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ANALYZING AGRICULTURAL PRACTICES: A COMPARATIVE EVALUATION OF CONVENTIONAL AND ORGANIC FARMING SYSTEMS IN SIKKIM

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Abstract: The study investigates the agricultural landscape in Sikkim by conducting a comparative analysis between conventional and organic farming systems. With agriculture serving as the primary source of livelihood for Sikkim's rural population, challenges like soil acidity, moisture issues, and climatic factors impede significant agricultural growth. Despite attempts to integrate modern technology, these challenges persist, leading to reduced crop yields. Organic farming emerged as a response to the environmental impacts associated with industrialized agriculture. In Sikkim, a transition to organic farming began over a decade ago, aiming to cultivate high-demand crops without chemical inputs. However, farmer reluctance, stemming from delayed benefits compared to conventional methods, poses a challenge to widespread adoption.

This paper reviews existing literature comparing organic and conventional farming globally, shedding light on yield differentials, economic profitability, constraints, and socio-economic implications. It explores Sikkim's specific context, detailing the state's organic farming initiatives, land use changes, crop productivity disparities, and the impact on food security and the local economy. The research underscores the significance of transitioning to organic farming, highlighting its potential economic viability, environmental sustainability, and positive impact on livelihoods. Moreover, it identifies the need for enhanced training, infrastructure development, and marketing support to facilitate this shift, ensuring the sustainability of agricultural practices in rural Sikkim.

Keywords: Organic farming, sustainability, livelihoods

Introduction

Agriculture is the source of livelihood for the majority of the rural population of Sikkim. The economy of the state is linked with agriculture which serves as the source of livelihood and economic security fora sizeable native population. The growth, of the agricultural sector has not shown remarkable changes because of the various biotic and abiotic factors. In Sikkim, 80 percent of the rural population depends on agriculture and allied sectors and derive their livelihood directly from them, mainly for economic, food, and nutritional security. The agricultural Sikkimese people practiced mainly dependent on nature and with experience or traditional methods. However, it is seen that a fractional improvement in the day-to-day lifestyle of the people of Sikkim can be observed because of the adoption of modern technology.

The agriculture scenario is mainly dependent on monsoon rainfall and suffers from the problem of soil acidity, over moisture, and various other factors, and after the monsoon, it suffers from heavy

weed infestation and hailstorms during March-April. The prevailing climate Favorsa high incidence of diseases and pests that drastically reduce crop yields. These factors certainly cause a fall in the production and productivity of major crops. Nevertheless, the root of the problem is the persistent domination of traditional cultivars in the various crops cultivated from maize to rice and other crops like finger millet, soybean, buckwheat, mustard, and others. In the organic farming scenario these traditional cultivars too can play a vital role since they are well adapted to the low-input situations and the elite germplasm needs to be identified from within the vast gene pool and used for the production of tailor-made varieties. Compared with the national level factor productivity, Sikkim is lower for all the major field crops. Only the way to bridge this gap will be Increasing per unit productivity by area expansion under HYV along with proper scientific measures of cultivation that will bring out the production potential of varieties designed for organic farming. The per capita land holding has also seen a continuous fall since the 1970s owing to various reasons.

Organic agriculture emerged as a reaction to the industrialization of agriculture and its associated environmental and social problems. Whether organic agriculture delivers overall advantages over conventional agriculture is however contentious. Some claim that organic farming systems are more profitable and environmentally friendly (Reginald and Wachter, 2016), while others question the role of organic agriculture in future sustainable food systemsThe United States Department of Agriculture (USDA)(2012)defines organic farming as*" a system which avoids or largely excludes the use of synthetic inputs (such as fertilizers, pesticides, hormones, feed additives etc) and to the maximum extent feasible rely upon crop rotations, crop residues, animal manures, off-farm organic waste, mineral grade rock additives and biological system of nutrient mobilization and plant protection".*

Organic agriculture includes all agricultural systems that promote the environmentally, socially, and economically sound production of food security. These systems take local soil fertility as a key to successful production. By respecting the natural capacity of plants, animals, and the landscape, it aims to optimize quality in all aspects of agriculture and the environment. Organic agriculture dramatically reduces external inputs by refraining from the use of chemo-synthetic fertilizers, pesticides, and pharmaceuticals. Instead, it allows the powerful laws of nature to increase both agricultural yields and disease resistance. Organic agriculture adheres to globally accepted principles, which are implemented within local social-economic, climatic, and cultural settings. Organic farming is gradually gaining in popularity as a movement across the world. The growing awareness of health and environmental issues in agriculture has led to the demand for the production of organic food which is emerging as an attractive source of income generation. (Shuklaet al., 2013). Organic agriculture is now being practiced in more than 130 countries with a total area of 30.4 million hectares, about 0.65% of the total agricultural land of the world (Willer et al., 2008). For the area under organic agriculture, Australia occupies the prime position followed by China, Argentina, USA, Italy, and many other countries (Willer et al., 2008).

