) 30 June, C) 13 July, D) 29 July, and E) 25 August.

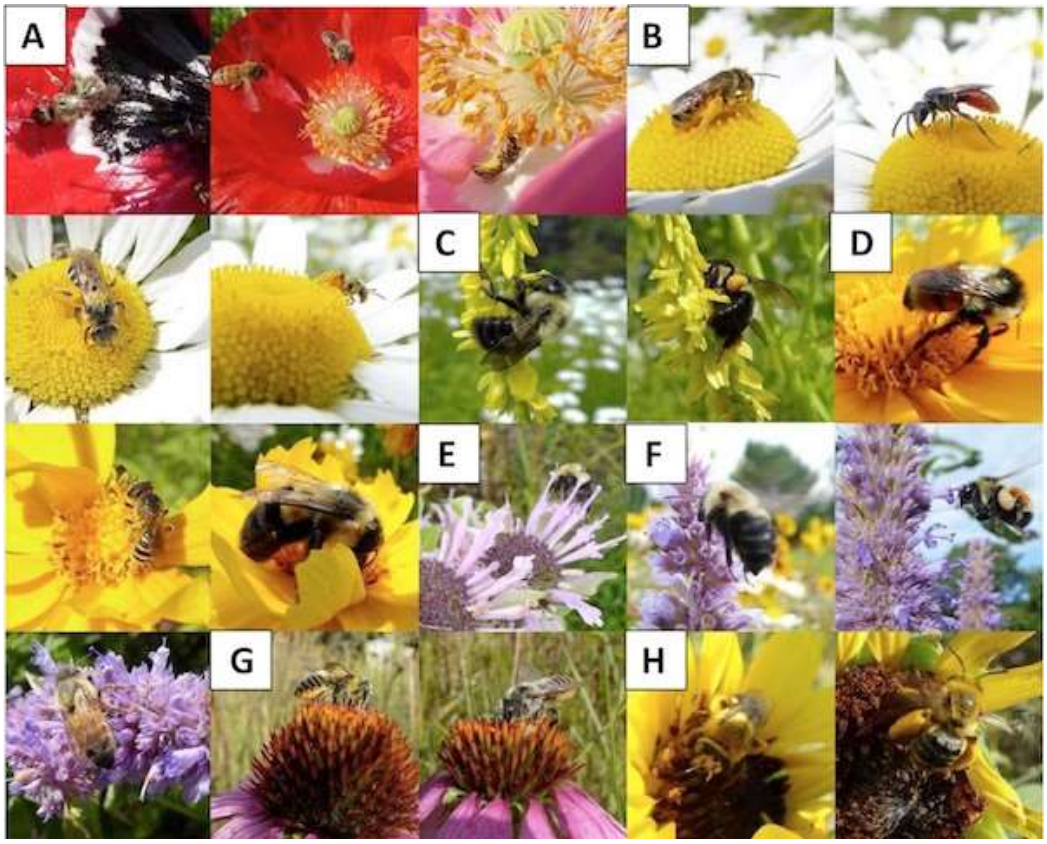

Figure 3. Top plant species growing in pollinator strips according to insect visitation: A) Corn Poppy, B) Ox-eye Daisy, C) Tall Yellow Clover, D) Lance leaf Coreopsis, E) Wild Bergamot, F) Anise Hyssop, G) Purple Cone Flower, H) Wild Sunflower.

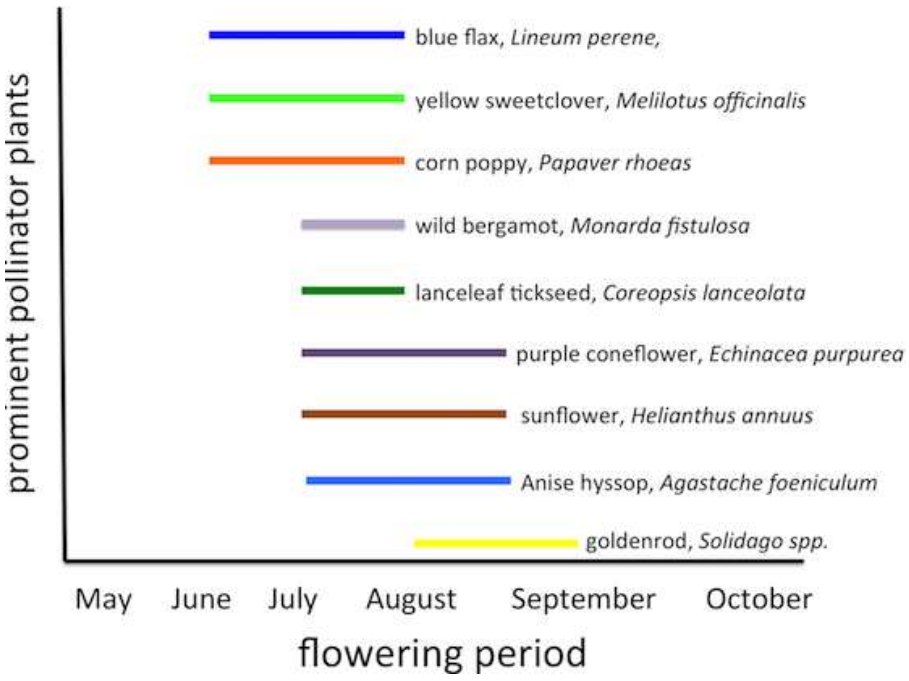

Figure 4. Flowering period for some of the most prominent pollinator plants in the pollinator strips at GMAS in 2016.

