SANDEE

Working Paper No. 107–16

The Relative Efficiency of Organic Farming in Nepal

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ECONOMICS & THE ENVIRONMENT

Published by the South Asian Network for Development and Environmental Economics (SANDEE)
PO Box 8975, EPC 1056, Kathmandu, Nepal.
Tel: 977-1-5003222 Fax: 977-1-5003299

SANDEE research reports are the output of research projects supported by the South Asian Network for Development and Environmental Economics. The reports have been peer reviewed and edited. A summary of the findings of SANDEE reports are also available as SANDEE Policy Briefs.

National Library of Nepal Catalogue Service:

Khem Raj Dahal, Shiva Chandra Dhakal
The Relative Efficiency of Organic Farming in Nepal

(SANDEE Working Papers, ISSN 1893-1891; WP 107–16)

Keywords
Organic farming
Productivity
Profits
Rice
Tea
Nepal

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April 2016

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PO Box 8975, EPC 1056, Kathmandu, Nepal

SANDEE Working Paper No. 107–16

The South Asian Network for Development and Environmental Economics

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SANDEE is financially supported by the International Development Research Center (IDRC), The Swedish International Development Cooperation Agency (SIDA), the World Bank and the Norwegian Agency for Development Cooperation (NORAD). The opinions expressed in this paper are the author's and do not necessarily represent those of SANDEE's donors.

The Working Paper series is based on research funded by SANDEE and supported with technical assistance from network members, SANDEE staff and advisors.

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Abstract

This study compares the productivity and profitability of organic and conventional farming for five crops (tea, coffee, rice, maize and cauliflower) in five different districts in Nepal.We find that organic farmers generally have a larger number of cattle and land holdings, but are not very different from conventional farmers in terms of education and household size. In terms of crop productivity, conventional yields are statistically higher than organic yields for two crops, tea and rice, and conventional profits in rice are also higher. Two crops, organic maize and coffee, show negative profits in both conventional and organic systems. However, net revenues are higher in organic maize and coffee relative to their conventional counterparts because of lower costs. In general, conventional crops are more costly to produce than organics. Organic farms face many more policy barriers than conventionally cropped farms. In this context, technological options such as suitable seed varieties, bio-fertilizers, vermi-compost, and improved farm yard manure would improve organic crop productivity. A shortage of organic manure could be overcome by promoting farm livestock enterprises.

Keywords

Organic farming, productivity, profits, rice, tea, Nepal

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1. Introduction

Following the success of Green Revolution Agriculture in neighboring countries, Nepal launched a program of agricultural intensification in the 1960s. While agricultural productivity has increased in Nepal, indiscriminate use of agrochemicals has also resulted in pollution of water, air and soils and contributed to health hazards and economic losses (Bhandari, 2006; Pokharel and Pant, 2008; Pokharel and Pant, 2009, Bhatta and Doppler, 2011). Further, monoculture based farming has displaced local land races, plant diversity and its associated knowledge base, on which the farming systems relied for centuries. In addition, farmers are now less self-reliance and face multiple market risks. Increased use of chemical fertilizers also contributes to the emission of greenhouse gases and climate change (Khanal, 2009).

In this context, it is useful to consider what agricultural practices may ensure food security and better livelihoods, while keeping the environment healthy. Organic farming is a widely discussed alternative farming system and represents a growing niche market in many countries (Charyulu and Biswas, 2010; Hewlett and Melchett, 2008). Organic farming claims to have the potential to provide such benefits in the form of environmental protection, conservation of non-renewable resources and improved resource use efficiency and food quality (Lampkin,1990; Scialabba and Hattam, 2002; Schnug *et al*., 2006; Sreenivasa, 2012; Sharma, 2001). A self-reliant system based on locally available inputs, it may be particularly suitable in countries where limited transportation and market access make commercial agriculture significantly risky. Most importantly, organic farming enhances biodiversity offering higher nutrient cycling and mineralization, better microclimatic regimes, which further reduces the risks borne by farmers.

Organic agriculture is gaining popularity worldwide. At present, 1.8 million farmers in 162 countries grow organically on more than 37 million hectares of agricultural land worldwide (FiBL and IFOAM, 2013). Between 2011 and 2013, there was an increase in farmland under organic management in Asia (by 34%) and Europe (by 6%). The global market for organic food has now reached 62.9 billion US dollars, which is 4 billion more than reported for 2010 (FiBL 2013).

Given the global trends in organic farming, in this paper we ask how successful organic farming can be in small developing countries such as Nepal. We seek to understand if this form of farming has the potential to expand within existing agricultural systems. We compare organic and conventional farming systems to understand differences in outputs and profits and the challenges faced by organic farmers. The paper concludes with a discussion on specific policy suggestions that emerge from our findings.

2. The Economics of Organic Agriculture

Organic agriculture is often criticized for lower yields in comparison to conventional agriculture (Muller, 2009). Studies conducted in different countries have shown that there is often a decline in production when conventional farms are converted into organic farms, with gradual increases over a period of time (Ricker, 1997). Avoidance of synthetic fertilizers in organic agriculture often results in lower yields per land unit. Lotter (2003), for instance, reported a 10–15% yield reduction in production in organic agricultural systems relative to convention agriculture in

East Africa. Badgley *et al*. (2007) find average yield losses in North American and European countries due to a shift from chemical nutrient management and plant protection to organic management to be in the range of 0–20%. For perennial crops, such as coffee or banana, yield reductions are more likely, even though higher yields were reported in some cases (Badgley *et al*.2007; Pulschen and Lutzeyer, 1993; Polius, 2000). Reinforcing such results, in Italy, Madau (2007), for instance, found that conventional farms were significantly more efficient than organic farms.