Organic farming in the Indian rural economy can be leveraged to mitigate the ever-increasing problem of food security in India. The rapidindustrialization of the states of India has brought about a scarcity of farmland. Currently, India ranks 10th among the top ten countries in terms of cultivable land under organic certification. The certified area includes 10% cultivable area with 0.50 million hectares and the rest 90% (4.71 million hectares) is forest and wild area for collection of minor forest produces. The total area under organic certification is 5.21 million hectares*(APEDA, 2013).* India produced around 1.34 million metric tons of certified organic products which include all varieties of food products namely sugarcane, cotton, basmati rice,

pulses, tea, spices, coffee, oil seeds, fruits and their value-added products. The production is not limited to the edible sector but also produces organic cotton fibres, functional food products etc *(APEDA, 2013).* Among all the states, Madhya Pradesh has the largest area under organic certification followed by Rajasthan and Uttar Pradesh. In terms of area Madhya Pradesh has highest area under organic farming (1.1 mha or 52%), Maharashtra is second (0.96 mha or 33.6%) and Orissa ranks third (0.67 mha or 9.7%) while Uttarakhand and Sikkim are organic States.

Sikkim, which is endowed with climatic conditions favorable for the production of fruits, flowers, and certain other crops, has been currently adapting the technique of organic farming for more than a decade. The state is now moving towards the organic mission by producing crops with high demand in both domestic as well as foreign markets, such as cardamom, ginger, oranges, medicinal plants, etc. As of 2010, almost 60% of the total cultivable land had been brought under organic farming. The total area under organic certification in the case of Sikkim was 1,391.04 hectare. The total area under certified organic cultivation in the state was 1,726.34 hectares and the total organic production was 5174.44 tonnes *(Yadav, 2012).* The contribution of the agricultural sector to the state gross domestic product (SGDP) was 7.4 percent (according to the Central Statistical Organisation) during 2012-2013. The use of chemical fertilizers and pesticides was completely withdrawn in the state after 2003 and the state government advocated the idea of making Sikkim an organic state. The Government of Sikkim has already set up a broad target of making the state largely organic by 2015. The cultivators have been encouraged to use bio-fertilisers for their farming activities. The practitioners are mostly supported by the government through the provision of different kinds of training relating to farming practices along with the provision of costly input materials for free for almost all the practitioners at the initial level. Despite these developments, a certain amount of reluctance has been observed among the farming community regarding the adoption of organic farming in Sikkim. One of the reasons for this could be that in contrast to conventional agriculture, the expected benefits from organic farming are not immediately obvious. This could result in the practitioners moving towards alternative forms of agriculture, which in turn could be counterproductive for the state in the long run.

Literature review

Tomar et al.(2018) examined that yield of wheat from the organic method of cultivation was 12.25q/acre and from inorganic cultivation it was 20.11q/acre.and the fertilizer, as well as the operational cost for inorganic farming was low compared to organic, Organic farming will play a vital role in attaining sustainable development, therefore, the government should take initiative to make farmers and consumers aware about benefits of organic farming and also advertise advantages of organic farming. They should also start new projects and funds for breeding programs inorder to yield higher organic productivity.

In a study by *Azam and Banumath (2015)* in the Nalanda district of Bihar where 90% of farmers moved to organic farming which leads to the improvement of socio economic and livelihood condition of the farmers. Kousaret al., (2019)analysed the constraints faced in adaptation of organic cultivation of wheat and impact on the returns on investment in Pakistan where 300 farm wheat growers were accounted for the study. The study used Econometric tool like endogenous switching regression (ESR) approach was employed to accounts selection bias. The study revealed that the organic wheat cultivation has significant and positive impact on returns on investment showing potential impact of organic farming in Pakistan. Moreover, returns on organic farming was higher than that of conventional farming but the conversion was very slow. Some of the factors that limits are illiteracy, lack of information and awareness extension services, complicated and costly certification process, lack of market facilities and small land holding are some of the major

constraints in adoption of organic farming. They also suggested that government and policy makers should reduce the constraints faced in adoptions of organic farming. They also support awareness and motivation of farmers should be done through education, training and effective role of extension services. Easy, timely and adequate credit should be the top priority of policy makers to improve the productivity of agriculture. *(McBride et al., 2012)* they examined the profitability of organic wheat crop production in comparison with conventional wheat crop. They used the data from Agricultural Resource Management Survey of United States of America for 2009 crop. They used the treatment effects models to analyse the data. The results based on long-term experimental trials indicated that similar yields with lower cost of production were possible by organic method as compared to conventional but little information were available about the relative costs and returns on commercial farms. In average conventional wheat yields were much higher than for organic wheat per acre operating plus capital costs were lower for organic wheat. The results indicated that operating costs per bushel for conventional wheat were higher than for organic wheat, but total economic costs were about $2 to $4 per bushel higher for organic wheat.

The organic farming has seen as inefficient in combating pests and crop diseases, while organic farming land certification is expensive and causes a burden on farmers. The lack of proper marketing and improvisation in organic farming is glaring, while the import of conventional produce from neighbouring states hampers the organic market. Farmer's training, proper implementation of policies, ensuring prices of organic produce, etc. are some of measures to mitigate the challenges faced by farmers (Das and Bhattacharyya, 2018).