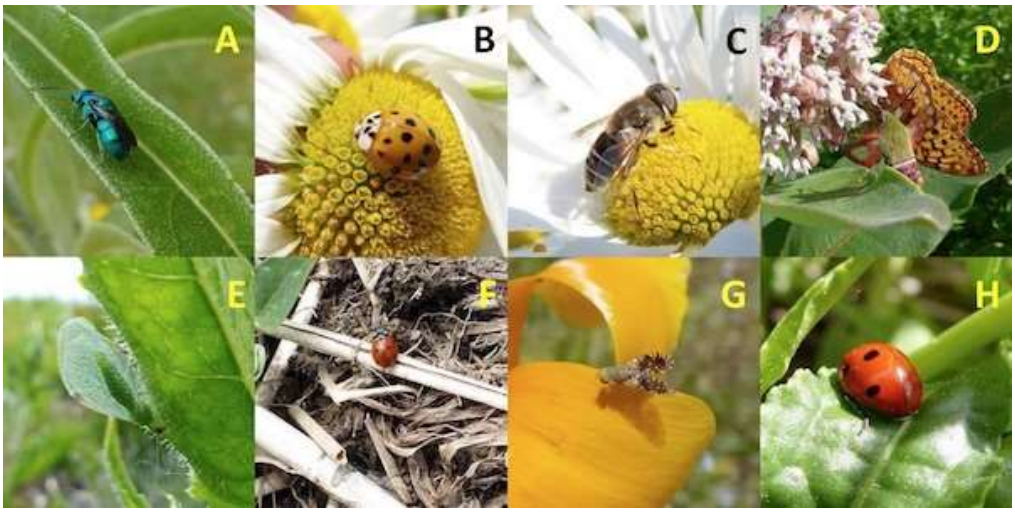

Figure 5. (A) Bees, (B, F, H) ladybeetles, (C) flower flies, (D) butterflies, (E) lacewings, and (G) picture wing flies were observed in the pollinator plantings.

Early season

The earliest flowering plants from the seed mixes were forget-me-not (starting in late May), blue flax, and various poppy varieties (middle of June). All of the earliest flowering plants were in the Johnny's plot. These were followed by tall yellow clover, lanceleaf coreopsis, and a mustard plant species. All of these flowers were present in the Ernst seed mix at the highest density, the Applewood and Johnny's seed mix had lanceleaf coreopsis as well but at a much lower density. The beginning of bloom for these flower mixes was the end of June.

Mid-season

From the end of June through the end of July none of the mixes contained a large abundance of flowers from any one species. Milkweed flowered at a high density just outside the pollinator strip at GMAS. Milkweed seed was included in the Ernst mix but few flowered in the plot, and might develop in subsequent years. From early July into September, black-eyed Susan was present in the surrounding landscape and also in the plots. Plant species that bloomed in late July included plains coreopsis, anise hyssop, purple coneflower, tidy tips and wild bergamot. All except plains coreopsis and tidy tips were included in the three seed mixes; plains coreopsis was not included in the Ernst seed mix. Tidy tips were included only in the Johnny's seed mix.

Late season

All three seed mixes produced adequate abundance of flowers through late season. Tall sunflowers were abundant in the later part of the growing season, with lesser abundance of New England aster and purple coneflower.

Top plants

The plants with the highest abundance were corn poppy, tall yellow clover, oxeye daisy, black-eyed Susan, anise hyssop, and wild bergamot. These plants flowered between the beginning of June and early September, and each began and ended their flowering period at different dates (Figure 4).

Bee visitation

Overall, the plants with the highest bee visitation were corn poppy, tall yellow clover, oxeye daisy, black-eyed Susan, anise hyssop, and wild bergamot. These plants flowered between the beginning of June and early September, and each began and ended their flowering period at different dates (Figure 4). In 2016, the Applewood mix produced no flowers from the planted seed mix until late June when lanceleaf coreopsis bloomed.

Applewood plants flowered later and were mostly unavailable to early pollinators. Plants present in the plots with low bee visitation were globe gilia, fleabane, and Siberian wallflower, all of which were in the Johnny's seed mix. That same mix had flowers from late May through August. Ernst had abundant flowers later in the season. In the perennial/shrub borders, Northern blue violet, yarrow and Rudbeckia 'Goldsturm' appeared to attract few insects.

Figure 6. Open house at (A) GMAS blueberry field and (B) Juniper Ridge landfill.

Technology transfer and outreach

In 2015, open houses and garden tours were held at GMAS and PTLF in September. We learned that a Friday afternoon is a difficult time to get people to come out to a blueberry farm (GMAS). The 2015 tour of PTLF was much better attended, but this landfill is not open to the public so only one event was scheduled there. In 2016, the open house for the public at GMAS was on a Saturday and the people who came were keen to see both gardens (Figure 6). Our best-attended event was at JRLF with its established open house each first Saturday in October. More than 180 people came to our booth (Figure 6), and many more enjoyed the garden itself.

Numerous bees, especially bumble bees, visited the garden. In all, we estimate that about 600 people saw the gardens and had a chance to take handouts we prepared.

SUMMARY AND CONCLUSION

Use of two types of gardens was successful in this demonstration. The shrubs and perennials in the border at both GMAS and PTLF did surprisingly well, and covered the very early and late seasons for pollinator forage. They were attractive and because they were heavily mulched thanks to Casella's contribution of bark mulch, were not overrun with weeds. The shrub/perennial border was an important part of the demonstration as it provided pollinators with resources that were not otherwise available. Landowners who hosted these two gardens at GMAS and PTLF were pleased with the appearance and function of the gardens. Shrubs that attract beneficial insects have an important place in the list of resources valuable to pollinators, but they are not suitable for some pollinator strips. By making a place for these on the landscape, we allowed for the contribution such plants can make.

