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Assessment of diversity, sustainable yield index, value index and system economic efficiency of organic and conventional farmers of Karnataka state, India

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Abstract
Organic farmers follow a lot of eco-friendly practices. Supply of nutrients through FYM (2.5 ton), vermicompost (10 q), compost (on farm wastes like weeds, coconut leaves, coconut husk, crop residues, glyricidia, jetropa, drumstick and custard apple are recycled in to compost to provide excellent nutrients to crops, biodigestor (200 lts), growing green manuring crops (1.5 t) as sunhemp, dhaincha, lucern, stylosanthous and pulses crops like greengram, blackgram cowpea, and horse bean, Also green leaf manuring crops are glyricidia, subabul etc were grown on field bunds, residue management, mulching (crop residues, weeds are used for mulching which helps to keep down evaporation loss besides adding valuable nutrients to soil as they decompose, Cropping system (included pulses) and seed treated with biofertilizer like rhizobium (1 kg), azospherilium (1 kg), Azatobactria (0.5 kg), PSP (1 kg) and Beejamruth for higher crop yield. Also farmers prepared some important growth promoters as jeevamruth (200 s), amruthpani, sassyamruth, panchagavy (250 l), coconut tender water, vermiwash and butter milk to boost crop yield. For pest and diseases management use botanicals like *Azadirecta indica*, *Akoras Kalimas*, *Adthoda vesica*, *Ageva american*, *vica rosa*, *clirodendran enarav*, *Vitex nigunda*, *Nirium olinder*, *Anona scamosa*, marigold, tulasi, *and aswagandha*, Theae leaves are fermented with cow urine and mixed with vermiwash to serve as foliar spray. neem oil, neemcake, butter milk, garlic, onion, ginger, glyricidia extraction also used as foliar spray. Average cost of cultivation, Gross return and net return (Rs/ha) of cereals were Rs. 9432, 24250 and 14818, respectively in one acre.

Keywords: Organic farming, conventional farming, socio economic

Introduction
Agriculture has been the basic source of subsistence for man over thousands of years and it provides livelihood to over half of the world's population every day. Organic farming helps to improve the physical, chemical and biological properties of soil and maintains the ecological balance as well as productivity of life supporting systems for the future generations (Rajagopal and Sreeramulu, 1999) [11]. Soil management practices that do not impair with health and structure are pre-requisites for achieving higher productivity and reduced cost of cultivation in agriculture. Haung *et al*. (1993) [3] advocated the integrated use of organic with limited use of chemical fertilizers and pesticides as the first stage of transition from conventional to organic farming. Gradual reduction of inorganic over 2-3 years and complete conversion to organic is the one option available. During conversion 3 years the reduction in yield may be noticed. The success of organic farming strategies would depend on long term whole farm system involving all aspects of crop production that will maintain soil productivity and reduce dependence on chemical inputs (Pathak, 1992) [7]. Organic Farming is gaining momentum all over the world as it addresses self- reliance in food, rural development and nature conservation and sustained biodiversity, (Pathak *et al*., 2006) [8]. The increasing awareness of the effects of indiscriminate use of artificial inputs in agriculture has led to the adoption of organic farming as an alternative methods for conventional farming. In recent years, organic product have gained niche position in global food market (31 billion$). Organic Farming has become a truly exiting and dynamic sector of the food industry.

In the process of attaining higher levels of food production to keep pace with population growth during the past four decades, emphasis was laid on intensive agricultural practices. Though, India has become self sufficient in food production over years, in three decades after the launch of green revolution, agricultural scientists are now discovering that chemical fertilizers and pesticides have been harmful in the long term with the poisoning of lands, contaminating the ground water, polluting the environment and thousands of farmers and farm workers loosing their lives. The serious soil Biodiversity, environmental degradation and health hazards to humans and animals, have resulted in lower returns to the farmers due to high input costs and dipping productivity and quality. Organic farming is a viable alternative to the conventional (Sreekrishna Bhat, 2004) [12] agriculture. It enlivens the soil, strengthens the natural resource base, sustains biological production, provides safe and nutritious food and environment friendly.