In Nagapattinam district of Tamil Naduthe medium farmer category has been observed to fetch a higher return as compared to other categories of farmers. while comparing the cost and return the cost is less and the return is high from organic farming as compared to inorganic farming. Therefore, it may be inferred from the results of the study that economic viability is high under organic farming as compared to inorganic farming *(*Abarham*,* 2014*)*. The study felt to see that there was a substantial need of financial support by the government to promotes organic agriculture. Moreover, North-Eastern states of India should be encouraged through subsidies and other kind supports as these states fully or least dependence on agriculture. It was also figured out that demand was not supplied appropriately. Thus, there was a need for market development as it plays crucial role for promoting domestic sales. In addition to these, producer organisation must be encouraged to get accredits certification in accordance to NSOP (National Standards for Organic Production), highlight of organic farming over conventional farming should be emphasised through campaign and identification of crop cultivation of organic farm is important. The organic farming is the most widely accepted and recognized as alternative farming method to the conventional farming there is demerits of conventional farming but there is alternatives of conventional farming also which are more sustainable then the conventional farming like biological farming, natural farming and permaculture but organic farming is the best and main alternatives in term of environmental health, nutritional value and economic viability *(Sharma, 2001)*.

In Karnataka the overall performance of organic farming has higher economic profits as compared to the modern agricultural system. These higher profits contribute to the economic development in the study region. While modern agriculture fetches low returns as that of organic farming and therefore, organic agriculture helps rising farmer's income as well as it contributes to economic performance and environmental sustainability(Siddaraju&Indira ,2013).Abdullah, (2020) analysed the implication of organic farming as an initiatives of livelihood diversification and sustainability and community development. Further, the study also takes into account the socio-

economics status of organic cultivators in Indian state of Sikkim. The study revealed that the percentage share of non-farm income in total income of the households was higher than the income from the farm activities. It was also witnessing that East district has higher non-farm income than the other districts. It was seen that organic agriculture has changed the socio-economics condition of farmers in the state due to increasing demand of organic produce. Educational qualification and experience, and government facilities for organic farming led to substantially increase in per capita income of sample respondent and thus, lead to overall economic development of the region. It was recommended that government should provide basic requirement facilities to organic producer, agricultural education to the local people, and there was a need for improvement of proper marketing system. Moreover, government need to promotes the organic farming through training, demonstration, and by providing inputs materials.Guha (2018)in his study of organic farming of tea-sector in Sikkim using the panel data of 17 independent tea growing farm for the period of 2001-2016 had been analysed using linearised Cobb-Douglas production function. It was observed that there was a declining trend in production of green leaf tea despite of expansion of tea plantation area and use of biofertilizers during the study period. Managerial and technical inefficiency can be attributed to low yielding of green leaf tea production. He suggested that imparting appropriate training to the farmers regarding efficient use of biofertilizers and plucking round may be helpful in reversing the declining trend of the of the farm output of green leaf tea in the state.

The comparative economics of Organic Farming System (OFS) with regard to Inorganic Farming System (IFS) in Himachal Pradesh shows that OFS had significantly yield higher productivity and profitability then the IFS. However, there seem lack of knowledge regarding availability of economic aspects of organic farming regarding inputs use pattern, potentiality of yielding, profitability to the farmers, market factors, etc. in the state(Thakur and Sharma, 2005).While comparing and contrasting conventional and organic enterprises for identifying the possibilities of development of organic farming in Ukraine it revealed that the enterprises of organic farming tend to yield higher output per hectare than that of conventional farming. It was also found that labor-intensive organic farming tends to low profitability especially in large organic companies and also seen that export of organic agricultural products of Ukraine was low in percentage (Ostapenko et.al, 2020).

To study the economies of chilies production in Guntur district of Andhra Pradesh, Sample of 120 farmers from four villages were contacted individually regarding chilies production during the crop year 2014-15. From the study it was evident that use of organic manure would increase yields of agriculture. Thus, it relevant to encouraged farmers to use organic manure. However, organic farming can assure the sustainable productivity and it practice should be starts. Thus, the government should provide subsidies and credits to the farmers and price assurance should be promised for organic crops. Therefore, organic farming can be encouraged in the country(Damodaran, 2015).

While studying the international trends of purchasing behavior of the consumer for the organic food products It was noted that the most of the consumers prefers to buy organic food products as they see it as healthier and good to environment as compared to conventional food products though the price is higher which is the only disadvantages to the consumer side. It was also observed that many farmers prefer to organic production as it retain higher profitability as compared to conventional farming as well as low inputs costs but high transportation cost which contribute to net profits. Thus, it was suggested to educates farmers regarding organic food processing and improve the production resulting in high supply and therefore, reduce the price for organic food

products(Uvaneswaram and Girimurugun, 2014). Asfawi et.al, (2019), analyzed the benefits of organic and conventional horticultural farming in the light of comparison between the two for the production of carrot in Batur village, Getasan District of Semarang Reganey where total 70 respondent were interviewed comprising 30 each for conventional and organic farming groups. Some statistical tools were used while processing data and had comparative in production cost and benefits cost ratios of the different method of cultivation. The resulting analysis shows that ratios of benefits cost was higher in cultivation of horticultural organic farming than the conventional farming practices and thus, also have higher prices relatively than the conventional farming despite of low productivity in organic farming. They recommend to shift the practice of farming from conventional to organic as it seems beneficial in term of environmentally sustainability and health of the farmers as well. There is inputs and outputs disparity between conventional and organic farming practices on wheat farms in Taba Tek Sing and Jhang district of Punjab, Pakistan. Routinely, farmers grow two main crops annually within two seasons namely Rabi and Kharif and paramount of wheat is cultivated during Rabi season by 78% of the farmers. For the purpose of study, 300 sample farmers are purposively drawn through purposive sampling technique and pre-structured questionaries. The study revealed that the organic farming techniques (12%) incurred higher costs than the conventional farming techniques (7%). On the other side, conventional farming usages higher level of fertilizers and pesticides as compared to organic farming. Comparatively, conventional farmers had higher yields than the organic farmers with varies 11% differences of the recorded total amount of yield(Aslamet.al, 2020).India has wide range of soil fertility level due to Himalayan range and ranked one in the world in organic agricultural production. Studies shows that organic farming yield low productivity but in due course of transition period of 2-4 years it contributes significantly (Singh, 2017).

