

**COMPARATIVE ASSESSMENT OF SOIL PROPERTIES
AND ORGANIC CARBON DISTRIBUTION UNDER
ORGANIC AND CONVENTIONAL FARMING SYSTEMS
IN SELECTED AGROCLIMATIC ZONES OF SOUTHERN
KARNATAKA**

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**DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY
UNIVERSITY OF AGRICULTURAL SCIENCES
BENGALURU
2010**

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Affectionately Dedicated to
Sarala (my beloved wife)
Soumya & Sneha (my lovely daughters)
My Parents, In-laws
and
Dr. V.R.R. Parama (my guide)

**DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY
UNIVERSITY OF AGRICULTURAL SCIENCES
BENGALURU - 560 065.**

CERTIFICATE

This is to certify that the thesis entitled “COMPARATIVE ASSESSMENT OF SOIL PROPERTIES AND ORGANIC CARBON DISTRIBUTION UNDER ORGANIC AND CONVENTIONAL FARMING SYSTEMS IN SELECTED AGROCLIMATIC ZONES OF SOUTHERN KARNATAKA” submitted by **Mr.M.VIJAY SANKAR BABU, ID No. PAK 7073**, in partial fulfillment of the requirement for the award of **DOCTOR OF PHILOSOPHY (Agriculture) in SOIL SCIENCE AND AGRICULTURAL CHEMISTRY** to the University of Agricultural Sciences, Bengaluru, is a record of bonafide research work done by him during the period of his study in this university under my guidance and supervision and no part of the thesis has been submitted for the award of any degree, diploma, associateship, fellowship or any other similar titles.

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**COMPARATIVE ASSESSMENT OF SOIL PROPERTIES AND ORGANIC
CARBON DISTRIBUTION UNDER ORGANIC AND CONVENTIONAL FARMING
SYSTEMS IN SELECTED AGROCLIMATIC ZONES OF
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M.VIJAY SANKAR BABU

ABSTRACT

The study was carried out to assess the comparative changes in physical, chemical and biological properties and organic carbon distribution in irrigated soils under different periods (0-3, 3-6 and over 6 years) of practice of organic and conventional farming in three selected agroclimatic zones viz., Central dry zone, Southern dry zone and Southern transition zones in Southern Karnataka. There was no significant difference in pH of soils due to the practice of organic or conventional farming. Organic carbon increased due to organic matter additions in all the zones. Available N, P, K and S, exchangeable Ca and Mg, micronutrients (Zn, Cu, Mn and Fe) increased with progress in years of practice of organic farming.

The SMB-C, SMB-N, LF-C and WS-C were higher due to organic farming compared to conventional farming. Activity of dehydrogenase, urease and phosphatases of soil increased significantly in the fields subjected to organic farming for the three specified time periods irrespective of cropping systems compared to conventional farming.

Significant differences were observed due to interaction between farming systems and periods of practice of organic or conventional farming for most of the measured parameters.

Pedon 3 (>6 years organic practice) of Southern transition zone recorded higher total carbon stock (239.6 Mg h⁻¹) followed by Southern dry (233.8 Mg h⁻¹) and Central dry zone (150.31 Mg h⁻¹). The current results suggested that three years of organic management is minimum to cause significant and consistent enhancement of microbial biomass and activities that support nutrient supply to crops.

The soil chemical and biological parameters showed significant positive correlations irrespective of agroclimatic zones in soils under organically managed farming systems. The organic carbon in soils exhibited a positive and significant correlation with available nitrogen, acid phosphatase, alkaline phosphatase, total nitrogen, microbial biomass carbon and total carbon.

Signature of the Student

(M.Vijay Sankar Babu)

Signature of Major Advisor

(V.R.Ramakrishna Parama)

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ABBREVIATIONS USED

ORG	-	Organic Farming
CON	-	Conventional Farming
CDZ	-	Central Dry Zone
SDZ	-	Southern Dry Zone
STZ	-	Southern Transition Zone
MSL	-	Mean Sea Level
N	-	Nitrogen
P	-	Phosphorus
K	-	Potassium
S	-	Sulphur
Ca	-	Calcium
Mg	-	Magnesium
Fe	-	Iron
Zn	-	Zinc
Cu	-	Copper
Mn	-	Manganese
EC	-	Electrical conductivity
CEC	-	Cation exchange capacity
GM	-	Green manure
WHC	-	Water Holding Capacity
SOC	-	Soil Organic Carbon
DTPA	-	Diehylene Triamine Penta Acidic acid
SMBC	-	Soil Microbial Biomass Carbon
SMBN	-	Soil Microbial Biomass Nitrogen
DHA	-	Dehydrogenase Activity
UA	-	Urease Activity
LF-C	-	Light Fraction Carbon
WS-C	-	Water Soluble Carbon
Tot-C	-	Total Carbon
Tot-N	-	Total Nitrogen



Introduction

I. INTRODUCTION

Soil fertility is one of the fundamental factors that determine the productivity of all farming systems. Soil fertility is most commonly defined in terms of the ability of a soil to supply nutrients to crops. It is more helpful to view soil fertility as an ecosystem concept integrating the diverse soil functions, including nutrient supply, which promote plant production. This broader definition is appropriate to organic farming, as organic farming recognizes the complex relationships that exist between different components of the system and sustainability of a system which is dependent upon the functioning of whole integrated and inter-related functions.

Organic farming systems rely on the management of soil organic matter to enhance the physical, chemical and biological properties of the soil, in order to optimize crop production. One of the fundamental differences between organic and conventional systems is the way in which problems are addressed. Conventional agriculture often relies on application of fertilizer, pesticide and other inputs. Organic systems, in contrast, rely on use of organic and natural nutrient resources.

Four decades of “Green Revolution” based technologies of high yielding varieties, chemical fertilizers, pesticides, fungicides and herbicides and irrigation enabled rise in agricultural production in India and led to self sufficiency. There was steep rise in food grain production from 50.8 million tones in 1950-51 to 233 million tonnes during 2008-2009. However, the impacts of high input agriculture, which envisage large chemical inputs and few carbon additions, have had their own consequences. Presently, Indian agriculture is faced with a fatigue in productivity and soil health has taken a toll.

Organic farming is one of the strategies to improve soil conditions which would result in enhancing soil attributes contributing to the good health of the soil.

Although the benefits of organic manures application to soil in improving its physical, chemical and biological properties have been well known, information on the changes that would take place on shifting from conventional farming system to organic

farming system is lacking. In the normal course, to generate data on effect of organic farming practice on soil properties would require minimum of 8-10 years of continued organic farming practice. There are a large number of farmers who are already adopting organic farming practices for the past two decades, evaluation of such farms could be of immense value in understanding the influence of organic farming *vis-à-vis* conventional farming on soil properties, fertility and soil health.

Through the present study, an attempt has been made to elicit information on what happens when there is a switchover from inorganic to organic practice of cultivation. As Soil Scientists, it is pertinent for us to understand what benefits are derived under organic farming and conventional farming. This study is not intended to convey, that only organic farming is good. However, it is an impartial assessment of the positives and negatives of organic and conventional farming adoption.

The present study “Comparative assessment of soil properties and organic carbon distribution under organic and conventional farming systems in selected agroclimatic zones of southern Karnataka” was carried out in Central dry zone, Southern dry zone and Southern transition agroclimatic zones of Karnataka in irrigated lands with the following objectives.

1. To study the physical and chemical properties of soils under organic and conventional farming systems.
2. To study the biological properties of soils under organic and conventional farming systems.
3. To study the organic carbon distribution in the soils under organic and conventional farming systems.
4. To assess the correlations among physical, chemical and biological parameters in the soils under organic and conventional farming systems.

A decorative horizontal scroll graphic with a light gray grid pattern background. The scroll has a white center area where the text is located. The left and right ends of the scroll are rolled up, and the top edge is slightly wavy.

Review of Literature

II. REVIEW OF LITERATURE

The literature pertaining to comparative assessment of soil physical, physio-chemical and biological parameters and carbon distribution influenced by different farming systems are reviewed in this chapter under the following headings.

- 2.1 Effect of organic and conventional farming systems on soil physical properties
- 2.2 Effect of organic and conventional farming systems on soil physico- chemical properties
- 2.3 Effect of organic and conventional farming systems on soil chemical properties
- 2.4 Effect of organic and conventional farming systems on soil carbon fractions and their vertical distribution
- 2.5 Effect of organic and conventional farming systems on soil biological and biochemical properties
- 2.6 Correlations among soil physico- chemical and biological parameters in organic and conventional farming

2.1 Effect of organic and conventional farming systems on soil physical properties

Soil physical properties are important for crop growth and maintaining soil quality. Organic inputs such as farm yard manure (FYM) and green manure, improve the soil water holding capacity and infiltration rates and decrease bulk density (Petersen *et al.*, 1999).

2.1.1 Bulk density

Application of organic manures and crop residues are known to decrease the bulk density of heavy soils which in turn would improve physical condition of soil.

A reduction in bulk density with the incorporation of FYM and vermicompost as compared to application of only chemical fertilizer was observed by Tester (1990).

Srikanth *et al.* (2000) found a significant decrease in bulk density (1.27 to 1.18 Mg m⁻³) of soil after harvest of second crop in the soil amended with compost compared to the inorganic fertilizers applied soil.

Sharma *et al.* (2000) observed a significant reduction in the bulk density in soils incorporated with residues and FYM and this was attributed to the build up of organic matter and better soil structure.

The bulk density of soil decreased considerably with application of farm yard manure (1.00 Mg m^{-3}) or sunhemp incorporation (1.04 Mg m^{-3}) or retention of stubbles on soil surface (1.02 Mg m^{-3}) compared to farmer practice (1.18 Mg m^{-3}) of use of inorganic fertilizer (Guled *et al.*, 2002).

Application of organic manures such as FYM, pressmud compost, wheat straw and sugarcane trash @ 5 tons per ha reduced the bulk density over the control in Vertisols (Bonde *et al.*, 2004).

2.1.2 Maximum water holding capacity

Jadhav *et al.* (1993) reported that maximum water holding capacity of the soil increased in the plots which received vermicompost @ 5 t ha^{-1} compared to that of control plots.

Bellakki and Badanur (1994) reported that in Vertisols water holding capacity of soil was increased when sorghum stubbles alone or in combination with subabul loppings were incorporated.

A study conducted by Sharma *et al.* (2000) revealed that the water holding capacity of soil significantly improved on application of organic residues and FYM due to build up of soil organic matter and improvement in soil structure.

Application of different organic nitrogen rich sources had significantly influenced the physical properties of soil over the inorganic fertilizers. Water holding capacity (48.6%) increased by 36 per cent with the application of 100 per cent N through

vermicompost over inorganic nitrogen application and control. It was attributed to higher pore space, low bulk density and favourable soil structure (Kannan *et al.*, 2005).

2.2 Effect of organic and conventional farming systems on soil physico- chemical properties

2.2.1 Soil reaction (pH) and EC

Soil reaction is the single most important property that affects the nutrient availability in the soil and plant growth through direct and indirect effects.

Badanur *et al.* (1990) studied the effect of organic matter (FYM, sunnhemp, sorghum and safflower stalk) on the soil properties and found that the pH and electrical conductivity of soil did not vary much compared to fertilizers application in Vertisols.

Singh and Yadav (1994) observed that the soil pH did not change markedly due to continuous use of ammonium sulphate, groundnut cake and FYM. However, electrical conductivity decreased over a time (49 years) and was more so with a basal application of compost or manure.

In an incubation study conducted at Ranchi, it was found that incorporation of organic wastes like lantana, water hyacinth, subabul leaves, lentil straw, maize stover and rice straw significantly increased pH of an acid clay loam soil (Lal *et al.*, 2000).

A study on the effect of FYM on soil pH revealed that it decreased from 7.99 to 7.65 with each increment of FYM. The soil pH decreased significantly due to organic acid production during its decomposition and mineralization (Patil *et al.*, 2003).

Rathod *et al.* (2003) reported that the pH of the sodic soil was reduced significantly due to application of FYM at 5 t ha⁻¹ which was similar to the pH reduction as above due to addition of 50 per cent gypsum requirement. Similarly, electrical conductivity was reduced significantly by application of FYM.

A comparative study of organic vs. mineral nutrient application in a greenhouse was conducted for nine years by Herencia *et al.*, (2007). Results obtained indicated that there were no significant differences in electrical conductivity (EC) between organic and inorganic nutrient addition.

2.3 Effect of organic and conventional farming systems on soil chemical properties

2.3.1 Organic carbon

Organic carbon is associated with many important processes in soil and is the chief element present in soil organic matter. The soil organic matter content of any soil is the result of equilibrium between the processes supplying fresh organic inputs and the rate of mineralization of added and existing soil organic matter. It is important to maintain the level of organic carbon through periodical additions of organic manures.

The results of the study on long term effect of continuous use of fertilizers and manures on fertility status of soil revealed that organic matter content in the soil increased at a steady rate over years due to application of organic manures (Patiram and Singh, 1993).

Soil organic carbon constitutes an important carbon reservoir of the biosphere and plays a preponderant role in the global biogeochemical cycle of major nutrients. Several authors have used it as an indicator to monitor land cover/use changes (O'Donnell, 1996).

Mathur (1997) studied the long-term effect of FYM and fertilizer on soil properties and yield in cotton–wheat rotation at North West Rajasthan. He observed that incorporation of 16 tonnes ha⁻¹ FYM accounted for highest increase in organic carbon content in soil.

Andrews *et al.* (2002) reported that the application of 11.2 to 22.5 Mg ha⁻¹ yr⁻¹ of different composts increased OC by 8% compared with conventional fertilized sites in the first two years. In the third year there was a 16% increase in OC in the organic sites

compared with conventional fertilized sites. Increased levels of soil organic matter, increased organic reserves of nutrients for organic systems (Stockdale *et al.* 2001).

However, Shepherd *et al.* (2002) concluded that small differences in organic matter content have been found between organic and conventionally managed pasture soils, and only small differences were found between conventionally and organically managed arable soils in the UK.

A study conducted by Marriott and Wander ((2006) in nine established farming systems that have comparisons of organic and conventional farming systems located across the USA, found that the organic management increased soil organic carbon concentrations approximately 14% above the values recorded in conventional systems over a period of ten years .

2.3.2 Available nitrogen

In sunflower–bengalgram cropping system, Quereshi *et.al.*, (1995) noticed that incorporation of cotton stalk @ 5 tonnes per ha significantly increased the available nitrogen content of soil.

Bellakki and Badanur (1997) observed an increase in available nitrogen due to organic materials application, which was attributed to the direct addition of nitrogen through organic materials and greater multiplication of soil microbes, which converts organically bound nitrogen to inorganic form.

In organically managed systems where no synthetic fertilizers were applied, soil microbes not only dominate nutrient supply through mineralization processes, but may also behave as a transient nutrient sink, increasing the nutrient reservoir and thus reducing the risk of mineral nutrient leaching, especially for N (Dalal, 1998; Friedel *et al.*, 2001).

Stockdale *et al.* (2001) concluded that absolute N leaching losses were generally smaller from organic systems than from conventional systems but, when expressed

relative to crop production, losses were similar. Stopes *et al.* (2002) also concluded that there were greater losses of N from conventional than organic systems, although the difference was small.

For the organic treatment, the Kjeldahl N content values ranged between 1.4 and 2.5 g kg⁻¹, while for the mineral plots values ranged between 0.8 and 1.2 g kg⁻¹ and the organic amended soils, a strong relationship between the content of N and OM was found by Herencia *et al.*, (2007).

Comparative studies between organic and conventional farming systems showed the higher soil mineralizable nitrogen and the mineralizable N to organic carbon ratio in the organic farm indicating a higher level of microbiological activity in this soil than in the conventionally farmed soil (Monokrousos *et al.* 2008).

2.3.3 Available phosphorus

During decomposition of organic matter various organic acids are produced which solubilize phosphates and other phosphate-bearing minerals and thereby lower phosphate fixation. The decrease in phosphate fixation is due to the reactions such as formation of phosphohumic complexes that are easily assimilated by plants, the replacement of the phosphate by the humate ion, and formation of a coating on sesquioxide particles by humus as a protective cover results in reducing the phosphate fixing capacity of the soil.

FYM treated plots showed an increase in available phosphorus than inorganic fertilizers, which was due to coating of sequioxides by organic materials that reduced phosphorus fixing capacity of soil (Bharadwaj and Omanwar, 1994).

Singh *et al.* (1998) reported that the soil available phosphorus improved appreciably with application of either FYM or green manures.

Biological processes also play an important role in solubilizing inorganic forms of P. The mechanism by which plant roots and soil organisms solubilize this P is uncertain but probably involves the production of carbonic acid and organic acids, the release of protons at the cell surface in the course of cation uptake and chelation of Ca, Fe or Al by organic acids (Paul & Clark 1996).

Guppy *et al.* (2005) reported that the incorporation of organic matter, that rapidly sorb applied phosphorus, increases P availability to plants. It was noticed that incubation of organic matter in soil, reduced phosphorus sorption. However, the decrease in phosphorus sorption was not related to competition from the decomposition products of organic matter, but was the result of phosphorus release from the organic matter.

Sangeeta *et al.* (2006) studied the uptake of P from organic manures in groundnut-corn sequence using radio tracer technique. It was observed that in both the crops, organic manure had a significant effect on the uptake of P as compared to SSP and control. Poultry manure and sewage sludge applications showed highest P uptake from soil. In case of residual corn, the per cent of P was more from organic manures than for SSP, obviously due to greater residual availability and P release from organic sources. The highest A value was associated with SSP and lowest with FYM. The highest P uptake and therefore the highest P use efficiency, was due to FYM.

It can be concluded that the addition of organic manures decreases the fixation of added P in soil through the decomposition products like organic acids, which chelate with multivalent metallic cations. Addition of organic manures also enhances soil microbial growth and phosphatase enzyme activity in soil and thus brings about P solubilization.

2.3.4 Available potassium

Mathur (1997) observed that application of 100 per cent of FYM significantly increased available potassium over 50 per cent FYM + 50 per cent NPK. Increase in

potassium was due to reduction of K fixation in soil and influence on release of potassium due to interaction of organic matter with clay under cotton-wheat sequence.

Increase in available potassium due to FYM and sunnhemp application was observed by Bellakki and Badanur (1997) it was attributed to direct addition of potassium to the available pool of soil besides the reduction of potassium fixation and release of potassium due to the interaction of organic matter with clay.

Field experiments conducted by Bulluck *et al.*, (2002), to examine the effects of organic and synthetic soil fertility amendments on soil biological, physical and chemical properties at three organic and conventional farming systems have shown that the potassium concentrations in soils amended with alternative fertility amendments increased by a factor of 3, and were higher at the end of the second year in soils with alternative amendments than in soils with synthetic fertility amendments, whereas potassium concentrations decreased over time in soils with synthetic fertilizers .

In a 3-yr study, Andrews *et al.* (2002) found higher K in organic systems, 11 and 20 per cent higher in years 1 and 3 after treatment, respectively, following applications of 11 to 23Mg ha⁻¹ yr⁻¹ of compost. They attributed the result to the high K content of the compost and the increase of exchange sites due to organic matter added, which do not fix K strongly.

Nalatwadmath *et al.* (2003) reported a build up of available K only in organic manure treatment which was maximum (33%) as compared to control.

2.3.5 Secondary nutrients

Exchangeable calcium, magnesium and available sulphur

Calcium concentrations in soils with alternative fertility amendments were increased two-fold over the 2-year period. In contrast, no increase in calcium concentrations occurred in soils with the synthetic fertilizers ($P < 0.01$). Similarly, magnesium concentrations increased more than two times in soils amended with

alternative fertility amendments, whereas only slight increases in magnesium concentrations were observed in soils with synthetic fertilizers over the same time period. (Bulluck *et al.*, 2002).

2.3.6 DTPA extractable Micro nutrients

Rajeev Kumar *et al.* (1993) noticed that available Fe and Zn level in soil declined in all treatments except FYM treated soil.

Mathur (1997) reported that the availability of zinc and iron in sandy loam soil decreased due to continuous cropping of cotton wheat sequence. However, application of FYM significantly increased available zinc of soil compared to RDF and other treatments.

Addition of organic materials like FYM and sunnhemp increased the availability of micronutrients (Bellakki and Badanur, 1997). The increased availability was attributed to enhanced microbial activity in the soil and the consequent release of complex organic substances that could have prevented micronutrients from precipitation, fixation, oxidation and leaching and also addition of these nutrients through organic sources.

Sharma *et al.* (2000) observed that the DTPA-extractable micronutrients like Zn, Fe, Mn and Cu enhanced significantly due to crop residues and FYM incorporation compared to chemical fertilizers application.

Field experiments conducted by Bulluck *et al.*, (2002), to examine the effects of organic and synthetic soil fertility amendments on soil biological, physical and chemical properties at three organic and conventional farming systems have shown that manganese and copper concentrations increased over time in soils amended with alternative fertility amendments, but decreased in soils with synthetic fertilizers. However the soil zinc and iron contents were not affected by the type of amendments.

2.3.7 Cation exchange capacity

Yaduvanshi *et al.* (1985) observed that continuous manuring with FYM in an Alfisol, resulted in a significant increase in CEC.

Reganold (1988) reported that application of farmyard manure resulted in significant increase in cation exchange capacity. The increase in CEC was associated with rise in organic matter content.

Regular applications of soluble K fertilizers in conventional systems may increase the nutrient reserves in exchangeable forms and may also increase the reserves of less labile forms. Applications of soluble K fertilizers tend to increase the proportion of the CEC which is occupied by K and may also build up reserves of nonexchangeable K (Johnston, 2001).

Mean soil organic matter, total C, and CEC were higher and bulk density was lower in plots added with the organic residues compared to synthetic fertilizers after two years (Bulluck *et al.*, 2002).

2.4 Effect of organic and conventional farming systems on soil carbon fractions and their vertical distribution

The management of organic inputs is a critical area for the management of nutrients in organic farming systems. In particular the manipulation of the quality and quantity of organic inputs has implications for the activity of soil microorganisms and the soil food web, biological processes of nutrient transformation and the accumulation of SOM (Stockdale *et al.*, 2001).

2.4.1 Soil microbial biomass Carbon and N (SMB-C & N)

The soil microbial biomass (SMB), comprising 2-3 percent of the total organic carbon in soil is a relatively labile fraction of soil organic matter; it is therefore a more

important repository of plant nutrients. The microbial biomass is an essential component of organic matter turnover and has been recognized as both transforming agent and as a source and sink for various nutrients.

Although microbial biomass is a small and labile fraction (1–3%) of soil organic matter, soil microorganisms carry out the major organic matter transformations. Changes in the microbial biomass-C can provide an early indication of short-term trends in the total organic C of soils (Bergstrom *et al.*, 1998).

Soil microbial biomass C (SMB-C) and potentially mineralized C (MIN-C) are considered active fractions of SOM. These active fractions are important for supplying plant nutrients, decomposing organic residues, and developing soil structure (Franzluebbers *et al.*, 2000)

Soil microbial biomass C comprises only 1 to 4% of organic carbon but, due to its fast turnover time, the microbial biomass plays a key role in controlling nutrient cycling and energy flow (Li and Chen, 2004)

Wang *et al.*, 2004 reported that the differences in microbial biomass and activity under different organic amendments may have implications for nutrient availability to crops. High microbial biomass and activity often lead to high nutrient availability to crops through enhancing both the microbial biomass turnover and the degradation of non-microbial organic materials.

The results obtained from the study on soil microbial biomass and activity in organic tomato farming systems, Cong Tu *et al.*,(2006), found that the organic amendments increased soil microbial biomass C and activity (microbial respiration) as compared to the synthetic fertilizers and the enhanced soil microbial biomass was associated with high net N mineralization (potential N availability for plants).

2.4.2 Soil Light Fraction Carbon (LF-C)

Janzen *et al.*(1992) reported that the light fraction carbon content of soils was strongly correlated to soil respiration rates , suggesting that the light fraction may be an important C and energy source for soil microorganisms. This fraction of carbon is not protected by clay minerals or other mechanisms, and hence it is readily accessible to microbial and enzyme activities.

The 'light fraction' of SOM, which consists of partially decomposed (i.e. non-humified) materials comprised mainly of dead materials from roots and unharvested shoots, is often found to be very labile, as described by Berry *et al.* (2002).This small fraction of SOM will be most influenced by the rate and regularity of returns of undecomposed organic matter.

2.4.3 Soil Water Soluble Carbon (WS-C)

The water soluble carbon is considered to be the most active component of soil organic matter. It is the main energy source for soil microorganisms and is a primary source of mineralisable N, P and S and it influences the availability of metal ions by forming soluble complexes (Stevenson, 1994).

WS-C is more sensitive to changes in the environment than SOC as a whole. WS-C is an alternative tool for monitoring adverse impacts of management on soil quality. Understanding the role of WS-C in nutrient cycling is an important factor for sustainable ecosystem management (Silveira, 2005).

2.4.4 Total Carbon and Nitrogen

At the Rhodale Institute in Pennsylvania, Drinkwater *et al.*, 1998, compared organic farming with conventional farming for different soil parameters and found that

the soil organic matter and total N contents were higher in organic practices than in conventional farming practices.

Fliessbach *et.al.*, (2007), reported that at the end of twenty one years of crop rotation management in Switzerland, soil total carbon and total nitrogen were greater under biodynamic management than conventional management, but organic management and integrated management were intermediate.

2.5 Effect of organic and conventional farming systems on soil biological properties

Organic matter additions (crop residue, green manuring) have the largest influence on microbial numbers and activity, while mineral fertilization has a limited effect on the microbial community in cropping situations (Fraser *et al.*, 1988).

Enzymes adsorbed on organic and mineral soil particles and/or complexed with humic acid are important on their activities (Trasar-Cepeda *et al.*, 1998). Any factor, which influences the soil microorganisms, will affect soil enzyme activities indirectly (Ruiz *et al.*, 2008).

Enzymes catalyze all biochemical reactions and thereby play a key role in soil nutrient cycles. Soil enzymes have also been suggested as indicators of soil quality, since they show a rapid response to changes in soil management practices such as fertilizer application, or pesticides use (Albiach *et al.*, 1999).

Soil microbes, the living part of soil organic matter, function as a transient nutrient sink and are responsible for releasing nutrients from organic matter for use by plants (e.g. N, P, and S) (Friedel *et al.*, 2001).

Soil enzyme activity estimates are often used as indices of microbial activity and soil fertility. The biological activity in soil provides better insight in understanding the transformation of organic matter (Castillo and Joergensen, 2001).