The conventional agriculture has caused: Soil erosion, soil salinization, soil pollution due to fertilizers and pesticides, genetic erosion, reduced socio-economic values, increased cost on production, ill effects on the bio-diversity and environment, high risk to food security, nutrition, quality, safety etc.

Organic Farming aims at production of nutritious, quality and safe, agricultural produce, following eco-friendly production methods and the farming systems that restore and maintain the soil humus.

- Does not pollute the soil and ground water with chemical residues.
- Increases the biological diversity among plants and animals.
- Reduces leaching of mineral from soil.
- Depends on and makes full use of natural. Local and renewable resources.
- Uses low energy inputs
- Depends largely on natural equilibrium for crop protection.

It is socially and economically viable in comparison to the conventional agriculture. Organic Farming requires less financial and little or no external inputs and places more reliance on the natural and human resources on the farm which are abundant in this country.

Organic farming is a production system that avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulator and livestock feed additives to the maximum extent. Organic farming systems rely on crop rotations, crop residues, animal manures, legumes, green manures, off farm organic wastes, and aspects of biological pest control. India has converted over 2.5 million hectares including 1.1 million hectares of cultivable lands in to organic. In Karnataka has converted over 11711.84 hectares (Organic farming news letter, September, 2007).

The documented information on organic farming practices can be made use, practices to identify important researchable issues to provide strong research support.

Methodology

An effort was made to document the existing practices of organic farmers of North Karnataka during 2009 and 2021. It comprises 12 districts namely Gulbarga, Bidar, Bijapur, Bagalkot, Dharwad, Belgaum. Haveri, North canara, Gadag, Koppal, Bellary and Raichur respectively. This will help to transfer organic farming practices between farmer to farmer modes and provide technical backup for the development of organic farming in the state.

Twenty farmers who are practicing organic farming since 4 to 5 years were selected randomly from each district. Total size of sample is 240. The relevant data were collected through pre-tested schedules by personal interview method. The various data are compared on the basis of average of different categories of farmers of North Karnataka (Khemchand.*et al*. 2002) [4] and expressed in percent age (%).

$$\text{Average} = \frac{\text{Sum of the all farmers (240)}}{\text{Total No. of farmers (240)}}$$

$$\text{Percent age of Farmers (\%)} = \frac{\text{No. of particular categories of farmers}}{\text{Total No. Farmers (240)}} \text{ x } 100$$

Sustainable Yield Index (SYI) was calculated by using following formula

$$\text{Sustainable yield index (SYI)} = \frac{y-\sigma}{y\ max} \quad \text{.....(1)}$$

where,

y = average yield of a treatment over the years

σ = standard deviation (SD) and

y max = observed maximum yield of a plot over the years.

Sustainable value index (SVI) was calculated by using following formula

$$\text{Sustainable value index (SVI)} = \frac{y-\sigma}{v\ max} \quad \text{.....(2)}$$

where, y=average net profit over the years, σ=standard deviation (SD) and vmax=maximum net profit obtain in any of the year.

Results and Discussion

Farmer's opinion about inorganic farming

Farmers opinion about inorganic farming are cost of cultivation is high, detoriation in soil health and yield stagnation, hazardous effect of fertilizer and pesticides on human and animal health.

Farmer's opinion about organic farming

The farmers opinion about organic farming are reduced cost of cultivation, improved the soil properties, soil moisture was conserved, less dependent on external inputs, producing healthy food and fodder, diversification in Farming system, improves the economic condition.

Farmer practices

These farmers follow some important practices (Mukeshkumar Pandey *et al*.,2008) [5] are mulching, green manuring, cover cropping, cropping systems which includes crop rotation, multiple cropping, inter cropping and mixed cropping, use of indigenous seeds, reduced tillage, enhancement of soil fertility through composting, vermicomposting, FYM and use of microbial bio-fertilizers mainly *Rhizobium* in groundnut and pulses, Azospirillum, azotobacter, in cereal crops, phosphate solubalising bacteria in all the crops azolla, blue green algae in rice.

1. Socio- Economic status of organic farmers (Table.1)

A. Age group of sample farmers

Among the 240 organic farmers of North Karnataka, most of the

organic farmer's age belongs to a group between 35- 55 years. It means all organic farmers are in middle age (35.4%) compared to other categories.

