HORTICULTURAL PRACTICES IN ORGANIC AND CONVENTIONAL COMMERCIAL VEGETABLE FARMS IN KATHMANDU VALLEY

Gautam Shrestha[1], Anup Bom[2], Sulochana Shakya[3]

[1] *Scientist, NARC, Regional Agricultural Research Station, Khajura*

[2] *BSc Ag., HICAST*

[3] *Associate Professor, HICAST, Department of Crop and Soil Sciences, Kalanki, Kathmandu*

ABSTRACT

Commercial organic and conventional vegetable farming is expanding around peri-urban areas in Kathmandu valley to fulfill the demand of skyrocketing urban population. However, without provision of knowledge and inputs, not all the farmers are able to be in the business for sustainable production in long time. Documentation of production practices followed by commercial farmers can contribute to the sustainable expansion of commercial peri-urban horticulture. The questionnaire survey was conducted to collect information on vegetable cultivation practices among sixty commercial organic and conventional commercial vegetable farmers in Bhaktapur, Kathmandu and Lalitpur districts to know the status of commercial organic and conventional farming. . Six vegetable crops namely tomato, cauliflower, cabbage, cucumber, bitter-gourd and chilli were selected for this study. The results revealed that 50% farmers were following nursery bed preparation method for seedling growing whereas 10% were following poly bag method and 7% cell tray methods. Sole plastic tunnel cultivation was practiced by 16.7% conventional farmers in comparison with 3.3% organic farmers. Conventional farmers had significant high density vegetable crops planting compared to organic farmers. Number of irrigations applied in tomato cultivation was significant higher in conventional farms (85 times) than organic farms (47 times). Application amount of bone meal for cabbage cultivation in organic farms (800 kg/ha) was significant higher than conventional farms (40 kg/ha). Cabbage yield was significant higher in conventional farms (37 t/ha) than organic farms (25 t/ha). Productivity of other five vegetables in concern were not significant different between organic and conventional farms. Sixty percentage conventional farmers were willing to convert to organic farmer acknowledging health and environmental hazards of chemical pesticides and fertilizers. Hence, feasibility of inputs for standard organic production and satisfactory yields will stimulate spreading of organic farms around the peri-urban areas in Kathmandu valley.

Key words: *farming systems, off season vegetable production, peri-urban agriculture, plastic tunnel horticulture*

Introduction

Fresh vegetables cultivation has increased in Nepal in the recent decades. Vegetable production area has expanded in the country from 140,500 ha in 1991 to 250,000 ha in 2012 (Statistics Section, 2013). It is due to increased consumption of fresh vegetables as a result of increased population, increased awareness of health benefits, increased purchasing

capacity and raised living standards in the country. Additionally, vegetable consumption has increased from 45 kg per caput per year (Rekhi et al., 1989) to 55 kg per caput per year (CBS, 2010) in Nepal. For the healthy living, World Health Organisation (WHO) prescribed about 400 g of fresh fruits and vegetables per person per day (WHO, 2015). But statistics showed that we are not consuming enough vegetables for the healthy living as per the WHO standards. Moreover, international demand for vegetables has also increased the vegetable cultivated area in Nepal. In the fiscal year of 2012/13, the country exported large volume of fresh vegetables to China, followed by India, Singapore, Malaysia and UK as well. The total value of export quantity was sixty millions plus. Exported vegetables include tomato, cauliflower, cucumber, cabbage, broccoli, leguminous vegetables, peas, leeks etc. (Statistics Section, 2013). In the future, vegetable producing areas needed to be expanded more to satisfy the demand. Otherwise, we will become dependent on other districts and countries for the vegetables.

Different vegetable growing techniques have different impacts in the human health. Use of different chemical pesticides and chemical fertilisers in agriculture i.e. conventional agriculture (MoAC, 2008) yields high in the short term (de Ponti et al., 2012). However, health (Atreya et al., 2012; PPD, 2014) and environmental impacts are seriously harmful due to applied chemical pesticides and chemical fertilisers. Use of organic manures and natural minerals as a source of plant nutrients and botanical pesticides and natural enemies as a plant protection agents i.e. organic agriculture (MoAC, 2008) yields less produce in the short term (Shrestha and Chaudhary, 2015). However, organic farming causes no negative health effects (Schoonbeek et al., 2013) and contributes in the environmental (Shrestha, 2015; Shrestha et al., 2014a) and economic (Shrestha et al., 2014b) sustainability. Traditional agriculture (MoAC, 2008) uses only local inputs and traditional varieties practiced by traditional farmers in the valley is no more able to supply the daily fresh vegetable demand of Kathmandu valley (Rekhi et al., 1989). All three methods of farming are in practice in Nepal.