Enzymes may react to changes in soil management more quickly than other variables and therefore may be useful as early indicators of biological changes (Masciandaro *et al.*, 2004).

Gopinath *et al.*, (2008) reported that all the treatments involving organic amendments, particularly at higher application rates, enhanced soil microbial activities of dehydrogenase, b-glucosidase, urease and phosphatase compared with the mineral fertilizer and unamended check treatments.

2.5.1 Dehydrogenase activity

Dehydrogenase activity is commonly used as an indicator of biological activity in soil. Dehydrogenase enzymes play a significant role in the biological oxidation of soil organic matter by transferring protons and electrons from substrates to acceptors.

Kukreja *et al.* (1991) noticed that the total microbial biomass and dehydrogenase activity of soil were significantly increased in the plots receiving FYM application annually for 20 years.

Sriramachandrasekharan *et al.* (1996) observed that green manures have potentials to maintain higher dehydrogenase activity over farmyard manure, coir pith compost and paddy straw. Nature of the plant materials incorporated probably governs the type and number of microbial communities that can flourish under given conditions.

Manna *et al.* (1996) studied the influence of FYM on dynamics of microbial biomass and its turnover and activities of enzymes under a soybean wheat system on a typic Haplustert. They observed that the microbial biomass of the soil was significantly higher under soybean than under wheat crop. All the three enzymes were positively correlated with microbial biomass N and P and there were also significant correlations between soil organic carbon and biomass C, N and dehydrogenase activity.

According to Rao and Pathak (1996) and Liang *et al.*, (2005), the incorporation of organic amendments to soil stimulated dehydrogenase activity because the added material may contain intra- and extracellular enzymes and may also stimulate microbial activity in the soil.

Madejon *et al.*, (2007) reported that the dehydrogenase, an oxidoreductase that only exists in viable cells and is considered a sensitive indicator of soil quality and was strongly correlated with soil organic carbon content.

2.5.2 Urease activity

Urease enzyme originates in soil from both soil microorganisms and plant roots (Bremner and Mulvaney, 1982) and is widely spread among the plant species. Many researchers have, thus observed a marked increase in the urease activity of soils when amended with green manures.

Urease activity generally correlates well with organic matter due to its existence as a complex with organic constituents. It may be affected by temperature, soil factors such as moisture content, pH, organic matter and number of microorganisms (Toole *et al.*, 1985).

Melero *et al* (2006) reported that the Urease activity in soils under organic management was greater than that in soils under inorganic management.

2.5.3 Acid and Alkaline Phosphatase activity

Large proportion of the phosphorus in soil exists in organic form (50-80% of total P). The cycling of organic P has a large effect on P availability and long term ecosystem productivity. The organic fraction of soil P has received relatively little attention, because of its complex nature. In order to become available to plants, P compounds must be hydrolyzed by phosphatases, which are of plant and microbial origin. Measurement of

specific enzyme activity is useful in determining soil biological activity which might be used as an index of soil fertility. Phosphatase produced by microorganisms and plant roots have a major role in the hydrolysis of soil organic P thereby releasing inorganic P for plant uptake. Ester hydrolysis of P by phosphatase enzymes is a major factor in the P cycle in soil.

The soil microbial biomass C and N increased with a balanced fertilization. The addition of organic amendments increases microbial biomass even when the organic C content of the soil did not increase. This increase in microbial biomass was attributed to better plant growth resulting in higher rhizodeposition. The crop yields and N uptake was higher with addition of farmyard manure or sesbania green manure (Goyal *et al.*, 1992).

Phosphatase activity is directly related to the level of organic phosphorus in the soil. Roots can hydrolyze organic and insoluble phosphate in soil by the production of the phosphatases, which are also produced by a large number of soil microbes (Bandick, and Dick, 1999.).

Fox and Comerford (2002) examined the phosphatase activity in the rhizosphere of slash pine grown in two forested spodosols and observed significant acid phosphatase activity in A and B horizons of two soils. Phosphorus fertilization reduced the phosphatase activity in the rhizosphere soil.

The activity of acid phosphatases has been found to be higher in organic and biodynamically managed soils than under conventional management (Oberson *et al.* 1996).

Colvan *et al.* (2001) studied the influence of acid and alkaline phosphomonoesterase and phosphodiesterase activities in soil. For this, the experimental plots were divided into three groups: those receiving FYM, those receiving mineral P and those receiving no P amendment. They observed that plots receiving FYM had the highest extractable P values and the greatest enzymes activities.

Fox and Comerford (2002) examined the acid phosphatase activity in the rhizosphere of slash pine and reported that phosphorus fertilization decreased the phosphatase activity in the rhizosphere soil. Soluble organic P comprised of 15 - 25 per cent of the total soluble organic P in two A horizon soils and over 75 per cent in the Bh horizon soils and between 20 and 30 per cent of the water soluble organic P in the A and Bh horizons of the two soils was hydrolyzed when an acid phosphomonoesterase was added.

Renella *et al.*, 2006, studied the phosphomonoesterase production and persistence during plant material decomposition in soils with various pH. Both acid and alkaline phosphomonoesterase were produced in greater amounts during plant residue decomposition. They concluded that the alkaline phosphatase activity increased by six to fifteen times and acid phosphatase activity increased by two to ten times. The acid phosphatase activity predominated in acid soils and alkaline phosphatase activity predominated in neutral and alkaline soils.

The mineralization of organic P is mediated by phosphatases that hydrolyze carbon-oxygen-phosphorus ester bonds. Therefore, these enzymes are very important in the P nutrition of plants (Kaleeswari, 2007).

2.5.4 Soil carbon and nitrogen stocks

Carbon and Nitrogen stocks in the soil depend largely on the areal extent besides other factors such as carbon content, depth and bulk density of soil.

Organic agricultural projects sequester carbon both in above ground (e.g. trees, hedges, permanent crops) and in below-ground (soil organic carbon) stocks. For grassland and annual crops, the primary carbon stock is below ground. Most of these ecosystems have large annual carbon uptake rates, but much of the gain is exported in the

form of agricultural products and their associated waste materials; this gain is rapidly released to the atmosphere. (Watson *et al.*, 2000).

Carbon stored in soils represents the largest terrestrial carbon pool. Arable soils usually have low soil organic carbon, whereas values are higher under permanent plant cover. Conversion of natural to agricultural land resulted in the loss of 50–100 Pg of soil organic carbon worldwide over the past 200 years (Jarecki and Lal, 2003).

With improved management practices carbon stocks of these soils can be restored, at least temporarily, thus removing CO₂ from the atmosphere. However, current estimates of the actual soil C sink capacity are only 50–66% of the cumulative historic C loss (Lal, 2004).

Two randomized long-term trials comparing organic and conventional farming practices for over 20 years showed remarkable higher carbon contents in the organic plots. In Switzerland, a long-term trial for a biodynamic system showed a stable carbon content, while a carbon loss of 15% in 21 years was measured for the compared conventional systems (Fliessbach *et al.*, 2007).

2.6 Correlations among soil physico- chemical and biological parameters in soils in organic and conventional farming systems

Interactions between agricultural management practices and soil biological, chemical, and physical processes affect the productivity of agricultural soils and their impact on their impact on environmental quality (Doran *et al.*, 1996).

Field experiments conducted by Bulluck *et al.*, 2002, to examine the effects of organic and synthetic soil fertility amendments on soil biological, physical and chemical properties at three organic and conventional farming systems have shown that the canonical correlations indicated significant correlation between soil chemical with biological properties.

The review of the literature with regard to assessing organic farming practices in comparison to the conventional systems under different headings indicate that the studies pertaining to the use of different organic sources to the soil over varying periods have had different impacts. The long term studies on the effect of organic matter usage have shown encouraging results in terms of improving physical, chemical and biological parameters. Nevertheless, inorganic practices have had their own impacts of influencing soil properties. In summary, it could be inferred from the studies that organic matter has been the central point healthy functional soil.



Material and Methods

III. MATERIAL AND METHODS

A “comparative assessment of soil properties and organic carbon distribution under organic and conventional farming systems in selected agroclimatic zones of southern Karnataka” was carried out. This included study of the soil physical, chemical and biological/biochemical parameters in both organic and conventional farming systems of irrigated lands in surface (0-15cm) and sub surface (15-30cm) soils. The distribution of carbon in the pedons under Central dry zone, Southern dry zone and Southern transition agroclimatic zones of Karnataka during both *kharif* 2008 and summer 2009 seasons was studied. The material used and the methods adopted during the study are presented in this chapter.

3.1 Survey of fields in different agroclimatic zones

The sites of soil sampling were finalized in consultation with the Organic Farmers’ Association of Karnataka, State Department of Agriculture, Regional Organic Farming Research Centre, Bangalore, Organic farming project scientists, University of Agricultural Sciences, Bangalore, NGOs, Extension Workers and KVKs. A survey of three agroclimatic zones namely Central dry zone (zone 4), Southern dry zone (zone 6) and Southern transition zone (Zone-7) was carried to identify the farmers who are practicing organic farming over different periods (*viz.*, 0-3 years, 3-6 years and over 6 years) in Southern Karnataka (Fig 1). To draw comparisons, farmers practicing conventional farming were also identified adjacent to the organic systems for the study. However it should be noted that in case of conventional systems, the periods (0-3 years, 3-6 years and over 6 years) were not a criterion. Further at most care was taken in selection of site in both the cases of farming systems such that they occurred in the same type of soil with local cropping systems. Data regarding soil type and land use system were collected using questionnaire (Tables 1, 2 and 3). The sites of soil sampling were fixed using GPS (Global Positioning System).

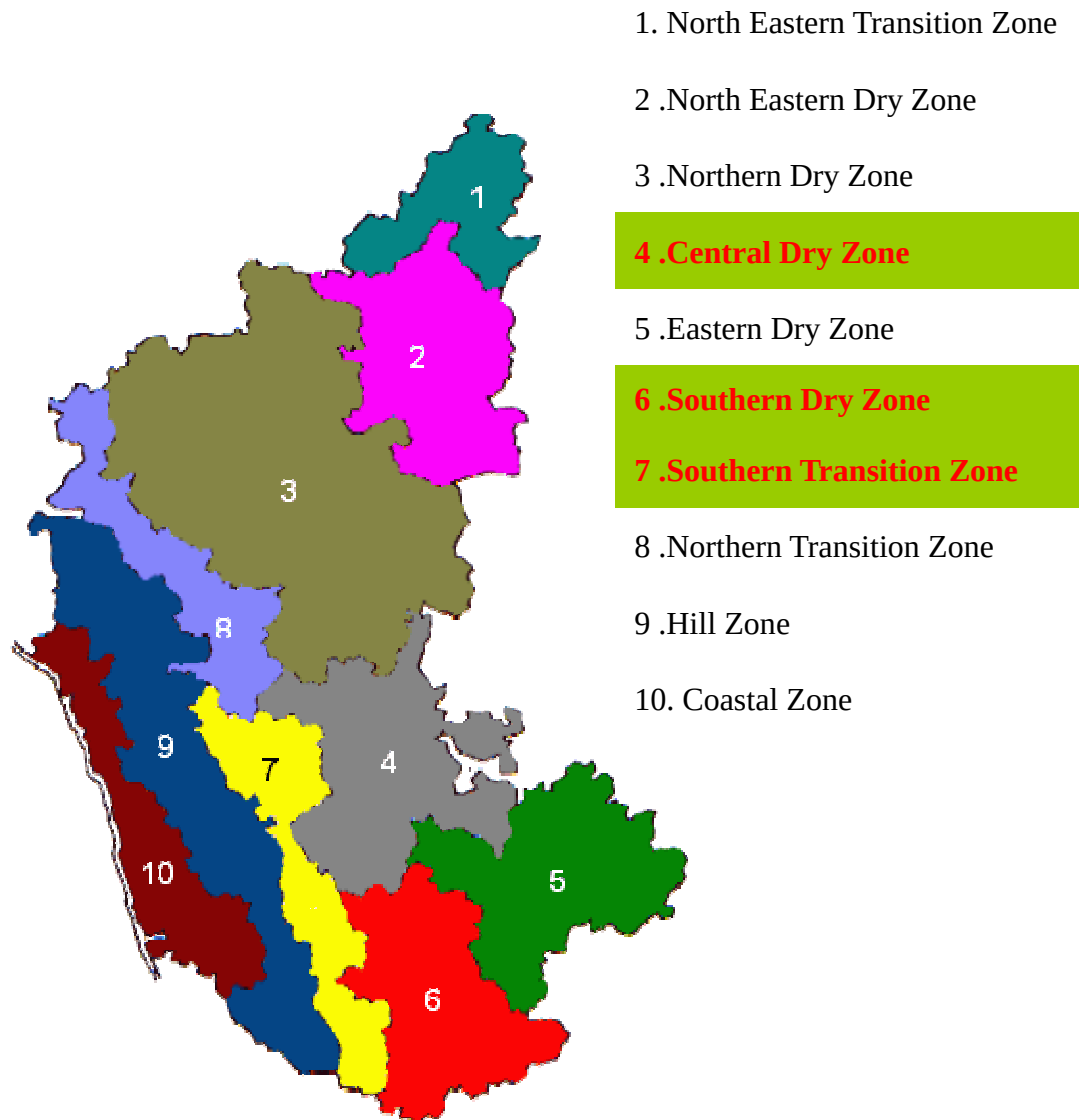


Fig 1 : Selected Agroclimatic zones (4,6 and 7) of Karnataka

Table 1. Soil sampling locations and other details (based on questionnaire) in Central Dry zone of Karnataka

0-3 Years*

S.No	FARMER NAME AND ADDRESS	Soil Texture	Years*	Area (ha)	Crop/ Cropping System	Latitude	Longitude	Elevation (MSL)
1	Sri.LOKESH Chilahalli, Hiriyur Taluk	Clay	ORG- 3 yrs	1.4	Groundnut- Redgram	14 ⁰ 02' 58.8" N	76 ⁰ 46' 21.8"E	597
2								
3	Sri. THIPPESWAMY Chilahalli, Hiriyur Taluk	Sandy clay	CON	2.5	Groundnut- Redgram	14 ⁰ 03' 20.6" N	76 ⁰ 46' 22.2"E	637
4								
5	Sri. SOMALINGAPPA Chilahalli, Hiriyur Taluk	Clay	ORG- 3 yrs	2.0	Groundnut	14 ⁰ 03' 6.7" N	76 ⁰ 46' 22.6"E	599
6								
7	Sri. MALLIKHARJUNA Chilahalli, Hiriyur Taluk	Clay	CON	2.0	Groundnut	14 ⁰ 03' 23.4" N	76 ⁰ 46' 28.4"E	622
8								
9	Sri. MOHAN Yelagundanahalli, Hiriyur Taluk	Clay	ORG- 2 yrs	2.0	Groundnut- Redgram	14 ⁰ 03' 3.6" N	76 ⁰ 46' 20.4"E	678
10								
11	Sri. MOHAN Yelagundanahalli, Hiriyur Taluk	Clay	CON	1.25	Groundnut- Redgram	14 ⁰ 03' 3.6" N	76 ⁰ 46' 20.2"E	627
12								
13	BABBUR FARM, Hiriyur	Sandy clay	ORG- 3 yrs	2.0	Onion-Maize	13 ⁰ 57' 35.6" N	76 ⁰ 38' 35.1"E	635
14								
15 16	BABBUR Farm, Hiriyur	Sandy clay	CON	3.2	Maize	13.57 ⁰ 57' 39"N	76 ⁰ 38' 51.4"E	622

Cont...

* CON: Conventional farming

* ORG: Organic farming

3-6 Years

17	Sri. BADAPPA Hosayelanadu via Hiriyur post	Clay	ORG- 4 yrs	2.5	Groundnut- Redgram	13° 58' 18.3"N	76° 40' 17.4"E	630
18								
19	Sri. KANTHIRAJ Hosayelanadu via Hiriyur post	Clay	CON	3.5	Groundnut- Redgram	13° 58' 18.2"N	76° 40' 16.6"E	621
20								
21	Sri. ASWARTHAPPA Hosayelanadu via Hiriyur post	Clay	ORG- 5 yrs	2.0	Maize	13° 58' 16.4"N	76° 40' 15.2"E	642
22								
23	Sri. MANMATHA Hosayelanadu via Hiriyur post	Clay	CON	2.5	Maize	13° 58' 17.2"N	76° 40' 15.4"E	628
24								
25	Sri. SHIVASHANKARAPPA- Sulthanipura Chitradurga	Sandy clay	ORG- 4 yrs	3.2	Cotton-Maize	14° 20' 20.4"N	76° 21' 14.3"E	666
26								
27	Sri. THIPPESWAMY Sulthanipura Chitradurga	Clay	CON	1.2	Cotton-Maize	14° 20' 18.2"N	76° 21' 15.1"E	638
28								
29	Sri. MUSTURAPPA Sulthanipura Chitradurga	Sandy clay	ORG- 5 yrs	2.0	Onion- Cotton	14° 20' 52.7"N	76° 21' 1.6"E	665
30								
31	Sri. PALANAIAK Sulthanipura Chitradurga	Sandy clay	CON		Cotton	14° 20' 52.0"N	76° 21' 2.3"E	660
32								

Cont...

> 6 Years

33	Sri. THIPPESWAMY- Madanayakanahalli, Chitradurga	Sandy clay	ORG- 8 yrs	4.0	Maize-Sunflower	14 ⁰ 20' 36.9"N	76 ⁰ 23' 25.6"E	708
34								
35	Sri.SADASHIVAPPA Madanayakanahalli, Chitradurga	Sandy clay	CON	2.5	Maize	14 ⁰ 20' 34.6"N	76 ⁰ 23' 23.2"E	725
36								
37	Sri. SATHISHA Madanayakanahalli, Chitradurga	Clay	ORG- 8 yrs	3.5	Areca nut-Banana	14 ⁰ 20' 35.4"N	76 ⁰ 23' 23.8"E	712
38								
39	Sri. SHASHIDHAR Madanayakanahalli, Chitradurga	Clay	CON	2.0	Areca nut	14 ⁰ 20' 33.2"N	76 ⁰ 23' 28.4"E	694
40								
41	Sri. MAHESHA Sultanipura , Chitrdurga	Sandy clay	ORG- 6 yrs	2.0	Areca nut -Maize	14 ⁰ 22' 2.9"N	76 ⁰ 24' 12.6"E	668
42								
43	Sri. MUSTURAPPA Sultanipura Chitrdurga	Sandy clay	CON	1.2	Areca nut -Maize	14 ⁰ 22' 3.9"N	76 ⁰ 24' 12.4"E	702
44								
45	Sri. NAGARAJ Sultanipura Chitrdurga	Clay	ORG- 7 yrs	2.2	Maize- Cotton	14 ⁰ 21' 1.9"N	76 ⁰ 23' 14.6"E	674
46								
47	Sri. MAHESHA Sultanipura Chitrdurga	Sandy clay	CON	2.5	Maize- Cotton	14 ⁰ 21' 3.9"N	76 ⁰ 23' 14.2"E	711
48								

Table 2. Soil sampling locations and other details (based on questionnaire) in Southern Dry zone of Karnataka**0-3 Years**

Sample Code #	FARMER NAME AND ADDRESS	Soil Texture	Years*	Area	Crop/ Cropping System	Latitude	Longitude	Elevation (MSL)
49	Sri. NRUPADA -Kadahalli	Clay	ORG- 3 yrs	2.0	Rice	12° 48' 32.7"N	76° 01' 13"E	964
50								
51	Sri, SIDDALINGAPPA Kadahalli	Clay	CON	1.5	Rice	12° 48' 31.4"N	76° 01' 22"E	924
52								
53	Sri. RAMESH- Kadahalli	Clay	ORG- 2 yrs	2.0	Maize	12° 54' 12.7"N	76° 01' 0.9"E	926
54								
55	Sri.NANDISH Kadahalli	Clay	CON	2.0	Maize	12° 54' 34.4"N	76° 01' 26"E	912
56								
57	Sri. GURUSWAMY Badanaguppe	Clay	ORG- 3 yrs	2.5	Coconut-Areca nut	13° 08' 12.1"N	76° 00' 35.3"E	760
58								
59	Sri. SHIVANNA Badanaguppe	Clay	CON	1.5	Coconut-Areca nut	13° 07' 48.1"N	76° 00' 0.33" E	795
60								
61	Sri. VEERAMALLAIAH Badanaguppe	Clay	ORG- 3 yrs	1.5	Cotton	13° 08' 32.4"N	76° 00' 26.4" E	785
62								
63	Sri. MANJUNATH Badanaguppe	Clay	CON	1.5	Maize	13° 07' 12.2"N	76° 00' 16.4" E	742
64								

Cont...

3-6 Years

65	Sri.KRISHNAIAH Bhogapuram	Clay	ORG- 5 yrs	1.5	Maize	11° 13' 50"N	76° 11' 55"E	720
66								
67	Sri.SHIVAMALLU Bhogapuram	Clay	CON	1.5	Maize	11° 13' 46"N	76° 11' 44"E	768
68								
69	SriMALLESHGOUDA -Muthige	Clay	ORG- 4 yrs	2.0	Rice	11° 32' 41"N	76° 13' 45"E	694
70								
71	Sri. NATARAJ Muthige	Clay	CON	1.5	Maize	11° 32' 48"N	76° 13' 34"E	742
72								
73	Sri. SHIVALINGEGOUDA- Pannedahundi	Clay	ORG- 5 yrs	2.5	Banana	12° 50' 31.7"N	76° 12' 0.3"E	930
74								
75	Sri.CHINNEGOUDA Pannedahund	Clay	CON	2.5	Banana	12° 50' 12.4"N	76° 12' 26"E	912
76								
77	Sri. DORESWAMY- Kumaranpura	Clay	ORG- 4 yrs	4.0	Sugarcane	12° 59' 15.7"N	76° 01' 2.5"E	921
78								
79	Sri. MALLESHPRABHU Kumaranpura	Clay	CON	4.0	Sugarcane	12° 54' 32.4"N	76° 00' 56.3"E	903
80								

Cont...

> 6 Years

81	Sri.BASAVARAJAIAH- Madhapur	Clay	ORG 7 yrs	2.5	Turmeric	11° 12' 50"N	76° 11' 45"E	710
82								
83	Sri.NAGESH Madhapura, Chamrajnagar	Sandy clay	CON	2.5	Turmeric	11° 12' 44"N	76° 11' 34"E	719
84								
85	Sri.NIJAGUNA- Kadahalli	Clay	ORG 9 yrs	4.2	Sapota-Mango	12° 54' 32.7"N	76° 01' 0.3"E	930
86								
87	Sri.VIRUPAKSHAPPA Kadahalli, Chamraj nagar	Sandy clay	CON	4.0	Sapota-Mango	12° 54' 31.4"N	76° 01' 26"E	912
88								
89	Sri.SEKHARA Kadahalli, Chamraj nagar	Sandy clay	ORG 7 yrs	1.2	Maize	12° 51' 22.7"N	76° 04' 12"E	948
90								
91	Sri.NAGE GOUDA Kadahalli, Chamraj nagar	Sandy clay	CON	1.5	Maize	12° 51' 26.2"N	76° 04' 26"E	879
92								
93	Sri. NARAYANSWAMY Badanaguppe,Kollegal	Clay	ORG 8 yrs	2.5	Cotton	13° 08' 26.1"N	76° 00' 40.7"E	920
94								
95	Sri. ANANTHA Badanaguppe,Kollegal	Clay	CON	2.5	Maize	13° 08' 43.6"N	76° 00' 58.6"E	910
96								

Table 3. Soil sampling locations and other details (based on questionnaire) in Southern Transition zone of Karnataka**0-3 Years**

Sample Code #	FARMER NAME AND ADDRESS	Soil Texture	Years*	Area (ha)	Crop/ Cropping System	Latitude	Longitude	Elevation (MSL)
97	Sri.BALAGANGADHAR Bharathavalli, Alur (Tq), Hassan (Dt)	Clay	ORG- 3 yrs	2.0	Ginger	13°12'16.1"N	76°02'32.4"E	864
98								
99	Sri.SHANKARA Bharathavalli, Alur (Tq), Hassan (Dt)	Clay	CON	2.0	Ginger	13°12'12.9"N	76°02'33.6"E	912
100								
101	Sri.JAGADEESHA Holabagere, Belur (Tq), Hassan(Dt)	Clay	ORG- 2 yrs	2.0	Ginger-beans	13°08'12.1"N	76°00'35.3"E	924
102								
103	Sri.JAGADEESHA Holabagere, Belur (Tq), Hassan(Dt)	Clay	CON	2.0	Ginger-beans	13°08'11.9"N	76°00'34.6"E	918
104								
105	Sri.GURUSWAMYGOUDA Harubihalli, Belur (Tq), Hassan(Dt)	Clay	ORG- 2 yrs	1.2	Turmeric-ginger- cocoa	13°07'41.2"N	76°00'28.3"E	915
106								
107	Sri.VIRUPAKSHAPPA Harubihalli, Belur (Tq), Hassan(Dt)	Clay	CON	2.5	Turmeric-ginger- cocoa	13°07'44.3"N	76°00'26.2"E	921
108								
109	SHIMOGA	Clay	ORG- 3 yrs	1.5	Groundnut	14°08'18.5"N	77°00'45.1"E	940
110								
111	SHIMOGA	Clay	CON	2.0	Groundnut	14°08'23.1"N	77°00'54.3"E	945
112								

Cont...

3-6 YEARS

113	Sri.RAJU.Y.M	Clay	ORG-5 yrs	2.5	Maize-potato	12° 59' 15.7"N	76° 01' 2.5"E	921
114	Yeduru, Alur (Tq), Hassan (Dt)							
115	Sri.SHEKARA	Clay	CON	2.0	Maize-potato	12° 59' 16.2"N	76° 01' 3.2"E	910
116	Yeduru, Alur (Tq), Hassan (Dt)							
117	Sri.VIJAY ANGADI	Clay	ORG-4 yrs	1.2	Ragi	12° 52' 12.2"N	76° 01' 10.3"E	914
118	Kadalu, Alur (Tq), Hassan (Dt)							
119	Sri. CHANDRANNA	Clay	CON	2.5	Ragi	12° 52' 14.2"N	76° 01' 9.2"E	925
120	Kadalu, Alur (Tq), Hassan (Dt)							
121	Sri. DARSHAN Hosaganur, Alur (Tq), Hassan(Dt)	Clay	ORG-4 yrs	2.5	Ragi	12° 54' 25.2"N	76° 01' 0.1"E	920
122								
123	Sri.SWAMY Hosaganur, Alur (Tq), Hassan(Dt)	Clay	CON	2.0	Ragi	12°54'25.0"N	76°01'0.5"E	910
124								
125	Sri.DEVARAJ Holabagere, Belur(Tq), Hassan(Dt)	Clay	ORG-4 yrs	3.0	Maize-Turmeric	13°08'22.1"N	76°00'35.0"E	920
126								
127	Sri.REVANNA Holabagere, Belur(Tq), Hassan(Dt)	Clay	CON	3.0	Maize-Turmeric	13°08'30.2"N	76°00'38.1"E	925
128								

Cont...

