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Economic performance of organic vs conventional vegetables production in Gaza strip

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Abstract: Organic farming has achieved significant growth in developing countries. However, it is still in some areas such as Gaza strip at embryonic stage. Introduction and promotion of organic farming would need more information about economic feasibility of shifting from the existing conventional farms to organic farming system. This is the main aim of this study. Data was collected from 100 randomly selected farmers in southern area of Gaza strip using standard questionnaire. Additional focus group discussions were conducted for further qualitative analyses. Data was also collected from the organic farm of Safe Agriculture Association where vegetables are organically produced and marketed. Gross margin and comparative analyses were used to describe cost structure of conventional and organic production and to assess economic potentialities to shift to organic farming. Results varied among vegetable crops as some crops showed very high economic potential to shift to organic farming while other crops did not. Major reasons for crops with good potential were higher yield under organic farming, premium market prices and lower production costs. Major reasons for lower economic potential to shift were the significant lower yield and higher production costs. The study recommends further technical research to explore organic production techniques that allows for higher yield and lower production cost. The study also recommends further market research to investigate consumers' preferences and willingness to pay for organic products.

***Keywords*:** Organic agriculture, developing countries, gross margin analyses, conventional farming, Gaza strip.

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Introduction

More and more international attention is directed to organic farming. In addition to its positive impact on environment and health (Lynch et al., 2012; Pimentel et al., 2005; Wells et al., 2000; Liebig and Doran, 1999; Drinkwater et al., 1998) demand is significantly increasing. Consumers' awareness on the risks that are associated with conventional agricultural products encourages more demand on organic farming products. Such demand was able to push the prices for organic products up to encourage farmers to produce more.

Adoption and expansion of organic farming in developing countries have positive advantage on environment, sustainability of natural resources and food security (in terms of safety). Environmental friendly agricultural practices are recognized as necessity to reduce dependency on external inputs and as response to the intensive use of agrochemicals and thus, decrease of their negative implications on natural resources, environment and health. Organic farming follows the principles of nature, which are self-sustaining developing systems. It respects the environment's own systems for controlling pests and diseases in raising crops and livestock, and avoids the use of synthetic pesticides, herbicides, chemical fertilizers, growth hormones, antibiotics or gene manipulation (GTZ Sustainet, 2006)

Current status of organic farming in developing countries indicates great potential for expansion. This is even true in the leading countries in organic agriculture such as Uruguay which cultivate only 6.26 % of its arable land organically (Willer and Kilcher, 2011). Further adoption of organic farming in developing countries is restricted by core challenges

such as food security, increased labor requirements, lack of domestic demand, and high certification costs (Priyanka and Hermann, 2013; Klimov, 2011; Oelofse et al., 2010; Kassie, et al., 2008; Scoones and Elsaesser, 2008; Devi, et al., 2007; Ramesh et al., 2005; Walaga, 2005)

Although organic farming was major traditional farming practice in Gaza strip, farmers nowadays do not practice organic farming. Declining the owned land szie pushed farmers to apply intensive farming approaches that depend on using fertilizers and other agrochemicals. Common agricultural practices in Gaza Strip are to a large extent dependent on using huge amounts of agro-chemicals. The amount of registered pesticides coming into Gaza through legal crossings during 2009 was around 646 tons (MoA, 2010). The total amount used may be higher than what has been recorded since there is also the illegal import of pesticides in Gaza Strip. Initiating and developing organic production in developing countries in general is seen as an urgent need to minimize agrochemical applications and the associated health and environmental risks.. Several studies (Safi, 2002; Yassin et al., 2002) have documented the negative impact of agro-chemical use in agriculture on the environment and public health.

This study is part of a wider research project that investigate potentialities of organic farming in Gaza strip and aims at designing proper policy to promote its application. The research follows holistic approach to analyze potentialities at three integrated levels. First level focuses at farm level where investigation on economic performance of organic farming vs conventional farming is conducted. It also explores farmers' knowledge and perception towards organic farming in Gaza strip. The second level studies marketing potential of organic products through questioning consumers' preferences and willingness to pay. The third level is a review of possible institutional frames for monitoring and certification of organic products and analyze optimal model that fits production and marketing settings in Gaza strip. This paper focuses on the first level of the research and based on data collected from farming families in Gaza strip.