Both conventional and organic methods of growing vegetables have merits and demerits. Conventional agriculture is required to supply the current demand of the urban population. For example, Kathmandu valley alone needs 750 tons of fresh vegetables on the daily basis (Republica, 2014). This volume is currently out of scope for organic farmers. However, in addition to other facts, lack of chemical fertiliser and chemical pesticides factory in the country and possibility to export certified organic produce with low cost and high benefit to the overseas market issues always prioritize the organic agriculture over conventional on the long run (Schoonbeek et al., 2013). Moreover, there is increasing demand for organic vegetables in the Kathmandu valley (Kathmandu post, 2014). With minimum use of pesticides, conventional agriculture will supply demand of mass population for decades to come. However, the ultimate goal of the agriculture sector should be to transform into organic production system.

You can find more details on the comparison of commercial organic and conventional farms on economic aspect (Shrestha et al., 2014b), phytopathology (Shrestha et al., 2014a) aspect and soil aspect (Shrestha, 2015) in our previous papers. In this paper, we have compared the horticultural management practices followed in commercial organic and conventional farms. We opt to find the possible amendments and learnings from both methods of farming for each other's benefit.

Materials and Methods

Study Site

Kathmandu valley was selected as the study site. The Kathmandu valley consists of three districts namely Kathmandu, Bhaktapur and Lalitpur district. The Kathmandu is the capital of the country. The urban dwellers in the valley have skyrocketed since 2046 B.S. due to migration from rural areas in the search of job and for better opportunities. Increased population has increased the demand for the daily fresh vegetables. Moreover, appearance of high class society, international personnel, tourists and health conscious citizens in the valley has increased the demand for organic vegetables (Bhatta et al., 2009). The fresh vegetable demand is mainly fulfilled by import from other districts and neighbouring countries (Basyal, 2015). As a way-out for this dependence for the fresh vegetables, commercial vegetable production has started in the peri-urban areas in Kathmandu valley. Map of the sampling sites in the Kathmandu valley is shown in Annex I.

Farmers Selection

For this study, commercial farmers in the three districts were identified through the District Agricultural Development Offices (DADOs) and Agriculture Service Centres (ASCs) personnel of the respective districts, Nepal permaculture group (NPG) and agricultural consultants providing advisory to commercial farmers. Ten each commercial conventional and organic farmers were selected from each district as per availability. We could find only five commercial vegetable producing organic farmers in the Bhaktapur district. Hence, we selected 15 commercial organic vegetable farmers from Kathmandu district. Contact details of the interviewed respondents are listed in Annex II (organic farmers) and Annex III (conventional farmers).

Data Collection and Analysis

Semi-structured questionnaire survey was conducted to gather information on vegetable production practices in the commercial organic and conventional farms. Questionnaire was prepared in Nepali language and was pre-tested before implementation. Total 30 each conventional farmers and organic farmers were interviewed. Farmers were interviewed in their own premises by bachelor degree final year students. Data were collected from May 16 to June 15, 2015 (i.e. Jestha 2070 B.S.). Filled questionnaire were entered in the Microsoft Excel software and analysed for statistical inferences. For this paper, we presented data on six crops namely tomato (Lycoersicon esculentum), cauliflower (Brassica oleracea var. botrytis) , cabbage (Brassica oleracea var. capitate), cucumber (Cucumis sativus), chilli (Capsicum annum) and bitter gourd (Momordica charantia).

Problem pointed out by organic and conventional farm on vegetable production were ranked using index developed by Mi□a (1993). The index was prepared mainly taking into account the qualitative data. On the basis of response frequencies, weighted indexes were calculated. The intensity of problems being faced by the farmers in organic and conventional farming system were identified by using five point scaling technique comparing most serious, serious, moderate, a little bit and no problem at all using scores of 5, 4, 3, 2 and 1 respectively. Then the priority index for each variable was calculated by weightage average mean in order to draw valid conclusion and make a reasonable decision. The intensity of problem was computed by using the formula:

$$I_{prob} = \sum \frac{S_i F_i}{N}$$

Where,

I_{prob} = Index value for intensity of problem

$\sum$ = Summation

S_i = Scale value of ith intensity

F_i = Frequency of ith response

N = Total number of respondents

Results and Discussion

Seed

Though both conventional and organic farmers chose high yielding varieties, conventional farmers were more carefree towards varieties which had more pest problems (Table 1). It's maybe because of the availability of different chemical pesticides to manage pests in conventional farms. Vendors were the main source of seed for both organic and conventional farms. However, in the case of organic farming, restriction of pesticide treated seed was violated while buying seeds from vendors. Most of the seeds sold in the packet in the vendor shops were already chemically treated. In the current situation, market unavailability of organic certified seeds maybe the problem for the organic farmers.

Nursery bed preparation (more than 50% in both management systems) was still the dominant seedling growing method among commercial farmers. Though not popular yet (Table 1), the cell tray method is known to have more successful in getting higher germination percentage and lesser transplanting shock. Furthermore, as cell tray can be reused 10 to 15 times, cell tray method is cost effective than polybag method as well (Mowbray et al., 1994).