Based on what we learned in this demonstration project, pollinator strips will be most successful if there is sufficient weed control before planting the wildflower mixes. This was already known, but our experience reinforced the point. We were following a method used successfully in another study, but we probably should have anticipated the emergence of weeds in a wet season. We then had to take a post-facto instead of preventive approach. Farmers will not want to take the time to weed around the perennials as we did at GMAS in 2016, and should be encouraged to put extra resources into controlling weeds 1-2 years ahead of sowing the expensive wildflower mixes. At GMAS, weed pressure in all three seed mixes was high but hand weeding in 2016 made a considerable difference in countering this, and was successful in allowing for emergence of intended subject plants. We might have mis-identified a few plants from the mixes and pulled them unknowingly, but there was sufficient germination and emergence to overcome this. When hand weeding plots, we suggest waiting until the first true leaves have developed before making a decision to pull or not. It is also important to note that flowering plants not included in the mixes (e.g., ox-eye daisy, black-eyed Susan) but allowed to remain were important to the three plots, especially in the Applewood mix where few other plants bloomed in the earlier part of the season (later, sunflower and coreopsis, along with anise hyssop, were available). The weed pressure was greatly reduced in the Ernst seed mix due to tall yellow clover ground coverage. This reduced the need for weeding and allowed bees to forage on the many other flowering plant species present in the section.

We recognize a need for development of weed control methods that should be implemented before planting wildflower seed. Presumably each site differs in the soil seed bank that could be present, and a one-size-fits-all approach might be inadequate. Weed control on organic and conventional farms could include repeated shallow tilling every few weeks through the growing season prior to planting. Some combination of cover crops with repeat tilling could be effective. Producers will want to allow sufficient budget to cover the garden maintenance, as we found this to be a necessary labor -- an estimated 1-2 h per week will help keep a perennial/shrub border that is 5 m x 10 m in size deadheaded, weeded, watered, and looking its best, thus offering maximum forage for bees.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENTS

The authors appreciate help with planning and implementation from Dr. Lois Berg Stack. We thank the NRCS and Casella Waste Systems for sponsoring the project. Casella Waste Systems staff who inspired and enabled this project included Don Meaghar, Wayne Boyd, and Jeremy Labbe. Among our other cooperators are Annie Allen and Martin Allen of G. M. Allen and Son, Inc. (GMAS), who hosted a demonstration at their headquarters. Judith Collins assisted by treating the weedy grasses with herbicide. The University farm crew, Josh Stubbs and Chris McManus, came twice with heavy equipment to prepare our sites. We thank Christian Beauregard, Hayley Bodmer, Cassie Garcelon, Peter Hanlon, Justus Hillebrand, Gary Morneault, Amanda Pelletier, Catherine Vogel, and Elesha Young, all students at University of Maine, who helped us with garden preparations, maintenance, and insect documentation. Dr. Leif Richardson (Montpelier, VT) and Michael Veit (Pepperell, MA) identified bee specimens for this project. This article is based upon work supported by the Natural Resources Conservation Service, U.S. Department of Agriculture, under University of Maine-CIG-#69-1218-14-4. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of the U.S. Department of Agriculture. This study was also supported by the University of Maine Agricultural and Forest Experiment Station; and the University of Maine Cooperative Extension.

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Vol.10(5), pp. 99-107, May 2018
DOI: 10.5897/JAERD2018.0948
Articles Number: 1780D6D56868
ISSN 2141-2170

http://www.academicjournals.org/JAERD

Journal of Agricultural Extension and Rural Development

Full Length Research Paper

Farmers' knowledge and practice of organic vegetable cultivation: A field level study of two villages from Bangladesh

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Received 20 February, 2018; Accepted 9 April, 2018

The study aimed to determine farmers' knowledge and practice regarding organic vegetable cultivation as well as to ascertain farmers' awareness concerning health and environmental aspects. The study was conducted at two villages of Kishoregonj District. The selected villages were Shadullar Char and Borobag Char. The total number of household was 800 in two villages. Among them 400 households were randomly selected and the head of each household was considered as the sample of the study; from them data were collected using structured interview schedule. The findings of the study indicate that about two-thirds (65%) of the farmers in the study area had poor knowledge concerning organic vegetable cultivation while, about three-fourth (73%) of the respondents had found low level of practice followed in cultivating organic vegetables. Concerning soil health management aspects, the item namely use of cow dung and use of poultry excreta were the top most items practice by the farmers in their locality. The use of ash and piercing, on the other hand, were found as the highest ranked items regarding disease and pest management related aspects. However, about three-fourths of the respondents had low to medium level of awareness concerning health and environmental related aspects caused by agro-chemicals use.

Key words: Organic vegetable, knowledge, practice, farmers, Bangladesh.

INTRODUCTION

Due to increasing consumer awareness of health and environmental issues, the demand for safe organic food has been growing significantly all over the world for the past several years and this offers producers and exporters in developing countries opportunities to improve their incomes and living conditions (FiBL, 2006). The statistics showed that 2.3 million certified organic farmers are growing organic produces on 43.7 million

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hectares of land in 172 countries for a global sales of organic food market worth of 80 billion US$ (FiBL and IFOAM, 2016). Among the global organic producing countries, there are 30 countries in Africa, 30 in Asia, 20 in Central America and the Caribbean, 10 in South America, 5 in Australasia and the Pacific and the most countries in Europe, as well as the United States and Canada (IFOAM, 2008). These figures include many developing countries, of which about 15 are regarded as Least Developing Countries (LDCs) (IFOAM, 2008). According to OTA (2012), organic agriculture is the most promising worldwide growth industry which can be profitable and sustainable business for agricultural producers interested in going through the certification process necessary to enter this market.