Small scale farmers in Gaza strip as most other developing countries earn their income mainly through their farming activities. Therefore, shifting to organic farming must at least generate the same income as conventional farming. This however, can be achieved when farm generates same level of profit after shifting to organic farming. This paper aims at assessing economic potential of shifting to organic farming through comparing Gross Margin (GM) of organic farm with GM of conventional farms in Gaza strip.

Literature review

Several studies were conducted to compare the economic performance of organic farming vs conventional one. Most of these studies were conducted in developed countries in Europe and USA. Less number of studies are available for developing countries. The studies are different in their methods of defining economic performance due to the different nature of profitability definition and the different production surrounding policy and technical environment (Nemes, 2009)

Literature review of studies in developed and developing counties revealed the higher profitability of organic farming compared to conventional. The reasons for better economic performance were however different. In developed countries profitability of organic farming was mainly caused by support payment, higher market prices, and or lower production costs. For instance, studies in Europe considered the Government support payments among the economic benefits of organic farming. (Offermann and Nieberg 2000) found that these payments on average contributed to 16-24 percent of profits in Germany, Austria, Switzerland and Denmark.

In some cases, combinations of reasons were involved such as higher yields and higher prices or higher premium and lower costs. Despite of lower organic yield in vegetables production, still organic farming in Europe generated higher profits. This is not only due to the governmental support payments but also because of higher market prices (IFAD, 2005); even with much higher costs and significantly lower yields, price premium made organic more profitable (McBride and Greene, 2008; Lyngboek et al., 2001; Brumfield et al., 2000) higher prices for organic accounted for 40-75 percent of profits in Germany and Britain for arable farms (Offermann and Nieberg, 2000). Lower production costs caused significant difference in net returns even without premiums (Mahoney et al., 2004; Mendoza, 2002). Low production cost along with the 20 percent premium on organic was the prime reasons for higher profit margin (Shah et al., 2005).

In developing countries, less number of studies was conducted to economically compare between organic and conventional farming. Most of these studies were conducted in India, Latin America and

Philippines. No studies were conducted in Palestine as organic farming is not widely practiced. All complied studies in developing countries showed higher profitability in organic agriculture (except for one study by Puelschen and Lutzeyer (1993), partly because of higher yields and reduced costs (Jalees, 2008; Eyhorn et al., 2005; Mendoza, 2002), partly because of much higher market prices (IFAD, 2005).

Organic agriculture is perceived as a farming system that needs additional labor requirements when compared with the conventional systems. These are especially a challenge in regions where there is a labor shortage and is henc expensive. Yet, the demand for labor is evenly distributed over the year in organic than in chemical usage farming systems (Pimental, et al, 2005).

Material and methods

Study areas

The Gaza Strip lies on the southern part of the eastern coast of the Mediterranean Sea with a coastline of 40 km. Gaza borders Israel to the north and east (51 km long), and Egypt to the South (11 km long) with an area of approximately 363 square km (The Applied Research Institute Jerusalem (ARIJ), 2003). Data were collected from farmers through family surveys using standardized questionnaire and informal interviews with key person. A survey in 100 representatively selected family farms in Western Rafah and records of single organic farm provided the empirical data base for analyses in Gaza strip. Organic agriculture is not practiced by farmers in Gaza strip. However, Safe Agriculture Association (SAA) manage organic vegetables farm. The farm represents a model for possible organic production under Gaza climate and technical capacities. The study therefore, used its production data as basis for comparison between conventional farming and organic farming.

Sampling and data collection

Initial list of 300 farmers who reside in western Rafah area was the basis select 150 case. The 150 names were randomly selected to cover 100 cases as main list and other 50 cases for replacement.

The questionnaire was designed to describe economic performance of farming activities and farmers' knowledge & perceptions towards organic farming. Additional information on demographic and household data were collected through the questionnaire.

Data was collected in 2013 in Arabic language. Both qualitative and quantitative methods were used to collect data in western Rafah area. Standard questionnaire was designed to describe economic performance of farming activities and farmers' knowledge and perceptions towards organic farming. Additional information on demographic and household data was collected through the questionnaire. The collected data at farm level included wide range of information including detailed information on farming practices and economic performance of each crops. Major means for comparing the economic performance between organic and non-organic farming is Gross Margin analyses. For SAA farm data was collected using farm performance and gross margin section of the standard questionnaire.

For further in-depth analyses two focus group discussions were conducted with group of vegetables farmers. Each focus group included 12 vegetables farmers.