In Karnataka there is transition from modern agriculture to organic farmingthe transition is mainly because of environmental sustainability as well as health and soil fertility improvement. Many farmers growing paddy and sugarcane reported that the inputs fertilizers pesticides were high in prices which may accounted to transitionV. G. and Indira, (2013). In the economics prospective font, the organic coconut has higher demand and also has higher copra weight as compared to conventional farming which led farmers to get higher returns. Moreover, it minimizes less water requirement and sustainable production by increase in soil fertility and nuts yield gradually per year. Problems like lack of market facilities exclusively for organic produce and conversion period of obtaining of organic certification is longer. It was seen that the conversion of organic coconut cultivation in 1st year yield losses was 10% only. However, these can be retained in two-four years of conversion period and thus, yield can increase year after year (Kalidaset. al, 2014). InBelgaum district of North Karnataka to study comparative economics of input used, cost incurred and returns of yield under both organic and inorganic chili crops were chosen because large numbers of farmers were engaged in organic farming of chili, where 30 sample of farmers was randomly selected, each practicing organic and inorganic farming of chili spread over the district. It was found that the cost and yield of per acre of organic chili cultivation was slightly lower than that of inorganic farming. Hence, advising farmers to switch to organic farming which minimizes environmental degradation. Organic farming will enhance better yield leading to higher net returns because of premium prices it fetches (Naika et.al, 2012).

While analysing the role of organic farming in improving food security from the prospective of the farmer in the Fars province of Iran a work had carried out based on the quantitative and descriptive research on 622 farmers of Fars region using Cochran's formula and student's t-statistic through proportional stratified sampling techniques. The works reveals that the organic

farming is one of the best approaches to improve food security as it enhances technical health and safety, and the optimisation of production respectively. And organic agriculture should emphasis on the proper management operation as ecosystem varies as the approaches is to enhance social, environmental and economic condition (Laleh Morshedi, et.al. 2017). To study The economic and enviromental performances of the organic farming system compared to conventional farming system to stimulate horticultural sector of the Niayes regional in Senegal. In the study, primary data was collected seperately for both conventional and organic farmers which consists of 20 each respondent from the two rural communities of Neiyas zone of Senegal. In order to analyase the representative farm linear programming method and general algebaric modeling system(GAMS) were used which were consider to be the best analysing techniques and compareing result in different production practices. The work concluded on the note rhat conventional farming system in the horticulture sector is economically more profitable than organic farming system. On the other hand former has very high carbon emession than the later system of farming. They also suggested that organic farming should be increase substantially by providing adequate managerial and other related facilities and improving local market for it in the Neiyas region of Senegal(Barbier, et. al. 2015).

There is growing importance and economic development of the organic farming in this era in the state of Sikkim. On the basis of secondary thesources of information and accordingly progress on the various method adapted and challenges faced by the farmers and thus to their produce. The study found out that organic farming and the economic development has a positive relation as there was an improvement in rural development and standard of living of rural households. The produce of organic is relatively higher than that of conventional produce. More policies and further research should be initiated in keeping the view of increasing demand to meet in future and to work on integrated production methods where both manmade chemical and non-chemical ingredients to be mixed in order to yield higher productivity (Buragohian, 2020).

Statement of the problem

The Indian economy is mainly dominated by the agricultural sector, where agriculture contributes about 14.6 percent in gross domestic product (GDP) and support over 58 percent of nation's population for livelihood (GOI, 2010). Although India holds the second position with respect to total number of certified organic farms (44,926), it has the 13th position as far as the area under organic agriculture is concerned. In India, about 528,171 hectares of area is under organic agriculture (including certified and area under organic conversion) accounting for about 0.3% of total agricultural land.

Despite of the economic boom in the last few decades, India is also witnessing some of important and interrelated issues in the agriculture sector such as increasing food production in the face of continuously shrinking land resources, rapid degradation of land, size of land holding and water resources and environmental and health related issues. The growth of organic farming in India is relatively slower and there are a number of constraints impeding Indian farmers - especially small farm holders - from adopting organic farming. (Pandey and Singh, 2012). The state of Sikkim with a favourable climatic condition has been adapting to the technique of organic farming for more than a decade. The state is now moving towards the organic mission by producing crops like cardamom, ginger, oranges, medicinal plants, etc. As of 2010 almost 60% of the total cultivable land had been brought under organic farming. The total area under organic certification in Sikkim was 1,391.04 hectares. The total area under certified organic cultivation in the state was 1,726.34 hectare while the total organic production was 5174.44 tones(Yadav 2012). The contribution of

the agricultural sector to the state gross domestic product (SGDP) was 7.4 percent (according to the Central Statistical Organisation) during 2012-2013.