Organic agriculture not only contributes in income improvement, a number of case studies reported that yields have increased substantially after conversion to organic farming (Giovannucci, 2005; Mendoza, 2004; Badgley et al., 2007; Amaduo and Bruno, 2015). Delate et al. (2003) reviewed numerous scientific studies conducted throughout the US between 1985 and 1993, and reported that yields and overall economic returns in organic farming systems demonstrate their economic viability. Organic farming offers an alternative method for production that can be suitably exploited to benefit some segment of farmers (Chand, 2003). Additionally, organic agriculture as one such technology that can reduce the harmful impacts of agro-chemicals, and is considered by many scientists to be the best form of agriculture in terms of maximizing cost-effectiveness and minimizing pollution (Christian et al., 2005).

However, unfortunately Bangladeshi farmers could not get their share from the global organic market and even failed to create a good domestic market of organic produces and developing sustainability of the agricultural systems through adoption of organic agriculture due to lack of proper knowledge on organic cultivation methods. In general, mass farmers in Bangladesh rely on chemical inputs to supply nutrients and manage pests to optimize crop yields. As, Department of Agricultural Extension (DAE) and others public extension organizations do not have any active initiative to disseminate organic agricultural information among the farming community (Rahman and Yamao, 2007). In parallel to these mass farmers, a small group of farmers are practicing organic cultivation methods to lower the production costs, reduce dependency on purchased agro-chemicals, increase income and improve the long-term sustainability of the agricultural system (Sarker and Itohara, 2007).

Progress in adopting organic farming has been very slow in many regions of Bangladesh, even though the country has great potential in this regard because of surplus labour, huge crop diversity, and considerable investment by Proshika and few other NGOs since the 1980s (Sarker and Itohara, 2008). Despite having some major problems including the lack of political recognition, Bangladesh has good prospects in organic farming (Sarker and Itohara, 2007). With few exceptions, organic farming in Bangladesh still occurs largely on an experimental basis. Total land area under organic cultivation in Bangladesh has been estimated at 0.177 million hectares (FiBL and IFOAM, 2016), representing only 2% of the country's total cultivable land. Among the private companies Kazi and Kazi Ltd. is the pioneer to invest in organic farming. They have established organic tea garden at Tetulia, in the Panchagarh district. This tea is certified by the SGS organic production standard in accordance with the EU Regulation 2092/91, and it is marketed both in local and export market (Tea International, 2005). Sarker and Itohara (2009a,b) reported that following the adoption of organic farming, the average household income declines in the first few years before increasing thereafter and 98% respondent farm households had successfully attained household level food security after adoption of organic farming. In this endeavor, GO's contribution is really invisible and only few of the NGOs are working to promote organic farming in Bangladesh. This individual approach, however, may result either in the lack of adequate funding or the lack of adequate knowledge of organic farming and/or marketing strategies (Sarker and Itohara, 2007).

However, by updating these age-old systems with modern research and technologies it is possible to increase knowledge and practice on organic farming by the Bangladeshi farmers that may open the door of endless possibilities of improving soil health, taking care of environment, and providing sustainable livelihoods for the peoples of the farming community. Thus the present study was taken into consideration with the following objectives:

1. To investigate and explain the socio-economic profile of the organic vegetable farmers;
2. To determine farmers' knowledge and practice regarding organic vegetable cultivation; and
3. To determine farmers' awareness concerning health and environmental aspects.

METHODOLOGY

Methodological issue is one of the prime considerations for conducting a research for yielding valid and reliable findings. In fact, it is the foundation on which the research process rests upon. From this point of view the researcher took a great care in using appropriate method. However, the methods and operational procedure, and operation of variables, use of statistical tests- all are presented in this section of the manuscript.