There is some empirical evidence that also points to superior outcomes with organic farming. Cacek and Langer (1986), for instance, offer contrary results and indicate that organic farming equaled or exceeded conventional farming in economic performance in Europe, even though there was significant variation. In the US, organic systems in Rodale Institute's Farming System Trials were competitive in returns, compared to conventional corn and soybean farming, even without market-based price premiums for organic products (LaSalle and Hepperly, 2008). In developed countries, production costs generally tend to be lower in established organic systems (Tackie, 2011) though labor costs can be high.

In developing countries, where most farmers rely on integrated farming and many have relatively limited access to commercial inputs, organic agriculture can offer a viable solution for food security and sustainable livelihoods (Scialabba, and Muller-Lindenlauf, 2010). However, the empirical results on the practicality of organic farming are mixed. In Madagascar, while conventional rice farms yields were 23% higher than organic rice farms, high input costs and lower farm gate price resulted in slightly lower net returns (Rubinos *et al*., 2007). In India, the unit cost of production was lower in organic farming of cotton and sugarcane crops, whereas the same was lower in conventional farming of paddy and wheat crops. A Data Envelop Analysis (DEA) from the same study indicates that the efficiency levels are lower in organic farming when compared to conventional farming (Charyulu and Biswas, 2010).

The reduction in yield and economic efficiency of organic farming often depends on various factors such as growing condition, region, crop, pricing policy etc. In low external input systems, and especially in arid and semi-arid areas, organic yields generally improve over time (Pretty, 2002 and Blaise,2006). Organically grown crops are also reported to produce higher yields than the conventional crops when grown under stress caused by drought, heat, excessive rain or unseasonably cold weather (COG, undated). In contrast, under favorable growing conditions, conventional farms outperform organic farms (Shearer *et al*., 1981). With climate change, if growing conditions become more unfavorable, organic farms may become increasingly viable.

Organic agriculture generally performs better than conventional agriculture with respect to direct energy consumption (fuel and oil) and indirect energy consumption (synthetic fertilizers and pesticides) (Scialabba and Hattam, 2002). It can reduce farmers' dependence on energy and increase the efficiency of energy use per unit of production (Ho and Ching, 2008). Organic farms are also generally better for soils management. As identified in a study conducted in 18 European countries, organic farming is associated with increases in soil organic matter, improvements in soil biology and lower nitrate leaching and pesticide contamination (Stolze *et al*., 2000). Finally, markets and price premiums play an important role in promoting organic agriculture. Because organic foods frequently fetch higher prices in the marketplace, the net economic return per hectare is often equal to or higher than that of conventionally produced crops (Pimentel *et al*., 2005). For instance, in the USA, certified-organic crop prices are 40 to 150 percent higher than conventional crop prices (LaSalle and Hepperly, 2008). Similarly, in India, the yield of organic sugarcane farming is relatively low, but farmers are more than compensated by the price premium received (Kshirsagar, 2006).

2.1. Nepal's experience

Until the 1950s Nepalese farming systems were largely organic. Introduction of green revolution agriculture in South Asia persuaded Nepal to use agrochemicals. In recent years, reflecting the growing understanding of the adverse impacts of chemical-based agriculture on health and the environment, organic farming is regaining some of its popularity among the farmers, academicians and entrepreneurs. However, the organized organic market in Nepal is very small. The International Federation of Organic Agriculture Movement reports that 9789 ha (0.23% percent of total agricultural land) of land is managed by 1470 producers in Nepal under organic farming (IFOAM, 2012).

Further, about 90 metric tons of certified organic coffee is produced in some 210 ha of land and 59 ha are under conversion (Shrestha, 2011). About 7 percent of traditional tea produced in Nepal is organic.

Promotion of organic agriculture first appeared as a priority in the10th Five Year Plan of the Government of Nepal (NPC, 2003). It is now embedded in the national agricultural policy. A National Coordination Committee for Organic Agriculture Production and Processing System (NCCOAPPS) was formulated in 2008 and National Organic Standards have been developed. The Government offers a 50% subsidy to entrepreneurs who may want to establish organic fertilizer factories. The National Adaptation Plan of Action to climate change mentions organic agriculture as an important agricultural strategy to adapt to the changing climate (MoE, 2010). At the same time, many of the farmers are aware of the negative impacts of conventional chemical-based intensive farming (Bhusal, 2005) and some among them are practicing organic agriculture independently in different parts of the country (Adhikary, 2005). Research on organic agriculture is sporadic and mostly done by the non-governmental agencies on project basis or by independent researchers in academia. Some examples include Adhikary (2008), who found that organic carrot crops had a higher benefic cost ratio relative to conventional crops in Chitwan and organic coffee production system was financially viable under different conditions in Gulmi (Poudel *et al*., 2010). Nepalese organic coffee fetches a 10-33% premium in international markets (Poudel *et al*., 2010). Beyond these studies, the empirical evidence on cost accounting and efficiency analysis of organic vs conventional farming is scarce. Thus, this study was designed to examine the relative economic efficiency of organic farming in Nepal.

3. Methods

The main objective of this study is to compare organic and conventional farms across different crops. The crops that are grown within conventional and organic systems in Nepal are tea, maize, coffee, rice and cauliflower. Thus, our study is based on farm level yields, inputs and cost information for all five crops.