A gross margin for an enterprise is its financial output minus its variable costs (Firth, 2002). The use of gross margins became widespread in the UK in 1960, when it was first popularised amongst farm management advisers for analysis and planning purposes (Barnard and Nix, 1979). In organic systems gross margins are also useful for farm planning and for making comparisons of enterprises, on the same farm, between organic holdings, or between conventional and organic enterprises (Lampkin, 2001).

Results and discussion

Sample description

Family size for vegetables farmers is of great importance as it is the major human resources for their labor intensive activities. Results revealed that 52 % of the interviewed farmers rely on family labor as major source for farm human resources while 24% hired labors on constant base and 23% hired seasonal labor to achieve farm activities. Family average size is 7 while the adults' number is 3. Usually field work is neither gender nor age restricted as women and children participate in farming activities.

All the interviewed farmers run vegetables production activities. However, not all of them considered it as their major income source. 49% of the interviewed farmers stated their major career as plant production farmers while 16% of them considered livestock production as the main occupation. The remaining 35% stated off farm activities as their major source of income. This indicates the significance of vegetables production for farmers as major sources of income. Integration between plant production and animal production can also be reflected as 16% of the interviewed farmers relay on their livestock as major income sources. Results indicated that 28% of the interviewed farmers possess sheep.

97% of the interviewed farmers ranked themselves in income categories that have income less than 2000 NIS (New Israeli Shekel = 0.29 US$) a month. 52% of them were under the income of 800 NIS a month. Such figure reflects very low living standards or at least that farmers see themselves as very poor and needy. The aggregated income calculations revealed similar results as the average income was as low as 1081 NIS a month with a standard deviation of 564 NIS. Such big deviation indicates the variance among the farmers in their reported income and reflects the low representativeness of the general average. Frequency analyses revealed that 51% of the sample has income less than the stated average.

Results indicated that 46% of the interviewed families receive loans. Long term loans are usually used for social events or to rebuild farm assets. 36% of the interviewed cases obtained long term loans from informal sources including friends and relatives with minor frequency of for formal credit sources. More than half of the interviewed farmers purchases food on credit from local groceries while 38% of them purchase farm inputs on credits. Similar result was revealed from the Focus Group Discussion as farmers complained that they can't pay their farm input credits back when they face production or market price failure. In some cases, this cause stopping production as input traders are not willing to give any additional input to farmers who could not pay their previous loans. Water resource was a recognized problem for 45% of the interviewed farmers as they purchase water. The other 55% owns or share wells.

Land size varied among the interviewed farmers. However, land size is small in general as 87% of the interviewed farmers operate less than 4 and half dunums and 98% of them have less than 10 dunums. Major part of this land is cultivated with open field vegetables. The total average of the operated land is 2.8 dunum with an average area of 1.9 open fields and 0.9 as greenhouses. Results showed that half of the interviewed farmers own greenhouses.

The small size of the operated land reflects the need to cultivate the land intensively as to generate enough income for the families. This implies the need to apply intensive agriculture techniques which rely 'to wide extent' on the use of chemical fertilizers. Shifting to organic farming prohibits the application of chemical fertilizers and other agrochemical protection measures. The alternative organic methods can't serve as quick as chemical methods, specially, in intensive production system that are dependent on agrochemicals. This indicates the potential technical complications for shifting to organic farming as farmers need to shift from an intensive production system with high dependency on agrochemicals to organic farming. This is also reflected in gross margin analyses as it shows the quantities of chemical fertilizers and other agrochemicals that are applied in vegetables production.

Gross Margin analyses

The interviewed farmers practiced intensive vegetables production for marketing purposes. Small land holding is major reason behind this as farmers have to use the scarce land resources intensively to enable profits that can cover the family expenditure.

Questionnaire covered all types of cultivated vegetables. However, only two crops will be presented in this section. The analyses here will include tomato and cucumber. The results of other vegetable crops will be presented in the next section when they are compared against the same crops in the organic farm of SAA.

Conducting these analyses will provide better understanding of the production system and to which level it is agrochemical dependent. Additionally it will show the cost structure and share of chemical fertilizers in the variable cost. This is to predict the needed changes and sequencing changes on costs when shifting to organic farming.

Table 1 shows the gross margin analyses of the most frequently cultivated crops in the study area. The table illustrates productivity, revenues, cost structure and profitability per unit of land (dunum).