Table 1. Considerations for choosing variety, source of seed and method of seedling growing by commercial organic and conventional vegetable farmers in Kathmandu valley.

Particular	Organic	Conventional
Considerations for choosing variety		
High production	83.0	75.8
Early variety	34.0	26.4
Less disease problem	20.8	21.6
Less pest problem	9.9	3.4
Source of seed		
Vendors	95.5	90.9
DADO/ASC	-	3.3
Home	4.5	3.3
Others	-	2.5
Method of seedling growing		
Nursery bed	66.9	50.4
Poly bag	10.5	17.9
Cell tray	10.5	7.7
Seedling purchase	0.8	8.5

Organic farmers were choosing diverse vegetable varieties compared to the conventional ones (Table 2). Commercial farmers were mainly cultivating hybrid varieties many of them were released and registered (VDD, 2010).

Table 2. Varieties of major vegetable crops (% respondents) used by commercial farmers in Kathmandu valley

Crop	Organic	Conventional
Tomato		
Srijana	60.0	93.3
Dalila	13.3	13.3
Cherry	3.3	-
Lapsigede	6.7	-
Samjhana	16.7	-
Trishna	3.3	-
Golo local	3.3	-
Makis F1	-	10.0
Amita	-	10.0
Manisha	-	3.3
Themes - 1	-	3.3
Cauliflower		
Snow Mystique	6.7	13.3
Snow Cup	3.3	
Silver Cup	6.7	3.3
White Top	3.3	6.7
Bhaktapur Local	3.3	3.3
Kathmandu Local	-	3.3
Snow Dome	-	3.3
Davi 2	-	3.3

Crop	Organic	Conventional
Cucumber		
Bhaktapur Local	30.0	13.3
New Narayani	3.3	-
Brought from Israel	-	3.3
Cabbage		
Green coronet	16.7	13.3
Snow crown	3.3	-
Super green	3.3	-
Green top	3.3	-
Green crown	3.3	3.3
T 621	3.3	-
Bhaktapur Local	3.3	3.3
Green cup	-	3.3
Chilli		
NS 1701	3.3	-
Panchthar Local	3.3	-
Local	6.7	10.0
Naamghari	-	3.3
Bitter gourd		
Pali	13.3	6.7
Hybrid	-	3.3

Plastic Tunnel/Open Field Cultivation

Sole plastic tunnel horticulture was practiced by 16.7% conventional farmers which was only 3.3% among organic farmers (Table 3). As commercial vegetable production is more about being able to supply in the off-season, none of the conventional farmers were doing only open field vegetable production. But for organic farmers, open field cultivation keeps low cost of production, hence open field cultivation is practiced. Moreover, plastic tunnel horticulture can certainly increase the period of supply of organic vegetables in the Kathmandu valley.

Table 3. Open field or plastic tunnel cultivation by commercial organic and conventional farmers in Kathmandu valley

Cultivation system	Organic farmers	Conventional farmers
Open field only	26.7	-
Plastic tunnel only	3.3	16.7
Both open field and plastic tunnel	70.0	83.3

Commercial vegetable growers cultivated tomato inside plastic tunnel only (Table 4). Almost half of the conventional farmers were growing off-season cauliflower in the plastic tunnel. Plastic tunnel cultivation of chilli was more practiced by organic farmers.

Table 4. Open field or plastic tunnel cultivation practice (% respondents) by commercial organic and conventional farmers in Kathmandu valley

Crop	Organic farmers		Conventional farmers	
	Open field	Plastic tunnel	Open field	Plastic tunnel
Tomato	-	100.0	-	100.0
Cucumber	92.3	7.7	83.3	16.7
Cauliflower	90.9	9.1	53.3	46.7
Cabbage	88.2	11.8	91.7	8.3
Chilli	70.0	30.0	85.7	14.3
Bitter gourd	85.7	14.3	100.0	-

Intercultural Operations

Conventional farmers had higher density planting compared to organic farmers. It was observed in conventional farms the significant higher seed rate used, less plant to plant distance and row to row distance (Table 5).

There was a significant higher number of intercultural operations in the cauliflower cultivation in conventional farms than in organic farms. Number of irrigations for tomato was significant higher in conventional farms compared to organic farms. For all other crops, number of irrigation was relatively higher in organic farms.

Table 5. Seed rate, plant to plant distance, row to row distance, intercultural operations and number of irrigations applied in commercial organic and conventional farms in Kathmandu valley

Vegetable	Seed rate (g/ha)		Plant to plant distance (cm)		Row to row distance (cm)		Inter-culture numbers		Irrigation numbers	
	Org	Conv	Org	Conv	Org	Conv	Org	Conv	Org	Conv
Tomato	137	131	50	50	60	70	4	3	47*	86*
Cauliflower	400*	317*	45	50	50	50	2*	6*	23	13
Cabbage	411	410	50	40	40	45	6	4	10	9
Cucumber	717*	1160*	150	140	130	170	8	13	13	8
Chilli	202*	357*	40	40	70	65	3	2	26	9
Bitter gourd	2300*	3933*	200	140	650	115	2	2	34	13

* Results of T-test showed level of significance has p value less than 0.05.