B. Education level of sample farmers

The farmers already practicing organic farming are progressive and educated majority from high school to degree. However, more than 40.8% belong to high school standard than others categories.

C. Average members per family of sample farmers

The average members per family of organic (130 farmers) are 4-6 persons compared to other categories.

D. Average family income of sample farmers

The average family annual income good as they is relatively between Rs 60,000-1,00,000 (37.1%) compared to other categories.

E. Average land holding of sample farmers

The average land holding of organic farmers are relatively between 2-4 ha (39.6%) compared to other categories. Most of organic farmers have more rainfed area (2.46 ha) compared to irrigated area (2.36 ha).

F. Average livestock population and income

Average live stock populations of organic farmers (Table-2) have two cows, one buffalo and also have some number of Goats and Sheeps. The average net income per cow and baffellow was Rs. 3470 and 3570 respectively.

2. Cropping patterns of organic farmers

Organic farmers are growing different crops in *Kharif*, Rabi and summer seasons (Table-3). These farmers are also included green manuring, crop rotation, inter cropping and cover crops in cropping systems.

A. *Kharif* seasons

In kharif season under monocropping, more number of farmers were grown Sugarcane, Groundnut soybean, paddy (Srinivasa Reddy *et al*., 2004) [13], cotton, redgram, chickpea, green gram compared to maize, chilli and sunflower. In case of delay in onset of monsoon the farmers were growing green manure crops like sunhemp, dhaincha, lucern, stylosanthous and pulses crops like greengramm, blackgramm cowpea, and horsegram etc. These green manure crops were incorporated in soil 30-40 days (flower initiation stage) after sowing. Under intercropping, (Sreekrishna Bhat., 2004) [12] maize + redgramme, chilli + onion + cotton, sorghum + redgram, redgram + greengram,/black/groundnut/soybean, redgram + sesamum, cotton + groundnut/greengram/sunhemp, sugarcane + onion/cabbage/beans/greengram,/cowpea, sugarcane + sunhemp + chilli, chilli + horsegram, mango + vegetables, banana + sunhemp + vegetables, mango + maize, coconut + banana/ginger/leguminous fodder were grown. In mixed cropping arecanut + pepper + vanilla, soyabean + black gram, papaya + Jasmine + sapota, tomatoes + onion + marigold, arecanut + vanilla + banana, mango + sapota + vegetables, mango + sapota + guava, coconut + jasmine, coconut + banana and coconut + sapota/lime are grown. Some important horticultural crops are Banana, Sapota, Mango, Grapes, Arecanut, Papaya, Rose, Jasmine and pomegranate *etc.*, along with these crops some green manuring crops and vegetable crops are grown in between these crops and green manuring crop as *insitue* green manuring. Also follows some crop rotation are rice - wheat, rice -cotton. and follows some cover crops are velvet bean and dolichos lablab etc were grown. Farmers were using different local varieties with respect to crops.

B. Rabi season

In Rabi season under monocropping, sorghum, wheat, groundnut, horsegram, safflower, maize, chilli and cowpea *etc.*, crops were grown. In case of inter cropping, Sorghum + safflower, Sorghum + Chickpea etc crops were grown. Under mixed cropping mango + sorghum, Sapota + vegetable and mango-horsegrame etc. crops were grown.

3. Cropping pattern of organic farmers in summer seasons.

The major crops cultivated under summer seasons were ground nut, paddy and vegetables under monocropping and Mango + vegetables under intercropping with using different varieties and hybrids respect to crops