Locale of the study

The study was conducted at two villages of Shadullar Char under

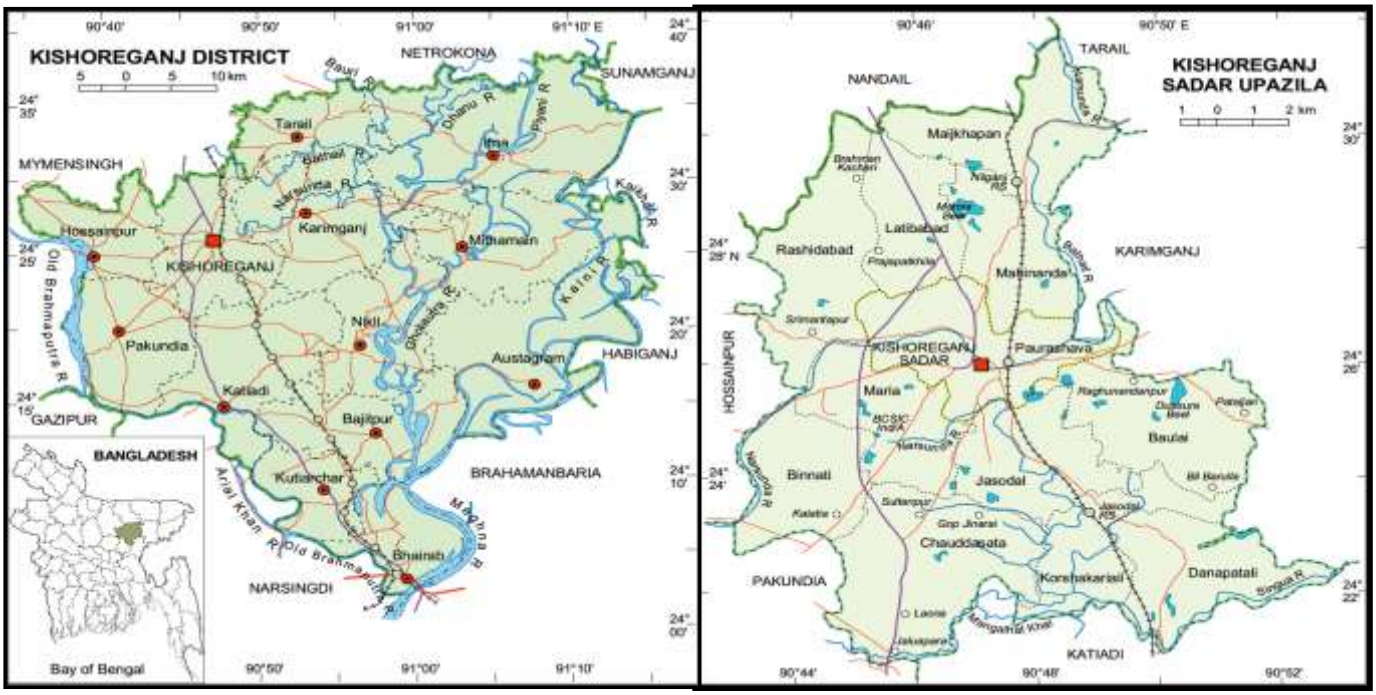

Figure 1. Map of Kishoregonj District and Sadar upazila indicating study area.

Kishoregonj District of Bangladesh. Names of the selected two villages were Shadullar Char and Borobag Char. These two villages were under the Kishoregonj Sadar sub-district under Kishoregonj district (Figure 1). Kishoregonj Sadar is one of the important vegetable growing areas of the district and especially these two selected villages are very famous for diversified vegetable cultivation due to their fertile alluvial soil and close vicinity with district town that has given the vegetable growers better opportunity for marketing their produces. Thus, these two villages were selected purposively for the present study.

All of the farm households having involvement with vegetable cultivation in Shadullar Char and Borobag villages were considered as the population of the study. The total number of farm household was 800 in those two villages. Among them 50%, that is 400 households were randomly selected and the head of the household was considered as the sample of the study.

A draft interview schedule was prepared for collecting data from the respondent farmers. The schedule was pre-tested in actual field situation. Based on the experiences of pre-testing of the interview schedule, it was modified and amended. The interview schedule was then finalized for the collection of data.

The empirical data for the study were collected through pre-tested structured interview schedule from the farmers of the selected villages during 01 April to 05 May 2015. Data were collected by the Field Staff of the Bondhon (A local NGO in the study area), Kishoregonj under the closed monitoring and supervision of the principal investigator and co-investigator of the project.

Variables of the study

Eight individual characteristics of the farmers were considered for the study. The selected characteristics were age, educational level, farm size, annual family income, training exposure, extension media contact, environmental awareness and health awareness.

Farmers' knowledge on organic vegetable cultivation was one of the focus variables and was measured on the basis of the responses of the vegetable farmers to the questions asked them. A total of twelve knowledge related questions were asked and the score could range from 0 to 24.

Another focus variable of the study was extent of practices concerning organic vegetable cultivation were divided into two aspects namely soil health management related issues and disease and pest management related issues. A total of twenty (20) practices, that is ten practices from each of the aspect were incorporated into the interview schedule. Farmers' response for each practice was measures by using a four-point rating scale. So the score could range from 0 to 80.

For having better understanding of each of the practices, practice index was developed by using following formula:

$$PI\ (Practice\ Index) = (P_f \times 3) + (P_0 \times 2) + (P_r \times 1) + (P_n \times 0)$$

Where, P_f = Number of respondents with frequent management practices; P_0 = Number of respondents with occasional management practices; P_r = Number of respondents with rare management practices; P_n = Number of respondents with not at all management practices.

The practice index (PI) of each practice could range from 0 to 1200, where 0 indicates no practice and 1200 indicate frequent practices.

Both the qualitative and quantitative data were collected. Quantitative data were collected through direct interviewing with farmers through interview schedules while the qualitative data were collected through Focus Group Discussions (FGDs). The collected data were coded, compiled, tabulated and analyzed as per objectives of the study.

Table 1. Distribution of the respondents by socio-economic characteristics.

Characteristic	Scoring system	Range		Mean	SD*
		Possible	Observed		
Age	Years	Unknown	22-72	44.16	10.84
Educational level	Years of schooling	Unknown	0-14	5.36	3.62
Farm size	Acres	Unknown	0.25-8.02	3.47	2.89
Annual family income	'000' BDT	Unknown	45-215	106.3	0.27
Training on organic farming	No of days	Unknown	0-3	0.15	0.35
Access to extension services	Scale score	0-12	0-8	3.13	2.31
Health awareness	Scale score	0-8	0-7	4.63	1.91
Environmental awareness	Scale score	0-8	0-7	4.65	1.89

* Note: SD= Standard Deviation

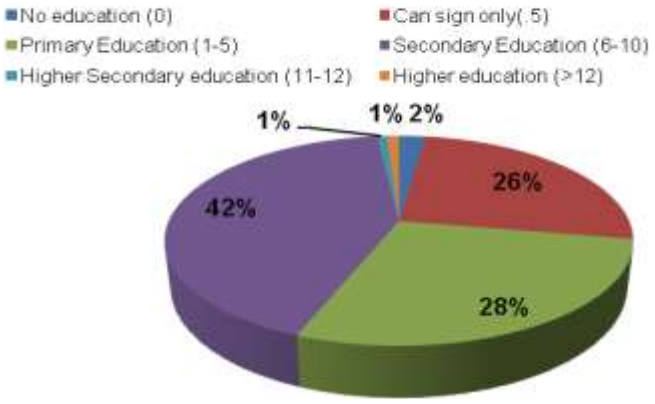

Figure 2. Distribution of the farmers based on their educational level.