The problem seems to be aroused due to extensive dependence of agricultural production on conventional techniques to meet the demand of agricultural goods. However, the techniques required considerable chemical inputs to enhance productivity which further incorporates in environmental damages and causes health hazards. In another way, there was a need for alternative techniques to conventional which could be sustainable and more domain in nature and therefore, calls for organic farming in the state.

Research justification

Organic farming is a practice that has been historically favoured by the farming community in the state of Sikkim. However, in the course of time chemical fertilisers and pesticides replaced organic nutrients. With reference to the literature on Sikkim it consists of descriptive work with hardly any exploratory efforts. If contemporary issues like community development and sustainable livelihood are taken into consideration, research on organic agriculture in the state would be beneficial at the national level in general and Sikkim in particular.

Moreover, organic farming being a very recent phenomenon in developing countries like India, it can be expected that with time we shall be witness much more in-depth efforts in this direction. Despites the fact that there are several researches conducted on various social and economics dimensions regarding organic and conventional farming in the state but it seems there is lacking in making comparisons between the two methods of farming and their productivity enhancement which is the question of food security in the state and economic aspect of the people of Sikkim.

Objectives of the study

The broad objectives are to have comparative study of conventional farming method over organic farming methods and to analyse its productivity in Sikkim. The specific objectives are as follows: -

a) To examines the extend of agricultural production during conventional period and organic period.
b) To examines the land used pattern in both methods of farming.
c) To see which of these methods is better in enhancing the productivity of the crops.

Research question

a) Is there is any significant difference between conventional and organic methods of crops cultivation?
b) Is there is any differences in the land use pattern under both the methods of cultivation?

Data source

The study is based on secondary data collected on eight different crops grown across the state for the period of 2003-18. Further these data were segregated into two partsi.e. conventional crops and organic crops which also comprises eight each crop. The conventional period is the crops year which is from 2003-04 to 2014-15 and the organic period is from 2015-16 to 2017-18 respectively. The data were obtained from the Annual Reports, Food Security & Agriculture Development Department, Government of Sikkim.

Analytical techniques.

Present study used the summery statistics such as mean, standard deviation, range and paired Student's t-test to examine and compare the land use pattern and production under conventional and organic farming. Under the summery statistics mean, standard deviation, range, and sample

test are calculated with standard formula. The Arithmetic mean is the most common type of Average. If n numbers are given, each number denoted by a_i(where $i = 1,2,\ldots, n$), the arithmetic mean is the sum of the values of variables, divided by n, then:

$$AM = \frac{1}{n}\sum a_i = \frac{1}{n}(a_1 + a_2 + a_3 + \cdots + a_n)$$

where, n is the number of observations;i represent index of summation; a_i = data value for the given index.

Again, which is mostly used to measures the variability of dataset from its mean value which is

$$= \sqrt{\frac{\sum_n^i (x_i - \bar{x})^2}{n-1}}$$

Where, $s =$ sample standard deviation

$n =$ number of observation

$x_i =$ the observed value of samples iteam

$\bar{x} =$ the mean value of observation

Further range is used to find the spread of data from the dataset and can be given by the formula,

$$maximum\ value - minimum\ value$$

The test statistic for the Paired Samples *t* Test, denoted *t*, follows the same formula as the one sample *t* test.

$$t = \frac{\bar{x}_{diff-0}}{s_{\bar{x}}}$$

$$\text{where, } s_{\bar{x}} = \frac{s_{diff}}{\sqrt{n}}$$

$\bar{x}_{diff} =$ samples mean of the differences

$n =$ sample size

$s_{diff} =$ sample standard deviation of the differences

$s_{\bar{x}} =$ estimated standard error of the mean $\left(s/\sqrt{n}\right)$

The calculated *t* value is then compared to the critical *t* value with df = *n* - 1 from the *t* distribution table for a chosen confidence level. If the calculated *t* value is greater than the critical *t* value, then we reject the null hypothesis (and conclude that the means are significantly different).

Table 1: Descriptive Statistics of Various Crops in case of Conventional and Organic Farming in Sikkim

Crops	Variables	Mean		Standard deviation		Range	
		Conventional	Organic	Conventional	Organic	Conventional	organic
OILSEEDS	area	9.26	8.74	0.72	1.53	2.05	3.38
	production	7.55	7.26	0.43	0.45	1.32	0
MAIZE	area	38.99	38.92	1.48	0.26	4.15	0.5
	production	64.46	65.19	3.97	0.4	11.77	0.85
PULSES	area	6.4	6.22	0.35	0.3	0.92	0.67
	production	6.01	5.85	0.37	0.22	1.31	0.5
RICE	area	12.99	12.44	1.42	0.66	3.7	1.54
	production	21.4	20.9	0.84	1.11	2.67	2.54
WHEAT	area	3.63	2.95	2.28	0.09	6.02	0.22
	production	4.61	3.74	3.57	0.09	9.98	0.22
FINGER MILLETS	area	4.49	4.12	3.08	0.26	11.18	0.6
	production	3.45	3.31	0.41	0.24	1.29	0.54
BARLEY	area	0.84	0.76	0.3	0.07	0.73	0.15
	production	0.91	0.82	0.43	0.07	1.12	0.15
BUCKWHEAT	area	3.42	3.44	1.42	0.14	3.53	0.3
	production	3.13	3.19	1.45	0.15	3.8	0.32

Source: Annual Reports, Food Security & Agriculture Development Department, Government of Sikkim. Note: Area units (000' hectare) and Production units (000' tons).