Discussions with farmers and district level agricultural officers suggest that yield and profit are the two main indictors considered in crop production decisions. Farmers indicate that the cost of production and price are also important indicators, but they are addressed automatically if profits are considered. For crops such as maize and rice, physical yield is more important than the value of yield, because these crops are largely for family consumption. However in decision-making related to cash crops, profit is most important.

The Department of Agriculture and Livestock, focusing on the export potential of cash crops, is interested in cost effectiveness and the profit potential of commercial crops. But for primary cereal food crops, the Department is concerned with physical yields so as to decrease the domestic food deficit. Thus, yields, costs and profits are useful for different purposes.

Taking into account both farmer and government interests in crop production, weexamine conventional and organic farms along several indicators related to productivity, profits and costs. We compare the mean values of different indicators for conventional and organic farms using unpaired t-tests.

We estimate four indicators of productivity (see Table 2). Based on gross farm income data, we measure: a) yield or quintals of physical output per hectare; b) labour productivity orrupees of output per manday; c) the monetary value of output per rupee of input cost, including the expenses on labour, and d) the monetary value of output per rupee of input cost, excluding expenses on labour. The first measure is the physical relation between output and land size. The second measure describes productivity in monetary terms per unit of labour. This is used because in subsistence agriculture, where labor is the main input and family labor is generally the only type of labor used, the returns to labor is important. The third measure calculates productivity in monetary terms per unit of all forms of cost incurred. The last productivity indicator measures productivity in monetary terms per unit costs, excluding expenditure on all labour, whether family or hired.

In addition to measures of productivity, we also estimate profits. We first estimate gross farm income by valuing the main and by-products of crops at their current market prices, irrespective of the end use of the products, i.e. whether they were for home consumption or for sale. Profit is then defined as the difference between the gross

income and total cost. Profit 1 is calculated on a per hectare basis and Profit 2 is calculated on a per quintal basis so that the profit is comparable with the price of the output.

Costs are made up of five components. Labour cost is estimated as the sum total of hired labour expenses and the imputed value of own human and bullocks used in the production process. Households in the study area are characterized by subsistence farming and thus the farmers generally don't hire farm labour (except for some commercial crops such as tea and coffee). Labour time is valued at the prevailing local wage rate i.e. Rs.250 per day in the study year. Expenses on organic manure include the expense on purchased and home produced farm yard manure, green manure, oil cakes, poultry manure and compost, valued at prevailing market prices. Expenses on chemical fertilizers cover the outlay incurred on all conventional fertilizer inputs. Expenses on plant protection chemicals include the total outlay made on organic and/or conventional pesticides and or materials cost required to purchase the raw materials. This covers expenses on conventional insecticides, fungicides, rodenticides, tobacco, cow dung, neem leaves and other plant materials required to prepare bio-pesticides. Expenses on transport incurred by the producer, electricity, seed and any hired machinery costs were pooled into a single item. Thus, as indicated in Table 2, the average cost of production, which is the sum of these five components, is calculated as: 1) Average Cost 1 (Rs./qt) = Total cost (Rs.)/Total production (qt); and 2) Average Cost 2 (Rs./ha) =Total cost (Rs.)/ Total Area under cultivation (ha).

3.1 Data

Data for this study comes from a primary survey of organic and conventional farmers. Field surveys were conducted to collect primary data during the period September 2010 to January 2012 in five districts of Nepal. We obtained farm specific data from a total of 300 organic and conventional farm households.

Our first task, crop selection, was based on crop dominance in production and level of commercialization. Maize and rice are the two major food crops in Nepal, whereas cauliflower is one of the most popular vegetables. Tea and coffee have an important role as cash crop. Crop selection was based on examining the literature and discussions with district agriculture officers and local NGOs.

Study districts were selected based on heterogeneity in biophysical and socioeconomic conditions as well as the types of farming systems. Ilam is one of the most eastern hill districts with high rainfall, whereas Banke is in the dry western plains. Udayapur represents inner foot hills and Kavre is in the middle hills. Thus, in Ilam, Kavre and Banke districts, we collected data on commercial crops tea, coffee and cauliflower. Data on organic and conventional maize farms were collected from Udayapur district and rice data is from Chitwan district. Figure 1 identifies the location of the study sites in Nepal and their short description is in Table 1.

The criterion for selecting villages (VDCs[1]) was the presence of farmers practicing organic farming. In each district, we identified villages where there were farmers who did not use conventional fertilizers, pesticides and other inorganic chemicals through discussions with NGOs, group and cooperatives working in organic farming. For example in Udayapur, WOREC is an NGO engaged in bio-intensive farming. In Kavre, a well-developed cooperative that is active with organic coffee was consulted. In Ilam, where tea is grown, organic tea production is certified by the tea processing factory, which regulates and tests the organic plantations from which it purchases green leaves. Thus, we obtained a list of organic farmers from either a local NGO (in Udayapur and Banke), or Cooperative (in Kavre and Chitwan) or Tea and coffee Development Board (in the case of Ilam).

Within selected VDCs, households were selected purposively based upon the presence of organic and conventional farming practitioners, matching each other with regard to comparable soil conditions, agricultural settings and cropping patterns. These matches were made after we had discussions with local NGOs, village leaders and teachers working in organic farming.

[1] Village Development Committees

Sixty households, thirty farmers practicing organic and conventional practice, were selected purposively in Chitwan, Ilam, Kavre and Banke districts for our farm survey. Further, in Udaypur, sixty farmers who practice both organic and conventional farming were selected, as farmers generally grow organic products in rain fed upland areas and conventional crops in irrigated low lands.