3. Some important technology developed by organic farmers for Nutrient, Pest and diseases management practices

These farmers developed many indigenous technologies for nutrient, pest and diseases management. Chemical manures and pesticides are (Mukeshkumar Pandey *et al*., 2008) [5] not at all used on the farm. These farmers follow a lot of eco-friendly practices. Supply of nutrients through FYM (2.5 t), (Table-4) vermicompost (10 q), compost (on farm wastes like weeds, coconut leaves, coconut husk, crop residues, glyricidia, jetropa, drumstick and custard apple are recycled in to compost (Prasad Rajendra., 2000) [9] to provide excellent nutrients to crops), biodigestor (200l), growing green manuring crops (1.5 t as sunhemp, dhaincha, lucern, stylosanthous and pulses crops like greengram, blackgram cowpea, and horse bean), Also green leaf manuring crops are glyricidia, subabul *etc*., were grown on field bunds, residue management, mulching (crop residues, weeds were used for mulching (Prasant Kumar Mishra., 2003) [10] which helps to keep down evaporation loss besides adding valuable nutrients to soil as they decompose, Cropping system (included pulses) and seed treated with biofertilizer like rhizobium (1 kg), azospherilium (1 kg), Azatobactria (0.5 kg), PSP (1 kg) and Beejamruth for higher crop yield. Also farmers prepared some important growth promoters as jeevamruth (200 l), amruthpani, sassyamruth, panchagavy (250 l) (Chalasani Dutt, (2006) [1], coconut tender water, vermiwash and butter milk to boost crop yield. For pest and diseases management use botanicals like *Azadirecta indica*, *Akoras Kalimas*, *Adthoda vesica*, *Ageva american*, *vica rosa*, *clirodendran enarav*, *Vitex nigunda*, *Nirium olinder*, *Anona scamosa*, marigold, tulasi, *and aswagandha*, Theae leaves are fermented with cow urine and mixed with vermiwash to serve as foliar spray. neem oil, neemcake,butter milk, garlic, onion, ginger, glyricidia extraction also used as foliar spray and some Biopesticides developed by UAS, Dharwad and NGOs are *Nomuraea*, NPV, Metarhizium, Beauvria, Bt.K, Trichoderma, Trichogramme, Lures and pheromone traps *etc*., were used to prevent pest and disease infection in different crops.

4. Economics of sample farmers

Average cost of cultivation, Gross return and net return of cereals were Rs. 9432,24250 and 14818 per acre (Srinivasa Reddy *et al*., 2004) [13], pulse crops Rs. 8460, 20975 and 12515 per acre, Oil seed crops Rs. 11236, 32500 and 21264 per acre,

Commercial crops Rs. 15383,47000 and 31617 per acre, plantation crops Rs. 20537,77525 and 56988 per acre, Fruit crops Rs. 29181,77333 and 48152 per acre and Flower crops Rs. 19761,48500 and 28739 per acre respectively.

5. Marketing facilities for organic growers

Organic farmers do not have any separate market to sale their products. But some of the horticultural crops likes mango, chikku, papaya. and agricultural crops like paddy, vegetables, groundnut, Soyabean etc. they are sell through some NGO's. Organisation like Skal, Tinna agro and some private companies like ITC, Reliance etc by which they are getting higher price. Small and marginal organic farmers presently facing certification problem for sale their organically growned products for higher prices, because cost of certification of farm is high. But with increasing competition, increasing numbers of products and introduction of grower groups certification system, per farmer costs have reduced drastically. Some important certification agencies are Skal, APOF, IMO and INDOCERT.

6. Sustainable yield index, value index and system economic efficiency of organic and convention farming system

The farmer adopted organic farming system having a sustainable yield index of 0.72 and sustainable value index of 0.76 and system economic efficiency of 477 per day over conventional farmers (0.52, 0.61 and 325, respectively)**.** It clarifies the benefits from different combinations/unit area, higher sustainability index and net returns was achieved in organic system (Vittal *et al*., 2002) [14].

Important constraints were observed in adopting organic farming

1. Less availability inputs.
2. Farmer has to prepare organic inputs themselves. It is time consuming and laborious.
3. Not feasible for small and marginal farmers.
4. Organic manures contain low nutrients hence it required large quantities which resulted in huge cost on transportation and application.
5. Slow release of nutrients in may not be appropriate for short duration crops.
6. Yield levels are not stable in the initial period of transition.
7. Pest and disease management appears to be difficult.
8. Certification of organic goods require which may adds extra cost to the cultivar.
9. At present there is no out lets for marketing every where it needs to be strengthened.
10. Organic production system require technical support.
11. Lack of technical guidance regarding organic manures, organic growth Promoter, green manuring, plant protection measures, including ioagent/parasites for the control of particular insect pests (Farkade.*et al*, 1999) [2].
12. Non availability of bio-agent/parasites at proper time.
13. Insufficient price for crops.