> 6 YEARS

129	Sri.DHARMALINGAM Hosaganur , Alur(Tq), Hassan (Dt.)	Clay	ORG- 8 yrs	3.5	Coffee	12°54'32.7"N	76°01'0.3"E	930
130								
131	Sri.SANNEGOUDA Hosaganur , Alur(Tq), Hassan (Dt.)	Clay	CON	3.0	Coffee	12°54'32.4"N	76°00'56.3"E	906
132								
133	Sri.CHAMEGOUDA Karigoudanahalli, Alur(Tq), Hassan (Dt.)	Clay	ORG- 6 yrs	2.0	Coffee	12°56'44.1"N	76°1.2'22.1"E	926
134								
135	Sri.CHANDREGOUDA Karigoudanahalli, Alur(Tq), Hassan (Dt.)	Clay	CON	2.0	Coffee	12°54'44.9"N	76°1.2'22.8"E	915
136								
137	Sri.THIMMANNA Holabagere, Belur (Tq), Hassan (Dt.)	Sandy clay	ORG- 7 yrs	2.0	Areca- Coconut	13°08'23.2"N	76°00'41.4"E	910
138								
139	Sri.NEELAKANTHA Holabagere, Belur (Tq), Hassan (Dt.)	Clay	CON	2.0	Areca- Coconut	13°08'22.5"N	76°00'41.1"E	924
140								
140	Sri.KUMARASWAMY Holabagere, Belur (Tq), Hassan (Dt.)	Sandy clay	ORG- 6 yrs	1.5	Banana	13°08'18.5"N	76°00'45.1"E	940
141								
142	Sri.PUTTARANGASWAMY Holabagere, Belur (Tq), Hassan (Dt.)	Clay	CON	2.0	Banana	13°08'23.1"N	76°00'54.3"E	945
144								

*Samples were also collected from conventional farming systems adjacent to the fields on which organic farming being practiced for the specified periods and in two depths

3.2 Description of soils of the selected agro climatic zones in Southern Karnataka

3.2.1 Central dry zone (Zone-4)

This zone covers an area of 1.94 million hectares covering the district of Chitradurga. The annual rainfall ranges from 454 to 718 mm, of which more than 55% is received in *kharif* season. The elevation ranges between 450 and 900 meters and the soils are red sandy loams in major areas and shallow to deep black in remaining areas. The principal crops grown are ragi, jowar, pulses and oil seeds.

3.2.2 Southern dry zone (Zone-6)

This zone extends over an area of 1.74 million hectares covering the districts of Chamrajnagar, Mandya, and Mysore. The annual rainfall ranges from 671 to 899 mm of which more than 50% rain is received in *kharif* season. The elevation is 450-900 meters and the soils are red sandy loam in major areas. The principal crops are rice, ragi, pulses, jowar, sugarcane and tobacco.

3.2.3 Southern transition zone (Zone-7)

This zone comprises an area of 1.22 million hectares covering the districts of Hassan Shimoga and parts of Mysore and Chickamangalore. The annual rainfall ranges from 612 to 1054 mm and more than 60% of this is received in *kharif* season. Soils are red sandy loams in major areas and red loamy in the remaining areas. The principal crops grown are rice, ragi, pulses, jowar, coffee and tobacco.

3.3 Soil sampling and soil profile studies

Two hundred and eighty eight soil samples at the rate of four samples from four farmers' fields practicing organic farming for different periods (0-3 years, 3-6 years and more than 6 years) were collected. Similar number of soil samples were also collected from plots practicing conventional farming. All samples were collected during *kharif*

2008 and these sampling points were physically marked using GPS to ensure the same location for subsequent sampling during summer'09.

In Zone IV, soil samples were collected from Hiriyr and Chitradurga taluks, Zone VI from Chamrajnagar, Kollegal and Mandya taluks and in Zone VII from Hassan, Katherlegere, Belur and Shivamogga taluks.

For the purpose of determining the bulk density of soils, soil samples using core sampler were sampled from different agroclimatic zones. The soil samples were divided into two subsamples. One was immediately packed in polyethylene bags loosely tied and covered with wet cotton to ensure sufficient aeration and to prevent moisture loss and was stored at 4°C for estimating enzyme activities. The other was dried in shade, sieved (2 mm) for chemical analysis.

Twelve (four in each zone) soil profiles representing the situation specified for the study, to a depth of 100 cm were exposed during February, 2009 taking support of National Bureau of Soil Science and Land Use Planning, Regional Centre, Bangalore. Soil samples from each diagnostic horizon were also collected.

Site descriptions and morphological characters of pedons are presented in tables 4, 5 and 6. The soils were classified as per keys to Soil Taxonomy (Soil Survey Staff, 1999).

Table 4. Description of representative soil profiles under Central Dry zone of Karnataka, India

Horizon	Depth (cm)	Matrix colour (moist)	Texture	Structure (grade- size-type)	Consistence (dry- mst-stk-pls)	Classification
Pedon-1: (Organic farming 0-3yrs) Village: Babbur Taluk: Hiriyr						
Latitude: 13 ⁰ 57' 35.6" N ; Longitude: 76 ⁰ 38' 35.1" E ; Elevation: 635 MSL						
Geology & Parent material: weathered schist ; Slope: 1-3% ; Erosion: Very slight						
A	0-12	10YR 3/3	s cl	2m sb k	h fi s p	Fine,mixed,iso hyper thermic,Lithic Haplustepts
BW1	12-24	10YR 3/2	s cl	2m sb k	h fi s p	
2BW2	24-70	10 YR 3/2	s cl	2m sb k	h fi s p	
C	>70	Weathered granite				
Pedon -2: (Organic farming 3-6 yrs) Village: Sultanipura Taluk: Chitradurg						
Latitude: 14 ⁰ 20' 20.4" N ; Longitude: 76 ⁰ 21' 14.3" E ; Elevation: 666 MSL						
Geology: ; Parent material: ; Slope: 1-3% ; Erosion: Very slight						
A	0-19	7.5YR 3/3	s cl	2m sb k	sh fi s p	Fine, mixed, iso hyper thermic, Typic Paleustals
BW1	19-34	7.5YR 3/3	s cl	2m sb k	sh fi ss p	
BW2	34-52	7.5YR 4/3	cl	2m sb k	sh fi ss p	
BW3	52-76	7.5YR 3/3	cl	2m sb k	sh fi ss p	
BW4	76-100	7.5YR 3/3	s cl	2m sb k	sh fi ss p	
Pedon -3: (Organic farming >6yrs) Village: M.N.Halli Taluk: Chitradurg						
Latitude: 14 ⁰ 20' 36.9" N Longitude: 76 ⁰ 23' 25.6" E Elevation: 708 MSL						
Geology: granite ; Parent material: ; Slope: 1-3% ; Erosion: moderate						
A	0-14	7.5YR 3/2	s cl	2m sb k	fi s p	Fine, mixed, isohyperthermic, Typic Haplustepts
BW1	14-35	7.5YR 3/3	s cl	2m sb k	fi s p	
BW2	35-60	7.5YR 3/2	s cl	2m sb k	fi s p	
BW3	60-80	7.5YR 4/2	s cl	2m sb k	fi s p	
BC	>80	30% soil + w.p.m		2m sb k	fi s p	
Pedon-4: (Conventional farming) Village: Babbur Taluk: Hiriyr						
Latitude: 13.57 ⁰ 57' 39"N ; Longitude: 76 ⁰ 38' 51.4" E ; Elevation: 622 MSL						
Geology: ; Parent material: ; Slope: 1-3% ; Erosion: Very slight						
AP		10 YR 3/2	s cl	2m sb k	fi s p	Clayey-skeletal, mixed, isohyperthermic, Typic Haplustepts
BW1		10 YR 3/2	s cl	2m sb k	fi s p	
BC1		10 YR 3/2	gc	2 f sb k	fi s ps	
BC2		10 YR 3/2	gc	2 f sb k	fi s ps	
C		Weathered parent material				

c-clay; sc-sandy clay

* **Grade:** 2-moderate;
3-strong

** **Dry:** sh- slightly hard

Size:

Moist: fi-firm
Plasticity: p-plastic ;
 ps-slightly plastic

Type: sbk- subangular blocky

Stickyness: s-sticky;
 ss-slightly sticky

**Table 2. Description of representative soil profiles under Southern Dry zone of
Karnataka, India**

Horizon	Depth (cm)	Matrix colour (moist)	Texture	Structure (grade- size-type)	Consistence (dry- mst-stk-pls)	Classification
Pedon-1: (Organic farming 0-3yrs) Village: Badanaguppe Taluk: Chamrajnagar						
Latitude: 13 ⁰ 08' 12.1" N ; Longitude: 76 ⁰ 00' 35.3" E ; Elevation: 760 MSL						
Geology: Granite ; Parent material: Granite gneiss ; Slope: 1-3% ; Erosion: Very slight						
AP	0-15	5 YR 3/3	c	2m sb k	sh fi	Fine-loamy, mixed, iso hyperthermic, Typic Haplustepts
BW1	15-39	5 YR 3/3	c	2m sb k	fi	
BC1	39-56	2.5 YR 3/4	sc	2m sb k	fi	
BC2	56-75	2.5 YR 3/6	sc	2m sb k	fi	
Pedon-2: (Organic farming 3-6 yrs) Village: Komaranpura Taluk: Chamrajnagar						
Latitude: 12 ⁰ 59' 15.7" N ; Longitude: 76 ⁰ 01' 2.5" E ; Elevation: 921 MSL						
Geology: granite ; Parent material: granite gneiss ; Slope: 0-1% ; Erosion: none/Very slight						
AP	0-20	10 YR 3/2	c	2m sb k	fi ss p	Very fine, mixed, isohyper thermic, Vertic Haplustepts
BW1	20-49	10 YR 3/2	c	3m sb k	fi s p	
BW2	49-64	10 YR 3/2	c	3m sb k	fi s p	
BW3	64-100	10 YR 3/2	c	3m sb k	fi s p	
Pedon-3: (Organic farming >6yrs) Village: Kadahalli Taluk: Madhpura						
Latitude: 12 ⁰ 54' 32.7"N ; Longitude: 76 ⁰ 01' 0.3"E ; Elevation: 930 MSL						
Geology: granite ; Parent material: granite gneiss ; Slope: 0-1% ; Erosion: Very slight						
AP	0-15	5 YR 3/4	c	2m sb k	fi s p	Fine, mixed, iso hyperthermic, Typic Haplustepts
BW1	15-28	5 YR 3/3	sc	2 m sb k	fi s p	
BW2	28-60	10 YR 3/2	c	3m sb k	fi s p	
BW3	60-100	10 YR 3/3	c	3m sb k	fi s p	
Pedon-4: (Conventional farming) Village: Taluk: Chamrajnagar						
Latitude: 12 ⁰ 54' 32.4" N; Longitude: 76 ⁰ 00' 56.3" E; Elevation: 903MSL						
Geology: granite ; Parent material: granite gneiss ; Slope: 1-3% ; Erosion: Very slight						
AP	0-22	10 YR 3/2	c	2m sb k	fi s p	Very fine, mixed, iso hyperthermic, Typic Haplustepts
BW1	22-48	10 YR 3/3	c	2m sb k	fi	
BW2	48-64	10 YR 3/2	c	3m sb k	fi	
Cr	64-100	10 YR 3/4	c	2m sb k	fi	

c-clay; sc-sandy clay

* **Grade:** 2-moderate;
3-strong

** **Dry:** sh- slightly hard

Size:

Moist: fi-firm
Plasticity: p-plastic ;
ps-slightly plastic

Type: sbk- subangular blocky

Stickyness: s-sticky;
ss-slightly sticky

**Table 6. Description of representative soil profiles under Southern Transition zone
of Karnataka, India**

Horizon	Depth (cm)	Matrix colour (moist)	Texture #	Structure* (grade- size-type)	Consistence** (dry- mst-stk-pls)	Classification
Pedon -1: (Organic farming 0-3yrs) Village: Taluk: Alur Latitude: 13° 08' 12.1" N ; Longitude: 76° 00' 35.3" E ; Elevation: 953 MSL Geology: ; Parent material: Granite ; Slope: 1-3% ; Erosion: Very slight						
AP	0-25	7.5YR3/2	c	2m sb k	fi s p	Fine,mixed, isohyper thermic, Typic Haplustepts
BW1	25-55	7.5YR3/2	c	2m sb k	fi s p	
BW2	55-75	7.5YR3/2	c	2m sb k	fi s p	
BW3/C	75-100	7.5YR3/3	sc	2m sb k	fi s p	
Pedon -2: (Organic farming 3-6 yrs) Village: Yedur Taluk: Hassan Latitude: 12° 59' 15.7" N ; Longitude: 76° 01' 2.5" E ; Elevation: 921 MSL Geology: ; Parent material: ; Slope: 1-3% ; Erosion: Very slight						
AP	0-10	7.5YR4/3	sc	2m sb k	fi ss ps	Fine,mixed, isohyper thermic, Typic Haplustepts
BW1	10-20	7.5YR3/3	sc	2m sb k	fi s p	
BW2	20-54	7.5YR4/3	sc	2m sb k	fi s p	
BW3	54-75	7.5YR4/3	sc	2m sb k	fi s p	
C	>75	Weathered parent material				
Pedon -3: (Organic farming >6yrs) Village: Hosaganur Taluk: Alur Latitude: 12° 54' 32.7" N ; Longitude: 76° 01' 0.3" E ; Elevation: 930 MSL Geology: granite ; Parent material: ; Slope: 0-1% ; Erosion: Very slight						
AP	0-10	7.5YR3/3	sc	2m sb k	fi s p	Fine,mixed, isohyper thermic, Typic Haplustepts
BW1	10-30	7.5YR4/4	sc	2m sb k	fi s p	
BW2	30-50	7.5YR4/3	sc	2m sb k	fi s p	
BW3	50-80	7.5YR4/4	sc	2m sb k	fi s p	
BW4	80-100	5 YR4/4	c	2m sb k	fi s p	
Pedon -4: (Conventional farming) Village: Hosaganur Taluk: Alur Latitude: 12° 54' 32.4" N ; Longitude: 76° 00' 56.3" E ; Elevation: 903 MSL Geology: granite ; Parent material: ; Slope: 1-3% ; Erosion: Very slight						
AP	0-20	7.5YR3/3	sc	2m sb k	fi s p	Fine,mixed, isohyper thermic, Typic Haplustepts
BW1	20-48	7.5YR4/4	sc	2m sb k	fi s p	
BW2	48-71	7.5YR4/3	sc	2m sb k	fi s p	
BW3	71-100	7.5YR4/4	sc	2m sb k	fi s p	

c-clay; sc-sandy clay

* **Grade:** 2-moderate;
3-strong

** **Dry:** sh- slightly hard

Size:

Moist: fi-firm
Plasticity: p-plastic ;
 ps-slightly plastic

Type: sbk- subangular blocky

Stickyness: s-sticky;
 ss-slightly sticky

3.4 Methods for soil analysis

The soil samples analyzed for different physical, physico- chemical and chemical properties following the standard procedures.

3.4.1 Analytical methods used for analysis of soils

	Parameters	Method	Reference
I)	Physical properties		
a)	Particle size analysis	Hydrometer method	Bouyoucos (1962)
b)	Bulk density	Core method	Black (1965)
c)	Particle density	Keens cup method	Piper (1966)
c)	Water holding capacity and % porespace	Keens cup method	Piper (1966)
II)	Physico-chemical properties		
a)	Soil reaction (pH) (1:2.5 soil : water suspension)	Potentiometry	Jackson (1973)
b)	Electrical conductivity (1:2.5 soil : water suspension)	Conductometry	Jackson (1973)
c)	Cation exchange capacity (C mol (p ⁺) kg ⁻¹)	Ammo. aetate method	Jackson (1973)
III)	Chemical properties		
a)	Organic carbon (g kg ⁻¹)	Wet oxidation method	Walkley and Black (1934)
a)	Avail. Nitrogen (kg ha ⁻¹)	Macrokjeldahl distillates	Subbiah and Asija (1956)
b)	Avail. Phosphorus (kg ha ⁻¹)	Spectrophotometry	Jackson (1973)
c)	Avail. Potassium (kg ha ⁻¹)	Flame photometry	Jackson (1973)
d)	Exchangeable calcium and magnesium (C mol (p ⁺) kg ⁻¹)	Versenate titration method	Jackson (1973)
e)	Available sulphur (mg kg ⁻¹)	Turbidometry	Jackson (1973)
f)	Micro nutrients ((mg kg ⁻¹)	DTPA - AAS	Lindsay and Norwell (1978).

3.4.2 Soil Carbon fractions

3.4.2.1 Microbial biomass C and N

Soil microbial biomass was estimated by following the fumigation and extraction method as proposed by Carter *et al.*, (1999). Ninhydrin-reactive N released during the fumigation of soil was determined by using ninhydrin reagent and was used as a measure of microbial biomass.

Each soil sample was divided into two sets. One set of moist soil sample equivalent to 10g soil on oven dry basis was fumigated with ethanol-free chloroform for 5 days in screw-capped bottles. Then the screw caps were removed and kept over night in an oven at 40 °C to remove the chloroform. Later soils were extracted with 2M KCl by placing these bottles on a reciprocal shaker for 30 min. The suspension was filtered using Whatman No.1 filter paper. In a similar manner unfumigated set of the same soil sample was also extracted. To a known aliquot of soil extract, 4 ml of freshly prepared ninhydrin reagent was added and the mixture was boiled in a water bath for 20 min. The contents were allowed to cool and the volume was made up to 10 ml using a 1:1mixture of methoxy ethanol and distilled water. The intensity of purple colour developed was recorded using Milton Roy spectrophotometer at 570 nm wavelength. A standard curve was developed using five different concentrations of L-Leucine-N (3.5 to 16.8 µg N m L⁻¹) dissolved in 2M KCl. Absorbance values were compared with a standard curve and the microbial biomass C and N were calculated using the formula.

$$\text{MB- C (} \mu\text{g g}^{-1} \text{ soil)} = \frac{(\text{Ninhydrin reactive-N in fumigated soil}) - (\text{Ninhydrin reactive-N in unfumigated soil})}{\text{Weight of soil sample}} \times 24$$

$$\text{MB-N } (\mu\text{g g}^{-1} \text{ soil}) = \frac{(\text{Ninhydrin reactive-N in fumigated soil}) - (\text{Ninhydrin reactive-N in unfumigated soil})}{\text{Weight of soil sample}} \times 2.8$$

3.4.2.2 Light Fraction Carbon (LF-C)

Light fraction carbon was separated from soil samples using densitometry technique (Janzen *et al.*, 1992) by dispersing approximately 10 g of soil in 40 ml NaI solution (Specific gravity = $1.7 \pm 0.02 \text{ kg L}^{-1}$) for 30 seconds using a homogenizer. The suspension was then equilibrated for 48 hours at room temperature. The suspended materials were removed using a vacuum pump and filtered using Whatman No.1 paper. The light fraction was then washed with three successive aliquots of 0.01 M CaCl_2 and three aliquots of distilled water. After keeping it overnight approximately for 17 hours at 70°C , the light fraction was scraped from the filter paper and carbon was estimated by Walkley and Black (1934) wet oxidation method.

3.4.2.3 Water Soluble Carbon (WS-C)

Water-soluble carbon was extracted by dichromate method (Mc Gill *et al.*, 1986) by centrifuging 1:2 ratio of soil and distilled water for 30 minutes at 10,000 rpm. The supernatant liquid was filtered. Five milliliter of this extract was used for estimating organic carbon by Walkley and Black (1934) wet oxidation method.

3.4.2.4 Total Nitrogen

The soil samples were digested using concentrated H_2SO_4 and digestion mixture containing K_2SO_4 , CuSO_4 and selenium (100:20:1 ratio). Nitrogen in the digest was estimated by distillation in an alkaline medium as per standard procedure (Piper, 1966).

3.4.2.5 Total Carbon

For the determination of carbonate (CO₃) carbon (inorganic), the calculation was made using 12% of C values in CaCO₃ using a similar procedure and summation of soil inorganic and organic C was taken as total C.

3.4.3. Total Carbon and Total Nitrogen Stocks

3.4.3.1 Total Carbon Stocks

The quantity of carbon stock in each depth was calculated following the method described by Batjes (1996). It involved multiplying bulk density (Mg m⁻³) of each layer, and thickness of each horizon (m) with the total carbon (g C g⁻¹ soil) in that layer.

Total C stock (Mg ha⁻¹) = Soil Tot C (g g⁻¹) in that horizon x Bulk density (Mg m⁻³) x depth (m). Summation of C in all the horizons was taken as C stock for the individual profile, and expressed on a per hectare basis.

3.4.3.2 Total Nitrogen Stocks

The quantity of N stock in each depth was calculated following the method described by Batjes (1996). It involved multiplying bulk density (Mg m⁻³) of each layer, and thickness of each horizon (m) with the total nitrogen (g C g⁻¹ soil) in that layer.

Tot N stock (Mg ha⁻¹) = Soil Tot N (g g⁻¹) in that horizon x Bulk density (Mg m⁻³) x depth (m). Summation of N in all the horizons was taken as N stock for the individual profile and expressed on a per hectare basis.

3.4.4 Soil biological / biochemical analysis

3.4.4.1 Dehydrogenase activity

The dehydrogenase activity was determined using procedure as given by Casida *et al.* (1964). For this, two grams of air-dried soil (<2mm) was thoroughly mixed with 0.2g of CaCO₃. To each sample tube 1ml of 3% aqueous solution of 2, 3, 5-triphenyl tetrazolium chloride (TTC) and 2.5 ml of distilled water were added. The contents of

each tube were mixed with a glass rod and the tubes were stoppered and incubated at 37°C. After 24 hours, the stopper was removed and 10 ml of methanol was added to the tube and shaken for 1min. The suspension was then filtered through a glass funnel plugged with absorbent cotton, into a 100 ml volumetric flask. The soil in the tube was washed repeatedly till the filtrate coming from the tip of the funnel was colorless. Then, the volume was made up to 100 ml with methanol. The intensity of reddish color was read using spectrophotometer at a wavelength of 485 nm with methanol as the blank. The amount of TPF (2, 3, 5-triphenyl formazan) produced was calculated using a standard graph prepared using different concentrations of TPF standards. For this 10 ml of the TPF standard solution containing $1000 \mu\text{g m L}^{-1}$ was diluted to 100 ml with methanol ($100 \mu\text{g}$ of TPF m L^{-1}). Aliquots of 5, 10, 15, and 20 ml were pipetted into 100 ml volumetric flasks (500, 1000, 1500 and 2000 μg of TPF/100ml). The volume was made to 100 ml with methanol and mixed thoroughly. Then, the intensity of red color of TPF was measured as described earlier.

3.4.4.2 Urease activity

The urease activity was determined by following the method outlined by Eivazi and Tabatabai (1977). Two grams of soil was taken in to a 50 ml Erlenmeyer flask and treated with 0.2 ml of toluene and 9 ml of THAM buffer and flasks were swirled for few seconds to mix the contents. Then, 1ml of 0.2 M urea was added and the flasks were swirled for few seconds and placed in an incubator at 37° C. After 2 h, the stoppers have been removed and approximately 35 ml of KCl-Ag₂SO₄ solution was added. Then, the flasks were swirled again and allowed to stand until the contents have got cooled to the room temperature. The volume was then made up to 50 ml by the addition of KCl-Ag₂SO₄. The NH₄N was determined by steam distillation. Control was performed in the same way, but 1ml of 0.2 M urea was added after the addition of 35 ml of KCl-Ag₂SO₄ solution.

3.4.4.3 Acid and alkaline phosphatase activity

Acid and alkaline phosphatase activities were estimated as per the procedure given by Tabatabai and Bremner (1969). For this, one-gram each of the soil sample

(<2mm) was placed in a wide mouth test tube and 0.2 ml of toluene, 4 ml of modified universal buffer (pH 6.5 for any assay of acid phosphatase or pH 11 for assay of alkaline phosphatase) and 1ml of p-nitro phenyl phosphate solution made in the same buffer were added. Tubes were swirled for a few seconds to mix the contents. Tubes were then stoppered with rubber cork and placed in an incubator at 37⁰ C. After one hour stoppers were removed and 1ml of 0.5 M CaCl₂ and 4 ml of 0.5 M NaOH were added. The suspension was centrifuged at 3000 rpm, filtered and the intensity of yellow color of the supernatant was measured using spectrophotometer at 420 nm wave length. The p-nitro phenol content of the filtrate was obtained by reference to a calibration graph plotted from the results obtained with standards containing 0, 10, 20, 30, 40, and 50 µg of p-nitro phenol. The control was performed with each soil analyzed to allow for colour not derived from p-nitro phenol released by phosphatase activity.

3.5 Statistical analysis of the data

The data were subjected to statistical analysis which was carried out in a factorial randomized block design considering farming systems (F1: Organic farming and F2: Conventional farming), different periods of practicing (Y1: 0-3 years, Y2: 3-6 years and Y3: over 6 years) and depths (D1: 0-15cm and D2: 15-30cm) as the three factors. The sampling was done in both *kharif* 2008 and summer 2009 seasons.

Statistical analysis was investigated with SAS statistical package (SAS Institute, 1989). Fisher's method of analysis of variance was adopted for statistical analysis and interpretation of the data. Level of significance used in 'F' and 't' test was p=0.05.

The results were analyzed by ANOVA, with treatment (Organic Farming and Conventional Farming) as the independent variable. All statistical analyses were performed with the program SPSS 11.0 for Windows (SPSS, 2001). All values are expressed as mean values. Significant statistical differences between treatments were established by the Tukey's test at $P < 0.05$. A correlation matrix was calculated with the values of the different parameters. The significance levels ($P < 0.05$) are based on the Pearson coefficients.