4. Results and Discussion

Our survey results suggest that the socio-economic characteristics of both organic and conventional farmers are similar, except with regard to livestock and total land holding size (see Table 3). The average size of the household in our dataset is about 5 and the age of the head of the household is some 48 years. The household head's education is approximately at the primary school level and the average land holding is about 1 hectare. Organic farmers have slightly more land and have higher livestock holdings relative to conventional households. Organic farmers keep larger number of cattle, which reflects the supportive role of livestock in managing farm nutrients.

A comparative account of tea, coffee, cauliflower rice and maize is as follows:

Rice: Conventional farming is more productive and offers significantly higher profits relative to organic rice farming. The average cost of production of organic rice is higher than in conventional production. Labor productivity is higher in conventional rice relative to organics even though both types of farmers make net positive profits (see Table 4a).

Maize: While there are no significant differences in yield, both organic and conventional maize farms have negative profits in due to low productivity and high labor costs (see Table 4b). However, the negative profits are significantly smaller in organic maize relative to conventional farming. Organic maize farms have significantly lower costs relative to conventional farms.

Tea: Conventional tea productivity is higher than organic tea productivity, but there are no significant differences in profits. Productivity may be lower in organic tea because of inadequate supply of organic manure. Farmers note that organic tea flowering or flushing is slower and leaves are more difficult to pluck in comparison to conventional farming, where new growth is succulent and easy to pluck. While production costs of conventional tea, in terms of fertilizers and pesticides are higher (see Table 4c), this is offset by higher labor costs in organic production. The higher price organic tea fetches does not make up for the high cost of production and there is no significant differences in profits.

Coffee: Profits in organic and conventional farms are negative. However, net revenues in organic coffee farming are significantly higher than conventional coffee. While there is no significant difference in yields between the two types of coffee, conventional coffee is significantly more costly to produce. This is because of the high costs of fertilizers and pesticides used (see Table 4d).

Cauliflower: There are no significant differences in productivity or profits between conventional and organic cauliflower. This may be partially because organic producers do not get a premium price for their product, in spite of growing awareness about the health hazards of consuming vegetables subject to high doses of pesticides. The average cost of production of organic cauliflower is lower on an acreage basis, but higher in terms of per unit cost (see Table 4e).

4.1. Discussion

Our two main indicators of crop success are yield and profits. Our analyses suggest that tea and rice producers obtain significantly higher yields per hectare in conventional production systems relative to organics (see Figure 2). There are no statistically significant differences in yields with regards to the other three crops under consideration.

In terms of average profits per hectare, conventional rice has significantly higher profits relative to organic systems, while there is no statistically significant difference in tea related profits. However, it is more profitable for farmers to grow organic coffee and organic maize relative to their conventional counterparts. Oddly, as evident in Figure 3,

profits for maize are negative in both conventional and organic systems – but organic maize and coffee profits are significantly less negative.

In terms of costs per quintal of yield, Figure 4 shows that conventional coffee, maize and cauliflower are costlier than their organic crops. There is no statistically significant difference in costs among the other crops. The main source of these higher costs is costs of in-organic inputs like fertilizers and pesticides.

Labor productivity, in terms of returns per manday, is higher with organic maizeand coffee relative to conventional systems of producing these crops (see Figure 5). However,labor productivity in conventional rice production is better than organic rice. There are no statistical differences in labor productivity with regard to tea and cauliflower.

5. Conclusions

This study, which compares five organic and conventionally produced crops, finds that there are significant differences in profitability and yields across these crops. Thus, the choice for farmers between organics and conventional systems is very crop specific.

In terms of subsistence crops, by all indicators, farmers are better off growing conventional rice. The results are less clear for maize, where our sample of farmers show negative profits in both conventional and organic production systems.

In terms of commercial crops, conventional tea has higher yields but with little difference in profits when compared to conventional tea. Neither organic nor conventional coffee show positive profits in our sample though net revenues are less negative with organic coffee. For the average farmer, there is no significant difference in growing organic or conventional cauliflower, primarily because organic cauliflower does not receive a price premium.

The productivity of three crops i.e. tea, rice and cauliflower, is lower in organic production systems relative to conventional systems. For yields to increase, it may be useful to invest in technological optionssuch as more suitable seed varieties, bio-fertilizers, vermi-compost, etc. In the case of organic tea, because plucking takes more time due to stiffness of the flushes, promoting mechanical plucking could be considered.

Farmers suggest that there is a shortage of organic manure, inhibiting its efficient use in both types of farms. This could be overcome by promoting livestock enterprises. If this accompanied by improved farm yard manure management and compost preparation with incorporation of weeds, crop residue and forest leaf litter, it is possible for organic manure to substitute chemical fertilizers.