Fertiliser Application

Organic farmers did not use any chemical fertilisers as input in their farms (Table 6). Different types of organic manures were used by commercial farmers. Higher amount of inputs use was in tomato production and lesser amount of inputs were applied in cucumber. Among organic manures, chicken manure, farmyard manure, mustard cake and compost mix were common between organic and conventional farmers. Relatively higher amount of chicken manure was used by conventional farmers whereas organic farmers used higher amount of bone meal.

Conventional farmers applied zinc and boron in cucumber and cabbage which was not practiced by organic farmers. Commercial "Vitamin" was applied in all six crops in concern by organic farmers whereas it was not a common among conventional farmers. Conventional farmers applied "vitamin" only in tomato and cabbage.

Concerning organic standards, poultry farms around the Kathmandu valley uses heavy doses of chemical pesticides and chemical inputs to gain profit. Hence, does poultry manures meet the standard?, it should be checked.

Conventional farmers were applying higher dose of chemical fertilizer than recommendation by ABPSD (2011) for tomato (200:120:100 Urea:DAP:MoP per hectare), Cauliflower and Cabbage (200:160:100 kg Urea:DAP:MoP per hectare). The chemical fertilisers amount applied by conventional farmers was lower than recommendation for the cucumber (200:200:250 kg Urea:DAP:MoP per hectare), chilli (600:600:300 kg Urea:DAP:MoP per hectare) and bitter gourd (200:130:130 kg Urea:DAP:MoP per hectare).

Table 6. Nutrient inputs used per hectare in different vegetables production in organic (Org.) and conventional (Conv.) farms in Kathmandu valley

Fertilisers*	Tomato		Cauliflower		Cabbage		Cucumber		Chilli		Bitter gourd	
	Org.	Conv.	Org.	Conv.	Org.	Conv.	Org.	Conv.	Org.	Conv.	Org.	Conv.
Urea (kg)	-	320	-	310	-	256	-	140	-	167	-	290
DAP (kg)	-	260	-	297	-	218	-	160	-	193	-	290
MoP (kg)	-	160	-	160	-	173	-	140	-	137	-	380
Chicken manure (ton)	16.0	28.1	10.6	6.7	12.4	86.2	11.3	10.7	0.8	1.2	20.3	12.5
FYM (ton)	50.8	32.3	10.0	16.8	42.6	25.5	31.6	23.5	79.0	90.0	41.5	35.0
Urban compost (ton)	17.8	16	0.8	15.0	14.1	15.0	15.2	-	21.0	16.0	45.3	15.0
Mustard cake (kg)	1180	660	660	850	618	900	526	560	440	450	1233	766
Bone meal (kg)	800	460	1000	-	800	40	630	220	1000	-	1400	-
Compost mix (ton)	70.0	17.1	23.5	10.1	19.0	21.0	22.4	31.5	40.0	10.7	15.0	30.0
Biozyme (kg)	20	40	-	80	-	-	-	40	-	-	-	-
Posan (l)	1.8	0.1	-	0.02	-	0.04	1.2	-	1.2	0.04	0.6	-
Boron (kg)	20	40	-	-	-	-	-	40	-	-	-	-
Zinc (kg)	20	20	-	-	-	40	-	40	-	-	-	-
Vitamin (l)	7.7	3.1	4.2	0.6	1.3	0.4	40.8	-	6	0.3	20	-
Vitamin (ton)	5.1	1.3	1.9	-	12.7	0.1	20.6	-	-	-	20	-

*Urea contains 46% nitrogen, DAP contains 18% nitrogen and 46% phosphorus, MoP (muriate of potash) contains 60% potassium as plant nutrient. FYM stands for farmyard manure, Compost mix is the mixture of different organic manures (e.g. chicken manure, urban compost, bone meal and mustard cake), Biozyme, Posan, Vitamin are all commercial products available in the market with such trade name.

Yield

In general productivity of crops was higher in the conventional farm than the organic farm. Yield of cabbage was significant higher in conventional farm (37 t/ha) than in organic farm (25 t/ha) (Table 7). In contrast, organic farms produced relatively higher yield of cauliflower, cucumber and bitter-gourd than conventional farms. It was maybe due to the longer harvesting period (Table 8) in the organic farms.

Table 7. Fresh vegetable yield (mean ± standard error of mean, ton per hectare) in commercial organic and conventional farms in Kathmandu valley

Vegetables	Organic farm	Conventional farm
Tomato	104.67±9.40	119.20±11.36
Cauliflower	25.60±5.74	22.94±3.29
Cabbage	25.00±1.20*	37.33±4.10*
Cucumber	39.80±10.12	38.80±10.84
Chilli	13.00±7.00	14.00±2.62
Bitter gourd	63.50±21.11	40.00±0.00

*Results of T-test showed level of significance has p value less than 0.05.