Results

IV. RESULTS

The results on comparative assessment of soil physical, physico-chemical, chemical and biological properties and carbon distribution under organic and conventional farming systems during three different periods of practice (0-3, 3-6 and >6 years) at two depths (0-15 and 15-30cm) and during two seasons (*kharif* 2008 and summer 2009) of three selected agroclimatic zones (Central dry zone, Southern dry zone and Southern transition zone) of Southern Karnataka are presented in this chapter.

4.1 Soil Physical Properties

4.1.1 Bulk Density

The data on changes in bulk density of soils under organic and conventional farming systems was compared over three different periods of practice under three selected agroclimatic zones of Southern Karnataka. The results are presented in tables 7, 8 and 9.

Central Dry zone (CDZ)

The bulk density (Mg m^{-3}) of soil samples collected in this zone (Table 7a.) differed significantly among farming systems and in three different periods of practice at two depths (0-15 and 15-30cm) during *kharif* 2008 and summer 2009.

The bulk density of surface soils of organic farming system, varied from 1.14 (3-6yrs) to 1.22 Mg m^{-3} (0-3yrs) during *kharif* 2008 and from 1.13 (3-6yrs) to 1.21 Mg m^{-3} (0-3yrs) during summer 2009, whereas in the conventional farming, it varied from 1.19 (3-6yrs) to 1.27 Mg m^{-3} (> 6yrs) during *kharif* 2008 and 1.23 (0-3yrs) to 1.31 Mg m^{-3} (> 6 yrs) during summer 2009.

Table 7 (a). Bulk Density (Mg m⁻³) of soils as influenced by Organic and conventional farming systems in Central Dry Zone of Karnataka

z	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	1.22	1.21	1.14	1.12	1.14	1.23	1.13	1.21	1.16	1.31	1.15	1.22
F2:CON	1.20	1.32	1.23	1.31	1.19	1.28	1.26	1.32	1.27	1.30	1.31	1.40
				Kharif '2008				Summer ' 2009				
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.01	0.02	0.01	0.01	0.01	0.01			
CD @ 5%				0.03	0.06	0.05	0.03	0.04	0.03			

Table 7(b). Interactions showing bulk density (Mg m⁻³) of soils in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	1.11	1.13	P1 x D1	1.14	1.18	F1 x D1	1.13	1.14
F1 x P2	1.18	1.17	P1 x D2	1.22	1.21	F1 x D2	1.22	1.27
F1 x P3	1.24	1.18	P2 x D1	1.16	1.20	F2 x D1	1.22	1.18
F2 x P1	1.26	1.27	P2 x D2	1.25	1.26	F2 x D2	1.30	1.34
F2 x P2	1.24	1.29	P3 x D1	1.22	1.23			
F2 x P3	1.28	1.36	P3 x D2	1.30	1.31			
F-test	NS	NS		NS	NS		NS	NS
Sem±	0.03	0.02		0.02	0.01		0.03	0.02
CD @ 5%	-	-		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
#: Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
*: Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 8(a). Bulk Density (Mg m^{-3}) of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	1.20	1.30	1.21	1.25	1.14	1.25	1.14	1.22	1.15	1.22	1.15	1.18
F2:CON	1.24	1.34	1.25	1.35	1.25	1.33	1.29	1.35	1.29	1.36	1.32	1.36
				<i>Kharif '2008</i>		<i>Summer ' 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem $\pm$				0.01	0.01	0.01	0.01	0.01	0.01			
CD @ 5%				0.03	0.03	0.03	0.02	0.02	0.02			

Table 8(b). Interactions showing bulk density (Mg m^{-3}) of soils in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	1.24	1.23	P1 x D1	1.21	1.23	F1 x D1	1.17	1.17
F1 x P2	1.22	1.18	P1 x D2	1.32	1.30	F1 x D2	1.25	1.28
F1 x P3	1.20	1.19	P2 x D1	1.20	1.21	F2 x D1	1.26	1.21
F2 x P1	1.28	1.30	P2 x D2	1.29	1.28	F2 x D2	1.35	1.35
F2 x P2	1.29	1.32	P3 x D1	1.22	1.24			
F2 x P3	1.33	1.34	P3 x D2	1.29	1.27			
F-test	NS	NS		NS	NS		NS	NS
Sem $\pm$	0.01	0.01		0.01	0.01		0.01	0.01
CD @ 5%	-	-		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant ($p=0.05$)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 9(a). Bulk Density (Mg m⁻³) of soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	1.16	1.27	1.17	1.24	1.16	1.26	1.11	1.22	1.20	1.26	1.15	1.24
F2:CON	1.23	1.33	1.25	1.34	1.19	1.27	1.26	1.31	1.29	1.38	1.34	1.40
				<i>Kharif '2008</i>		<i>Summer ' 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.01	0.01	0.01	0.01	0.01	0.01			
CD @ 5%				0.03	0.04	0.03	0.03	0.04	0.03			

Table. 9 (b). Interactions showing bulk density (Mg m⁻³) of soils in organic and conventional farming systems in Southern Transition Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	1.21	1.21	P1 x D1	1.19	1.21	F1 x D1	1.17	1.14
F1 x P2	1.21	1.16	P1 x D2	1.30	1.29	F1 x D2	1.24	1.28
F1 x P3	1.23	1.19	P2 x D1	1.18	1.18	F2 x D1	1.26	1.23
F2 x P1	1.28	1.29	P2 x D2	1.27	1.26	F2 x D2	1.33	1.35
F2 x P2	1.23	1.28	P3 x D1	1.25	1.24			
F2 x P3	1.33	1.37	P3 x D2	1.32	1.32			
F-test	NS	NS		NS	NS		NS	NS
Sem±	0.02	0.02		0.01	0.01		0.02	0.02
CD @ 5%	-	-		-	-		-	

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

The differences in bulk density was non significant irrespective of farming systems, periods of practice and depth of sampling interactions (Table 7b) during both *kharif* 2008 and summer 2009 seasons .

Southern Dry zone

The bulk density of soils differed significantly due to organic and conventional farming systems at both the depths during both the seasons (Table 8a).

The bulk density of surface soils in organic farming system ranged from 1.14 (3-6yrs) to 1.20 (0-3yrs) during *kharif* 2008 and 1.15 (> 6 yrs) to 1.21 Mg m⁻³ (0-3yrs) during summer 2009, whereas in soils under conventional farming it ranged from 1.24 (0-3yrs) to 1.29 Mg m⁻³ (> 6yrs) during *kharif* 2008 and 1.25 (0-3yrs) to 1.32 Mg m⁻³ (> 6yrs) during summer 2009. The bulk density of subsurface soil layer (15-30cm) was higher compared to surface soil (0-15cm) in both the seasons of organic as well as conventional farming.

Soil bulk density did not show any significant variations among interactions of farming systems, periods and depth of sampling during *kharif* 2008 and summer 2009 seasons (Table 8b).

Southern Transition zone

In Southern Transition zone of Karnataka, the bulk density (Table 9a) of soils collected from organic and conventional farming systems differed significantly with farming systems during different periods (0-3, 3-6 and >6 years) of practice, at two depths (0-15 and 15-30cm) during *kharif* 2008 and summer 2009.

The bulk density of surface soils under organic farming system ranged from 1.16 (0-3 and 3-6yrs) to 1.20 Mg m⁻³ (>6yrs) during *kharif* 2008 and 1.11 (3-6yrs) to 1.17 Mg m⁻³ (0-3yrs) during summer 2009, whereas in conventional farming it ranged from 1.19

(3-6yrs) to 1.29 Mg m⁻³ (> 6yrs) during *kharif* 2008 and 1.25 (0-3yrs) to 1.34 Mg m⁻³ (>6yrs) during summer 2009. There was an increasing trend observed in soil bulk density from 0-15cm to 15-30cm depth in both the farming systems during all the periods and in both the seasons.

However, the difference in soil bulk density was non significant for interactions (Table 9 b) among farming systems, periods of practice and depth of sampling in two season's viz., *kharif* 2008 and summer 2009.

4.1.2 Particle Density

The particle density of soils collected from organic and conventional farming systems were compared over three different periods of practice in three selected agroclimatic zones of Southern Karnataka are presented in tables 10, 11 and 12.

Central Dry zone

The differences between particle density of soils from Central Dry zone of southern Karnataka (Table 10a.) has shown insignificant variations among farming systems in three different periods of practice, at two depths (0-15 and 15-30cm) during *kharif* 2008 and summer 2009.

The particle density of surface soils of organic farming system ranged from 2.34 (3-6yrs) to 2.36 Mg m⁻³ (>6yrs) and 2.33 (3-6 and >6yrs) to 2.40 Mg m⁻³ (0-3yrs) during *kharif* 2008 and summer 2009, respectively, whereas in conventional farming it ranged from 2.44 (0-3 and >6yrs) to 2.47 Mg m⁻³ (> 6yrs) and 2.33 (> 6yrs) to 2.42 Mg m⁻³ (3-6 yrs) during *kharif* 2008 and summer 2009, respectively.

The interactions between the farming systems, periods and depth (Table 10b), the interactions were non significant during both the seasons.

Table 10 (a).Particle Density (Mg m⁻³)of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	2.35	2.42	2.40	2.39	2.34	2.39	2.33	2.39	2.36	2.45	2.33	2.41
F2:CON	2.44	2.48	2.41	2.42	2.47	2.43	2.42	2.42	2.44	2.42	2.33	2.37
				Kharif '2008		Summer ' 2009						
				F	P	D	F	P	D			
F-test				NS	NS	NS	NS	NS	NS			
Sem±				0.02	0.03	0.02	0.02	0.02	0.02			
CD @ 5%				-	-	-	-	-	-			

Table 10(b). Interactions showing particle density (Mg m⁻³) of soil in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	2.39	2.40	P1 x D1	2.40	2.41	F1 x D1	2.35	2.35
F1 x P2	2.37	2.36	P1 x D2	2.45	2.41	F1 x D2	2.45	2.39
F1 x P3	2.41	2.37	P2 x D1	2.40	2.38	F2 x D1	2.42	2.40
F2 x P1	2.46	2.41	P2 x D2	2.41	2.41	F2 x D2	2.44	2.40
F2 x P2	2.45	2.42	P3 x D1	2.40	2.33			
F2 x P3	2.43	2.35	P3 x D2	2.43	2.39			
F-test	NS	NS		NS	NS		NS	NS
Sem±	0.04	0.03		0.03	0.04		0.04	0.03
CD @ 5%	-	-		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
#:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
*: Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 11 (a). Particle Density (Mg m⁻³) of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	2.42	2.43	2.40	2.35	2.35	2.47	2.32	2.43	2.33	2.42	2.35	2.37
F2:CON	2.45	2.49	2.40	2.43	2.54	2.43	2.42	2.45	2.34	2.41	2.40	2.39
				<i>Kharif '2008</i>			<i>Summer ' 2009</i>					
				F	P	D	F	P	D			
F-test				NS	*	NS	NS	NS	NS			
Sem±				0.01	0.02	0.01	0.01	0.02	0.01			
CD @ 5%				-	0.06	-	-	-	-			

Table 11 (b). Interactions showing particle density (Mg m⁻³) of soil in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	2.42	2.37	P1 x D1	2.43	2.40	F1 x D1	2.37	2.35
F1 x P2	2.41	2.37	P1 x D2	2.46	2.39	F1 x D2	2.44	2.41
F1 x P3	2.38	2.36	P2 x D1	2.44	2.37	F2 x D1	2.44	2.38
F2 x P1	2.47	2.41	P2 x D2	2.45	2.44	F2 x D2	2.44	2.42
F2 x P2	2.29	2.43	P3 x D1	2.33	2.37			
F2 x P3	2.37	2.40	P3 x D2	2.41	2.38			
F-test	NS	NS		NS	NS		NS	NS
Sem±	0.03	0.03		0.02	0.02		0.03	0.03
CD @ 5%	-	-		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 12(a). Particle Density (Mg m^{-3}) of soils as influenced by Organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	2.39	2.43	2.41	2.36	2.35	2.47	2.26	2.43	2.39	2.47	2.32	2.47
F2:CON	2.40	2.33	2.38	2.32	2.45	2.44	2.42	2.44	2.38	2.43	2.37	2.38
				<i>Kharif '2008</i>		<i>Summer ' 2009</i>						
				F	P	D	F	P	D			
F-test				NS	NS	NS	NS	NS	NS			
Sem±				0.01	0.01	0.01	0.01	0.01	0.01			
CD @ 5%				-	-	-	-	-	-			

Table 12 (b). Particle Density (Mg m^{-3})of soil in organic and conventional farming systems in Southern Transition Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	2.41	2.39	P1 x D1	2.39	2.39	F1 x D1	2.38	2.33
F1 x P2	2.41	2.34	P1 x D2	2.38	2.34	F1 x D2	2.41	2.39
F1 x P3	2.43	2.39	P2 x D1	2.40	2.34	F2 x D1	2.45	2.42
F2 x P1	2.37	2.35	P2 x D2	2.46	2.43	F2 x D2	2.40	2.38
F2 x P2	2.44	2.43	P3 x D1	2.38	2.34			
F2 x P3	2.41	2.38	P3 x D2	2.45	2.43			
F-test	NS	NS		NS	NS		NS	NS
Sem±	0.02	0.02		0.02	0.02		0.02	0.02
CD @ 5%	-	-		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant ($p=0.05$)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Southern Dry zone

The particle density of soils of Southern Dry zone of Karnataka (Table 11a) did not differ significantly in both farming systems at two depths (0-15 and 15-30cm) during *kharif* 2008 and summer 2009. However, particle density varied significantly with different periods of organic or conventional farming practices during *kharif* 2008.

The particle density of surface soils for organic farming system ranged from 2.33 (> 6yrs) to 2.42 (0-3yrs) and 2.32 (3- 6 yrs) to 2.40 Mg m⁻³ (0-3yrs) during *kharif* 2008 and summer 2009 respectively, whereas in conventional farming it ranged from 2.34 (> 6yrs) to 2.54 Mg m⁻³ (3- 6yrs) and 2.40 (0-3 and > 6yrs) to 2.42 Mg m⁻³ (3- 6yrs) during *kharif* 2008 and summer 2009 respectively.

However, soil particle density (Table 11b) has shown non significant interactions between farming systems, depths and periods in both the seasons.

Southern Transition zone

The particle density of soils under Southern Transition zone of Karnataka (Table 12a) was not significantly different in farming systems in the three different periods (0-3, 3-6 and >6 years) of practice, at two depths (0-15 and 15-30cm) during *kharif* 2008 and summer 2009.

Particle density of surface soils ranged from 2.35 (3-6yrs) to 2.39 Mg m⁻³ (0-3 and > 6yrs) during *kharif* 2008 and 2.26 (3-6yrs) to 2.41 Mg m⁻³ (0-3yrs) during summer 2009 in organic farming system, whereas in conventional farming it ranged from 2.38 (> 6yrs) to 2.45 Mg m⁻³ (3- 6yrs) during *kharif* 2008 and 2.37 (> 6yrs) to 2.42 Mg m⁻³ (3-6yrs) during summer 2009.

The interactions between farming systems, periods and depth of sampling (Table 12b), were found non significant during *kharif* 2008 and summer 2009.

4.1.3 Maximum Water Holding Capacity (WHC)

The maximum water holding capacity of soils under organic and conventional farming systems was compared over three different periods of practice in three selected agroclimatic zones of Southern Karnataka. The results are presented in tables 13, 14 and 15.

Central Dry zone

The maximum water holding capacity of soils collected from organic and conventional farming systems under Central Dry zone of Karnataka differed significantly with farming systems in periods 3-6 and > 6 years of practice, in two depths (0-15 and 15-30cm) during *kharif* 2008 and summer 2009 (Table 13a.).

The maximum water holding capacity of surface soils of organic farming system ranged from 39.94 (0-3yrs) to 48.65% (> 6yrs) during *kharif* 2008 and from 39.55 (0-3yrs) to 47.59% (> 6yrs) during summer 2009, whereas in conventional farming it ranged from 39.31 (0-3yrs) to 42.22 % (>6yrs) during *kharif* 2008 and from 36.44 (3-6yrs) to 38.97% (0-3yrs) during summer 2009. There was an increasing trend observed in WHC from 0-3 years to > 6 years of practice of organic farming, whereas it was not with conventional farming in both the depths and in both the seasons.

Insignificant differences were found for interactions between farming systems & depth and periods & depth of sampling (Table 13b) with regard to MWHC during both the seasons. However, farming systems and different periods of practice interaction recorded significant variation in WHC during summer, 2009.

Table 13 (a). Max. water holding capacity (%) of soil as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	39.94	34.67	39.55	35.81	44.14	38.12	43.88	39.70	48.65	47.29	47.59	46.03
F2:CON	39.31	33.95	36.97	36.14	40.08	33.97	36.44	30.39	42.22	36.98	36.71	33.66
				<i>Kharif '2008</i>			<i>Summer ' 2009</i>					
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.97	1.19	0.97	0.89	1.09	0.89			
CD @ 5%				2.81	3.44	2.81	2.57	3.15	2.57			

Table 13(b) Interactions showing max. water holding capacity (%) of soil in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	37.31	37.68	P1 x D1	39.62	39.26	F1 x D1	44.24	43.67
F1 x P2	41.13	41.79	P1 x D2	34.31	33.47	F1 x D2	40.53	37.38
F1 x P3	47.17	46.81	P2 x D1	42.11	40.16	F2 x D1	40.03	40.51
F2 x P1	36.63	35.05	P2 x D2	36.04	35.04	F2 x D2	34.97	31.73
F2 x P2	37.02	33.42	P3 x D1	45.43	42.15			
F2 x P3	39.60	35.18	P3 x D2	42.13	39.85			
F-test	NS	*		NS	NS		NS	NS
Sem±	1.69	1.55		1.38	1.26		1.69	1.55
CD @ 5%	-	4.46		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 14 (a). Max.water holding capacity (%) of soil as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	41.23	36.19	40.83	36.67	38.23	34.64	44.21	37.23	43.89	40.26	44.87	40.01
F2:CON	37.04	32.82	36.54	32.55	31.50	27.69	29.01	25.05	39.05	36.04	36.99	31.27
				<i>Kharif '2008</i>		<i>Summer ' 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				1.15	1.40	1.15	1.05	1.29	1.05			
CD @ 5%				3.31	4.05	3.31	3.03	3.84	3.03			

Table 14(b). Interactions showing max.water holding capacity (%) of soil in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	38.71	38.75	P1 x D1	40.64	38.68	F1 x D1	41.12	41.63
F1 x P2	36.44	38.72	P1 x D2	36.01	34.61	F1 x D2	33.43	30.85
F1 x P3	44.08	43.44	P2 x D1	34.86	34.61	F2 x D1	38.36	38.97
F2 x P1	37.93	34.55	P2 x D2	31.16	31.14	F2 x D2	29.85	27.63
F2 x P2	29.59	27.03	P3 x D1	36.47	35.43			
F2 x P3	27.54	26.13	P3 x D2	35.15	34.15			
F-test	*	*		NS	NS		NS	NS
Sem±	1.99	1.82		1.62	1.49		1.99	1.82
CD @ 5%	5.73	5.26		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 15 (a). Max.water holding capacity (%) of soil as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	34.93	32.23	35.37	33.32	37.76	32.37	39.39	34.35	42.79	35.49	45.34	38.52
F2:CON	28.55	25.54	27.81	24.64	24.83	25.93	26.12	24.28	36.24	32.27	37.21	33.12
				<i>Kharif '2008</i>		<i>Summer ' 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				1.12	1.38	1.12	0.98	1.20	0.98			
CD @ 5%				3.24	3.97	3.24	2.82	3.45	2.82			

Table 15(b). Interactions showing max. water holding capacity (%) of soil of soils under organic and conventional farming systems in Southern Transition Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	33.58	34.35	P1 x D1	31.74	31.59	F1 x D1	38.49	40.03
F1 x P2	35.06	36.87	P1 x D2	28.88	28.98/	F1 x D2	28.99	27.05
F1 x P3	39.14	41.93	P2 x D1	32.79	32.76	F2 x D1	33.36	35.39
F2 x P1	27.04	26.23	P2 x D2	29.15	29.32	F2 x D2	25.91	24.47
F2 x P2	26.88	25.20	P3 x D1	36.70	36.28			
F2 x P3	28.44	25.85	P3 x D2	30.88	31.50			
F-test	NS	NS		NS	NS		NS	NS
Sem±	1.95	1.69		1.59	1.38		1.95	1.69
CD @ 5%	-	-		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Southern Dry zone

The maximum water holding capacity of soils of Southern Dry zone of Karnataka (Table 14a) differed significantly with farming systems in three different periods (0-3, 3-6 and > 6 periods) of practice, at two depths and in both the seasons.

During *kharif* 2008, the maximum water holding capacity of surface soils of organic farming system ranged from 38.23 (3-6yrs) to 43.89% (>6yrs) and during summer 2009, it was from 40.83 (0-3yrs) to 43.89% (>6yrs), whereas in conventional farming it ranged from 29.05 (> 6yrs) to 37.04 % (0-3yrs) during *kharif* 2008 and 26.99 (> 6yrs) to 36.54% (0-3yrs) during summer 2009.

The soil maximum water holding capacity showed significant difference in farming systems and periods of organic or conventional farming practice interactions (Table 14b). However, interactions between farming systems and depth and periods and depth were found non significant during both the seasons.

Southern Transition zone

The maximum water holding capacity of soils collected from organic and conventional farming systems in Southern Transition zone of Karnataka (Table 15a) differed significantly among farming systems during three different periods of practice at both the depths during *kharif* 2008 and summer 2009.

The maximum WHC of surface soils ranged from 34.93 (0-3yrs) to 42.79% (over 6yrs) during *kharif* 2008 and 35.37 (0-3yrs) to 45.34% (over 6 yrs) during summer 2009 in organic farming system, whereas in conventional farming it ranged from 24.83 (3-6yrs) to 36.24% (over 6yrs) and 26.12 (3-6yrs) to 37.21% (over 6yrs) during *kharif* 2008 and summer 2009, respectively. An increasing trend was observed in WHC from 0-3 years to >6 years of organic farming practice, whereas it was not the case with conventional farming.

However, there were no significant differences found in interactions between farming systems & periods, periods & depth, and farming systems & depth of sampling (Table 15b) during *kharif* 2008 and summer 2009.

4.1.4 Pore space (%)

The percent pore space of soils under organic and conventional farming systems was compared over three different periods of practice under three selected agroclimatic zones of Southern Karnataka. The results are presented in tables 16, 17 and 18.

Central Dry zone

The percent pore space of soils of Central Dry zone of Southern Karnataka (Table 16a.) differed significantly with farming systems in the three different periods (0-3, 3-6 and > 6yrs) of practice, at two depths (0-15 and 15-30cm) during *kharif* 2008 and summer 2009.

The percent pore space of surface soils of organic farming system ranged from 50.99 (> 6yrs) to 53.81% (0-3yrs) during *kharif* 2008 and ranged from 50.87 (> 6yrs) to 52.61% (0-3yrs) during summer 2009, whereas in conventional farming it ranged from 47.48 (> 6yrs) to 51.30 % (3- 6yrs) during *kharif* 2008 and from 43.52 (> 6yrs) to 49.33% (3- 6 yrs) during summer 2009.

Significant differences were observed in interaction between farming systems and periods of organic or conventional practice. However, farming systems and depth, and periods and depth of sampling interactions (Table 16b), pore space showed no variations during both *kharif* 2008 and summer 2009 seasons.

Table 16 (a). Pore space (%) of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	43.81	43.64	42.61	43.07	51.57	48.61	51.24	47.48	50.99	46.49	50.87	49.56
F2:CON	40.73	36.71	38.86	45.66	51.30	47.15	45.33	42.48	47.48	43.37	38.37	40.77
				<i>Kharif '2008</i>		<i>Summer ' 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.67	0.82	0.67	0.62	0.75	0.62			
CD @ 5%				1.94	2.37	1.94	1.78	2.18	1.78			

Table 16 (b). Interactions showing pore space (%) of soil in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	53.72	52.84	P1 x D1	52.27	50.73	F1 x D1	52.03	51.57
F1 x P2	50.03	49.36	P1 x D2	50.18	49.36	F1 x D2	49.92	47.24
F1 x P3	48.74	50.21	P2 x D1	51.43	50.28	F2 x D1	49.58	50.04
F2 x P1	48.84	47.26	P2 x D2	47.88	46.48	F2 x D2	45.74	43.97
F2 x P2	49.36	47.40	P3 x D1	49.24	47.19			
F2 x P3	45.42	42.15	P3 x D2	44.93	45.16			
F-test	*	*		NS	NS		NS	NS
Sem±	1.16	1.07		0.95	0.87		1.16	1.07
CD @ 5%	3.36	3.01		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 17 (a). Pore space (%) of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	50.15	46.34	49.23	46.93	51.99	49.08	50.86	49.88	48.42	49.34	47.86	50.28
F2:CON	42.78	40.24	47.90	44.34	49.26	44.97	46.80	44.61	45.74	43.07	44.95	42.93
				<i>Kharif '2008</i>		<i>Summer ' 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.50	0.61	0.50	0.41	0.50	0.41			
CD @ 5%				1.44	1.78	1.44	1.18	1.17	1.18			

Table 17 (b). Interactions showing pore space (%) of soil in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	48.32	48.08	P1 x D1	50.19	48.57	F1 x D1	50.57	50.31
F1 x P2	50.03	50.37	P1 x D2	46.11	45.63	F1 x D2	48.89	46.55
F1 x P3	49.88	50.57	P2 x D1	50.87	48.83	F2 x D1	48.25	49.03
F2 x P1	47.98	46.12	P2 x D2	47.03	47.25	F2 x D2	44.64	43.96
F2 x P2	47.87	45.70	P3 x D1	48.08	47.90			
F2 x P3	44.41	43.94	P3 x D2	46.21	46.60			
F-test	*	*		NS	NS		NS	NS
Sem±	0.87	0.71		0.07	0.58		0.87	0.71
CD @ 5%	2.50	2.04		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 18 (a). Pore space (%) of soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	51.38	47.40	51.28	47.29	50.51	48.03	50.80	49.85	49.67	49.01	50.41	49.75
F2:CON	48.67	42.78	47.37	42.27	51.53	47.62	47.94	46.18	45.78	43.31	43.54	41.23
				<i>Kharif '2008</i>		<i>Summer ' 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.55	0.68	0.55	0.47	0.58	0.47			
CD @ 5%				1.60	1.96	1.60	1.37	1.68	1.37			

Table 18 (b). Interactions showing pore space (%) of soils in organic and conventional farming systems in Southern Transition Zone

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	49.39	49.28	P1 x D1	50.03	49.32	F1 x D1	50.52	50.83
F1 x P2	49.27	50.32	P1 x D2	45.09	44.78	F1 x D2	48.64	46.29
F1 x P3	49.34	50.08	P2 x D1	51.02	49.39	F2 x D1	48.14	48.96
F2 x P1	45.72	44.82	P2 x D2	47.83	48.01	F2 x D2	44.57	43.23
F2 x P2	49.58	47.07	P3 x D1	47.69	46.97			
F2 x P3	44.51	42.39	P3 x D2	46.16	45.49			
F-test	*	*		NS	NS		NS	NS
Sem±	0.96	0.82		0.78	0.67		0.96	0.82
CD @ 5%	2.78	2.38		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Southern Dry zone

The percent pore space of soils collected from organic and conventional farming systems under Southern Dry zone of Karnataka (Table 17a) differed significantly among farming systems during different periods of organic or conventional farming practices during *kharif* 2008 and summer 2009.