As agricultural production copes with increasing climatic changes, it may be useful to think of moving towards land-use benign organic farming. However, for these types of farms to flourish, either yields would need to increase, input costs would need to go down or output prices increase. In this context, raising awareness among producers, consumers and planners is important for increasing the scale of operation, demand for organic products and sustainability of the production system

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Tables

Table 1: Brief description of study sites

Districts	Location	VDCs	Crop	Selection of organic farms	Selection of matched conventional crops	Promoter of organic farming
Ilam	Eastern Hill	Phikkal, Sundarban	Tea	Random selection	Selection of matched conventional and organic farms was done based on agro-climatic, edaphic and socio-economic conditions. Information was obtained by consulting organic farmers, local leaders, schools teachers, organic promotingNGOs and officials.	NCDC, Gorkha Tea Estate
Udaypur	Eastern inner Terai	Triveni	Maize	Random selection		WoReC
Chitwan	Central inner Terai	Phulbari, Mangalpur	Rice	Purposive selection		SECARD, Cooperatives
Kavre	Central Hills	Panchkhal, Dhulikhel	Coffee	Random selection		HASERA, Coffea Producers' Association
Banke	Western Terai	Kohalpur	Cauliflower	Purposive selection		Dalit Sewa Samuha, Care Nepal

Table 2: Description of variable used in economic analysis of crops

	Name of variable	Description
1	Area (ha.)	Average net area under cultivation of a selected crop by a household in a year.
2	Yield (qt/ha)	Physical output of main product of the crop divided by area.
3	Gross income (Rs./ha)	Total gross value of a crop valued at the prevailing market price per hectare
4	Price (Rs./quintal)	Market price of the main product of the selected crop per weight in quintals
5	Labour cost (Rs./ha)	Total labour cost incurred in cultivation ofthe selected crop calculated by valuing the family and hired human labor at the prevailing market wage rate.
6	Labour use (manday/ha)	Units of hired and family human labour used for cultivation of a crop in per hectare basis.
7	Expenses on organic manure (Rs./ha)	Total expenses on farm yard manure, poultry manure, compost, bio fertilizer and vermi-compost valued at prevailing market prices.
8	Expenses on chemical fertilizer (Rs./ha)	Total monetary expenses on all the forms of chemical fertilizers purchased by farmers for applying to the selected crop under cultivation.
9	Expenses on plant protection chemicals (Rs./ha)	Total expenses on purchase and preparation of all the forms of organic and conventional plant protection chemicals.
10	Expenses on transport, electricity, seed and others (Rs.)	Total expenses on transport, electricity, seed and other includes cost on gunny bags, loading and unloading charge, snacks etc.
11	Average cost 1 (Rs./ha)	Total cost incurred to cultivate a hectare of land for the selected crop (5+7+8+9+10)
12	Average cost 2 (Rs./quintal)	Total cost incurred to produce a quintal of the selected crop
13	Labor Productivity(Rs./man day)	Total value of output contributed per man day of human labor (3/6)
14	Variable cost (Rs.)	The total of cost incurred in variable inputs such as seed, fertilizer, human labor, irrigation etc. (11* Average no of ha cultivated)
15	Profit1 (Rs./ha)	Gross income (3) minus variable costs (11) incurred in production of a crop per hectare.
16	Profit 2 (Rs./qt)	Gross income minus variable cost incurred in production of a crop per quintal of product.
17	Productivity1 (Rs.)	Total value of output per rupee of input cost, includinglabor
18	Productivity2 (Rs.)	Total value of output per rupee of input cost, excluding labor.

Table 3: Descriptive statistics of household characteristics in study areas

SN	Name of the variable		Organic	Conventional	Mean difference using t-test
1	Gender composition of family members	Male	2.7	2.7	0.00 (1.00)
		Female	2.62	2.61	0.01 (0.460)
2.	Average age of family members (yrs)		31.84	31.97	0.12 (0.450)
3.	Average age of household head (yrs)		47.6	48.3	0.70 (0.321)
4.	Education of household head (years)		6.81	6.41	0.40 (0.180)
5.	Household size (numbers)		5.32	5.31	0.01 (0.476)
6.	Total land holding size (ha)		1.15	0.960	0.19 (0.030)
7.	Cultivated land (ha)		0.860	0.796	0.06 (0.180)
8.	Total livestock holding (cattle equivalent)*		3.37	2.41	0.96 (0.000)

Figure in parenthesis indicates level of significance of mean difference(p-value).

*Cattle equivalent is 1 cattle=0.6 buffalo=5 goat/sheep/pig=100 poultry

Table 4a: Rice production in organic and conventional systems

SN	Particulars	Farming system (Mean)		Mean difference using t-test
		Conventional (N=30)	Organic (N=30)	
1.	Area per farm (ha.)	0.59	0.64	-0.05
2.	Yield (qt/ha)*	47	40	7
3.	Gross income (Rs./ha)*	95790	80227	15564
4.	Price (Rs./quintal)	2017	1978	38
5.	Labour cost (Rs./ha)	50709	54650	-3941
6.	Labour use (manday/ha)	203	219	-16
7.	Organic manure expenditures (Rs./ha)	6377	8041	-1664
8.	Chemical fertlizer expenditures (Rs./ha) *	934	0	934
9.	Plant protection chemical expenditures (Rs./ha)	874	778	96
10.	Transport, electricity, seed and other expenditures (Rs.)	1785	1634	151
11.	Average cost 1 (Rs./ha)	61255	64628	-3373
12.	Average cost 2 (Rs./quintal)**	1346	1862	-515
13.	Labor Productivity (Rs./man day)**	500	410	89
14.	Profit 1 (Rs./ha)*	34536	15599	18937
15.	Profit 2 (Rs./qt) **	670	116	554
16.	Productivity 1 (value of output/ input cost including labor) **	2	1	1
17.	Productivity 2 (value of output./ input cost excluding labor)	11	12	-1

* indicates 1 per cent level of significance and ** indicates 5 percent level of significance in t-tests of mean differences.