Cropping Calendar

Cropping calendar revealed harvesting period in organic production system was longer for chilli and bitter-gourd whereas the conventional farms harvested tomato, cauliflower, cabbage and cucumber for longer period (Table 8).

Conventional farmers harvested their tomato fruit a month before than organic farmers. Conventional farmers started top dressing, weeding, hoeing second thirds of the Chaitra than last thirds by organic farmers.

Organic farmers prepared land for cucumber planting at the start of Poush whereas conventional farmers prepared their land on the last thirds of Poush. Organic farmers planted cucumber on the last thirds of Magh whereas conventional farmers on second thirds of Phagun. As consequence, weeding hoeing was also done earlier by organic farmers. Similar to the tomato, organic farmers got harvest later than conventional farmers. It was due to fast growing habit of plants with supply of chemical fertilizers.

Cauliflower was grown by conventional farmers almost around the year with less availability of produce during the months of Shrawan and Bhadra. Organic cauliflowers were available in the market from the month of Kartik to Magh. Organic farmers transplanted cauliflower from second thirds of Shrawan whereas conventional farmers transplanted seedlings from last thirds of Asar. Organic farmers started weeding and hoeing in cauliflower from Asoj first week whereas conventional farmers from last thirds of Shrawan.

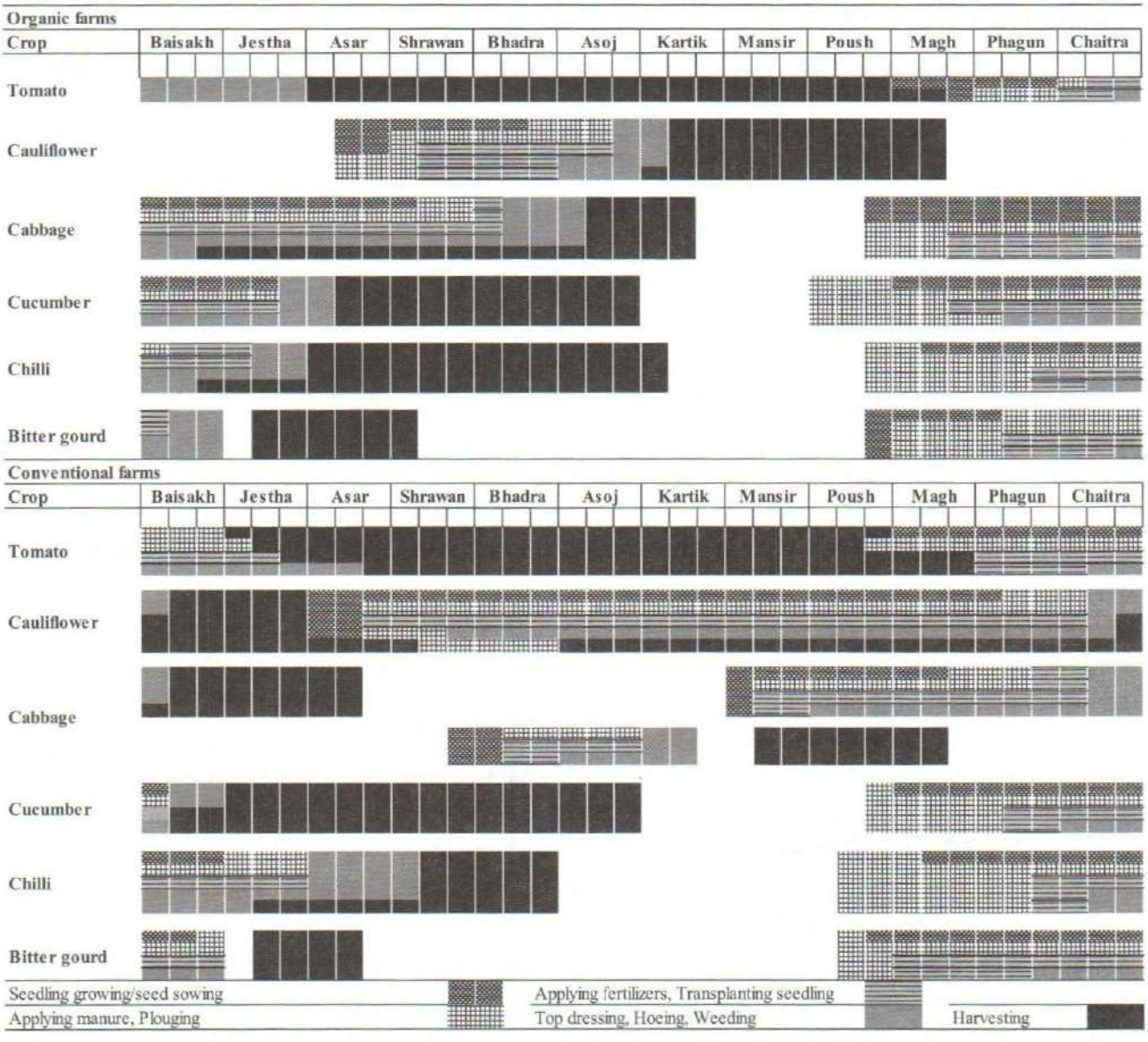
Organic farmers served cabbage to consumers for longer time as the growth rate is slower compared to cabbage in the conventional farms.