The percent pore space of surface soils from organic farming system ranged from 48.42 (>6yrs) to 51.99 (3-6yrs) during *kharif* 2008 and ranged from 47.86 (>6yrs) to 50.86% (3-6) during summer 2009, whereas in conventional farming it ranged from 45.74 (> 6yrs) to 49.78 % (0-3yrs) during *kharif* 2008 and 44.95 (> 6yrs) to 47.90% (0-3yrs) during summer 2009.

The percent pore space differed significantly in farming systems and periods of organic or conventional practice interactions (Table 17b); however, for farming systems and depth and, periods and depth interactions soil pore space (%) showed non significant difference during *kharif* 2008 and summer 2009.

Southern Transition zone

The percent pore space of soils collected from organic and conventional farming systems under Southern Transition zone of Karnataka (Table 18a) was found to differ significantly with farming systems in all the three different periods of practice, in two depths during *kharif* 2008 and summer 2009.

The percent pore space of surface soils of organic farming system ranged from 49.67 (> 6yrs) to 51.38% (0-3yrs) during *kharif* 2008 and 50.41 (> 6yrs) to 51.28% (0-3yrs) during summer 2009, whereas in conventional farming it ranged from 45.78 (> 6yrs) to 51.33% (3- 6yrs) during *kharif* 2008 and from 43.54 (> 6yrs) to 47.94% (3-6yrs) during summer 2009.

The percent pore space differed significantly in farming systems and periods interactions (Table 18b). However, differences were found non significant for farming systems with depth and periods with depth interactions during *kharif* 2008 and summer 2009.

4.2 Soil physico-chemical Properties

4.2.1 Soil reaction

The pH (soil reaction) of soils under organic and conventional farming systems was compared over three different periods of practice under three selected agroclimatic zones of Southern Karnataka. The results are presented in tables 19, 20 and 21.

Central Dry zone (CDZ)

The pH of soils under Central Dry zone of Karnataka (Table 19a) did not differ significantly in both organic farming and conventional farming systems. However, the soil reaction recorded significant change over the periods of practice (0-3, 3-6 and >6 years) during *kharif* 2008 and summer 2009.

The pH of the surface soils sampled from organic farming systems ranged from 7.63 (0-3yrs) to 8.24 (3-6yrs) during *kharif* 2008 and 7.62 (0-3yrs) to 7.81 (3-6yrs) during summer 2009, whereas in conventional farming it ranged from 7.89 (0-3yrs) to 8.23 (3-6yrs) during *kharif* 2008 and ranged between 7.89 (0-3yrs) to 8.32 (3-6 yrs) during summer 2009.

The interaction studies (Table 19b) has shown that there was no significant variation in soil pH irrespective of the farming systems, periods of practice or depths during both the seasons.

Table 19 (a).Soil pH (1:2.5) of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	7.63	7.55	7.62	7.54	8.24	8.45	7.81	8.43	7.76	7.88	7.71	7.84
F2:CON	7.89	7.50	7.89	7.48	8.23	8.28	8.32	8.34	8.06	8.14	8.12	8.11
				<i>Kharif '2008</i>		<i>Summer ' 2009</i>						
				F	P	D	F	P	D			
F-test				NS	*	NS	NS	*	NS			
Sem±				0.11	0.12	0.11	0.11	0.12	0.10			
CD @ 5%				-	0.36	-	-	0.36	-			

Table 19(b) Interactions showing soil pH (1:2.5) of soils in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	7.59	7.58	P1 x D1	7.76	7.75	F1 x D1	7.88	7.71
F1 x P2	8.34	8.12	P1 x D2	7.52	7.51	F1 x D2	8.06	8.11
F1 x P3	7.82	7.77	P2 x D1	8.23	8.07	F2 x D1	7.96	7.94
F2 x P1	7.69	7.68	P2 x D2	8.36	8.38	F2 x D2	7.97	7.98
F2 x P2	8.25	8.33	P3 x D1	7.91	7.91			
F2 x P3	8.10	8.11	P3 x D2	8.01	7.98			
F-test	NS	NS		NS	NS		NS	NS
Sem±	0.17	0.18		0.14	0.14		0.17	0.18
CD @ 5%	-	-		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 20 (a). Soil pH (1:2.5) of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	7.72	7.77	7.67	7.72	7.55	7.69	7.57	7.70	8.14	7.92	8.04	7.91
F2:CON	8.21	7.61	8.27	7.76	7.28	7.10	7.27	7.76	8.42	8.47	8.57	8.54
				<i>Kharif '2008</i>		<i>Summer ' 2009</i>						
				F	P	D	F	P	D			
F-test				NS	*	NS	NS	*	NS			
Sem±				0.11	0.14	0.11	0.12	0.15	0.12			
CD @ 5%				-	0.41	-	-	0.43	-			

Table 20 (b). Interactions showing soil pH (1:2.5) of soils in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	7.75	7.70	P1 x D1	7.97	7.97	F1 x D1	7.80	7.76
F1 x P2	7.62	7.63	P1 x D2	7.69	7.74	F1 x D2	7.97	8.03
F1 x P3	8.03	7.97	P2 x D1	7.42	7.42	F2 x D1	7.79	7.78
F2 x P1	7.91	8.01	P2 x D2	7.40	7.43	F2 x D2	7.73	7.82
F2 x P2	7.19	7.22	P3 x D1	8.28	8.30			
F2 x P3	8.45	8.55	P3 x D2	8.20	8.22			
F-test	NS	NS		NS	NS		NS	NS
Sem±	0.21	0.21		0.16	0.17		0.21	0.17
CD @ 5%	-	-		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 21 (a).Soil pH (1:2.5) of soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	7.48	7.79	7.50	7.77	7.09	6.74	7.05	6.76	7.25	7.46	7.12	7.45
F2:CON	6.92	6.36	6.80	6.33	6.04	5.85	5.86	5.76	7.03	6.87	6.75	6.71
				Kharif '2008			Summer ' 2009					
				F	P	D	F	P	D			
F-test				*	*	NS	*	*	NS			
Sem±				0.13	0.16	0.13	0.14	0.17	0.14			
CD @ 5%				0.38	0.47	-	0.42	0.51	-			

Table 21 (b). Interactions showing soil pH (1:2.5) of soils in organic and conventional farming systems in Southern Transition Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	7.63	7.63	P1 x D1	7.20	7.15	F1 x D1	7.27	7.22
F1 x P2	6.91	6.90	P1 x D2	7.07	7.05	F1 x D2	6.67	6.47
F1 x P3	7.35	7.21	P2 x D1	6.56	6.46	F2 x D1	7.33	7.32
F2 x P1	6.64	6.56	P2 x D2	6.29	6.26	F2 x D2	6.36	6.26
F2 x P2	5.95	5.81	P3 x D1	7.14	6.94			
F2 x P3	6.95	6.73	P3 x D2	7.16	7.08			
F-test	NS	NS		NS	NS		NS	NS
Sem±	0.23	0.25		0.18	0.20		0.23	0.25
CD @ 5%	-	-		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Southern Dry zone (SDZ)

The pH of soils collected from organic and conventional farming systems of Southern Dry zone of Karnataka (Table 20a) did not show any significant difference. However, there was a significant difference in pH of the soils due to the periods of organic or conventional farming practice during both the seasons.

The pH of surface soils in organic farming system ranged from 7.55 (3-6yrs) to 8.14 (> 6yrs) during *kharif* 2008 and from 7.57 (3-6 yrs) to 8.04 (> 6yrs) during summer 2009, whereas in conventional farming it ranged from 7.28 (3- 6yrs) to 8.42 (> 6yrs) during *kharif* 2008 and 7.27 (3- 6yrs) to 8.57 (> 6yrs) during summer 2009.

Soil pH did not show any variation in interaction studies (Table 20b), irrespective of the farming systems, periods of practice or depths during *kharif* 2008 and summer 2009.

Southern Transition zone (STZ)

The pH of soils collected from organic and conventional farming systems of Southern Transition zone of Karnataka (Table 21a) showed significant difference among farming systems during three different periods of practice. However, the soil reaction did not differ significantly among two depths and two seasons.

The pH of surface soils sourced from organic farming system ranged from 7.09 (3-6yrs) to 7.48 (0-3yrs) during *kharif* 2008 and from 7.05 (3-6yrs) to 7.50 (0-3yrs) during summer 2009, whereas in soils of conventional farming system it ranged from 6.04 (3-6yrs) to 7.03 (> 6yrs) during *kharif* 2008 and ranged from 5.86 (3-6yrs) to 6.80 (0-3yrs) during summer 2009.

However, the interaction studies (Table 21b), showed that there were no significant variations in soil pH irrespective of the farming systems, periods of practice or depths of sampling during *kharif* 2008 and summer 2009.

4.2.2 Electrical Conductivity (EC)

The electrical conductivity, an indicator of soluble salt content of soil, under organic and conventional farming systems was compared over three different periods of practice under three selected agroclimatic zones of Southern Karnataka. The results are presented in tables 22, 23 and 24.

Central Dry zone (CDZ)

The EC of soil samples collected from organic and conventional farming systems under Central Dry zone of Karnataka (Table 22a.) showed no significant difference among farming systems, at two depths, and during different periods of practice during *kharif* 2008 and summer 2009.

The EC of surface soils under organic farming system ranged from 0.29 (3-6yrs) to 0.37 dSm⁻¹ (> 6yrs) during *kharif* 2008 and ranged from 0.34 (0-3 and >6yrs) to 0.39 dSm⁻¹ (3-6yrs) during summer 2009, whereas in soils of conventional farming system it ranged from 0.19 (3-6yrs) to 0.38 dSm⁻¹ (0-3yrs) during *kharif* 2008 and ranged from 0.20(3-6 yrs) to 0.39 dSm⁻¹ (0-3yrs) during summer 2009.

The electrical conductivity of soils showed no variations (Table 22b) among the farming systems, periods of practice and depths of soil sampling as revealed by interaction studies for *kharif* 2008. However, during summer 2009, the EC showed significant difference among farming systems and periods of practice of organic and conventional systems.

Table 22 (a).Soil EC (dSm⁻¹) of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	0.33	0.29	0.34	0.28	0.29	0.29	0.39	0.38	0.37	0.32	0.34	0.32
F2:CON	0.38	0.36	0.39	0.36	0.19	0.22	0.20	0.25	0.20	0.20	0.24	0.21
				<i>Kharif '2008</i>			<i>Summer ' 2009</i>					
				F	P	D	F	P	D			
F-test				NS	NS	NS	NS	NS	NS			
Sem±				0.02	0.03	0.02	0.02	0.03	0.02			
CD @ 5%				-	-	-	-	-	-			

Table 22(b). Interactions showing soil EC (dSm⁻¹) of soils in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	0.31	0.31	P1 x D1	0.36	0.37	F1 x D1	0.33	0.36
F1 x P2	0.29	0.30	P1 x D2	0.33	0.32	F1 x D2	0.26	0.28
F1 x P3	0.34	0.33	P2 x D1	0.24	0.30	F2 x D1	0.30	0.33
F2 x P1	0.37	0.37	P2 x D2	0.25	0.32	F2 x D2	0.26	0.27
F2 x P2	0.21	0.22	P3 x D1	0.28	0.29			
F2 x P3	0.21	0.22	P3 x D2	0.26	0.26			
F-test	NS	NS		NS	NS		NS	NS
Sem±	0.04	0.04		0.03	0.03		0.04	0.04
CD @ 5%	-	-		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 23 (a).Soil EC (dSm⁻¹) of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	0.25	0.21	0.24	0.24	0.18	0.16	0.17	0.20	0.21	0.23	0.22	0.23
F2:CON	0.20	0.17	0.22	0.19	0.15	0.14	0.17	0.18	0.20	0.21	0.19	0.20
				<i>Kharif '2008</i>			<i>Summer ' 2009</i>					
				F	P	D	F	P	D			
F-test				NS	NS	NS	NS	NS	NS			
Sem±				0.02	0.03	0.02	0.02	0.02	0.02			
CD @ 5%				-	-	-	-	-	-			

Table 23 (b). Interactions showing soil EC (dSm⁻¹) of soils in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	0.24	0.25	P1 x D1	0.23	0.24	F1 x D1	0.21	0.21
F1 x P2	0.16	0.18	P1 x D2	0.20	0.22	F1 x D2	0.23	0.23
F1 x P3	0.22	0.22	P2 x D1	0.15	0.16	F2 x D1	0.21	0.23
F2 x P1	0.19	0.21	P2 x D2	0.15	0.19	F2 x D2	0.01	0.23
F2 x P2	0.15	0.17	P3 x D1	0.27	0.25			
F2 x P3	0.31	0.31	P3 x D2	0.26	0.28			
F-test	NS	NS		NS	NS		NS	NS
Sem±	0.04	0.03		0.03	0.02		0.04	0.03
CD @ 5%	-	-		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 24 (a).Soil EC (dSm⁻¹)of soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	0.05	0.13	0.19	0.18	0.06	0.04	0.11	0.09	0.11	0.11	0.17	0.21
F2:CON	0.07	0.06	0.11	0.10	0.04	0.04	0.09	0.10	0.09	0.11	0.14	0.14
				Kharif,2008		Summer, 2009						
				F	P	D	F	P	D			
F-test				*	*	NS	*	*	NS			
Sem±				0.01	0.01	0.01	0.01	0.01	0.01			
CD @ 5%				0.02	0.03	-	0.03	0.04	-			

Table 24 (b). Interactions showing soil EC (dSm⁻¹)of soils in organic and conventional farming systems in Southern Transition Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	0.14	0.18	P1 x D1	0.11	0.15	F1 x D1	0.10	0.15
F1 x P2	0.05	0.10	P1 x D2	0.10	0.14	F1 x D2	0.07	0.11
F1 x P3	0.11	0.19	P2 x D1	0.05	0.10	F2 x D1	0.09	0.16
F2 x P1	0.07	0.10	P2 x D2	0.04	0.09	F2 x D2	0.07	0.11
F2 x P2	0.04	0.09	P3 x D1	0.10	0.15			
F2 x P3	0.10	0.14	P3 x D2	0.11	0.18			
F-test	NS	NS		NS	NS		NS	NS
Sem±	0.01	0.02		0.01	0.01		0.01	0.02
CD @ 5%	-	-		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
#: Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
*: Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Southern Dry zone (SDZ)

The electrical conductivity of soils of Southern Dry zone of Karnataka (Table 23a) showed no significant difference among farming systems, at two depths, and during different periods of practice.

The EC of surface soils in organic farming system ranged between 0.18 (3-6yrs) to 0.25 dSm⁻¹ (0-3yrs) during *kharif* 2008 and from 0.17 (3-6 yrs) to 0.24 dSm⁻¹ (0-3yrs) during summer 2009, whereas in conventional farming it ranged from 0.17 (3- 6yrs) to 0.23 dSm⁻¹ (over 6yrs) in 0-15 cm depth during *kharif* 2008 and 0.15 (3- 6yrs) to 0.22 dSm⁻¹ (0-3 yrs) in summer 2009 .

The soil electrical conductivity as indicated by interaction studies showed no variation (Table 23b) among the farming systems, periods of practice and depths during *kharif* 2008 and summer 2009.

Southern Transition zone (STZ)

The electrical conductivity of soils collected from organic and conventional farming systems under Southern Transition zone of Karnataka (Table 24a) was significantly different among farming systems at all the three different periods of practice. However, the EC of soils did not differed significantly at two depths except in 0-3 years during *kharif* 2008 and in over 6 years during summer 2009.

The electrical conductivity of surface soils under organic farming system ranged from 0.05 (0-3yrs) to 0.11 dSm⁻¹ (over 6yrs) during *kharif* 2008 and ranged from 0.11 (3-6yrs) to 0.19 dSm⁻¹ (0-3yrs) in summer 2009, whereas in conventional farming it ranged from 0.04 (3-6yrs) to 0.09 dSm⁻¹ (over 6yrs) during *kharif* 2008 and ranged from 0.09 (3-6yrs) to 0.11 dSm⁻¹ (0-3yrs) during summer 2009.

Soil electrical conductivity did not show significant variations (Table 24b) among the farming systems, periods and depths interactions during *kharif* 2008 and summer 2009.

4.3 Soil Chemical Properties

4.3.1 Soil Organic Carbon (SOC)

The data on comparative changes in soil organic carbon content under organic and conventional farming systems over three different periods of practice under three selected agroclimatic zones of Southern Karnataka are presented in tables 25, 26 and 27.

Central Dry zone

Significantly higher organic carbon content recorded in soils of organic farming fields compared to conventional farming during three different periods of practice, at two depths during both *kharif* 2008 and summer 2009 seasons (Table 25a.).

The soil organic carbon content in surface soils of organic farming system varied from 9.67 (0-3yrs) to 14.75 g kg⁻¹ (> 6yrs) during *kharif* 2008 and 9.05 (0- 3yrs) to 14.97 g kg⁻¹ (>6yrs) during summer 2009, whereas in conventional farming it varied from 5.25 (0-3yrs) to 7.55 g kg⁻¹ (> 6yrs) and 4.77 (0-3yrs) to 7.37 g kg⁻¹ (> 6 yrs) during *kharif* 2008 and summer 2009, respectively. An increasing trend in organic carbon content was noticed both in organic and conventional farming systems from 0-3years to > 6years practice. However, increase in soil organic carbon was significantly higher in soils with organic farming practice than in conventional farming.

The soil organic carbon showed non significant differences for interactions between farming systems, depth and periods (Table 25b). However, significant interaction found between farming systems and periods of practice during both the seasons.

Table 25 (a).Soil organic carbon (g kg⁻¹) content of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	9.67	6.80	9.05	6.50	11.87	9.75	11.67	9.60	14.75	11.65	14.97	11.67
F2:CON	5.25	4.35	4.77	3.87	6.52	4.42	5.40	3.77	7.55	5.90	7.37	5.67
				<i>Kharif,2008</i>				<i>Summer, 2009</i>				
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.45	0.55	0.45	0.39	0.48	0.39			
CD @ 5%				1.29	1.58	1.29	1.13	1.39	1.13			

Table 25 (b). Interactions showing soil organic carbon (g kg⁻¹) of soils in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	8.23	7.77	P1 x D1	7.46	6.91	F1 x D1	12.10	11.90
F1 x P2	11.81	10.63	P1 x D2	5.57	5.18	F1 x D2	6.44	5.85
F1 x P3	14.20	13.13	P2 x D1	9.20	8.53	F2 x D1	9.40	9.25
F2 x P1	4.80	4.32	P2 x D2	7.08	6.68	F2 x D2	4.89	4.44
F2 x P2	5.47	4.58	P3 x D1	11.15	11.17			
F2 x P3	7.72	6.52	P3 x D2	8.77	8.67			
F-test	*	*		NS	NS		NS	NS
Sem±	0.77	0.68		0.63	0.55		0.77	0.68
CD @ 5%	2.28	1.97		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 26 (a).Soil organic carbon (g kg⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	9.75	7.20	9.07	6.45	15.67	12.52	15.82	12.22	17.82	14.50	16.87	14.15
F2:CON	7.95	5.87	6.75	4.77	9.97	7.87	8.62	7.20	9.80	7.67	9.15	6.80
				<i>Kharif '2008</i>		<i>Summer '2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.40	0.49	0.40	0.42	0.52	0.42			
CD @ 5%				1.15	1.41	1.15	1.22	1.50	1.22			

Table 26 (b). Interactions showing soil organic carbon (g kg⁻¹) of soils in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	8.47	7.76	P1 x D1	8.85	7.91	F1 x D1	14.41	14.35
F1 x P2	14.10	14.02	P1 x D2	6.53	5.61	F1 x D2	9.24	7.84
F1 x P3	16.15	15.51	P2 x D1	12.82	12.22	F2 x D1	11.40	11.20
F2 x P1	6.91	5.76	P2 x D2	10.20	9.71	F2 x D2	6.80	5.92
F2 x P2	8.92	7.91	P3 x D1	13.81	13.01			
F2 x P3	8.73	7.97	P3 x D2	10.58	10.37			
F-test	*	*		NS	NS		NS	NS
Sem±	0.49	0.51		0.56	0.60		0.49	0.51
CD @ 5%	1.32	1.44		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 27 (a).Soil organic carbon (g kg⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	9.45	8.12	8.80	7.65	15.07	11.62	15.07	11.62	19.42	13.57	18.90	14.05
F2:CON	8.47	6.52	7.07	5.67	8.30	6.50	8.02	6.75	10.65	8.10	9.37	7.15
				<i>Kharif '2008</i>		<i>Summer '2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.58	0.71	0.58	0.55	0.67	0.55			
CD @ 5%				1.67	2.04	1.67	1.58	1.94	1.58			

Table 27 (b). Interactions showing soil organic carbon (g kg⁻¹) of soils in organic and conventional farming systems in Southern Transition Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	8.78	8.22	P1 x D1	8.96	7.93	F1 x D1	14.65	14.25
F1 x P2	13.35	13.35	P1 x D2	7.32	6.66	F1 x D2	8.47	7.15
F1 x P3	16.50	16.47	P2 x D1	10.68	10.05	F2 x D1	11.10	11.10
F2 x P1	7.50	6.37	P2 x D2	8.06	7.68	F2 x D2	5.37	4.52
F2 x P2	7.4	7.38	P3 x D1	15.03	14.13			
F2 x P3	9.37	8.26	P3 x D2	9.33	9.10			
F-test	*	*		NS	NS		NS	NS
Sem±	1.01	0.95		0.82	0.77		1.01	0.95
CD @ 5%	2.89	2.74		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Southern Dry zone

The soils collected from Southern Dry zone of Karnataka (Table 26a) recorded significant differences in organic carbon content with organic and conventional farming systems in all the three different periods of practice during both the seasons.

The organic carbon content of surface soils from organic farming system varied from 9.75 (0-3yrs) to 17.82 g kg⁻¹ (> 6yrs) during *kharif* 2008 and from 9.07 (0-3 yrs) to 17.87 g kg⁻¹ (> 6yrs) during summer 2009. In conventional farming system it varied from 7.95 (0-3yrs) to 9.97 g kg⁻¹ (3-6yrs) during *kharif* 2008 and from 6.75 (0-3yrs) to 8.62 g kg⁻¹ (> 6yrs) during summer 2009. An increasing trend was observed in soil organic carbon content from 0-3 years to over 6years of organic farming practice, whereas it was not the case with conventional farming in both the seasons.

Soil organic carbon content showed significant differences for interactions between farming systems and periods (Table 26b) during both the seasons. However, for farming systems with depth and periods with depth the interactions were non significant. Soil organic carbon content differed significantly due to practicing of different farming systems for different periods.

Southern Transition zone

The organic carbon content differed significantly with farming systems in soils collected from organic and conventional farming systems under Southern Transition zone of Karnataka (Table 27a) during *kharif* 2008 and summer 2009.

Organic carbon content of surface soils of organic farming system varied from 9.45 (0-3) to 19.42 (>6yrs) during *kharif* 2008 and from 8.80 (0-3yrs) to 18.90 Mg m⁻³ (> 6yrs) during summer 2009, whereas in conventional farming it varied from 6.30 (3-6yrs) to 10.65 Mg m⁻³ (> 6yrs) during *kharif* 2008 and from 5.02 (3-6yrs) to 9.37 Mg m⁻³ (>6yrs) during summer 2009. An increasing trend was noticed in soil organic carbon

content from 0-3 years to over 6 years of organic farming practice, whereas it was not with the conventional farming practice.

Significant difference in soil organic carbon content was recorded in interactions between farming systems & periods (Table 27b). However, for farming systems with depth and periods with depth interactions the differences were non significant during *kharif* 2008 and summer 2009.

4.3.2 Soil Available Nitrogen

The data on comparative changes in soil available nitrogen (kg ha^{-1}) during different periods of organic and conventional farming systems under three selected agroclimatic zones of Southern Karnataka are presented in tables 28, 29 and 30.

Central Dry zone

Soils collected from organic and conventional farming systems in Central Dry zone of Karnataka differed significantly in the available nitrogen among the farming systems in three different periods of practice, at two depths during *kharif* 2008 and summer 2009.

The available nitrogen of surface soils of organic farming system (Table 28a.) varied from 279.25 (0-3yrs) to 435.75 kg ha^{-1} (> 6yrs) during *kharif* 2008 and 259.50 (0-3yrs) to 429.25 kg ha^{-1} (> 6yrs) during summer 2009, whereas in conventional farming it varied from 208.75 (3-6yrs) to 234.50 kg ha^{-1} (> 6yrs) and 185.75 (0-3yrs) to 213.00 kg ha^{-1} (> 6 yrs) during *kharif* 2008 and summer 2009 respectively. An increasing trend was observed in available nitrogen from 0-3 years to over 6 years of organic farming, and was not so with the conventional farming practice.

The available nitrogen content of soils showed significant differences for interactions between farming systems with periods and periods with depth (Table 28a).