Table 1: Profile of organic farmers of North Karnataka n = 240

Characters		
A. Age group	**No. of farmers**	**% of farmers**
< 35	40	16.6
35-45	70	29.2
46-55	85	35.4
>55	45	18.8
B. Education level		
Illiterate	-	-
Primary	75	31.3
High school	98	40.8
College	67	27.9
C. Family size		
< 3	18	7.5
4 to 6	130	54.2
> 7	92	38.3
D. Income		
<10000	-	-
10000 to 20000	20	8.3
20000 to 40000	28	11.7
40000 to 60000	52	21.6
60000-100000	89	37.1
>100000	54	21.3
E. Land holdings (ha)		
< 1	-	-
1-2	75	31.1
2-4	95	39.6
> 4	70	29.3
F. **Land holding in different systems**		
Land Category	Land holding (ha)	Average land holding of 240 farmers
Rainfed	590.4	2.46
Irrigation	566.4	2.36
Total	1156.8	4.82

Table 2: Dairy activities

Animal	No. of Animals	Total milk production per annum (lts)	Gross return (Rs)	Cost of rearing (Rs)	Net return (Rs)	Average Net returns per animal (Rs)
Cow	506	273240	3005640	1250000	1755640	3470
Buffalo	332	185920	2045120	860000	1185120	3570

Table 3: Cropping pattern followed by the sample farmers

Cropping system	Crops	Varieties	Productivity per ha
A. Kharif season	Sugar cane	Co-8014, Gangavati, Co671, Co-86032	100 ton
Mono cropping	Maize	Alround, Kaveri, Laxmi Kanchana and other Hybrids	45 Quintal
	Paddy	Jaya, Abilash, Intan, Doddagya, IR-64, Sona, BPT, Ankursona	60 Quintal
	Cotton	DCH-32, JK-99, DHH-11,	24 Quintal
	Chilli	Baydagi dabbi, Baydagi Kaddi. Jwala and other local varirtires	7.5 Quintal
	Ground nut	TMV-2, GPBD-4, JL-24, Maradur	30 Quintal
	Sunflower	KBSH-1 and other hybrids	12 Quintal
	Redgramme	Maruti-1, Gulal and other local varieties	12 Quintal
	Chickpea	A-1 and other local varieties	9 Quintal
	Soybean	JS-335 and other local varieties	15 Quintal
	Greengramme	Chinamung, pusa, Karihesaru and other local varieties	8 Quintal
Inter cropping	Maize + Pigeonpea, Chilli + Onion + Cotton, Sorghum + Pigeonpea + Greengram,/Blackgram/Groundnut/Soybean, Pigeonpea + Sesamum, Cotton + Groundnut/Greengram/Sunhemp, Sugarcane + Onion/Cabbage/Beansns/Greengram,/Cowpea, Sugarcane + Sunhemp + Chilli, Chilli + Horsegram, Mango + Vegetables, Banana + Sunhemp + Vegetables, Mango + Maize, Coconut + Banana/Ginger. Coconut + Lime		
Mixed cropping	Arecanut + Pepper + Vanilla, Papaya + Jasmine + Sapota, Tomatoes + Onion + Marigold, Arecanut + Vanilla + Banana, Mango + Sapota + Vegetables, Mango + Sapota + Guava, Coconut + Jasmine, Coconut + Banana and Coconut + Sapota/Lime		
Horticultural crops	Banana	G-9, Robusta, Rajpuri and other Varieties	37.5 tonne
	Sapota	Cricket ball, Kalipathi and DSH-1&2	9 tonne
	Mango	Alpanso, Mallika and Ratnagiri	10 tonne
	Grapes	Thomson seedless, Arkavati	10-12 tonne
	Arecanut	Mangala, Sirsi,VS-1	17.5 tonne
	Papaya	Taiwan-786	60 tonne
	Rose	Gladiator	170000 No,s
	Jasmine	Hadagali mallige,mysore mallige sujimallige and Kakada	1875 kg
	Pomegranate	Kesar, Ganesh	7 tonne
B. Rabi season			
Mono cropping	Sorghum	M-35-1,DSV-4	1500
	Wheat	DWR-162 Dicoccum wheat and local varieties	3000
	Horsegramm	Local varieties	6 00
	Pigeonpea	Maruti	12 00
	Safflower	A-1	7 00
	Cotton	DCH-32,Sahana	2000
	Maize	Laxmi, Kanchana,M-900 and other Hybrids	4000
	Cowpea	C-152 and Local varieties	600
	Chilli	Baydagi dabbi, Baydagi Kaddi and Devanur local	700
Inter cropping	Sorghum + Safflower Sorghum + Chickpea	8 00 + 300 800 + 500	