Table 4b: Maize production in organic and conventional systems

SN	Particulars	Farming system (Mean)		Mean difference using t-test
		Conventional (N=30)	Organic (N=30)	
1.	Area per farm (ha.) *	0.41	0.2	0.21
2.	Yield (qt/ha)	16	16	1
3.	Gross income (Rs./ha)	24150	23379	771
4.	Price (Rs./quintal) **	1500	1508	-8
5.	Labour cost (Rs./ha) **	21180	19002	2178
6.	Labour use (manday/ha)	85	76	9
7.	Organic manure expenditures (Rs./ha) *	5295	7161	-1866
8.	Chemical fertlizer expenditures (Rs./ha) *	2413	0	2413
9.	Plant protection chemical expenditures (Rs./ha) *	89	0	89
10.	Transport, electricity, seed and other expenditures (Rs.) *	688	396	293
11.	Average cost 1 (Rs./ha) *	32166	26439	5726
12.	Average cost 2 (Rs./quintal) *	2261	1831	430
13.	Labor Productivity (Rs./man day) **	305	408	-103
14.	Profit 1 (Rs./ha) *	-8016	-3061	-4955
15.	Profit 2 (Rs./qt) *	-761	-323	-438
16.	Productivity 1 (value of output/ input cost including labor) *	0.79	1	-0.20
17.	Productivity 2 (value of output./ input cost excluding labor)	2	7	-4

* indicates 1 per cent level of significance and ** indicates 5 percent level of significance in t-tests of mean differences.

Table 4c: Tea production in organic and conventional systems

SN	Particulars	Farming system (Mean)		Mean difference using t-test
		Conventional (N=30)	Organic (N=30)	
1.	Area per farm (ha.)**	0.55	0.99	-0.43
2.	Yield (qt/ha)*	40	16	24
3.	Gross income (Rs./ha)	110575	86798	23783
4.	Price (Rs./quintal) *	2477	5493	-3017
5.	Labour cost (Rs./ha) **	46669	54828	-8159
6.	Labour use (manday/ha) **	187	219	-33
7.	Organic manure expenditures (Rs./ha)	17114	11727	5387
8.	Chemical fertlizer expenditures (Rs./ha) *	1329	0	1329
9.	Plant protection chemical expenditures (Rs./ha) **	2410	1088	1322
10.	Transport, electricity, seed and other expenditures (Rs.) *	9203	4086	5118
11.	Average cost 1 (Rs./ha)	63469	71048	-7579
12.	Average cost 2 (Rs./quintal) *	2105	5630	-3525
13.	Labor Productivity (Rs./man day)	546	399	147
14.	Profit 1 (Rs./ha)	47107	15774	31363
15.	Profit 2 (Rs./qt)	371	-136	508
16.	Productivity 1 (value of output/ input cost including labor)	2	1	1
17.	Productivity 2 (value of output./ input cost excluding labor)	13	7	6

* indicates 1 per cent level of significance and ** indicates 5 percent level of significance in t-tests of mean differences.

Table 4d: Coffee production in organic and conventional systems

SN	Particulars	Farming system (Mean)		Mean difference using t-test
		Conventional (N=30)	Organic (N=30)	
1.	Area per farm (ha.) *	0.09	0.15	-0.06
2.	Yield (qt/ha)	28	32	-3
3.	Gross income (Rs./ha)	85049	96031	-10982
4.	Price (Rs./quintal)	3000	3003	-3
5.	Labour cost (Rs./ha)	53927	46609	7318
6.	Labour use (manday/ha)	216	186	29
7.	Organic manure expenditures (Rs./ha)	22212	23923	-1711
8.	Chemical fertlizer expenditures (Rs./ha) *	2088	0	2088
9.	Plant protection chemical expenditures (Rs./ha) *	5707	3617	2090
10.	Transport, electricity, seed and other expenditures (Rs.)	6763	7914	-1151
11.	Average cost 1 (Rs./ha) **	92595	81008	11586
12.	Average cost 2 (Rs./quintal) *	3929	3432	497
13.	Labor Productivity (Rs./man day) *	457	660	-203
14.	Profit 1 (Rs./ha) **	-7545	15023	-22569
15.	Profit 2 (Rs./qt)	-929	-428	-500
16.	Productivity 1 (value of output/ input cost including labor) **	1	1	0
17.	Productivity 2 (value of output./ input cost excluding labor)**	2	3	-1

* indicates 1 per cent level of significance and ** indicates 5 percent level of significance in t-tests of mean differences.

Table 4e: Cauliflower production in organic and conventional systems

SN	Particulars	Farming system (Mean)		Mean difference using t-test
		Conventional (N=30)	Organic (N=30)	
1.	Area per farm (ha.)*	0.11	0.07	0.04
2.	Yield (qt/ha)	78	69	9
3.	Gross income (Rs./ha)	107540	108915	-1375
4.	Price (Rs./quintal)	1385	1443	-58
5.	Labour cost (Rs./ha)	43179	42695	484
6.	Labour use (manday/ha)	173	171	2
7.	Organic manure expenditures (Rs./ha)	8759	8532	228
8.	Chemical fertlizer expenditures (Rs./ha) *	4122	0	4122
9.	Plant protection chemical expenditures (Rs./ha) *	2303	892	1410
10.	Transport, electricity, seed and other expenditures (Rs.)	4999	4821	178
11.	Average cost 1 (Rs./ha)*	66362	56448	9915
12.	Average cost 2 (Rs./quintal) **	922	1151	-229
13.	Labor Productivity (Rs./man day)	635	679	-44
14.	Profit 1 (Rs./ha)	41178	52467	-11290
15.	Profit 2 (Rs./qt)	463	292	171
16.	Productivity 1 (value of output/ input cost including labor)	2	2	0
17.	Productivity 2 (value of output./ input cost excluding labor)	5	9	-4

* indicates 1 per cent level of significance and ** indicates 5 percent level of significance in t-tests of mean differences.