Table 28 (a). Available Nitrogen (kg ha^{-1}) content of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	279.25	184.50	259.50	179.00	365.75	266.00	357.00	280.50	435.75	342.25	429.25	345.00
F2:CON	224.00	185.25	185.75	173.50	208.75	169.00	193.50	167.00	234.50	202.00	213.00	193.25
				<i>Kharif,2008</i>			<i>Summer, 2009</i>					
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				5.69	6.97	5.69	5.42	6.63	5.42			
CD @ 5%				16.39	20.07	16.39	15.59	19.10	15.59			

Table 28 (b). Interactions showing available nitrogen (kg ha^{-1}) of soils in Organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	231.87	219.25	P1 x D1	251.62	222.62	F1 x D1	360.25	348.58
F1 x P2	315.87	318.75	P1 x D2	184.87	176.25	F1 x D2	222.41	197.41
F1 x P3	389.00	387.12	P2 x D1	287.25	275.25	F2 x D1	264.25	268.16
F2 x P1	204.62	179.62	P2 x D2	217.50	223.75	F2 x D2	185.41	177.91
F2 x P2	188.87	180.25	P3 x D1	335.12	321.12			
F2 x P3	218.25	203.12	P3 x D2	272.12	269.12			
F-test	*	*		*	*		NS	NS
Sem±	9.86	9.38		8.05	7.66		9.86	9.38
CD @ 5%	28.38	27.01		23.18	22.05		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 29 (a). Available Nitrogen (kg ha⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	292.00	212.50	290.50	244.50	422.75	311.00	431.50	312.50	488.00	422.50	416.50	388.00
F2:CON	249.25	174.00	233.00	174.50	264.00	210.50	241.00	193.00	239.75	192.25	221.25	186.50
				<i>Kharif,2008</i>		<i>Summer, 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				10.92	13.38	10.92	10.82	13.25	10.82			
CD @ 5%				31.44	38.51	31.44	31.15	38.15	31.15			

Table 29 (b). Interactions showing available nitrogen (kg ha⁻¹) of soils in Organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	252.25	367.50	P1 x D1	270.62	261.75	F1 x D1	411.58	412.83
F1 x P2	366.85	372.00	P1 x D2	193.25	209.50	F1 x D2	251.00	231.75
F1 x P3	455.25	402.25	P2 x D1	343.37	336.25	F2 x D1	315.33	331.00
F2 x P1	211.62	203.75	P2 x D2	260.75	252.75	F2 x D2	192.25	184.66
F2 x P2	237.25	217.00	P3 x D1	379.87	368.87			
F2 x P3	216.00	203.87	P3 x D2	307.37	311.25			
F-test	*	*		NS	NS		NS	NS
Sem±	18.92	18.75		15.45	15.31		18.92	18.71
CD @ 5%	54.46	53.95		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
#:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
*: Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 30 (a). Available Nitrogen (kg ha⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	211.75	190.00	202.00	174.00	318.50	249.00	335.00	254.25	440.25	318.50	403.50	326.00
F2:CON	191.25	166.75	169.00	148.75	165.25	127.75	149.00	115.00	302.00	255.00	285.00	234.00
				<i>Kharif,2008</i>			<i>Summer, 2009</i>					
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				7.30	8.94	7.30	7.29	8.93	7.29			
CD @ 5%				21.02	25.74	21.02	20.98	25.70	20.98			

Table 30 (b). Interactions showing available nitrogen (kg ha⁻¹) of soils in organic and conventional farming systems in Southern Transition Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	200.87	188.00	P1 x D1	201.50	185.50	F1 x D1	323.50	330.16
F1 x P2	283.75	294.62	P1 x D2	178.37	161.37	F1 x D2	186.16	167.66
F1 x P3	379.37	364.75	P2 x D1	241.87	242.00	F2 x D1	252.50	254.75
F2 x P1	179.0	158.87	P2 x D2	188.37	184.62	F2 x D2	149.83	132.58
F2 x P2	146.50	132.00	P3 x D1	321.12	319.25			
F2 x P3	278.50	259.50	P3 x D2	236.75	235.00			
F-test	*	*		NS	NS		NS	NS
Sem±	12.65	12.63		10.33	10.31		12.65	12.63
CD @ 5%	36.40	36.35		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
#: Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
*: Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

However, the interactions between farming systems with depth was non significant during both the seasons.

Southern Dry zone

The available nitrogen of soils from Southern Dry zone of Karnataka differed significantly among organic and conventional farming systems (Table 29a).

The available nitrogen content of surface soils collected from organic farming system varied from 292 (0-3yrs) to 520 kg ha⁻¹ (> 6yrs) during *kharif* 2008 and 290.50 (0-3 yrs) to 516.50 kg ha⁻¹ (>6yrs) during summer 2009, whereas in conventional farming it varied from 239.75 (> 6yrs) to 264 kg ha⁻¹ (3-6yrs) during *kharif* 2008 and 221.25 (> 6yrs) to 241 kg ha⁻¹ (3-6yrs) during summer 2009. There was an increasing trend observed in available nitrogen content in soils from 0-3 years to >6 years of organic farming, and was not so with the conventional farming.

For farming systems with depth and periods with depths interactions (Table 29b), the soil available nitrogen showed no significant difference. However, significant difference for interactions between farming systems & periods of organic or conventional farming practice were observed in both the seasons.

Southern Transition zone

The available nitrogen content of soils from Southern Transition zone (Table 30a) differed significantly due to organic and conventional farming systems in three different periods of practice, at two depths during *kharif* 2008 and summer 2009.

The available nitrogen content of surface soils of organic farming system varied from 211.75 (0-3yrs) to 440.25 kg ha⁻¹ (over 6yrs) during *kharif* 2008 from 202 (0-3yrs) to 453.50 kg ha⁻¹ (over 6yrs) during *summer* 2009. In conventional farming it varied from 165.25 (3- 6yrs) to 202 kg ha⁻¹ (over 6yrs) during *kharif* 2008 and 149 (3-6yrs) to 185 kg ha⁻¹ (over 6yrs) during summer 2009. An increasing trend was observed in soil available

nitrogen from 0-3 years to >6 years of organic farming practice, whereas it was not so with the conventional farming.

The interaction studies between farming systems, periods and depths (Table 30 b), showed non significant difference. However, significant differences were observed for interactions between farming systems with periods of practice during both the seasons.

4.3.3 Soil Available Phosphorus

The available phosphorus content in soils for different periods of organic and conventional farming practice under three selected agroclimatic zones of Southern Karnataka were compared and the results are presented in tables 31, 32 and 33.

Central Dry zone

The available phosphorus content in soils collected in Central Dry zone of Karnataka differed significantly among organic and conventional farming systems during the periods and seasons.

In organic farming system, the available phosphorus content (Table 31a.) varied from 13.11 (0-3yrs) to 24.10 kg ha⁻¹ (over 6yrs) during *kharif* 2008 and from 12.17 (3-6yrs) to 23.98 kg ha⁻¹ (over 6yrs) during summer 2009, whereas in conventional farming it ranged from 5.20 (over 6yrs) to 9.15 kg ha⁻¹ (0-3yrs) during *kharif* 2008 and from 5.46 (over 6yrs) to 9.88 kg ha⁻¹ (0-3 yrs) in summer 2009.

The interaction studies between farming systems, periods and depths (Table 32 b), the available phosphorus did not show significant differences. However, significant difference in soil available phosphorus was found in interactions between farming systems with periods of practice and seasons.

Table 31 (a). Available Phosphorus (kg ha⁻¹) content of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	13.11	8.67	12.89	9.16	17.64	9.04	12.17	9.71	19.10	15.04	17.98	14.79
F2:CON	9.15	8.43	9.88	5.32	8.98	6.03	7.35	5.06	10.20	8.82	8.46	7.62
				<i>Kharif,2008</i>		<i>Summer, 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.88	1.08	0.88	0.68	0.83	0.68			
CD @ 5%				2.54	2.98	2.54	1.95	2.39	1.95			

Table 31 (b). Interactions showing available phosphorus (kg ha⁻¹) of soils in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	10.89	11.02	P1 x D1	11.13	11.38	F1 x D1	16.16	16.34
F1 x P2	10.84	10.94	P1 x D2	8.55	7.24	F1 x D2	7.11	7.23
F1 x P3	17.07	16.38	P2 x D1	9.81	9.26	F2 x D1	10.92	11.18
F2 x P1	8.79	7.60	P2 x D2	6.04	6.38	F2 x D2	4.83	4.01
F2 x P2	7.50	6.20	P3 x D1	14.65	14.72			
F2 x P3	9.51	8.04	P3 x D2	9.03	10.21			
F-test	*	*		NS	NS		NS	NS
Sem±	1.53	1.17		1.25	0.96		1.53	1.17
CD @ 5%	4.41	3.39		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 32 (a). Available Phosphorus (kg ha⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	19.19	13.61	17.27	13.03	18.89	12.09	20.69	13.85	22.01	18.13	21.77	17.68
F2:CON	15.68	9.81	13.65	9.87	13.38	9.15	12.00	9.01	13.82	8.98	11.11	9.04
				<i>Kharif,2008</i>			<i>Summer, 2009</i>					
				F	P	D	F	P	D			
F-test				*	NS	*	*	NS	*			
Sem±				0.92	1.33	0.92	0.76	1.12	0.76			
CD @ 5%				2.67	-	2.67	2.21	-	2.21			

Table 32 (b). Interactions showing available phosphorus (kg ha⁻¹) of soils in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	16.40	15.15	P1 x D1	17.43	15.46	F1 x D1	20.03	20.57
F1 x P2	15.49	17.27	P1 x D2	11.71	11.45	F1 x D2	13.96	12.25
F1 x P3	20.07	19.78	P2 x D1	16.13	16.34	F2 x D1	14.61	15.19
F2 x P1	12.74	11.76	P2 x D2	10.62	11.43	F2 x D2	8.31	8.31
F2 x P2	11.26	10.51	P3 x D1	17.41	17.44			
F2 x P3	11.09	10.07	P3 x D2	12.06	12.36			
F-test	NS	*		NS	NS		NS	NS
Sem±	1.60	1.32		1.31	1.08		1.60	1.32
CD @ 5%	-	3.82		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 33(a). Available Phosphorus (kg ha⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	26.60	17.59	25.22	17.89	28.14	20.08	26.58	19.55	32.70	28.40	30.63	26.66
F2:CON	25.77	15.48	20.99	15.06	14.30	9.88	12.61	8.12	22.37	13.21	20.53	12.12
				<i>Kharif,2008</i>				<i>Summer, 2009</i>				
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				1.12	1.38	1.12	0.89	1.10	0.89			
CD @ 5%				3.24	3.97	3.24	2.58	3.16	2.58			

Table 33(b). Interactions showing available phosphorus (kg ha⁻¹) of soils in organic and conventional farming systems in Southern Transition Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	22.87	21.55	P1 x D1	26.95	23.10	F1 x D1	31.15	30.14
F1 x P2	23.34	23.06	P1 x D2	16.53	16.47	F1 x D2	20.81	17.38
F1 x P3	30.55	28.64	P2 x D1	20.45	19.59	F2 x D1	22.02	23.03
F2 x P1	20.62	18.02	P2 x D2	14.98	13.84	F2 x D2	12.80	11.77
F2 x P2	12.09	10.37	P3 x D1	30.53	28.58			
F2 x P3	17.79	16.33	P3 x D2	20.18	21.89			
F-test	*	*		NS	NS		NS	NS
Sem±	1.95	1.55		1.59	1.27		1.95	1.55
CD @ 5%	5.62	4.48		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
#: Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
*: Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Southern Dry zone

The available phosphorus content in soils collected under Southern Dry zone of Karnataka (Table 32a) showed significant differences among farming systems. However, the available phosphorus content not differed significantly with different periods of practice of organic and conventional farming during *kharif* 2008 and summer 2009.

The available phosphorus of surface soils of organic farming system varied from 18.89 (3-6yrs) to 22.01 kg ha⁻¹ (> 6yrs) during *kharif* 2008 and 17.27 (0-3 yrs) to 23.77 kg ha⁻¹ (>6yrs) during summer 2009, whereas in conventional farming it ranged from 12.82 (over 6yrs) to 15.68 kg ha⁻¹ (0-3yrs) and 11.11 (> 6yrs) to 13.65 kg ha⁻¹ (0-3yrs) during *kharif* 2008 and summer 2009, respectively.

The available phosphorus was not differed significantly in farming systems with depth and periods with depth interactions (Table 32b) during *kharif* 2008 and summer 2009. However, during summer, 2009 between farming systems and periods of practice, significant interactions were recorded.

Southern Transition zone

The available phosphorus in soils from Southern Transition zone of Karnataka (Table 33a) differed significantly with organic and conventional farming systems in all the three different periods of practice, in two depths during *kharif* 2008 and summer 2009.

In surface soils, the available phosphorus content in organic farming system varied from 26.60 (0-3yrs) to 38.70 kg ha⁻¹ (over 6yrs) and 25.22 (0-3yrs) to 38.63 kg ha⁻¹ (over 6yrs) during *kharif* 2008 and summer 2009 respectively, whereas in conventional farming it ranged from 14.30 (3- 6yrs) to 25.77 kg ha⁻¹ (0-3yrs) during *kharif* 2008 and 12.61 (3-6yrs) to 20.99 kg ha⁻¹ (0-3yrs) during summer 2009. There was an increasing trend observed in soil available phosphorus from 0-3 years to >6 years of organic

farming, whereas it was not so with the conventional farming practice in both the depths and in both the seasons.

For farming systems with depth and periods with depths interactions (Table 33b), the soil available phosphorus content was not significantly different. However, significant differences were found in farming systems with periods of practice interactions during both the seasons.

4.3.4 Available Potassium

The data on comparative changes in available potassium content of soils during different periods of organic and conventional farming systems under three selected agroclimatic zones of Southern Karnataka are presented in tables 34, 35 and 36.

Central Dry zone

Soils collected from the two farming systems under Central Dry zone of Karnataka differed significantly in soil available potassium in all the three different periods of practice, in two depths during both *kharif* 2008 and summer 2009.

The available potassium content (Table 34a.) in surface soils of organic farming system varied from 188.25 (0-3yrs) to 316.25 kg ha⁻¹ (over 6yrs) during *kharif* 2008 and from 188.75 (0-3yrs) to 339 kg ha⁻¹ (over 6yrs) during summer 2009, whereas in conventional farming it ranged from 184 (0-3yrs) to 207.25 kg ha⁻¹ (over 6yrs) during *kharif* 2008 and from 173.25 (0-3yrs) to 188.5 kg ha⁻¹ (over 6 yrs) during summer 2009.

For farming systems with depth and periods with depths interactions (Table 34 b) soil available potassium content was not significantly different. However, significant difference was recorded in farming systems with periods of organic or conventional practice interactions during *kharif* 2008 and summer 2009.

Table 34 (a). Available Potassium (kg ha⁻¹) content of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	188.25	142.00	185.75	144.00	313.25	253.75	338.75	260.75	316.25	218.75	339.00	231.25
F2:CON	184.00	144.75	173.25	139.25	196.25	122.75	183.00	121.25	207.25	161.75	188.50	149.25
				<i>Kharif,2008</i>				<i>Summer, 2009</i>				
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				12.37	15.15	12.37	12.94	15.85	12.94			
CD @ 5%				35.59	43.59	35.59	37.23	45.60	37.23			

Table 34 (b). Interactions showing available potassium (kg ha⁻¹) of soils in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	165.12	164.87	P1 x D1	186.12	179.50	F1 x D1	272.58	287.83
F1 x P2	285.00	299.87	P1 x D2	143.37	141.62	F1 x D2	195.83	181.58
F1 x P3	266.00	285.00	P2 x D1	256.25	261.00	F2 x D1	204.83	212.00
F2 x P1	164.37	156.25	P2 x D2	188.25	191.00	F2 x D2	143.08	136.58
F2 x P2	159.50	152.12	P3 x D1	260.25	263.62			
F2 x P3	184.50	168.87	P3 x D2	190.25	190.25			
F-test	*	*		NS	NS		NS	NS
Sem±	21.42	22.41		17.49	18.30		21.40	22.41
CD @ 5%	61.65	64.50		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 35 (a). Available Potassium (kg ha⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	183.50	141.75	176.50	140.00	251.75	186.50	267.00	199.75	312.50	269.00	284.00	271.50
F2:CON	164.50	130.75	156.75	133.00	186.25	139.75	171.50	135.00	169.00	172.25	168.00	141.50
				<i>Kharif,2008</i>		<i>Summer, 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				8.13	9.96	8.13	7.84	10.15	7.84			
CD @ 5%				23.40	28.66	23.40	22.86	29.23	22.86			

Table 35 (b). Interactions showing available potassium (kg ha⁻¹) of soils in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	162.16	158.25	P1 x D1	174.00	166.62	F1 x D1	282.58	289.16
F1 x P2	219.12	233.37	P1 x D2	136.25	136.50	F1 x D2	173.25	165.41
F1 x P3	290.75	277.5	P2 x D1	219.00	219.25	F2 x D1	232.41	237.08
F2 x P1	147.62	144.87	P2 x D2	163.12	167.37	F2 x D2	134.25	136.50
F2 x P2	163.00	153.25	P3 x D1	290.75	296.00			
F2 x P3	170.62	154.75	P3 x D2	250.62	256.50			
F-test	*	*		NS	NS		NS	NS
Sem±	12.08	12.36		11.50	11.72		12.08	12.36
CD @ 5%	35.53	36.33		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 36 (a). Available Potassium (kg ha⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	253.00	209.25	260.50	216.25	227.50	183.75	233.25	189.25	273.25	230.00	293.75	238.75
F2:CON	225.00	157.00	202.25	145.50	176.75	127.50	164.25	121.50	188.25	127.75	173.00	126.50
				<i>Kharif,2008</i>			<i>Summer, 2009</i>					
				F	P	D	F	P	D			
F-test				*	NS	*	*	NS	*			
Sem±				9.12	11.17	9.12	9.12	11.18	9.12			
CD @ 5%				26.26	-	26.26	26.26	-	26.26			

Table 36 (b). Interactions showing available potassium (kg ha⁻¹) content of soils in organic and conventional farming systems in Southern Transition Zone

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	231.12	238.37	P1 x D1	239.00	231.37	F1 x D1	251.25	262.50
F1 x P2	205.62	211.25	P1 x D2	183.12	181.87	F1 x D2	196.66	179.83
F1 x P3	251.62	266.25	P2 x D1	202.12	198.75	F2 x D1	207.66	214.75
F2 x P1	191.00	174.87	P2 x D2	155.62	155.37	F2 x D2	137.41	131.83
F2 x P2	152.12	142.87	P3 x D1	230.75	233.37			
F2 x P3	158.0	149.75	P3 x D2	178.87	182.62			
F-test	NS	NS		NS	NS		NS	NS
Sem±	15.80	15.81		12.90	12.91		15.80	15.81
CD @ 5%	-	-		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Southern Dry zone

The available potassium in soils of Southern Dry zone of Karnataka (Table 35 a) showed significant differences among the two farming systems in three different periods of practice, at two depths during both the seasons.

The soil available potassium content in surface soils of organic farming system ranged from 183.50 (0-3yrs) to 312.50 kg ha⁻¹ (> 6yrs) during *kharif* 2008 and 176.50 (0-3 yrs) to 284 kg ha⁻¹ (> 6yrs) during summer 2009, whereas in conventional farming it ranged from 164.50 (0-3yrs) to 186.25 kg ha⁻¹ (3-6yrs) during *kharif* 2008 and 156.75 (0-3yrs) to 171.50 kg ha⁻¹ (3-6yrs) during summer 2009.

For interactions among farming systems with depth and periods with depths (Table 35 b), the soil available potassium content was not significantly different. However, significant difference was recorded in farming systems with periods of their practice interactions during *kharif* 2008 and summer 2009.

Southern Transition zone

The soils of Southern Transition zone of Karnataka (Table 36a) differed significantly with farming systems. However, the available potassium content was found on par with different periods of practice during *kharif* 2008 and summer 2009.

The available potassium content in surface soils of organic farming system ranged from 227.50 (3-6yrs) to 273.25 kg ha⁻¹ (over 6yrs) during *kharif* 2008 and 233.25 (3-6yrs) to 293.25 kg ha⁻¹ (over 6yrs) during summer 2009, whereas in conventional farming it ranged from 176.25 (3- 6yrs) to 225 kg ha⁻¹ (0-3yrs) and from 164.25 (3-6yrs) to 202.25 kg ha⁻¹ (0-3yrs) during *kharif* 2008 and summer 2009 respectively.

However, no significant differences were recorded in soil available potassium for farming systems with periods, farming systems with depth and periods with depth interactions (Table 36b) during *kharif* 2008 and summer 2009.

4.3.5. Secondary Nutrients

4.3.5.1 Exchangeable Calcium

The data on comparative changes in soil exchangeable calcium in different periods of organic and conventional farming systems under three selected agroclimatic zones of Southern Karnataka are presented in tables 37, 38 and 39.

Central Dry zone

The exchangeable calcium content in soils of Central Dry zone of Karnataka has differed significantly with farming systems in three different periods of practice, at two depths during *kharif* 2008 and summer 2009.

The exchangeable calcium content of surface soils (Table 37 a.) of organic farming system ranged from 9.05 (0-3yrs) to 14.15 C mol (p⁺) kg⁻¹ (over 6yrs) during *kharif* 2008 and 10.17 (0-3yrs) to 15.05 C mol (p⁺) kg⁻¹ (over 6yrs) during summer 2009, whereas in conventional farming it ranged from 9.00(0-3yrs) to 10.70 C mol (p⁺) kg⁻¹ (over 6yrs) and 7.00 (0-3yrs) to 9.37 C mol (p⁺) kg⁻¹ (over 6 yrs) during *kharif* 2008 and summer 2009, respectively.

For farming systems with depth and periods with depths interactions (Table 37b), the soil exchangeable calcium variations were found on par. However, significant differences were noticed in exchangeable calcium content in interactions between farming systems and periods of organic or conventional practice during *kharif* 2008 and summer 2009.

Southern Dry zone

The soil samples collected from Southern Dry zone of Karnataka (Table 38a) were found to differ significantly in exchangeable calcium content with organic and conventional farming systems during *kharif* 2008 and summer 2009.

Table 37 (a). Exchangeable calcium [c mol (p⁺) kg⁻¹] content of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	9.05	8.95	10.17	8.12	11.75	11.35	12.25	11.17	14.15	13.27	15.05	14.17
F2:CON	9.00	8.75	7.00	6.07	9.10	6.05	7.22	5.87	10.70	8.50	9.37	7.17
				Kharif '2008		Summer '2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.30	0.37	0.30	0.37	0.45	0.37			
CD @ 5%				0.87	1.07	0.87	1.06	1.30	1.06			

Table 37 (b). Interactions showing Exchangeable calcium [c mol (p⁺) kg⁻¹] content of soils in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	9.00	9.15	P1 x D1	9.02	8.58	F1 x D1	11.65	12.49
F1 x P2	11.55	11.71	P1 x D2	8.85	7.10	F1 x D2	9.60	7.86
F1 x P3	13.71	14.61	P2 x D1	10.42	9.73	F2 x D1	11.19	11.15
F2 x P1	8.87	6.53	P2 x D2	8.70	8.52	F2 x D2	7.76	6.37
F2 x P2	7.57	6.55	P3 x D1	12.42	12.21			
F2 x P3	9.60	8.27	P3 x D2	10.88	10.67			
F-test	*	*		NS	NS		NS	NS
Sem±	0.52	0.64		0.43	0.52		0.52	0.64
CD @ 5%	1.51	1.84		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
#: Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
*: Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 38 (a). Exchangeable calcium [c mol (p⁺) kg⁻¹] content of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	11.40	9.10	11.25	8.12	15.90	15.10	16.32	14.60	18.80	17.65	19.25	18.30
F2:CON	10.20	7.55	8.47	5.95	12.25	10.30	10.19	9.10	12.60	8.65	10.17	7.15
				<i>Kharif,2008</i>		<i>Summer, 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.45	0.56	0.45	0.47	0.58	0.47			
CD @ 5%				1.31	1.61	1.31	1.37	1.68	1.37			

Table 38 (b). Interactions showing Exchangeable calcium [c mol (p⁺) kg⁻¹] content of soils in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	10.25	9.68	P1 x D1	10.80	9.86	F1 x D1	15.36	15.60
F1 x P2	15.50	15.46	P1 x D2	8.32	7.03	F1 x D2	11.68	9.85
F1 x P3	18.22	18.77	P2 x D1	14.07	13.61	F2 x D1	13.95	13.67
F2 x P1	8.87	7.21	P2 x D2	12.70	11.85	F2 x D2	8.83	7.40
F2 x P2	11.27	10.00	P3 x D1	15.70	14.71			
F2 x P3	10.62	8.66	P3 x D2	13.15	12.72			
F-test	*	*		NS	NS		NS	NS
Sem±	0.79	0.82		0.64	0.67		0.79	0.82
CD @ 5%	2.28	2.38		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 39 (a). Exchangeable calcium [c mol (p⁺) kg⁻¹] content of soils in as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	11.15	10.05	10.47	9.57	19.37	14.85	18.92	14.65	19.95	16.37	21.80	16.90
F2:CON	10.52	8.45	8.82	7.12	9.47	5.90	6.37	4.62	13.10	6.87	11.72	5.20
				Kharif '2008		Summer '2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.53	0.65	0.53	0.57	0.70	0.57			
CD @ 5%				1.54	1.88	1.54	1.66	2.03	1.66			

Table 39 (b). Interactions showing exchangeable calcium [c mol (p⁺) kg⁻¹] content of soils in organic and conventional farming systems in Southern Transition Zone

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	10.60	1.02	P1 x D1	10.83	9.65	F1 x D1	16.82	17.06
F1 x P2	17.11	16.78	P1 x D2	9.25	8.35	F1 x D2	11.03	8.97
F1 x P3	18.16	19.35	P2 x D1	14.42	12.65	F2 x D1	13.75	13.70
F2 x P1	9.48	7.97	P2 x D2	10.37	9.63	F2 x D2	7.07	5.65
F2 x P2	7.68	5.50	P3 x D1	16.52	16.76			
F2 x P3	9.98	8.46	P3 x D2	11.62	11.05			
F-test	*	*		NS	NS		NS	NS
Sem±	0.92	1.0		0.75	0.81		0.92	1.00
CD @ 5%	2.66	2.87		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

The exchangeable calcium content in surface soils of organic farming system ranged from 11.40 (0-3yrs) to 18.80 C mol (p⁺) kg⁻¹ (> 6yrs) and 11.25 (0-3 yrs) to 19.25 C mol (p⁺) kg⁻¹ (> 6yrs) during *kharif* 2008 and summer 2009, respectively, whereas in conventional farming it ranged from 10.20 (0-3yrs) to 12.60 C mol (p⁺) kg⁻¹ (> 6yrs) during *kharif* 2008 and 8.47 (0-3yrs) to 10.19 C mol (p⁺) kg⁻¹ (3-6yrs) during summer 2009.