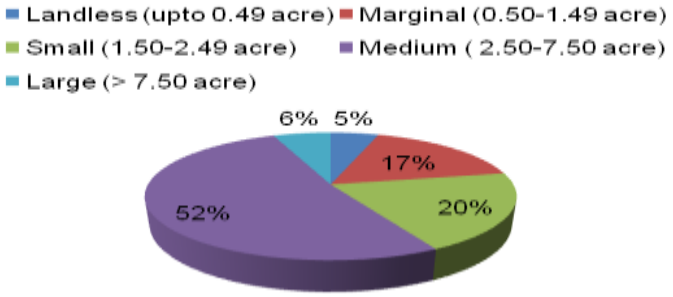

Figure 3. Distribution of farmers based on their farm size (unit included).

RESULTS AND DISCUSSION

Socio-economic characteristics of the farmers

The empirical data concerning socio-economic characteristics of the respondents were collected and presented in Table 1. Table 1 show that the age of the respondents was ranged from 22 to 72. The mean age of the respondents was 44.16 when standard deviation was 10.84.

Education of farmers varied found to vary from 0 to 14 years, the average being 5.36 with a standard deviation 3.62. Based on their age score the respondents were classified into six categories: 'No Education (0)', 'Can sign only (0.5)', 'Primary Education (1-5)', 'Secondary Education (6-10)', 'Higher Secondary Education (11-12)' and 'Higher Education (>12)'.

Data furnished in the Figure 2 reveal that the highest proportion (42.2%) of the respondents had secondary education. The lowest proportion (0.8%) of the respondents had higher secondary education level.

28.20% of the respondents had primary education and 25.50% had can sign only. About 2.20% of the respondents had no education where only 1.0% of the respondents had higher education. However, the average farm size of the respondents was 3.47 acre with a standard deviation of 2.89. Based on their farm size the respondents were classified into five categories: 'Landless (0.00.49 acre)', 'Marginal (5-1.49 acre)', 'Small (1.50-2.49 acre)', 'Medium (2.50-7.49 acre)'and 'Large (>7.50 acre)'.

Data presented in the Figure 3 indicated that more than half (52%) of the respondents had medium farm size and only 6% had large farm size. However, 20% of the respondents had small farm size and 17% of the respondents had marginal farm size and only 4.5% of the respondents were land less. Thus, it is clear from the study that medium to large farmers are more interested towards organic vegetable cultivations compared to small and marginal farmers. This is also reality that small and marginal farmers usually do not dare to take risk with organic farming due to their limited farm size. The average annual income of the respondents was 106.69 thousand BDT (Bangladeshi currency; 1US$=approx. 80 BDT) with a standard deviation 0.27.

The findings of the study also revealed that mean training received on organic vegetable farming was 0.15 day where standard deviation was 0.35. The study also

Table 2. Distribution of farmers based on their training exposure on organic farming.

Category	Frequency	Percentage
No training	340	85.0
Have training	60	15.0
Total	400	100.0

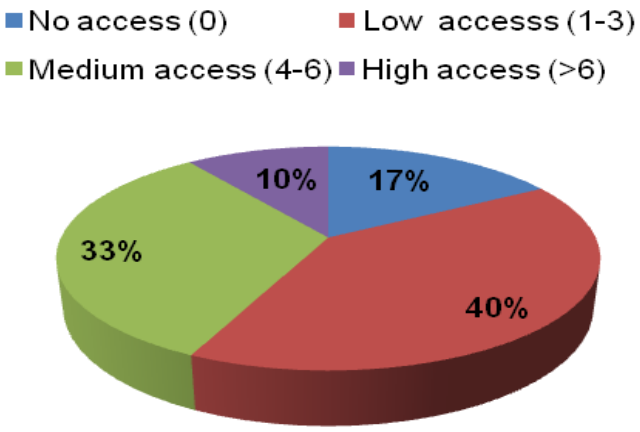

Figure 4. Distribution of farmers based on their access to extension services.

explored that the highest proportion of the respondents (85.0%) had no training and only 15% of the respondents had received training on organic vegetable cultivation (Table 2).

It is really very frustrating that the majority of the farmers do not have any training on organic vegetable cultivation. This is due to the fact that the public extension services do not have proper attention on organic farming. The respondents additionally mentioned that among the recipients of the organic training course, 60% of the respondents received training on compost preparation and 10% received training on integrated pest management (IPM) in vegetable cultivation.

The average score of access to extension services of the respondents was 3.13 with a standard deviation of 2.31. Based on their access to extension services the respondents were classified into four categories: 'No access (0)', 'Low access (1-3)', 'Medium access (4-6)' and 'High access (>6)'. Data presented in the Figure 4 indicated that the less than half (40.20%) of the respondents had low level access to extension service, while 32.38% had medium access to extension services to get information on organic vegetable cultivation. However, a significant portion (16.80%) of the farmers had no access to extension services and only 10.20% of the respondents had high level access to extension services for organic farming information. The respondents also mentioned that among the majority of them (70%) get necessary information on organic vegetable cultivation from NGO staff and neighboring farmers.