Figures

Figure 1: Map of Nepal with study sites

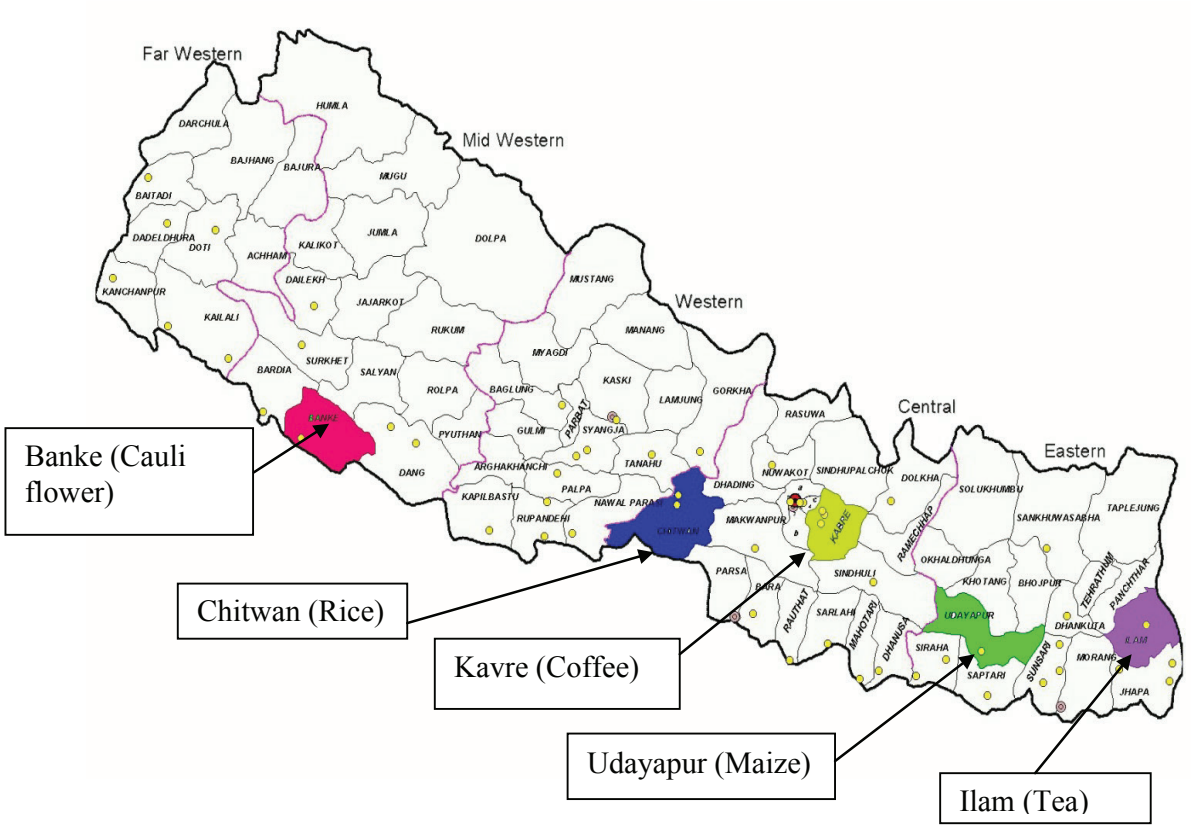
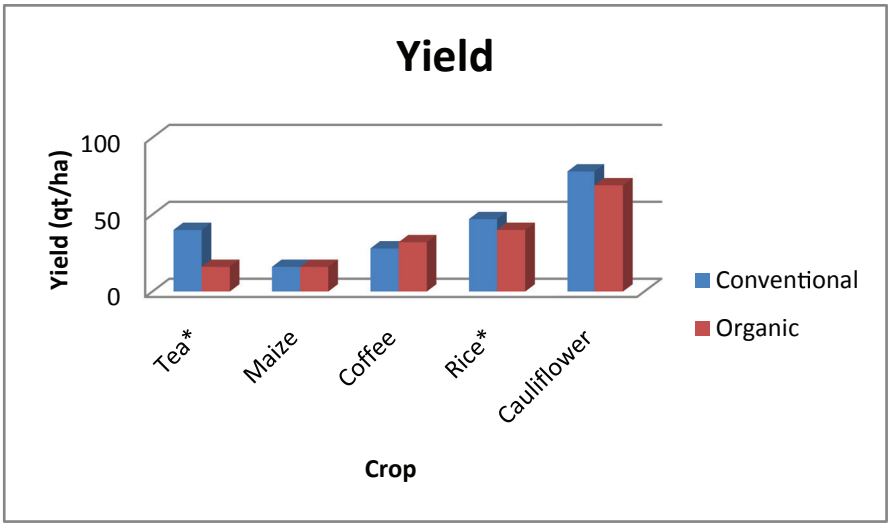


Figure 2: Yield differences among crops



* indicates 1 per cent level of significance in t-tests of mean differences.