The soil exchangeable calcium content varied significantly for interaction between farming systems and periods of practice during both the seasons (Table 38 b).

Southern Transition zone

The exchangeable calcium in soils sampled from Southern Transition zone of Karnataka (Table 39a) differed significantly among farming systems during different periods of practice during *kharif* 2008 and summer 2009.

The surface soil's exchangeable calcium content in organic farming system ranged from 11.15 (0-3yrs) to 19.95 C mol (p⁺) kg⁻¹ (over 6yrs) during *kharif* 2008 and 10.47(0-3yrs) to 21.80 C mol (p⁺) kg⁻¹ (over 6yrs) during summer 2009, whereas in conventional farming it ranged from 9.47 (3- 6yrs) to 13.10 C mol (p⁺) kg⁻¹ (> 6yrs) during *kharif* 2008 and 6.37 (3-6yrs) to 11.72 C mol (p⁺) kg⁻¹ (over 6yrs) during summer 2009.

Exchangeable calcium content was found to differ significantly among interactions between farming systems and periods practice during both the seasons. However, the interactions for farming systems & depth and periods & depth of sampling were on par (Table 39b).

4.3.5.2 Exchangeable Magnesium

The exchangeable magnesium content in different periods of organic and conventional farming systems under three selected agroclimatic zones of Southern Karnataka were compared and the results are presented in tables 40, 41 and 42.

Central Dry zone

The exchangeable magnesium content of soils collected from Central Dry zone of Karnataka showed significant variations with organic and conventional farming systems in three different periods of practice, at two depths during *kharif* 2008 and summer 2009.

In surface soils, the exchangeable magnesium content (Table 40a.) of organic farming system ranged from 2.12 (0-3yrs) to 2.75 C mol (p⁺) kg⁻¹ (over 6yrs) during *kharif* 2008 and 2.30 (0-3yrs) to 2.97 C mol (p⁺) kg⁻¹ (over 6 yrs) during summer 2009, whereas in conventional farming it ranged from 1.62(3-6yrs) to 1.85 C mol (p⁺) kg⁻¹ (0-3yrs) during *kharif* 2008 and 1.30 (3-6yrs) to 1.72 C mol (p⁺) kg⁻¹ (0-3 yrs) during summer 2009.

For farming systems with depth and periods with depths interactions (Table 40b), the variations in exchangeable magnesium was on par. However, it varied significantly among farming systems and periods of practice interactions during both the seasons.

Southern Dry zone

The soils of Southern Dry zone of Karnataka (Table 41a), the exchangeable magnesium content significantly differed with organic and conventional farming systems.

The surface soil exchangeable magnesium content in organic farming system ranged from 2.20 (0-3yrs) to 3.27 C mol (p⁺) kg⁻¹ (> 6yrs) and 2.25 (0-3 yrs) to 3.45 C mol (p⁺) kg⁻¹ (> 6yrs) during *kharif* 2008 and summer 2009 respectively, whereas in

Table 40(a) Exchangeable magnesium [c mol (p⁺) kg⁻¹] content of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	2.12	1.80	2.30	1.95	2.15	1.90	2.37	2.12	2.75	2.55	2.97	2.70
F2:CON	1.85	1.70	1.72	1.45	1.62	1.27	1.30	1.25	1.80	1.52	1.70	1.47
				<i>Kharif,2008</i>				<i>Summer, 2009</i>				
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.04	0.06	0.04	0.05	0.07	0.05			
CD @ 5%				0.14	0.17	0.14	0.16	0.21	0.16			

Table 40(b). Interactions showing exchangeable magnesium [c mol (p⁺) kg⁻¹] content of soils in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	1.97	2.12	P1 x D1	2.00	2.01	F1 x D1	2.34	2.55
F1 x P2	2.01	2.25	P1 x D2	1.75	1.70	F1 x D2	1.75	1.57
F1 x P3	2.65	2.83	P2 x D1	1.87	1.83	F2 x D1	2.08	2.25
F2 x P1	1.77	1.58	P2 x D2	1.58	1.68	F2 x D2	1.50	1.39
F2 x P2	1.45	1.27	P3 x D1	2.27	2.33			
F2 x P3	1.66	1.58	P3 x D2	2.03	2.08			
F-test	*	*		NS	NS		NS	NS
Sem±	0.08	0.11		0.06	0.08		0.08	0.11
CD @ 5%	0.24	0.29		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 41 (a). Exchangeable magnesium [c mol (p⁺) kg⁻¹] content of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	2.20	1.75	2.25	1.80	2.75	2.55	3.05	2.67	3.27	3.00	3.45	3.10
F2:CON	1.99	1.62	1.80	1.57	2.32	2.02	2.20	2.05	2.12	1.62	1.90	1.55
				<i>Kharif,2008</i>		<i>Summer, 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.05	0.07	0.05	0.04	0.05	0.04			
CD @ 5%				0.16	0.20	0.16	0.12	0.15	0.12			

Table 41 (b). Interactions showing exchangeable magnesium [c mol (p⁺) kg⁻¹] content of soils in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	1.97	2.02	P1 x D1	2.09	2.02	F1 x D1	2.74	2.91
F1 x P2	2.65	2.86	P1 x D2	1.68	1.68	F1 x D2	2.14	1.96
F1 x P3	3.13	3.27	P2 x D1	2.53	2.62	F2 x D1	2.43	2.52
F2 x P1	1.80	1.68	P2 x D2	2.28	2.36	F2 x D2	1.75	1.72
F2 x P2	2.17	2.12	P3 x D1	2.70	2.67			
F2 x P3	1.87	1.72	P3 x D2	2.31	2.32			
F-test	*	*		NS	NS		NS	NS
Sem±	0.09	0.07		0.08	0.06		0.09	0.07
CD @ 5%	0.28	0.22		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 42 (a). Exchangeable magnesium [c mol (p⁺) kg⁻¹] content of soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	2.09	1.93	2.50	2.35	3.22	2.60	3.25	2.85	3.44	2.86	3.72	3.07
F2:CON	2.12	1.97	2.20	1.95	2.11	1.91	1.90	1.75	2.20	1.75	2.07	1.62
				<i>Kharif,2008</i>			<i>Summer, 2009</i>					
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.05	0.07	0.05	0.06	0.07	0.06			
CD @ 5%				0.17	0.20	0.17	0.17	0.21	0.17			

Table 42 (b). Interactions showing Exchangeable magnesium [c mol (p⁺) kg⁻¹] content of soils in organic and conventional farming systems in Southern Transition Zone

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	2.01	2.42	P1 x D1	2.11	2.35	F1 x D1	2.92	3.15
F1 x P2	2.91	3.05	P1 x D2	1.95	2.15	F1 x D2	2.15	2.05
F1 x P3	3.15	3.40	P2 x D1	2.66	2.57	F2 x D1	2.46	2.75
F2 x P1	2.05	2.07	P2 x D2	2.26	2.30	F2 x D2	1.87	1.77
F2 x P2	2.01	1.82	P3 x D1	2.82	2.90			
F2 x P3	1.97	1.85	P3 x D2	2.30	2.35			
F-test	*	*		NS	NS		NS	NS
Sem±	0.10	0.10		0.08	0.08		0.10	0.10
CD @ 5%	0.29	0.29		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

conventional farming it ranged from 1.99 (0-3yrs) to 2.32 C mol (p⁺) kg⁻¹ (3- 6yrs) during *kharif* 2008 and from 1.80 (0-3yrs) to 2.20 C mol (p⁺) kg⁻¹ (3-6yrs) during summer 2009.

However, exchangeable magnesium content was significantly varied between farming systems and periods of practice interaction (Table 41b), during *kharif* 2008 and summer 2009.

Southern Transition zone

The exchangeable magnesium content in soils collected from the Southern Transition zone of Karnataka (Table 42a) differed significantly among farming systems during different periods of practice of organic and conventional farming during *kharif* 2008 and summer 2009.

The exchangeable magnesium content in surface soils of organic farming system ranged from 2.09 (0-3yrs) to 3.44 C mol (p⁺) kg⁻¹ (over 6yrs) during *kharif* 2008 and from 2.50 (0-3yrs) to 3.72 C mol (p⁺) kg⁻¹ (over 6yrs) during summer 2009, whereas in conventional farming it ranged from 2.11 (3- 6yrs) to 2.20 C mol (p⁺) kg⁻¹ (> 6yrs) during *kharif* 2008 and from 1.90 (3-6yrs) to 2.20 C mol (p⁺) kg⁻¹ (0-3yrs) during summer 2009.

Interaction studies between farming systems & depth and periods & depths (Table 42b), revealed that the variations in exchangeable magnesium was on par. However, significant difference was found in farming systems and periods of their practice during *kharif* 2008 and summer 2009.

4.3.5.3 Available Sulphur

The available sulphur content in soils sampled from organic and conventional farming systems compared over three different periods of practice under three selected

Table 43 (a). Available sulphur (mg kg⁻¹) content of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	4.69	4.28	4.59	4.10	5.90	5.43	5.63	5.15	7.67	7.08	7.84	7.31
F2:CON	4.95	4.40	4.96	4.31	3.86	3.51	3.57	3.34	5.33	4.67	4.96	4.23
				<i>Kharif '2008</i>		<i>Summer ' 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.14	0.17	0.14	0.14	0.17	0.14			
CD @ 5%				0.40	0.49	0.40	0.41	0.50	0.41			

Table 43 (b). Interactions showing available sulphur (mg kg⁻¹) content of soils in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	4.49	4.34	P1 x D1	4.82	4.78	F1 x D1	6.09	6.02
F1 x P2	5.67	5.39	P1 x D2	4.34	4.20	F1 x D2	4.71	4.50
F1 x P3	7.37	7.57	P2 x D1	4.88	4.60	F2 x D1	5.60	5.52
F2 x P1	4.67	4.64	P2 x D2	4.47	4.24	F2 x D2	4.19	3.96
F2 x P2	3.69	3.45	P3 x D1	6.50	6.40			
F2 x P3	5.01	4.59	P3 x D2	5.87	5.77			
F-test	*	*		Ns	NS		Ns	NS
Sem±	0.24	0.24		0.19	0.20		0.24	0.20
CD @ 5%	0.69	0.70		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 44 (a). Available sulphur (mg kg⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)								
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009						
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)					
F1:ORG #	4.58	4.16	4.52	3.79	3.91	3.54	3.89	3.49	4.34	4.70	4.18	4.23					
F2:CON	4.21	3.54	3.79	3.10	3.10	2.73	3.00	2.72	2.72	2.34	2.56	2.28					
				Kharif '2008				Summer '2009									
				F		P		D		F		P		D			
				F-test		*		*		*		*		*			
				Sem±		0.12		0.15		0.12		0.10		0.12		0.10	
				CD @ 5%		0.36		0.44		0.36		0.29		0.36		0.29	

Table 44 (b). Interactions showing available sulphur (mg kg⁻¹) content of soils in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	4.37	4.16	P1 x D1	4.39	4.15	F1 x D1	4.27	4.20
F1 x P2	3.72	3.69	P1 x D2	3.85	3.45	F1 x D2	3.34	3.12
F1 x P3	4.52	4.20	P2 x D1	3.50	3.45	F2 x D1	4.13	3.84
F2 x P1	3.87	3.44	P2 x D2	3.18	3.10	F2 x D2	2.97	2.70
F2 x P2	2.96	2.86	P3 x D1	3.53	3.37			
F2 x P3	2.63	2.42	P3 x D2	3.62	3.25			
F-test	*	*		NS	NS		NS	NS
Sem±	0.22	0.17		0.18	0.14		0.22	0.17
CD @ 5%	0.63	0.51		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 45 (a). Available .sulphur (mg kg-1) content of soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	7.07	6.57	6.36	6.03	6.97	6.14	7.12	6.57	7.37	6.99	7.86	6.79
F2:CON	7.30	6.71	5.91	5.42	6.06	5.53	5.30	5.25	6.12	5.88	5.86	5.50
				<i>Kharif '2008</i>		<i>Summer '2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.13	0.17	0.13	0.18	0.23	0.18			
CD @ 5%				0.40	0.49	0.40	0.53	0.67	0.53			

Table 45 (b). Interactions showing available sulphur (mg kg-1) content of soils in organic and conventional farming systems in Southern Transition Zone

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	6.28	6.39	P1 x D1	7.18	6.33	F1 x D1	7.14	7.01
F1 x P2	6.35	6.84	P1 x D2	6.64	5.72	F1 x D2	6.49	5.69
F1 x P3	7.18	6.97	P2 x D1	6.51	6.21	F2 x D1	6.56	6.46
F2 x P1	7.01	7.66	P2 x D2	5.83	5.91	F2 x D2	6.04	5.39
F2 x P2	5.79	5.27	P3 x D1	6.74	6.51			
F2 x P3	6.01	6.68	P3 x D2	6.43	6.14			
F-test	*	*		NS	NS		NS	NS
Sem±	0.24	0.32		0.19	0.26		0.24	0.32
CD @ 5%	0.69	0.94		-	--		-	-

F: Farming Systems (2)
 F1- ORG: Organic Farming
 F2- CON: Conventional Framing
 # :Mean of 4 farmers

P: Years (3)
 P1 :0-3 Years
 P2: 3-6 Years & P3: > 6 Years
 * : Significant (p=0.05)

D: Depth (cm) (2)
 D 1:0-15
 D 2: 15-30
 NS: Non Significant

agroclimatic zones of Southern Karnataka. The results are presented in tables 43, 44 and 45.

Central Dry zone

The available sulphur content in surface soils collected from Central Dry zone of Karnataka (Table 43a.) differed significantly with organic and conventional farming systems in three different periods of practice, at two depths during *kharif* 2008 and summer 2009.

In organic farming system, the available sulphur content in surface soils ranged from 4.69 (0-3yrs) to 7.67 mg kg⁻¹ (>6yrs) during *kharif* 2008 and from 4.59 (0-3 yrs) to 7.84 mg kg⁻¹ (>6yrs) during summer 2009. In conventional farming it ranged from 3.86 (3-6yrs) to 5.33 mg kg⁻¹ (> 6yrs) and from 3.57 (0-3yrs) to 4.96 mg kg⁻¹ (> 6 yrs) during *kharif* 2008 and summer 2009, respectively.

Interaction studies revealed that there was a significant difference in soil available sulphur content between farming systems and periods (Table 43 b), during both the seasons .However, the interactions between farming systems & depth and periods & depth varied non significantly w.r.t available sulphur content.

Southern Dry zone

The soils sampled from Southern Dry zone of Karnataka (Table 44a) has recorded significant differences in available sulphur content with farming systems during three different periods of practice in both the seasons viz., *kharif* 2008 and summer 2009.

The surface soil's available sulphur content in organic farming system ranged from 3.90 (3-6yrs) to 4.58 mg kg⁻¹ (0-3yrs) during *kharif* 2008 and from 3.89 (3-6 yrs) to 4.52 mg kg⁻¹ (0-3yrs) during summer 2009, whereas in conventional farming it ranged

from 2.72 (over 6yrs) to 4.21 mg kg⁻¹ (0-3yrs) and from 2.56 (over 6yrs) to 3.79 mg kg⁻¹ (0-3yrs) during *kharif* 2008 and summer 2009, respectively.

The available sulphur recorded significant variations in farming systems and periods of organic or conventional practice interactions (Table 44b), during *kharif* 2008 and summer 2009 seasons.

Southern Transition zone

Significant differences in available sulphur content with organic and conventional farming systems were recorded in soils sampled under Southern Transition zone of Karnataka (Table 45a) in all the three different periods of practice, in two depths during *kharif* 2008 and summer 2009.

The available sulphur content in surface soils of organic farming system ranged from 6.97 (3-6yrs) to 7.37 mg kg⁻¹ (over 6yrs) during *kharif* 2008 and 6.36 (0-3yrs) to 7.86 mg kg⁻¹ (over 6yrs) during summer 2009, whereas in conventional farming it ranged from 6.06 (3-6yrs) to 7.30 mg kg⁻¹ (0-3yrs) during *kharif* 2008 and from 5.30 (3-6yrs) to 5.91 mg kg⁻¹ (0-3yrs) during summer 2009.

The interaction studies (Table 45b) showed significant variations in available sulphur (mg kg⁻¹) content between farming systems and different periods of their practice during *kharif* 2008 and summer 2009.

4.3.6 DTPA extractable Micro Nutrients

4.3.6.1 DTPA extractable Iron (Fe)

The data on comparative changes in soil DTPA extractable iron (mg kg⁻¹) in different periods of organic and conventional farming systems under three selected agroclimatic zones of Southern Karnataka are presented in tables 46, 47 and 48.

Table 46 (a). DTPA extractable iron (mg kg⁻¹) content of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	6.62	6.02	5.95	5.27	7.55	5.65	6.65	5.32	8.17	5.94	7.88	6.06
F2:CON	6.27	4.98	5.71	4.52	5.27	3.54	4.68	3.01	5.51	3.10	4.85	3.13
				<i>Kharif,2008</i>		<i>Summer, 2009</i>						
				F	P	D	F	P	D			
F-test				*	-	*	*	*	*			
Sem±				0.24	0.29	0.24	0.19	0.24	0.19			
CD @ 5%				0.69	0.71	0.69	0.57	0.69	0.57			

Table 46 (b). Interactions showing DTPA extractable iron (mg kg⁻¹) content of soils in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	6.32	5.81	P1 x D1	6.44	5.83	F1 x D1	7.21	6.69
F1 x P2	6.66	5.79	P1 x D2	5.50	5.09	F1 x D2	5.35	4.75
F1 x P3	7.05	6.97	P2 x D1	6.06	5.46	F2 x D1	5.87	5.69
F2 x P1	5.63	5.11	P2 x D2	4.59	4.17	F2 x D2	3.84	3.39
F2 x P2	4.40	3.85	P3 x D1	6.34	5.87			
F2 x P3	4.30	3.99	P3 x D2	4.47	4.35			
F-test	*	*		NS	NS		NS	NS
Sem±	0.41	0.34		0.33	0.28		0.41	0.34
CD @ 5%	1.19	0.98		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 47 (a). DTPA extractable iron (mg kg⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	6.44	4.91	6.22	4.85	9.55	6.77	8.55	7.71	13.14	9.28	12.17	10.39
F2:CON	6.32	4.18	5.26	3.72	5.53	3.95	4.60	3.30	8.14	6.25	7.24	6.01
				Kharif,2008		Summer, 2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.34	0.41	0.34	0.32	0.39	0.32			
CD @ 5%				0.98	1.20	0.98	0.93	1.14	0.93			

Table 47 (b). Interactions showing DTPA extractable iron (mg kg⁻¹) content of soils in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	5.67	5.54	P1 x D1	6.38	5.74	F1 x D1	9.71	10.31
F1 x P2	8.16	9.13	P1 x D2	4.54	4.28	F1 x D2	5.66	4.70
F1 x P3	11.21	12.28	P2 x D1	7.54	7.57	F2 x D1	6.98	7.65
F2 x P1	5.25	4.49	P2 x D2	5.36	5.50	F2 x D2	3.79	3.47
F2 x P2	4.74	3.95	P3 x D1	9.14	9.21			
F2 x P3	4.19	3.82	P3 x D2	6.26	6.90			
F-test	*	*		NS	NS		NS	NS
Sem±	0.59	0.56		0.48	0.45		0.59	0.56
CD @ 5%	1.70	1.61		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 48(a). DTPA extractable iron (mg kg⁻¹) content of soils as influenced by Organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	24.87	22.01	23.64	24.93	32.22	25.85	31.04	28.12	39.99	32.22	38.75	31.68
F2:CON	23.65	21.05	22.94	20.79	26.38	15.34	21.41	13.34	30.17	28.60	29.35	22.28
				<i>Kharif '2008</i>		<i>Summer '2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				2.28	2.40	2.28	1.88	2.30	1.88			
CD @ 5%				6.48	7.54	6.48	5.42	6.58	5.42			

Table 48 (b). Interactions showing DTPA extractable iron (mg kg⁻¹) content of soils in organic and conventional farming systems in Southern Transition Zone

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	23.44	24.28	P1 x D1	31.26	26.79	F1 x D1	34.69	33.15
F1 x P2	29.53	29.58	P1 x D2	26.03	22.86	F1 x D2	28.40	22.90
F1 x P3	36.10	35.21	P2 x D1	29.80	26.23	F2 x D1	28.36	28.24
F2 x P1	22.35	22.86	P2 x D2	20.59	20.73	F2 x D2	22.99	18.13
F2 x P2	20.86	17.37	P3 x D1	33.58	31.05			
F2 x P3	29.38	25.81	P3 x D2	30.41	25.98			
F-test	*	*		NS	NS		NS	NS
Sem±	2.96	2.26		3.23	2.66		3.96	3.26
CD @ 5%	8.78	6.42		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Central Dry zone

The iron content of soils from Central Dry zone of Karnataka differs significantly among organic and conventional farming systems. However, it did not show significant variation in three different periods of practice in the both the seasons.

During *kharif* 2008, Iron content of surface soils (Table 46a.) from organic farming system ranged from 6.62 (0-3yrs) to 8.17 mg kg⁻¹ (over 6yrs) and during summer 2009 it ranged from 5.95 (0-3yrs) to 7.88 mg kg⁻¹ (over 6yrs). In conventional farming, iron content ranged from 4.51(over 6yrs) to 6.27 mg kg⁻¹ (0-3yrs) and from 3.85 (over 6yrs) to 5.71 mg kg⁻¹ (0-3 yrs) during *kharif* 2008 and summer 2009, respectively. An increase in DTPA extractable iron content was observed from 0-3 yrs to >6 yrs of organic farming, whereas it was not with conventional farming in both the depths and in both the seasons.

For farming systems with depth and periods with depths interactions (Table 46 b), the soil DTPA extractable iron content varied non significantly. However, it varied significantly among farming systems and periods of their practice during both the seasons.

Southern Dry zone

In soils sampled from Southern Dry zone of Karnataka (Table 47 a) , DTPA extractable iron content differed significantly with farming practice in three different periods of practice, at two depths during *kharif* 2008 and summer 2009.

The DTPA extractable iron content of surface soils from organic farming system ranged from 6.44 (0-3yrs) to 13.14 mg kg⁻¹ (> 6yrs) and from 6.22 (0-3 yrs) to 14.17 mg kg⁻¹ (> 6yrs) during *kharif* 2008 and summer 2009, respectively, whereas in conventional farming it ranged from 5.14 (over 6yrs) to 6.32 mg kg⁻¹ (0-3yrs) during *kharif* 2008 and from 4.24 (over 6yrs) to 5.26 mg kg⁻¹ (0-3yrs) during summer 2009. An

increasing trend was observed in soil available iron from 0-3 yrs to >6 years of organic farming, and was not so with the conventional farming in both the depths and in both the seasons.

However, DTPA extractable iron content has shown significant variation in interactions (Table 47 b) between farming systems & periods of their practice during *kharif* 2008 and summer 2009.

Southern Transition zone

The DTPA extractable iron content of soils from Southern Transition zone of Karnataka (Table 48a) has showed significant difference among organic and conventional farming systems during *kharif* 2008 and summer 2009.

In organic farming system, iron content in surface soils ranged from 24.87 (0-3yrs) to 39.99 mg kg⁻¹ (over 6yrs) during *kharif* 2008 and from 23.64 (0-3yrs) to 38.75 mg kg⁻¹ (over 6yrs) during summer 2009. In conventional farming iron (mg kg⁻¹) content ranged from 23.65 (0-3yrs) to 30.17 mg kg⁻¹ (>6yrs) during *kharif* 2008 and from 21.41 (3-6yrs) to 29.35 mg kg⁻¹ (0-3yrs) in summer 2009. Increase in iron content was observed from 0-3 yrs to >6 yrs of organic farming practice, whereas it was not so with the conventional farming.

Interaction studies (Table 48 b) showed non significant differences in DTPA extractable iron content irrespective of farming systems, periods or depths during *kharif* 2008 and summer 2009.

4.3.6.2 DTPA extractable Copper (Cu)

DTPA extractable Copper content in soils sampled from three different periods of practice of organic and conventional farming systems under three selected agroclimatic

Table 49 (a). DTPA extractable copper (mg kg^{-1}) content of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	1.74	1.71	1.45	1.38	2.25	1.69	2.39	1.76	3.85	2.37	3.31	2.44
F2:CON	1.57	1.64	1.35	1.23	1.44	1.26	1.06	0.95	2.02	1.90	1.59	1.55
				Kharif '2008		Summer '2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem $\pm$				0.11	0.14	0.11	0.09	0.11	0.09			
CD @ 5%				0.33	0.41	0.33	0.27	0.33	0.27			

Table 49 (b). Interactions showing DTPA extractable copper (mg kg^{-1}) content of soils in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	1.65	1.42	P1 x D1	1.64	1.40	F1 x D1	2.55	2.38
F1 x P2	1.97	2.07	P1 x D2	1.69	1.31	F1 x D2	1.72	1.33
F1 x P3	3.11	2.88	P2 x D1	1.84	1.73	F2 x D1	1.93	1.86
F2 x P1	1.67	1.29	P2 x D2	1.47	1.35	F2 x D2	1.60	1.24
F2 x P2	1.35	1.00	P3 x D1	2.93	2.45			
F2 x P3	1.96	1.57	P3 x D2	2.13	2.00			
F-test	*	*		NS	NS		NS	NS
Sem $\pm$	0.20	0.16		0.16	0.13		0.20	0.16
CD @ 5%	0.58	0.46		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant ($p=0.05$)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 50 (a). DTPA extractable copper (mg kg⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	2.13	1.74	1.87	1.51	2.51	1.77	2.278	2.13	3.74	2.14	3.92	2.23
F2:CON	1.98	1.45	1.46	1.18	1.12	0.74	1.56	1.25	1.75	1.36	1.29	1.04
				<i>Kharif '2008</i>		<i>Summer '2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	NS	*			
Sem±				0.12	0.15	0.12	0.14	0.17	0.14			
CD @ 5%				0.35	0.43	0.35	0.41	-	0.41			

Table 50 (b). Interactions showing DTPA extractable copper (mg kg⁻¹) content of soils in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	1.93	1.16	P1 x D1	2.05	1.66	F1 x D1	2.79	2.85
F1 x P2	2.14	2.45	P1 x D2	1.59	1.34	F1 x D2	1.62	1.44
F1 x P3	2.94	3.07	P2 x D1	1.81	2.17	F2 x D1	1.88	1.95
F2 x P1	1.72	1.32	P2 x D2	1.25	1.69	F2 x D2	1.18	1.15
F2 x P2	0.93	1.41	P3 x D1	2.75	2.60			
F2 x P3	1.55	1.16	P3 x D2	1.75	1.63			
F-test	*	*		NS	NS		NS	NS
Sem±	0.21	0.25		0.17	0.20		0.21	0.25
CD @ 5%	0.61	0.72		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 51 (a). DTPA extractable copper (mg kg^{-1}) content of soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	2.53	2.28	2.60	2.03	3.57	2.06	3.61	2.16	4.32	3.82	4.68	3.99
F2:CON	2.34	1.81	2.06	1.60	2.35	1.65	1.97	1.26	2.78	2.40	2.24	1.93
				<i>Kharif '2008</i>		<i>Summer '2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.16	0.20	0.16	0.16	0.19	0.16			
CD @ 5%				0.47	0.58	0.47	0.46	0.56	0.46			

Table 51 (b). Interactions showing DTPA extractable copper (mg kg^{-1}) content of soils in organic and conventional farming systems in Southern Transition Zone

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	2.40	2.31	P1 x D1	2.44	2.33	F1 x D1	3.47	3.63
F1 x P2	2.81	2.88	P1 x D2	2.04	1.81	F1 x D2	2.45	2.09
F1 x P3	4.07	4.33	P2 x D1	2.96	2.79	F2 x D1	2.72	2.72
F2 x P1	1.92	1.83	P2 x D2	1.85	1.71	F2 x D2	1.95	1.60
F2 x P2	2.00	1.61	P3 x D1	3.55	3.46			
F2 x P3	2.99	2.08	P3 x D2	3.11	2.96			
F-test	*	*		NS	NS		NS	NS
Sem±	0.28	0.27		0.23	0.22		0.28	0.27
CD @ 5%	0.79	0.79		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant ($p=0.05$)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

zones of Southern Karnataka were compared and the results are presented in tables 49, 50 and 51.