The mean shows the averages of all subsequent years of values of both areas and productions of crops under conventional and organic farming system. Its value is widely used to represent all the dataset in the observation.Thistable shows the comparatives results of both Organic and Conventional Farming adopted for the cultivation of various crops in Sikkim where two subsequent variables are taken into account (I, e. area under cultivation and yield of those crops under consideration). Following is the crops wise discussion.it is clear that the area and production of oilseeds are higher in conventional farming system as compared to organic farming system whose averages values for areas are 9.26 and 7.40 (000' hector) and average production of oilseeds are 7.54 and 6.29 (000' tons) respectively, in case of Maizeit can be interestingly seen that the land under cultivation were significantly increases under organic farming but nevertheless, the crop yielding both under conventional and organic farming system seem to be no change although whose averages values for the former was 64.46 and 68.27 (000' hector) and the later averages values are 38.99 and 38.70 (000' tons) respectively, the production and area of pulses under cultivation walk hand-in-hand both in case of organic as well as conventional farming system whose average value of production and area under cultivations are 6.39 & 5.61 (000' hector) and 6.1 & 5.31 (000' tons) respectively. It can be seen thatunder conventional farming system land use

for Rice cultivation and the crop yields are significantly higher than under organic farming system. However, whose averages land use and crops yields are 12.98 & 10.42 (000' hector) and 21.39 & 19.24 (000' tons) respectively. In case of wheat, it can be drawn that conventional farming had drastically highly resulted both in terms of land use and production of wheat as compared to organic farming system. Considering its averages values for both land use and crop yields {I, e. 3.63 & 0.28 (000' hector) and 4.60 & 0.31 (000' tons)} respectively declined during organic periods, it can be observed that both land use and crops yield in case of finger millets show similar pattern both in case of conventional and organic farming system and whose average values stand as 4.48 & 2.75 (000' hector) and production level of 3.45 & 2.81 (000' tons) respectively, itis also observed that barley production is very minimal as compared to any other crops in Sikkim. Moreover, its production has substantially decreased after the introduction of organic farming system in the state. Though its production during conventional period was less but much higher than in organic period whose average of land use and its production level are 0.84 & 0.47 (000' hector) and 0.91 & 0.5 (000' tons) respectively, there seem not much changes in the productivity of buckwheat during both conventional and organic period and whose averages of land use and production are 3.42 & 3. 46 (000' hector) and 3.13 & 3.65 (000' tons) respectively.

Standard deviation is used here to capture the variability of the per crops areas and cultivation of crops both conventionally and organically adopted for production. Basically, a small standard deviation means that the values in a statistical data set are close to the mean of the data set, on an average, and large standard deviation means the values in the data set are farther away from the mean, on an average.

Table 1-shows the comparatives variability in area under cultivation and its crops production in both case of techniques. It can be clearly seen that in case of conventional crops like maize, rice, wheat and buckwheat has higher variability of area used under cultivation and as a result there also observed production variability over time. But however, during organic period there seems less variability in area under cultivation and production of various crops under consideration except oilseeds and rice which still has higher fluctuation both in-terms of land use and production yields over the time period under consideration. Therefore, it can be said that organic system of cultivation has greater economic aspects of production of some crops in the state.

The range is a measure of the total spread of values in a quantitative dataset. Unlike other more popular measures of dispersion, the range actually measures total dispersion (between the smallest and largest values) rather than the relative dispersion around a measure of central tendency. Here actually range is used to compares the two values (I, e. lowest and highest values) for the area and production of different crops in both the cases of farming in Sikkim.

Referring to table1 the comparatives spread of area under cultivation with respect to its crops production in both the cases of farming methods in the state and it is observed that the land use was increases in case of oilseeds under organic farming than the conventional farming but there seem no differences in production in case of organic farming of oilseeds over the period. Likewise, maize and pulses cultivation under organic farming seems to be consistent over time as opposed to the wide spread in its cultivation in case of conventional farming. A similar pattern can be observed in cultivation of rice under both methods of farming over time period. However, wheat cultivation in case of conventional farming system there was fluctuation in both land use pattern and production over time. Whereas, there is no such fluctuation can observe in organic farming over time period.

Further, in case of finger millets there is a wide range of land use pattern over time but less spread in terms of its production under conventional farming. Nevertheless, there is least dispersion of both land use and its production under organic farming over time. Moreover, crops like barley and buckwheat are two crops whose cultivation overtime under conventional farming system has similar kind of trend where as these crops under organic farming has quite least dispersed.
The paired sample test is used to draw comparatives differences in conventional farming and organic farming whether or not on dependence of production on area under cultivation. Paired samples t-test is a hypothesis testing conducted to determine whether the mean of the same sample group has a significant difference or not.