Tomato production is popular in the study area. 22 farmers out of the 100 interviewed cultivated tomato. An average cultivated area is around 2 dunums which is relatively small area. Although productivity per dunum is low as compared to the production potential per dunum which can reach 18-20 tons, however, farmers usually end tomato season in its final stages as its costs exceeds the revenues.

Table 1 Gross margin of vegetables production under conventional farming system

Crop	Tomato	Cucumber
Number of cases	N =22	N=16
Cultivated area du	2.09	1.56
Prod. quantity Ton per farm	22.2	6.36
Production Ton per dunum	9.7	5.03
Average price NIS/ton	1400	2000
Total revenue NIS per farm	35,324	13937.5
Total revenue NIS per du	16,543	10062.5
Seedling cost NIS per dunum	682.5	1111.4
Nr. of farmers use chem. Soil sterilisers	8	10
Cost of soil steriliser NIS per dunum weighted average	290	340
Chem. Fertilizers cost per du	767.5	600
Org. Fertilizer cost	0	0
Pesticides costs per du	918.2	1080.4
Labour Man days per dunum	66.2	31.25
Labour cost NIS per du	2314.4	1093.8
Water quantity M^3	933.2	583.3
Water cost per du	1104	291.7
Total cost per farm NIS	12200	7430.9
Variable cost NIS /du	6246	4755.8
Total farm profit / loss	23,047.6	6505.6
Gross margin per (NIS/ du)	10,251.5	5306.7

The achieved average price per ton is moderate and could achieve significant revenues that covered all costs and generate profits. Usually farmers would give an average price that represents the whole period of production which last seven months. Usually tomato prices are fluctuating during the production season. Sometimes it can be very low that it does not cover transportation costs. However, farmers keep harvesting and marketing as they expect better prices in future.

The revenue per dunum is 16,543 NIS for the crop that remains in the soil for almost 10 months. 3 of them are nonproductive (vegetation growth period) while the remaining 7 months are productive. Dividing these revenues on 7 productive months will generate around 2350 NIS per month. This can represent the cash inflow during production period. However, does not represent the profit as costs are not deducted from this amount. Some of these costs are explicit such as seedlings and other input costs while other costs are implicit such as cost of the family labor as it does not require any cash transfer and usually is not counted in the costs.

Cost structure shows that 40% of the variable costs are spent on agrochemicals including chemical fertilizers, pesticides and soil sterilizers. Results also showed 37% is spent on implicit laborer costs while the remaining costs are other inputs such as seedlings and irrigation water. Such results indicate that shifting to organic or safe agricultural practices can generate significant saves in the costs. However, laborer costs may increase but may not reach 40% as the costs of agrochemicals. On the other hand production revenue is expected to decrease as production is not as high as conventional farming. This is not always the case as in some crops the production may increase. This will be shown in the next section when comparison is conducted between vegetables crops under conventional system with the same crops in the organic farm of SAA.

Performance of cucumber production was almost no difference from tomato. The only major difference is the length of production period as cucumber can generate significant profit in relatively very short time of 3 months. Cost structure is almost the same as tomato but with lower total costs for cucumber due to the shorter period of cultivation.

Farmers usually don't get such profits as prices fluctuation can leave them with very minor profit or even loses. In general, introduction of safe agriculture practices will help farmers to reduce major portion of their variable costs. This is however, does not mean increase in their profit as their production may decrease (especially in such environment where farmers are agrochemical dependent). Shifting to safe agricultural practices would need market support to offer farmers higher prices to compensate the reduction in prices.

Comparative Analyses

Table 2 shows the percentage differences between conventional farming and organic farming in SAA. The organic farm of SAA reflects organic farming under the local climate and environmental settings. However, it reflects good experience of organic

farming as it has been operating since 10 years. Shifting of organic farming usually takes a period of 3 years to transfer from chemical dependent intensive production system and fully organic farming. After this period organic production reaches to its maximum capacity that is presented in SSA organic farm. SAA also presents marketing model for organic products as consumers purchase the organic products from the farm for relatively higher prices.

As shown in table 2 all vegetables except Tomato and Maize produce less yield under organic farming system. Several studies have reported the lower yield of organic produced vegetables (IFAD, 2005). Other study has revealed the possibility to achieve higher yield in organic farming in developing countries (Parrot and Marsden, 2002).