While only 2% of the farmers get information from public sector extension staff. However, this finding was supported by the findings of Sarker and Itohara (2008a).

The findings of the study also exhibit that the average health awareness score of the respondents ranged from 0-7 with an average score of 4.63 and standard deviation of 1.91. On the other hand, the environmental awareness score of the respondents were ranged from 0 to 7 with an average score of 4.65 and standard deviation of 1.89. It is clear from the study that the environmental and health awareness score of the respondent vegetable farmers was moderate.

Farmers' knowledge on organic vegetable cultivation

One of the important objectives of the study was to determine farmers' knowledge on organic vegetable cultivation and data were presented in Table 3. The average knowledge about organic vegetable cultivation of the respondents was 11.70 with a standard deviation 4.69. Based on their knowledge about organic vegetable cultivation, the respondents were classified into three categories: 'Poor knowledge (1-12)', 'Medium knowledge (13-24)' and 'High knowledge (25-36)'.

Data presented in the Table 3 indicated that the highest proportion (65%) of the respondents had poor knowledge, where 34.50% had medium knowledge and only 0.50% of the respondents had poor knowledge on organic vegetable cultivation.

Farmers' extent of practice of organic vegetable cultivation

The information regarding extent of practice of organic technologies by the respondents were collected and presented in Table 4.

Data presented in Table 4 shows that the average score of farmers' extent of practice of organic technologies was 16.66 with a standard deviation of 5.90. Based on their practice of organic technology the respondents were classified into four categories: 'No practice (0)', 'low practice (1-20)', 'medium practice (21-40)' and 'high practice (41-80)'. The study revealed that the around two-thirds (73.20%) of the respondents had low practice, where a quarter (25.20%) had medium practice. However, it is observed that still a small portion (1.5%) of the organic vegetable growing farmers did not practice organic technologies.

Moreover, rank order of the organic technologies was made based on the score of the Practice Index (PI) as

Table 3. Distribution of farmers based on their knowledge about organic vegetable cultivation.

Category	Frequency	Percent	Mean	SD
Poor knowledge (1-12)	260	65.0	11.70	4.69
Medium knowledge (13-24)	138	34.5		
High knowledge (25-36)	2	0.5		
Total	400	100.0		

Table 4. Distribution of farmers based on their practice followed in organic vegetable cultivation.

Level of practice	Frequency	Percent	Mean	SD
No practice (0)	6	1.5	16.66	5.9
Low practice (1-20)	293	73.2		
Medium practice (21-40)	101	25.2		
High practice (41-80)	0	0		
Total	400	100.0		

Table 5. Farmers' distribution based on their extent of practice followed to cultivate organic vegetable.

Name of item	Extent of practice followed				Practice index (PI)
	Not at all	Rarely	Occasionally	Frequently	
Soil health management related technologies					
Ordinary compost	0(0)	59(14.75)	221(55.25)	120(30.00)	861
Vermi-compost	400(100)	0(0)	0(0)	0(0)	0
Commercial organic manure	392(98.0)	8(2.0)	0(0)	0(0)	8
Ash	357(89.25)	30(7.5)	13(3.25)	0(0)	56
Bio-fertilizer	348(87.0)	32(8.0)	20(5.0)	0(0)	72
Green manure	327(81.75)	40(10.0)	23(5.75)	10(2.5)	116
Crop rotation	181(45.25)	60(15.0)	39(9.75)	120(30.0)	498
Slurry of biogas	357(89.25)	40(10.0)	3(0.75)	0(0)	46
Cow dung	0(0)	0(0)	36(9.0)	364(91.00)	1164
Poultry litter	0(0)	10(2.50)	43(10.75)	347(86.75)	1137
Disease and pest management related technologies					
Ash (as pesticide)	0(0)	20(5.0)	40(10.0)	340(85.0)	1120
Light trap	115(28.75)	238(59.5)	37(9.25)	10(2.5)	342
Perching	13(3.25)	158(39.5)	172(43.0)	57(14.25)	673
Sex pheromone	317(79.25)	53(13.25)	30(7.5)	0(0)	113
Hand net	149(37.25)	101(25.25)	150(37.5)	0(0)	401
Trichoderma	270(67.5)	130(32.5)	0(0)	0(0)	130
Neem oil	200(50.0)	178(44.5)	22(5.5)	0(0)	222
Pitraj oil	367(91.75)	33(8.25)	0(0)	0(0)	33
Mahagoni oil	349(87.25)	45(11.25)	6(1.5)	0(0)	57
Botanical pesticide	341(85.25)	49(12.25)	10(2.5)	0(0)	69

Numbers in the parentheses indicate percentages.

responded by the farmers (Table 5).

Table 5 shows that among the soil health management related technologies, the highest majority (91%) frequently use cow dung after that 87% frequently use poultry litter

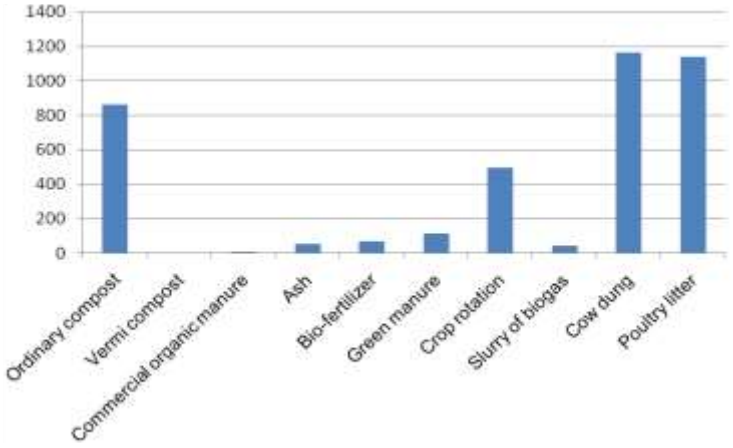

Figure 5. Rank order of the soil health management related technologies followed by the farmers.