In the case of chilli, organic farmers harvested from second thirds of Baisakh and continued to Kartik first thirds. Conventional farmers harvested from Jestha second thirds till the end of Bhadra.

Organic farmers grew bitter gourd seedling from the last thirds of Poush, prepared land from start of Magh and transplanted seedlings from second thirds of Phagun till the first thirds of Baisakh. Organic farmers did weeding, hoeing practice from last thirds of Chaitra till the end of Baisakh. Then they harvested bitter gourd from second thirds of Jestha till the first thirds of Shrawan (Table 8).

Compared to past as shown by Rekhi et al. (1989) the vegetable supply period has increased (Table 8). It is due to use of different hybrid varieties and plastic tunnel vegetable cultivation which were not common in the past.

Table 8. Cropping calendar (in Nepali calendar months*) in commercial organic and conventional vegetable farms in Kathmandu valley



*Nepali months approximates to English calendar: Baisakh= Apr 16 to May 15, Jestha = May 16 to June 15, Asar = June 16 to July 15, Shrawan = July 16 to Aug. 15, Bhadra = Aug. 16 to Sept. 15, Asoj = Sept. 16 to Oct. 15, Kartik = Oct. 16 to Nov. 15, Mansir = Nov. 16 to Dec. 15, Poush = Dec. 16 to Jan 15, Magh = Jan. 16 to Feb. 15, Phagun = Feb. 16 to Mar. 15, Chaitra = Mar. 16 to Apr. 15.

Problems

The main problem among organic farmers was labour scarcity whereas it was quality seed materials among conventional farmers (Table 9). Organic farming becomes laborious farming without proper mechanization hence, it generates employment opportunities (Harrison et al., 2002). Because as herbicides are not used, hand weeding becomes laborious, organic farmers need to apply lot of organic manures, hand picking of pests as mechanical control measure, hand removal of early disease showing plant parts all cost labour (Eyhorn et al., 2002). Hence, organic farmers need to find enough labour for the year round period.

Table 9. Production related problems faced by organic and conventional farmers in Kathmandu valley

Production related problems	Organic farmers		Conventional farmers	
	*Index value	Rank	Index value	Rank
1. Quality seed materials	2.30	3	2.47	4
2. Availability of fertilizer and manures	2.00	2	2.27	3
4. Irrigation water and facility	1.63	1	1.80	1
5. Labour scarcity	2.37	4	2.20	2

* Index value range from 5 to 1, where 5= most serious, 4 = serious, 3 = moderate, 2 = little bit and 1 = no problem at all.

Trainings and Advice

In comparison with commercial organic farmers (73.3%), lesser conventional farmers (63.3%) had taken formal trainings (Table 10). It was maybe because organic farming needs more agro-ecosystem knowledge compared to conventional agriculture. Knowledge is required to manage plant nutrients via organic sources, identifying the natural enemies of different pests and finding methods of pest and disease management (Eyhorn et al., 2002).

Table 10. Training obtained by commercial vegetable farmers (%) in Kathmandu valley

Type of training	Organic farmers	Conventional farmers
Vegetable production techniques	40.0	46.7
Organic farming	20.0	-
Integrated pest management	10.0	10.0
Market management	3.3	-
Junior Technical Assistant	-	6.7
Untrained farmers	26.7	36.7

Among others, agricultural consultants were the main resort of advice among commercial farmers. Seeking for advice was more common among conventional farmers than organic farmers. Conventional farmers were seeking help from the private consultants more often than from government support office staffs and agricultural shop owners (Table 11).

Table 11. Resort for advice and information by commercial organic (Org) and conventional (Conv) vegetable farmers (percentage respondents out of 30 each) in Kathmandu valley

Advice type	Agricultural consultant		Government offices		Vendors	
	Org	Conv	Org	Conv	Org	Conv
Variety selection	13.3	33.3	10.0	23.3	3.3	16.7
Crop selection	6.7	30.0	6.7	20.0	-	13.3
Cropping practice	6.7	26.7	20	13.3	10.0	6.7

Willingness to Continue Farming

Sixty percentage commercial conventional farmers were willing to convert to organic farmer acknowledging health and environmental hazards of chemical pesticides (Figure 1). Hence, availability of inputs (both physical and non-physical) for standard organic production will contribute in expansion of organic farms in the peri-urban areas in Kathmandu valley.