Figure 3: Profit differences among crops

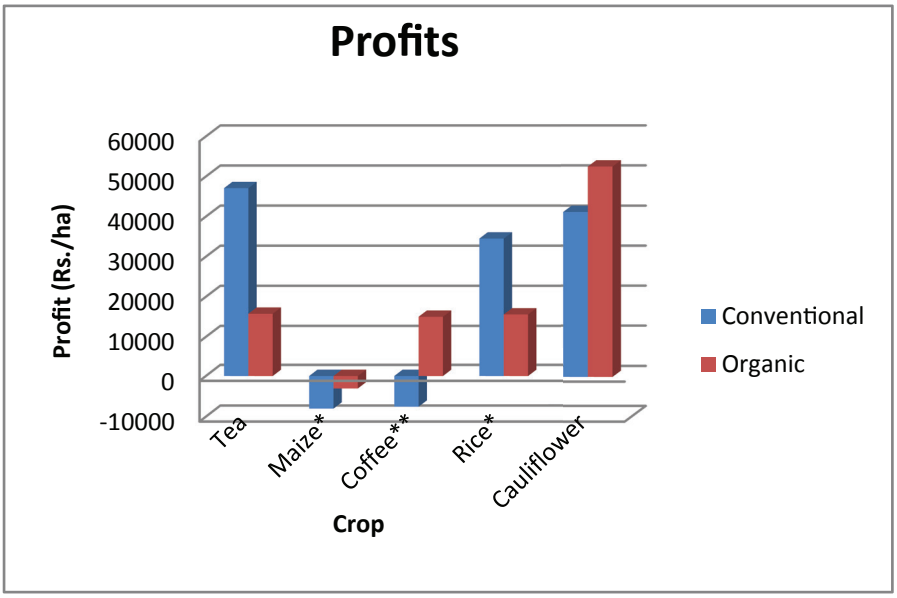


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Figure 4: Costs differences among crops

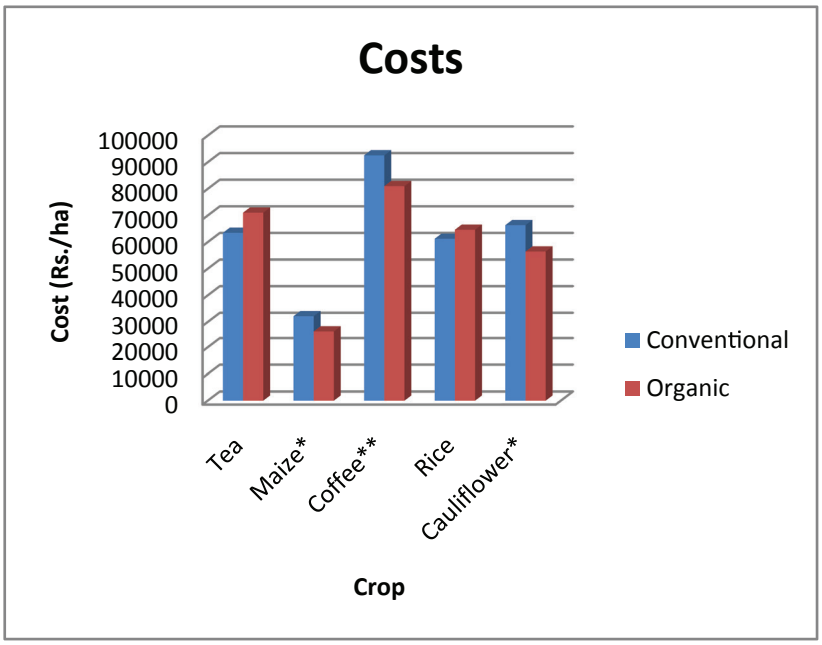

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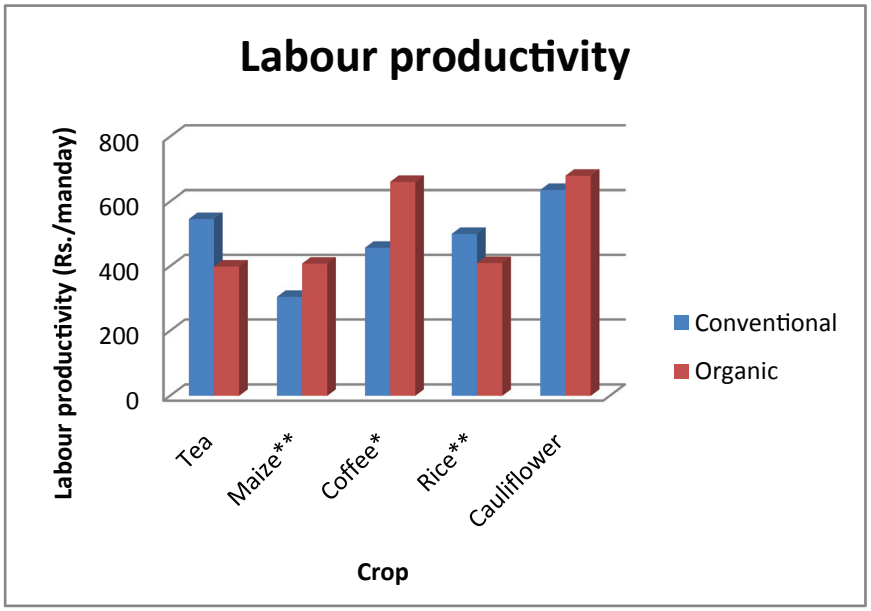
Figure 5: Labor productivity differences among crops



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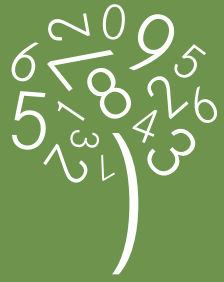

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