Table 4: Input management practices followed by sample farmers

Input	On farm Quantity produced	Quantity purchased	Unit cost (Rs)	
			On farm production	Purchased
FYM	7925 tonne	810 tonne	240/tonne	500/tonne
Vermicompost	1200 tonne	55 tonne	900/tonne	2500/tonne
Green manuring	2800 tonne		80/tonne	-
Neem Cake		400 tonne	-	6000/tonne
Jeevamruth	390000 l	-	75/100 l	-
Panchgavvya	48000 l	-	150/100 l	-
Neem oil		1200 l	-	200/l
Rhizobium		680 kg	-	50/kg
Azospirillum		580 kg	-	50/kg
PSB		390 kg	-	50/kg
Azolla production	4 tonne	-	95/tonne	-
NPV		250 No,s LE	-	200/200 LE
Biodynamic preparation	34000 l	-	80 - 100 lts	-
Gypsum		150 q		200/q

Table 5: Economics of different crops grown by organic farmers.

Sl. No.	Crops	Gross Income (Rs/ha)	Total cost of cultivation (Rs/ha)	Net Income (Rs/ha)
Cereal crops				
1	Paddy	30000	10109	19891
2	Sorghum	15250	5394	9856
3	Wheat	22500	10286	12214
4	Maize	29,250	11,940	17310
	Mean	24250	9432	14818
Pulses Crops				
5	Pigeonpea	26400	12670	13730
6	Chickpea	20000	8315	11685
7	Soybean	22500	6916	15584
8	Greengram	15000	5938	9062
	Mean	20975	8460	12515
Oil Seeds				
9	Groundnut	40000	12919	27081
10	Sunflower	25000	9552	15448
	Mean	32500	11236	21264
Commercial Crops				
11	Cotton	48000	13996	34004
12	Sugarcane	80000	27276	52724
13	Chilli	30000	9540	20460
14	Onion	30000	10718	19282
	Mean	47000	15383	31617
Plantation Crops				
15	Arecanut	122500	30028	92472
16	Coconut	32550	11045	21505
	Mean	77525	20537	56988
Fruit Crops				
17	Banana	130000	48558	81442
18	Sapota	36000	14111	21889
19	Mango	40000	14447	25553
20	Grapes	136000	49611	86389
21	Papaya	60000	20359	39641
22	Pomegranate	62000	28,000	34000
	Mean	77333	29181	48152
Flower Crops				
23	Rose	35000	11521	23479
24	Jasmine	62000	28000	34000
	Mean	48500	19761	28739

Table 6: Sustainable yield, value index and system economic efficiency of irrigated IFS model

Indices	Sustainable yield index	Sustainable value index	System economic efficiency Rs. Per day
Organic farmers	0.73	0.78	477
Conventional farmers	0.52	0.61	325

Conclusion

The findings of the survey conducted on organic farmers of North Karnataka clearly showed that farmers were developed their own technology for nutrient, pest and disease management of various crops grown in organic farm. These farmers have good opinion about organic farming because there is reduction in cost of cultivation, improve soil fertility, produced healthy food and fodder for human and animal consumption and diversification in farming systems create employment opportunity over entire year. Farmer wanted scientific background regarding nutrient, pest and disease management of various crops grown in organic farming and marketing facilities for sale of their organically grown products.

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