Table2: Paired Samples Statistics ofconventional and organic farming system

	bles			eviation	ror mean
ntional system				.32	35
	ction			.46	.59
ic system				.63	.46
	ction			3.03	.14

Note: Area (000' hectare) and Production (000' tons)

Source: Authors own calculation
Fromtable 2, it can be drawn that there is a mean difference in both land use pattern and corresponding crops production (i.e., 10.01 and 8.64) thousand hectare and similarly production by 13.69 and 13.26 thousand tons in both the system of farming in the state. Moreover, the standard deviation shows there is more or less dispersed in both land use and production of crops. However, it can also be said that organic farming has better overall performance in terms of land use and higher yielding of productivity.

Table3: Combined results of t-test of conventional and organic farming

Differences inpaired variables	Paired differences in variables					t-value	dof	Sig. (2-tailed
	Mean	Std. deviation	Std. Error Mean	95% confidence interval of the differences				
				Lower	Upper			
Area-production (conventional)	-3.69	9.43	3.35	-11.59	4.23	-1.10	7	0.30

Area-production (organic)	-4.62	10.57	3.74	-13.45	4.22	-1.24	7	0.25

Note: variables- (1) area (000' hectare) and (2) production (000' tons).
Source: Authors own calculation

Table 3 shows that there are paired differences in variables in both the system of farming where conventional system has (mean = -3.69, std. dev. = 3.35) and the organic has (mean = -4.62 and Std. dev. = 3.74) respectively. However, it can be said that organic farming has better opportunity than the conventional farming in the state. Further, the repeated-measures t-test found that the mean difference to be significant, $t_7 = -1.10$, $p = 0.30$; which is significant at 5% level of significance for conventional farming at the difference of -3.69. Therefore, null hypothesis may be rejected which means there is significant differences in the mean value of area and production. Moreover, again the repeated-measures t-test found that the mean difference to be significant, $t_7 = -1.24$, $p=0.25$; which is significant at 5% level of significance for organic farming at the difference of -4.62. Thus, null hypothesis may be rejected, implies that there is statistically significant in the mean differences between area and production. Altogether, it can be concluded that the organic farming has more significant in crops cultivation than the conventional farming which can be intensified from their mean differences in variables.

Conclusion

Contemporarily, Organic farming is practicing almost all the countries of the world by its better socio-economic advantages. With a suitable climatic condition, Sikkim has been adapting the technique of organic farming for more than a decade and it has become a basic source of livelihood for those who belong from the rural areas of the state.

The current study basically focused on the agriculture production of certain substantial crops which are basically grown in rural Sikkim. Ever since, Sikkim agriculture system are mixed of both conventional and organic farming, but the initiative of government of Sikkim to make the sate completely chemical-free farming was successful in 2015. Thus, the works involves in analysing the crops production in organic farming over conventional farming. The study revealed that crops like maize, rice, pulses and oilseeds are rigorously grown in higher volume in both the system of farming and their productivities does not much fall during organic farming period. On other hand, crops like barley, wheat, finger-millets, buck wheat are barely grown in the state and therefore, its productivities decrease during organic farming.

However, there is significance differences in both the methods of farming; there is subsequent increase in land use pattern during the organic farm period and as results production of crops increases. Therefore, it can be said that though the initiation of organic farming in Sikkim was only from past couples of years and it is very difficult to contrast the conventional farming over organic farming because in both the methods there seems not very much changes in agriculture productivity in the state. But it can be more generally predict that in coming days organic farming will be more benefitting way of agriculture production.

Hence, as a part of suggestion, it will be beneficial to bring more cultivable land under crop production and government should motivate the organic cultivators by giving regular training, demonstration and providing proper inputs, so that they can increase the quality as well as quantity of the production. The state government should also be more flexible to promote or invite all the organisation as well group-based growers by providing more inputs required in farming, financial assistance, market facilities, etc he proper road connection or transport facilities are needed for

both organic producer as well as consumer of the state. These would help the producer to get proper value for their produce and at the same time consumer will gets fresh farm product at cost effective price. To achieve this, government should be more conscious and should focus on rural areas having lack of roads facilities.

Limitation of the study

The study is purely based on secondary data collected from the Annual Reports, Food Security & Agriculture Development Department, Government of Sikkim. Therefore, the study itself limits to the extent of comparing conventional and organic farming in growing different crops in the state.

References

Abarham, D. J. (2014). Agricultural situation in India. *LXXI*, 2-38. New Delhi: Directorate of Economics and Statastics, Ministery of Agriculture.

Abdullah, M. (2020). *Organic Farming through sustinable production, Its effects in Rural Livlihood and for community development.* University of Malaya, Kuala Lumpur, Malaysia, department of Geography. Kuala Lampur: Research Gate. Retrieved april 12, 2021, from https://www.researchgate.net/publication/343140901

B. A. Gudade, P. C. (2013). Organic Cultivation of Large Cardomom (Amomum subulatum Roxb.) in Sikkim. *Popular Kheti, 1*(3), 1-7. Retrieved april 13, 2021, from www.popularkheti.info

Banumathi, M. S. (2015). The role of demographic factors in adopting organic farming: A logistic model approach. *International Journal of Advanced Research, 3*(8), 713-720. Retrieved april 6, 2021, from http:// www.journalIijar.com

Barbier, A. B. (2015, June 27). Economic and enviromental perfermances of organic farming system compared to conventional farming system: A case farm model to stimulate the horticultural sector of the Niayes region in Senegal. *Horticulture journal, 2*(4), 1-10. doi:10.4172/2376-0354. 1000152