Value of products was also lower in conventional farming as it reflects the lower yield and lower market prices. Opposite results are found in tomato, maize and potatoes. For tomato and maize value of products was higher mainly because of the higher yield of the organic farming while it was because the higher prices for potatoes. This result goes in line with numerous studies that reported the premium prices of organic products as major reason for higher revenues and profits (McBride and Greene, 2008; Lyngboek et al., 2001; Brumfield et al., 2000).

Table 2: Change in economic performance of vegetables crops as a result of shifting to organic farming.

	% change					
Parameters Crops	**Yield**	**Production Value**	**price**	**Variable Cost**	**labor cost**	**Fertilizer Cost**
Tomato N= 22	**40**	**38**	**-2**	**7**	**77**	**163**
Squash N=3	**-38**	**-24**	**23**	**-54**	**157**	**43**
Maize N=21	**25**	**12**	**-9**	**117**	**780**	**264**
Potatoes N=27	**-5**	**56**	**56**	**67**	**275**	**202**
Jews mallow N=5	**-52**	**-47**	**9**	**-66**	**-56**	**-160**
Eggplant N=3	**-56**	**-36**	**44**	**-18**	**35**	**111**
Carrot N= 4	**-69**	**-46**	**76**	**-45**	**40**	**2**
Pepper N= 2	**-55**	**-27**	**63**	**20**	**620**	**216**
Watermelon N= 16	**-66**	**-11**	**158**	**-11**	**13**	**417**
Cucumber N=16	**-91**	**-80**	**130**	**-48**	**-33**	**-39**

Except tomato and maize, unit prices are higher in all vegetables in organic farm. This reflects consumers' actual willingness to pay for organic products. SAA, however, is an NGO that does not aim at generating profit. Their major aim is to promote organic farming in Gaza strip through practicing organic farming and selling products for interested consumers at fair price that can cover production costs.

Organic products usually attract well educated and high income consumers who are willing to pay higher prices (Ngobo, 2011; Dettmann and Dimitri, 2010; Smith et al., 2009; Dettmann, 2008; Wang and Suns, 2003).

Results showed variation in potential changes that can occur as a result of shifting to organic farming. Six crops have less variable cost under conventional farming while it was higher for other four crops. In general, the costs for chemical fertilizers and pesticides are saved in organic farming. Such savings in some crops like carrot and watermelon were very high that could compensate for the additional costs of organic fertilizers and additional labor costs. As shown in table 2 squash, eggplant, carrot, and watermelon still have lower variable cost under organic farming system even with higher costs for organic fertilizers and additional labor. This is mainly because of the saving of agrochemicals. In Jews Mallow and cucumber savings are made due to savings in fertilizers and labor. These results agree with previous studies which indicated lower production costs as major reason for profitability of organic farming (Shah et al., 2005; Mahoney et al., 2004; Mendoza, 2002).

SAA organic farm bears additional costs for organic fertilizers as it purchases animal manure from livestock farmers. Mixed farming system that integrates plant and livestock productions has the advantage of lower costs for organic fertilizers as it is produced in farm. Organic farming is usually presented as safe agricultural practices that have less dependency on external inputs (Leifeld, 2012; Scialabba, 2000). Such concept indicates the advantage of farming family system in developing countries that uses farm and family resources as means for production (Doppler,1993; Doppler,1991) SAA farm uses hired labor while the situation is different for farming families where family members are major source for labor as it can increase savings.

Profitability analyses

Figure 1 describes the changes of gross margin that can occur as a result of shifting from conventional to organic farming system. The changes are presented in percentage and were calculated by comparing gross margin of conventional farms and the gross margin of the same crops under organic farming in SSA farm.

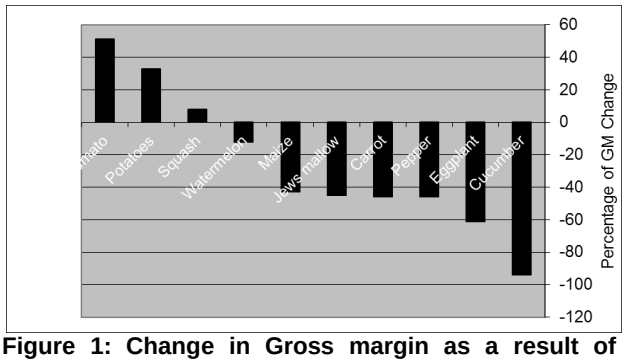

Figure 1: Change in Gross margin as a result of shifting from conventional to organic farming.