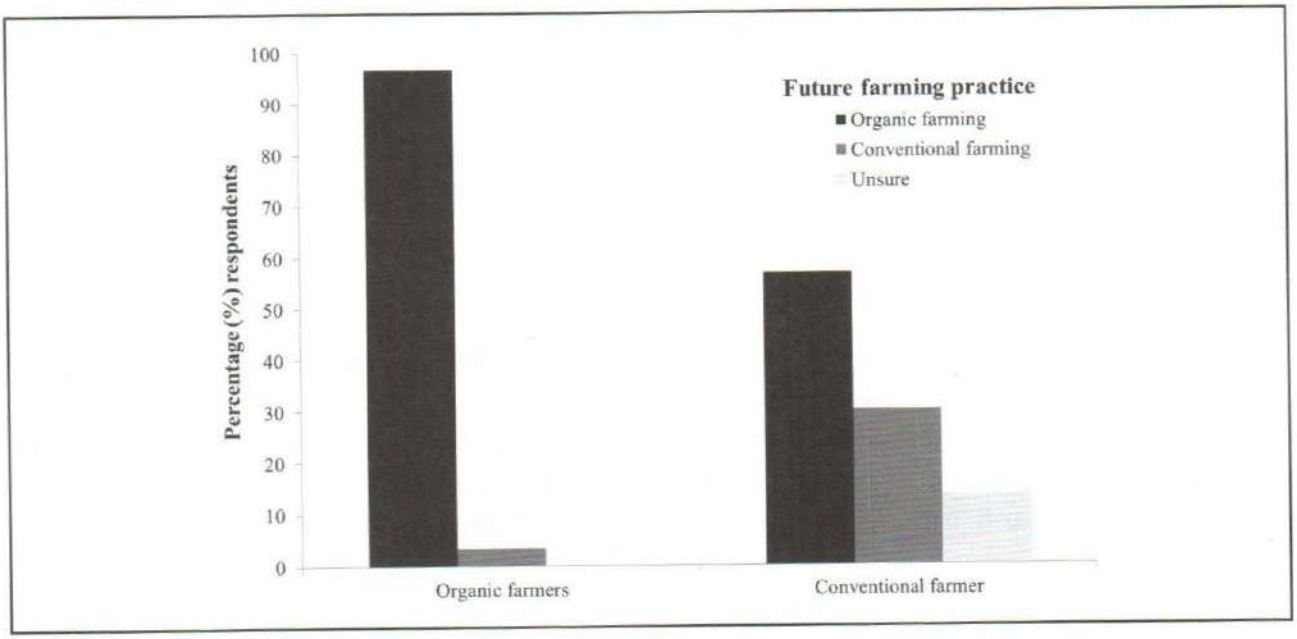


Figure 1. Willingness to continue the current farming system among commercial vegetable growing organic and conventional farmers in Kathmandu valley

Conclusions

To maintain the organic agriculture standards, organic farmers should use the organically grown seeds without any chemical pesticides treatment. Increasing off season vegetable production by organic farmers using plastic tunnel cultivation of vegetables will expand their period of vegetable supply. With heavy doses of chemical fertilisers, conventional farmers gain higher yield in the short term. In long term, organic farmers gain relative yield with lesser inputs. Conventional farmers should increase the use of organic manures to maintain sustainable yield from the land. Standards of organic manures like poultry manures and commercial products like Posan, Vitamin and should be checked for suitability as per organic standards. With availability of organic inputs like seeds and organic manures organic agriculture can gain momentum in the future as export opportunities grows. Furthermore, environmental and health benefits of organic agriculture also attracts both farmers and consumers towards organic agriculture.

Acknowledgements

Authors are much obliged to respondent farmers for their invaluable information and time without which this work was impossible. We are grateful to University Grants Commission (UGC), Nepal for providing faculty research grant (FR-069/70 – 88) to conduct this research as a part of the project "Disease suppressiveness level of vegetable growing soils in Kathmandu valley" at Himalayan College of Agricultural Sciences and Technology (HICAST). We thank DADO personnel of Kathmandu, Bhaktapur and Lalitpur for providing information on commercial farmers in the valley. We acknowledge agricultural consultants especially Mr Shiva Yendyo and Mr Bimal Prajapati for providing contact list of commercial farmers in the valley. Our humble thanks to Nepal permaculture group (NPG) for providing contact information of commercial organic farmers in Kathmandu valley. We thank Dr. Ishwori Prasad Gautam (PhD Horticulture) for corrections in the manuscript prepared. Last but not least, our gratitude to HICAST for providing logistic support for this research.

References

ABPSD. (2011) तरकारी खेती प्रबिधि Agribusiness Promotion and Statistics Division (ABPSD), Ministry of Agriculture and Co-operatives SinghDurbar, Kathmandu, Nepal.