Bhattacharyya, J. D. (2018). An Enquiry into Challenges of Organic Farming in Sikkim. *Business Studies, XXXIX*(1 and 2), 1-9. Retrieved april 12, 2021

Buragohian, U. (2020, january). Importance of organic farming in economy with sepcial reference to Sikkim. *International journal of recent technology and engineering, 8*(5), 1-4. doi:10.35940/jrte.D9710.018532

Damodaran, D. L. (2015, september). An Economic Analysis of Chillies Production in Guntur District of Andhra Pradesh. *International Journal of Research in Economics and Social Sciences, 5*(9), 1-8. Retrieved april 14, 2021, from http://researchgate.net/publication/283205227

Girimurugun, D. M. (2014, May). International Trends and Buying Behavior of Organic Food Products. *International Journal of Scientific Research, 4*(5), 1-3. Retrieved march 13, 2021

Guha, P. (2018, April). Organic Tea Farming and its Performance in Sikkim. *Indian Journal of Economics, XCVIII*(391), 621-637. Retrieved april 13, 2021, from http://researchgate.net/publication/349074159

Indira, D. S. (2013, August). Transition Process from Morden Agriculture to Organic Agriculturein Karanataka-An Emperical Analysis. *International Journal of Scientific Research, 2*(8), 1-3. Retrieved march 12, 2021

Indira, D. S. (2013, August). Transition Process from Morden Agriculture to Organic Agriculturein Karanataka-An Emperical Analysis. *International Journal of Scientific Research, 2*(8), 1-3. Retrieved march 12, 2021

K. Kalidas, M. D. (2014, June). Organic Coconut Cultivation in India-Problems and Prospects. *International Journal of Scientific Research, 3*(6), 1-3. Retrieved march 12, 2021

Kumar, S. k. (2017, august 1). An economic analysis of production and marketing of chilli in Durg district of Chhatisgarh. *Journal of Pharmacognosy and Phytochemestary, 6(5): 1291-1293*, 1-3. Retrieved febuary 28, 2021, from www.phytojournal.com

Laleh Morshedi, F. L. (2017, nov 14). The role of organic farming for improving food security from the prospective of Fars farmers. *sustinability*, 1-14.

McBride, W. D. (2012). The structure and profitbility of Organic field crop: the wheat. *Reasearch in agriculture and Appliied Economics* (pp. 1-26). AgEcon SEARCH. doi:10.22004/ag.econ.123835

Narayanan, D. S. (2005). *Organic Farming in India: Relevance.* Department of Economics analysis and research. Mumbai: National Bank for Agriculture and Rural development. Retrieved april 13, 2021

Rakhshanda Kousar, M. S. (2019, june 10). Economic Analysis of Organic Wheat Production in Pakistan: Adoption and return on investment. *European Online Journal of Natural and Social Sciences, 8*(3), 564-574. Retrieved april 7, 2021, from http://www.europen-science.com

Roman Ostapenko. Yuliia Herasymenko. Vitalii Nitsenko, S. K. (2020, Aprial 22). Analysis of Production and Sales of Organic Products in Ukrainian Agricultural Enterprises. *MPDI Sustinability, 12*, 1-14. doi:10.3390/su12083416

S Asfawi, A. P. (2019). Economic Valuation of Horticulture Organic Farming in Getasan, Semarang Regency. *The 4th International Conference IN Planning in the 2019Era of Uncertinity.328(2019) 012029*, pp. 1-7. Getasan: IOP Publishing. doi:10.1088/1755-1315/328/1/012029

Sadiq, N. K. (2019, september). Socio Economic Aspect of Organic Farming Practices for Improving Farmer's income in Some Locations of Kerala, India. *Bangladesh Journal of Agricultural Research*, 1-8. Retrieved march 11, 2021

Shakti Singh Tomar, S. K. (2018). A Comparative Economic Analysis of Organic and Inorganic Wheat in Punjab. *Journal of Agricultural Development and Policy, 28*(2). Retrieved april 6, 2021

Sharma, A. K. (2001). *A handbook of organic farming.* Jodhpur: Agrobios. Retrieved april 12, 2021

Singh, D. (2011). *Comperative profit-cost Analysis of organic and conventional farming (In reference of Haridwar district).* Dehradun: Directorate of Economics and Statistics, Uttarakhand, Dehradun.

Singh, P. (2017, november 08). Economic Perspectives of Organic Agriculture: A Review of Literature. *International Journal for Research in Enginnering Application and Management, 03*(08), 1-4. doi:10.18231/2454-9150.2017.0048

Singh, P. (2017, november 08). Economic Perspectives of Organic Agriculture: A Review of Literature. *International Journal for Research in Enginnering Application and Management, 03*(08), 1-4. doi:10.18231/2454-9150.2017.0048

V. R. Naik, L. B. (2012, may). Organic and Inorganic Cultivation of Chilli and its Marketing- An Economic analysis. *Karnataka Journal 0f Agriculture Sciences, 25*(2), 1-6. Retrieved march 13, 2021

Waqas Aslam, R. S. (2020, april 25). Comperative Economic Analysis of Crop Yield Under Organic and conventional Farming systems in Punjab, Pakistan. *Asian Journal of Agriculture and Biology, 8*(2), 1-6. doi:10.35495/ajab.2020.02.093.