Gross margin is used to assess performance of an individual enterprise and as a mean for comparing economic performance across enterprises (Wachholtz, 1996). Goss margin is calculated by deducting the variable cost of each crop from the value of production (Bhatta, 2010). Hence, it is an aggregated value that is affected by its original components. As the results show that three crops has higher gross margin under organic farming system. The reason behind this however, is not the same. Higher yield in tomato was major reason for higher gross margin under organic farming while premium market price was the major reason for potatoes higher gross margin under organic production system. Squash higher gross margin was caused by its lower production costs and its premium market prices. The results indicate the unique performance of each crop as three crops could achieve higher gross margin under organic farming system but with different reason for such achievement.

Except maize, the lower gross margin under conventional system was caused by lower yield and lower market prices. However, other reasons were participating to the lowered gross margin such as higher cost as in pepper case. Maize under organic farming system has significantly higher yield and slightly lower product price. Consequently, it has higher value for its production. However, it still gives lower gross margin under organic farming as the additional production costs for labor and organic fertilizers cause significant decrease to gross margin.

Figure 2 shows the needed percentage change of organic product price to achieve the same gross margin as conventional farming system. Such figure indicates the lowest level of price change that would facilitate shifting to organic farming. As expected in tomato case, a decrease in price by 25% would still good and can achieve the same gross margin as in conventional farming system. This is due to the significant increase in tomato yield under organic farming. Squash has higher gross margin under organic farming system. However, there is still need to get higher prices of 15% to achieve the same gross margin as conventional system. This is due to the significant yield loss when shift to organic. Maize has similar situation but with different reason as its production cost under organic farming system is significantly higher.

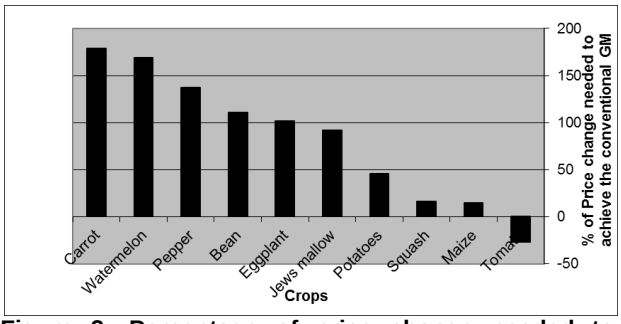

Figure 2: Percentage of price change needed to achieve the same gross margin as conventional farming.

As shown in figure 2 all other crops need significant increase in prices to enable shifting to organic farming. In some crops such as carrot, watermelon, pepper and beans the price need to be doubled to facilitate shifting organic production system. This however, may not be possible in the local markets in Gaza. Export can be an option that facilitates such

high prices. Still additional exportation and certification costs have to be considered.

Other option should be working on improved production techniques that decrease cost production and increase productivity of organic farming system in Gaza strip.

Conclusion

Analyses of cost structure for vegetable crops production in Gaza strip revealed that conventional farming system is to wide extent dependent on agrochemicals. In one side this is expected to complicate shifting process as the system became chemical addicted. On the other side, it facilitates easier shifting as saving of agrochemical costs will reduce the production costs and make organic farming economically attractive.

Assessment of economic performance of organic production against conventional farming showed wide range of results. Three crops showed good economic potentialities for shifting to organic farming. However, reason behind such performance differed and included higher organic yield, premium prices for organic products, and lower organic production costs. Results showed that significant lower yield and higher production costs were major reason behind the low economic potential for seven vegetable crops to shift to organic. Such results revealed the need to improve technicalities of organic production to achieve higher yield at lower price.

Results also indicated the significance of market prices as major factor affect economic potential for vegetable crops to shift to organic system. Almost in all crops, a significant increase in product price was necessary to enable shifting to organic farming. This indicates the need for further market research to investigate consumers' preferences and willingness to pay for organic products.

The study recommends further technical research on potential organic farming procedures that can generate the same yield as conventional farming system. For some crops, it seems impossible to shift to organic farming as market price needs to be doubled to compensate for the lowered yield and higher production costs. In such situation, shifting can never occur without improved production techniques.

Further studies are needed to explore optimal institutional frames for monitoring and certifications; and the associated costs. Potentialities of organic farming must be analyzed using holistic approach that integrates farm level, market level and the institutional frames.

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