Atreya K., Johnsen F.H., Sitaula B.K. (2012) Health and environmental costs of pesticide use in vegetable farming in Nepal. Environmental Development and Sustainability 14:477-493.

Basyal S. (2015) 27pc of veggies, fruits imported from India, The Kathmandu Post, Kantipur Publications Pvt. Ltd., Kathmandu.

Bhatta G.D., Doppler W., KC K., Shrestha G. (2009) Changing agriculture land use practice towards organics in peri-urban areas of Nepal: through producers and consumers perspective (31 March - 1 April 2009), International symposium on environment, energy and water in Nepal: recent researches and direction for future, Global COE program and international research center for river basin environment, university of yamanashi, Japan, Center of research for enviornment, energy and water, Nepal, Institute for global environmental strategies, Japan, Hotel Himalaya, Kathmandu, Nepal. pp. 212-218.

CBS. (2010) Nepal Vegetable Crops Survey 2009-10: A statistical report, Central Bureau of Statistics (CBS), National Planning Commission Secretariat, Government of Nepal, Thapathiali, Kathmandu.

de Ponti T., Rijk B., van Ittersum M.K. (2012) The crop yield gap between organic and conventional agriculture. Agricultural Systems 108:1-9.

Eyhorn F., Heeb M., Wieidmann G. (2002) IFOAM Training manual for organic agriculture in the Tropics: Theory, transparencies, didactic apporach. International federation of organic agriculture movements (IFOAM), Research institute of organic agriculture (FiBL), CABI Bioscience, Agrecol Afique (Senegal), Agrecol Andes (Bolivia) and INOCERT (India).

Harrison P., Bruinsma J., de Haen H., Alexandratos N., Schmidhuber J., Bödeker G., Ottaviani M. (2002) World agriculture: towards 2015/2030. Online, http://www. fao. org/documents.

Kathmandu post. (2014) People rushing to organic stores amid pesticide scare, The Kathmandu Post, Kantipur Publications Pvt. Ltd., Kantipur Complex, Subidhanagar, Kathmandu.

Mi□a M.Ā.K. (1993) Applied Statistics: A Course Handbook for Human Settlements Planning Division of Human Settlements Development, Asian Institute of Technology.

MoAC. (2008) Nepalese standards of organic agriculture, Ministry of Agriculture and Cooperative (MoAC), Government of Nepal, Kathmandu, Nepal.

Mowbray P., Kumarage G., Marlowe G.A. (1994) Methods of producing vegetable seedlings with containerized technology, The Agro-Enterprise Development Project, Colombo, Sri Lanka.

PPD. (2014) High pesticide residue in vegetables, Plant Protection Directorate (PPD).

Rekhi S.S., Shah B.B., Aryal S.B. (1989) Vegetable development in Nepal: present status, future strategy, and constraints, in: S. S. Teaotia (Ed.), International expert meeting on horticultural development in the hindu kush-himalayan region (19-21 June, 1989), International Centre for Integrated mountain Development (ICIMOD), Kathmandu, Nepal. pp. 139-165.

Republica. (2014) Veg imports up by 31 percent, my Republica, Nepal Republica Media, Kathmandu.

Schoonbeek S., Azadi H., Mahmoudi H., Derudder B. (2013) Organic agriculture and undernourishment in developing countries: main potentials and challenges. Critical reviews in food science and nutrition 53:917-28.

Shrestha G. (2015) Soil properties and soil management practices in commercial organic and conventional vegetable farms in Kathmandu valley. Nepal Journal of Science and Technology 15:13-22.

Shrestha G., Chaudhary R.D. (2015) Agronomic performance of paddy-wheat system under long term soil fertility trial: a guide-line for fertilizer recommendation in mid-western terai region, in: Y. G. Khadka, et al. (Eds.), 28th summer crops workshop, Nepal Agricultural Research Council, National Rice Research Programme (NRRP).

Shrestha G., Prajapati S., Mahato B. (2014a) Plant diseases and their management practices in commercial organic and conventional vegetable farms in Kathmandu valley. Nepalese Journal of Agricultural Sciences:129.

Shrestha K., Shrestha G., Pandey P.R. (2014b) Economic analysis of commercial organic and conventional vegetable farming in Kathmandu valley. The Journal of Agriculture and Environment 15:58-71.

Statistics Section. (2013) Statistical information on nepalese agriculture 2012/13, Agri Statistics Section, Agribusiness Promotion and Statistics Division, Ministry of Agricultural Development, Government of Nepal, Singh Durbar, Kathmandu.

VDD. (2010) तरकारी खेति प्रविधिका लागि उन्मोचित तथा पन्जिकृत तरकारी बालीका जातहरु सम्बधि प्राबिधिक पुस्तिका Vegetable Development Directorate, Khumaltar, Lalitpur, Nepal.