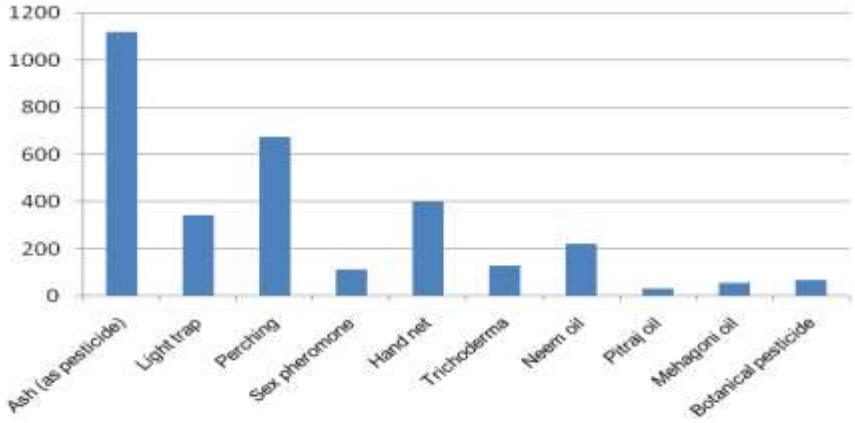

Figure 6. Rank order of the disease and pest management related technologies followed by the farmers.

for soil health management. However, this is really wondering that while vermin-compost is getting popularity in all over the country but none of them are using vermin-compost in soil health management. On the contrary, more than a quarter (30%) of the farmers frequently follows crop rotation practices for maintaining their soil health. While the extent of use of bio-gas slurry, green manure and ordinary compost is still poorer by the farmers of the study area. Like, soil health management the respondents were asked to mention their extent of use of organic technologies relating to disease and pest management in vegetable cultivation. The findings of the study showed that the highest majority (85%) of the farmers frequently use ash for controlling insect. Next to ash, 14% of the farmers practice perching as a means of biological control for disease and insect pest management. The findings of the study also revealed that few farmers have already started to use sex pheromone, *neem* oil and other botanicals for managing disease and insect pests.

The respondents were asked to indicate the extent of practice followed by the farmers' in organic vegetable cultivation in a four point rating scale. Frequently, occasionally, rarely and not at all with the weightage of 3, 2, 1 and 0 respectively based on which a Practice Index (PI) was made. Based on PI score different technologies were ranked in an order.

From Figure 5, it was evident that farmers' extent of practice in organic vegetable cultivation, among the soil health management related technologies cow dung was top in the rank order with the Practice Index (PI) of 1164 and it was followed by poultry litter (PI=1137), Simple compost (PI= 861), crop rotation (PI=498), green manure (PI=116), bio-fertilizer (PI=72), ash (PI= 56), slurry of

biogas (PI= 46), commercial organic manure (PI=8) and vermi-compost (PI=0).

On the other hand, farmers' extent of practice of disease and pest management technologies in organic vegetable cultivation were also assessed and the findings show that among the selected 10 technologies ash was ranked first with the PI score of 1120 and followed by perching (PI= 673). Next to these two technologies, the use of hand net, light trap, *neem* oil, sex pheromone, Trichoderma, botanical pesticide, *Mehagoni* oil and *Pitraj* oil ranked 3rd, 4th, 5th, 6th, 7th, 8th, 9th and 10th respectively.

Thus, it can be concluded that the extent of practice of organic practices in vegetable cultivation in the study area was still low.

CONCLUSION AND RECOMMENDATIONS

Despite the great potentials of organic vegetable cultivation in improving soil, environmental and human health as well as improving farmers' income, the adoption of Bangladeshi farmers seems to be slow. The major factor behind this reality is poor knowledge of the farmers on organic cultivation. It is evident from the study that about two-thirds (65%) of the farmers in the study area had poor knowledge on organic vegetable cultivation while, a little less than three-fourths (73%) of the respondents had found with low extent of practice of organic technologies in vegetables cultivations. It may be concluded in such a way that there is ample scope to work on the farming communities in the study area about organic vegetable cultivation. Concerning soil health management aspects, the item namely use of cow dung and use of poultry litter were the top most technologies practiced by the farmers in their locality. Use of ash and perching, on the other hand, were found as the highest ranked practices among the disease and pest management related technologies used in vegetable cultivation. However, about three-fourths of the respondents had low to medium level of awareness concerning health and environmental related issues due to use of agrochemicals.

Based on the findings the following recommendations may be put forward:

1. Arrangement of campaigns by the public extension organization (Department of Agricultural Extension) and the local level NGOs need to be increased for improving farmers' knowledge concerning organic vegetable cultivation.
2. Organization of training programmes as well as conduction of result demonstration by the concerned agencies will be effective in changing the mindset of the farmers regarding organic vegetable cultivation.
3. Conduction of method demonstrations to show the easy way of preparing compost and botanical pesticide might improve the capacity of the farmers in practicing organic technologies.
4. Extension campaign is needed to generate awareness among the farmers concerning health and environmental benefits of organic cultivation methods

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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