Central Dry zone

The DTPA extractable copper content of soils from organic and conventional farming differed significantly with farming systems in all the three different periods of practice, in two depths during *kharif* 2008 and summer 2009

The DTPA extractable copper in surface soils (Table 49 a.) of organic farming system ranged from 1.74 (0-3yrs) to 3.85 mg kg⁻¹ (over 6yrs) during *kharif* 2008 and from 1.45 (0-3yrs) to 3.31 mg kg⁻¹ (over 6yrs) during summer 2009, whereas in conventional farming it ranged from 1.44 (3-6yrs) to 2.02 mg kg⁻¹ (over 6yrs) and from 1.06 (3-6yrs) to 1.59 mg kg⁻¹ (over 6yrs) during *kharif* 2008 and summer 2009 respectively.

For farming systems & depth and periods & depths interactions (Table 49 b), the variation in DTPA extractable copper content in soil variation was non significant. However, it varied significantly in farming systems with periods during *kharif* 2008 and summer 2009.

Southern Dry zone

Soils sampled under Southern Dry zone of Karnataka (Table 50a) differed significantly in DTPA extractable copper content with farming systems in all the three different periods (except during summer 2009) of practice, in two depths during *kharif* 2008 and summer 2009.

The surface soil DTPA extractable copper content in organic farming system ranged from 2.13 (0-3yrs) to 3.74 mg kg⁻¹ (> 6yrs) during *kharif* 2008 and from 1.87 (0-3 yrs) to 3.92 mg kg⁻¹ (> 6yrs) during summer 2009, whereas in conventional farming it ranged

from 1.12 (3-6yrs) to 1.98 mg kg⁻¹ (0-3yrs) during *kharif* 2008 and from 1.29 (over 6yrs) to 1.56 mg kg⁻¹ (3-6yrs) during summer 2009.

Interactions between farming systems & depth and periods & depths (Table 50 b), the soil DTPA extractable copper content varied not significantly during both the seasons. However, it varied significantly in interactions between farming systems & periods of practice.

Southern Transition zone

The soil samples collected from Southern Transition zone of Karnataka (Table 51 a) significantly different in DTPA extractable copper content with organic and conventional farming in three different periods of practice, at two depths during *kharif* 2008 and summer 2009.

During *kharif* 2008, DTPA extractable copper content in surface soils of organic farming system ranged from 2.53 (0-3yrs) to 4.32 mg kg⁻¹ (over 6yrs) and during summer 2009 it ranged from 2.60 (0-3yrs) to 4.68 mg kg⁻¹ (over 6yrs). In conventional farming the copper content ranged from 2.34 (0-3yrs) to 2.78 mg kg⁻¹ (over 6yrs) during *kharif* 2008 and from 1.97 (3-6yrs) to 2.24 mg kg⁻¹ (over 6yrs) during summer 2009.

Interactions between farming systems & depth and periods & depths (Table 51 b), soil DTPA extractable copper content varied non significantly. However, the copper content varied significantly in farming systems and periods of their practice during *kharif* 2008 and summer 2009.

4.3.6.3 DTPA extractable Manganese (Mn)

The data on comparative changes in soil manganese content in three different periods of organic and conventional farming practice systems under three selected agroclimatic zones of Southern Karnataka are presented in tables 52, 53 and 54.

Table 52 (a). DTPA extractable manganese (mg kg^{-1}) content of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	16.92	17.54	15.95	15.49	24.18	19.92	26.38	22.06	39.68	29.82	36.73	31.86
F2:CON	14.51	19.64	12.98	15.72	12.74	10.08	10.03	8.41	27.00	22.22	22.86	18.38
				Kharif '2008		Summer '2009						
				F	P	D	F	P	D			
F-test				*	*	NS	*	*	NS			
Sem $\pm$				1.67	2.05	1.67	1.26	1.54	1.26			
CD @ 5%				4.82	5.90	-	3.63	4.45	-			

Table 52 (b). Interactions showing DTPA extractable manganese (mg kg^{-1}) content of soils in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	17.23	15.72	P1 x D1	15.71	14.47	F1 x D1	26.93	26.35
F1 x P2	22.05	24.22	P1 x D2	18.59	15.60	F1 x D2	18.08	15.29
F1 x P3	34.75	34.30	P2 x D1	18.46	18.21	F2 x D1	22.42	23.14
F2 x P1	17.08	14.35	P2 x D2	15.00	15.23	F2 x D2	17.31	14.17
F2 x P2	11.41	9.22	P3 x D1	33.34	29.80			
F2 x P3	24.61	20.62	P3 x D2	26.02	25.12			
F-test	NS	*		NS	NS		NS	NS
Sem $\pm$	2.90	1.18		2.36	1.78		2.90	2.18
CD @ 5%	-	6.29		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant ($p=0.05$)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 53 (a). DTPA extractable manganese (mg kg⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	14.46	9.67	12.91	9.51	32.91	24.06	32.92	23.05	34.15	26.42	33.81	27.15
F2:CON	12.32	8.82	10.54	7.91	11.40	8.07	10.47	7.82	17.60	14.82	14.78	12.07
				<i>Kharif '2008</i>		<i>Summer '2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				1.01	1.24	1.01	0.80	0.98	0.80			
CD @ 5%				2.91	3.57	2.91	2.31	2.83	2.31			

Table 53 (b). Interactions showing DTPA extractable manganese (mg kg⁻¹) content of soils in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	12.07	11.21	P1 x D1	13.39	11.73	F1 x D1	27.17	26.55
F1 x P2	29.10	27.98	P1 x D2	9.24	8.71	F1 x D2	11.44	10.26
F1 x P3	29.67	30.48	P2 x D1	24.27	22.69	F2 x D1	20.05	19.90
F2 x P1	10.57	9.23	P2 x D2	17.07	15.95	F2 x D2	7.90	7.28
F2 x P2	9.73	9.14	P3 x D1	20.25	20.79			
F2 x P3	16.21	13.42	P3 x D2	15.62	16.11			
F-test	*	*		NS	NS		NS	NS
Sem±	1.75	1.39		1.43	1.13		1.75	1.39
CD @ 5%	5.05	4.01		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 54 (a). DTPA extractable manganese (mg kg⁻¹) content of soils as influenced by organic and conventional farming in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	38.98	29.54	35.77	27.30	32.30	24.02	31.92	25.80	39.91	30.31	41.75	33.05
F2:CON	36.26	31.54	31.87	27.75	24.22	18.69	18.67	14.70	23.06	18.35	18.72	15.45
				Kharif '2008		Summer '2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				1.60	1.96	1.60	1.34	1.64	1.34			
CD @ 5%				4.60	5.64	4.60	3.87	4.74	3.87			

Table 54 (b). Interactions showing DTPA extractable manganese (mg kg⁻¹) content of soils in organic and conventional farming systems in Southern Transition Zone

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	34.72	31.53	P1 x D1	38.09	33.82	F1 x D1	37.06	36.48
F1 x P2	28.16	28.86	P1 x D2	30.54	27.52	F1 x D2	27.85	23.09
F1 x P3	34.64	37.40	P2 x D1	28.26	25.30	F2 x D1	27.95	28.71
F2 x P1	33.90	29.81	P2 x D2	21.36	20.25	F2 x D2	22.86	19.30
F2 x P2	21.46	16.68	P3 x D1	31.02	30.22			
F2 x P3	20.70	17.08	P3 x D2	24.33	24.25			
F-test	NS	*		NS	NS		NS	NS
Sem±	2.77	2.33		2.26	1.90		2.77	2.33
CD @ 5%	-	6.70		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Signifif (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Central Dry zone

The DTPA extractable manganese content in soils under Central Dry zone of Karnataka differ significantly with organic and conventional farming systems over different periods of practice (0-3, 3-6 and >6 years). However, non significant results were recorded in manganese content with the depths during *kharif* 2008 and summer 2009.

The DTPA extractable manganese content in surface soils (Table 52 a.) of organic farming system ranged from 16.92 (0-3yrs) to 39.68 mg kg⁻¹ (over 6yrs) during *kharif* 2008 and 15.95 (0-3yrs) to 36.73 mg kg⁻¹ (over 6yrs) during summer 2009, whereas in conventional farming it ranged from 12.74 (3-6yrs) to 27.00 mg kg⁻¹ (over 6yrs) during *kharif* 2008 and 10.03 (3-6yrs) to 22.86 mg kg⁻¹ (over 6yrs) during summer 2009. An increasing trend was observed in soil available manganese content from 0-3 yrs to >6 yrs of organic farming, and it was not so with the conventional farming.

The interaction studies showed significant variation in soil DTPA extractable manganese content between farming systems & depth and periods & depths (Table 52 b). However, it varied significantly in interactions between farming systems and periods of practice during both the seasons.

Southern Dry zone

The DTPA extractable manganese content of soil samples collected under Southern Dry zone of Karnataka (Table 53 a) was varied significantly with farming systems , different periods of practice and in two depths (0-15 and 15-30cm) during *kharif* 2008 and summer 2009.

The DTPA extractable manganese content of surface soils in organic farming system ranged from 14.46 (0-3yrs) to 34.15 mg kg⁻¹ (> 6yrs) during *kharif* 2008 and 12.91 (0-3 yrs) to 33.81 mg kg⁻¹ (> 6yrs) during summer 2009, whereas in conventional

farming it ranged from 7.60 (over 6yrs) to 14.40 mg kg⁻¹ (3-6yrs) during *kharif* 2008 and 7.78 (over 6yrs) to 12.47 mg kg⁻¹ (3-6yrs) during summer 2009.

The interactions between farming systems & depth and periods & depths (Table 53 b) of soil DTPA extractable manganese content varied non significantly. However, it varied significantly for farming systems & periods during both the seasons as revealed by interaction studies.

Southern Transition zone

The DTPA extractable manganese content of soils of Southern Transition agroclimatic zone of Karnataka (Table 54 a) differed significantly in organic and conventional farming systems, in 3-6 years and over 6 years of practice, and in two depths during *kharif* 2008 and summer 2009.

The surface soil DTPA extractable manganese content (mg kg⁻¹) in organic farming system ranged from 32.30 (3-6yrs) to 39.91 mg kg⁻¹ (over 6yrs) during *kharif* 2008 and 31.92 (3-6yrs) to 41.75 mg kg⁻¹ (over 6yrs) during summer 2009, whereas in conventional farming it ranged from 23.06 (over 6yrs) to 36.26 mg kg⁻¹ (0-3yrs) and from 18.67 (3-6yrs) to 31.87 mg kg⁻¹ (0-3yrs) during *kharif* 2008 and *summer* 2009 respectively.

However, DTPA extractable manganese content showed (Table 54 b) non significant interactions between farming systems & periods (except during summer 2009), farming systems & depth and periods & depths interactions in both the seasons.

4.3.6.4 DTPA extractable Zinc (Zn)

The DTPA extractable zinc content of soils under organic and conventional farming systems was compared over three different periods of practice under three selected agroclimatic zones of Southern Karnataka. The results are presented in tables 55, 56 and 57.

Table 55 (a). DTPA extractable zinc (mg kg⁻¹) content of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	0.39	0.22	0.35	0.19	0.79	0.24	0.91	0.31	0.98	0.63	1.08	0.73
F2:CON	0.41	0.27	0.32	0.20	0.32	0.23	0.24	0.15	0.44	0.42	0.30	0.28
				<i>Kharif '2008</i>		<i>Summer '2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.03	0.04	0.03	0.03	0.04	0.03			
CD @ 5%				0.10	0.13	0.10	0.10	0.12	0.10			

Table 55(b). Interactions showing DTPA extractable zinc (mg kg⁻¹) content of soils in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	0.30	0.27	P1 x D1	0.40	0.34	F1 x D1	0.72	0.78
F1 x P2	0.52	0.61	P1 x D2	0.24	0.19	F1 x D2	0.39	0.29
F1 x P3	0.80	0.90	P2 x D1	0.56	0.57	F2 x D1	0.36	0.41
F2 x P1	0.34	0.26	P2 x D2	0.23	0.23	F2 x D2	0.30	0.21
F2 x P2	0.27	0.19	P3 x D1	0.71	0.69			
F2 x P3	0.43	0.29	P3 x D2	0.52	0.50			
F-test	*	*		*	*		NS	NS
Sem±	0.06	0.06		0.05	0.05		0.06	0.06
CD @ 5%	0.18	0.17		0.15	0.14		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 56 (a). DTPA extractable zinc (mg kg⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	0.38	0.30	0.37	0.27	0.51	0.33	0.71	0.40	1.02	0.73	1.27	0.87
F2:CON	0.37	0.27	0.31	0.22	0.29	0.22	0.21	0.17	0.40	0.29	0.28	0.18
				Kharif '2008		Summer '2009						
				F	P	D	F	P	D			
F-test				*	*	NS	*	*	*			
Sem±				0.06	0.07	0.06	0.04	0.06	0.04			
CD @ 5%				0.17	0.21	-	0.14	0.17	0.14			

Table 56 (b). Interactions showing DTPA extractable zinc (mg kg⁻¹) content of soils in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	0.34	0.32	P1 x D1	0.37	0.34	F1 x D1	0.64	0.78
F1 x P2	0.42	0.55	P1 x D2	0.28	0.24	F1 x D2	0.35	0.27
F1 x P3	0.87	1.07	P2 x D1	0.40	0.46	F2 x D1	0.45	0.51
F2 x P1	0.32	0.26	P2 x D2	0.27	0.28	F2 x D2	0.26	0.19
F2 x P2	0.25	0.1	P3 x D1	0.71	0.77			
F2 x P3	0.34	0.23	P3 x D2	0.51	0.52			
F-test	NS	*		NS	NS		NS	NS
Sem±	0.10	0.08		0.08	0.06		0.10	0.08
CD @ 5%	-	0.24		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 57 (a). DTPA extractable zinc (mg kg^{-1}) content of soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	1.64	1.08	1.44	0.95	1.08	0.85	1.13	0.92	1.10	0.74	1.31	0.92
F2:CON	0.82	0.68	0.72	0.56	0.69	0.47	0.55	0.39	0.49	0.42	0.36	0.30
				<i>Kharif '2008</i>		<i>Summer '2009</i>						
				F	P	D	F	P	D			
F-test				*	NS	NS	*	NS	NS			
Sem $\pm$				0.11	0.13	0.11	0.09	0.12	0.09			
CD @ 5%				0.32	-	-	0.28	-	-			

Table 57 (b). Interactions showing DTPA extractable zinc (mg kg^{-1}) content of soils in organic and conventional farming systems in Southern Transition Zone

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	1.36	1.19	P1 x D1	1.23	1.08	F1 x D1	1.27	1.29
F1 x P2	0.96	1.02	P1 x D2	0.88	0.76	F1 x D2	0.66	.54
F1 x P3	0.92	1.11	P2 x D1	0.88	0.84	F2 x D1	0.89	0.93
F2 x P1	0.75	0.64	P2 x D2	0.66	0.65	F2 x D2	0.52	0.42
F2 x P2	0.58	0.47	P3 x D1	0.80	0.83			
F2 x P3	0.45	0.33	P3 x D2	0.58	0.61			
F-test	NS	NS		NS	NS		NS	NS
Sem $\pm$	0.19	0.16		0.16	0.13		0.19	0.16
CD @ 5%	-	-		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant ($p=0.05$)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Central Dry zone

The DTPA extractable zinc content in soils under Central Dry zone of Karnataka has recorded significant variations among organic and conventional farming systems over three different periods of practice, at two depths during *kharif* 2008 and summer 2009.

The DTPA extractable Zinc content in surface soils (Table 55a.) of organic farming system ranged from 0.39 (0-3yrs) to 0.98 mg kg⁻¹ (over 6yrs) during *kharif* 2008 and 0.35 (0-3yrs) to 1.08 mg kg⁻¹ (over 6yrs) during summer 2009, whereas in conventional farming it ranged from 0.32 (3-6yrs) to 0.44 mg kg⁻¹ (over 6yrs) during *kharif* 2008 and 0.24 (3-6yrs) to 0.32 mg kg⁻¹ (0-3yrs) during summer 2009. An increasing trend was observed in soil DTPA extractable zinc content from 0-3 yrs to >6 yrs of organic farming practice, and the same was not with conventional farming.

However, DTPA extractable zinc content varied during *kharif* 2008 and summer 2009 seasons and showed significant interaction between farming systems with periods and depths (Table 55 b).

Southern Dry zone

The DTPA extractable zinc content in soils of Southern Dry zone of Karnataka (Table 56a) differed significantly in organic and conventional farming systems over three different periods of practice.

During *kharif* 2008, the DTPA extractable zinc content of surface soils from organic farming system ranged from 0.38 (0-3yrs) to 1.02 mg kg⁻¹ (> 6yrs) and during summer 2009 zinc content ranged 0.37 (0-3 yrs) to 1.27 mg kg⁻¹ (> 6yrs). In conventional farming zinc content (mg kg⁻¹) ranged from 0.29 (3-6yrs) to 0.40 mg kg⁻¹ (over 6yrs) and from 0.21 (3-6yrs) to 0.31 mg kg⁻¹ (0-3yrs) during *kharif* 2008 and summer 2009 respectively. An increasing trend was recorded in soil DTPA extractable zinc content from 0-3 years to >6 years of organic farming, and the same was not true with the conventional farming system.

The interactions between farming systems & depth and periods & depths interactions (Table 56 b), soil DTPA extractable zinc content showed no significant difference. However, it recorded significant variations among farming systems & periods interaction during summer 2009.

Southern Transition zone

The DTPA extractable zinc content of soils sampled under Southern Transition zone of Karnataka (Table 57a) showed significant variations with the farming systems. However, it was found non significant with the three different periods of practice and in two depths in both the seasons.

The DTPA extractable zinc content of surface soils of organic farming system varied from 1.08 (3-6yrs) to 1.64 mg kg⁻¹ (0-3yrs) during *kharif* 2008 and 1.13 (3-6yrs) to 1.44 mg kg⁻¹ (0-3yrs) during summer 2009, whereas in conventional farming it was varied from 0.49 (over 6yrs) to 0.82 mg kg⁻¹ (0-3yrs) and from 0.36 (over 6yrs) to 0.72 mg kg⁻¹ (0-3yrs) during *kharif* 2008 and summer 2009 seasons respectively.

However, in interaction studies, DTPA extractable zinc content showed non significant variation (Table 57b) irrespective of farming systems, periods and depth of sampling during *kharif* 2008 and summer 2009.

4.2.3.7 Cation Exchange Capacity (CEC)

The data on cation exchange capacity [C mol (p⁺) kg⁻¹] of soil during different periods of organic and conventional farming systems under three selected agroclimatic zones of Southern Karnataka are presented in tables 58,59 and 60.

Table 58 (a). Cation exchange capacity [c mol (p+) kg⁻¹] of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	16.98	14.33	18.17	15.39	17.05	15.23	18.83	17.07	21.78	20.34	23.67	21.42
F2:CON	14.94	13.45	13.53	11.45	12.81	9.96	10.39	10.02	14.22	12.39	13.44	11.86
				<i>Kharif '2008</i>				<i>Summer '2009</i>				
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.39	0.48	0.39	0.46	0.57	0.46			
CD @ 5%				1.14	1.40	1.14	1.34	1.65	1.34			

Table 58 (b). Interactions showing cation exchange capacity [c mol (p+) kg⁻¹] of soils in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	15.69	16.78	P1 x D1	15.99	15.85	F1 x D1	18.60	20.23
F1 x P2	16.10	17.95	P1 x D2	13.89	13.42	F1 x D2	13.99	12.46
F1 x P3	21.06	22.54	P2 x D1	14.89	14.61	F2 x D1	16.63	17.96
F2 x P1	14.19	12.49	P2 x D2	12.59	13.54	F2 x D2	11.93	11.11
F2 x P2	11.38	10.20	P3 x D1	18.00	18.56			
F2 x P3	13.31	12.65	P3 x D2	16.37	16.64			
F-test	*	*		NS	NS		NS	NS
Sem±	0.68	0.81		0.56	0.66		0.68	0.81
CD @ 5%	1.98	2.33		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 59 (a). Cation exchange capacity [c mol (p+) kg⁻¹] of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	17.40	13.96	17.83	14.27	22.10	20.27	24.09	21.12	25.94	23.87	27.53	24.85
F2:CON	15.75	12.98	14.49	12.46	18.23	16.18	17.56	16.19	16.77	13.04	15.05	12.42
				<i>Kharif '2008</i>		<i>Summer '2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.45	0.55	0.45	0.35	0.43	0.35			
CD @ 5%				1.30	1.60	1.30	1.01	1.24	1.01			

Table 59 (b). Interactions showing exchange capacity [c mol (p+) kg⁻¹] of soils in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	15.68	16.05	P1 x D1	16.57	16.16	F1 x D1	21.81	23.15
F1 x P2	21.18	22.60	P1 x D2	13.45	13.36	F1 x D2	16.92	15.70
F1 x P3	24.90	26.19	P2 x D1	20.16	20.83	F2 x D1	19.36	20.08
F2 x P1	14.36	13.48	P2 x D2	18.23	18.65	F2 x D2	14.06	13.69
F2 x P2	17.21	16.87	P3 x D1	21.35	21.29			
F2 x P3	14.90	13.73	P3 x D2	18.45	18.63			
F-test	*	*		NS	NS		NS	NS
Sem±	0.78	0.61		0.64	0.50		0.78	0.61
CD @ 5%	2.26	1.76		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 60 (a). Cation exchange capacity [c mol (p+) kg⁻¹] of soil as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	16.63	15.38	19.73	18.61	25.48	20.71	25.88	22.59	27.35	22.77	29.55	24.54
F2:CON	16.98	15.57	17.34	15.37	16.86	15.24	15.30	13.82	17.46	13.99	16.29	12.89
				<i>Kharif '2008</i>		<i>Summer '2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.47	0.58	0.47	0.47	0.57	0.47			
CD @ 5%				1.37	1.67	1.37	1.35	1.66	1.35			

Table 60 (b). Interactions showing cation exchange capacity [c mol (p+) kg⁻¹] of soil in Organic and conventional farming systems in Southern Transition Zone

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	16.00	19.17	P1 x D1	16.80	18.53	F1 x D1	23.15	25.05
F1 x P2	23.10	24.23	P1 x D2	15.48	16.99	F1 x D2	17.10	16.31
F1 x P3	25.06	27.05	P2 x D1	21.17	20.59	F2 x D1	19.62	21.91
F2 x P1	16.27	16.35	P2 x D2	17.98	18.21	F2 x D2	14.93	14.03
F2 x P2	16.05	14.56	P3 x D1	22.40	22.92			
F2 x P3	15.73	14.59	P3 x D2	18.38	18.71			
F-test	*	*		NS	NS		NS	NS
Sem±	0.82	0.81		0.67	0.66		0.82	0.81
CD @ 5%	2.37	2.35		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Central Dry zone (CDZ)

The cation exchange capacity of soils collected from organic and conventional farming systems under Central Dry zone of Karnataka differed significantly with farming systems at all the three different periods of practice and at two depths during *kharif* 2008 and summer 2009.

Cation exchange capacity (Table 58 a.) of surface soils in organic farming system ranged from 16.98 (0-3yrs) to 21.78 C mol (p⁺) kg⁻¹ (> 6yrs) during *kharif* 2008 and 18.17 (0-3yrs) to 23.67 C mol (p⁺) kg⁻¹ (over 6yrs) during summer 2009, whereas in conventional farming system it ranged from 12.81 (3-6yrs) to 14.94 C mol (p⁺) kg⁻¹ (0-3yrs) during *kharif* 2008 and 10.39 (3-6yrs) to 13.53 C mol (p⁺) kg⁻¹ (0-3 yrs) during summer 2009. An increasing trend was observed in CEC from 0-3 years to over 6years of organic farming practice, whereas it was not so with the conventional farming at both the depths and both the seasons.

The cation exchange Capacity of soils showed no variation among farming systems with depth and periods of practice with depths of soil sampling as revealed by interaction studies (Table 58 b). However, CEC showed significant difference in interactions between farming systems and periods of practice during *Kharif* 2008 and summer 2009.

Southern Dry zone (SDZ)

The cation exchange capacity of soils under Southern Dry zone of Karnataka collected from organic and conventional farming systems (Table 59a) differed significantly among farming systems during all the three different periods of practice, at two depths during *kharif* 2008 and summer 2009. Significantly higher CEC values were recorded in organic farming fields compared to conventional farming.

In surface soils of organic farming system, the CEC ranged from 17.40 (0-3yrs) to 25.94 C mol (p⁺) kg⁻¹ (> 6yrs) during *kharif* 2008 and ranged from 17.83 (0-3 yrs) to 27.53 C mol (p⁺) kg⁻¹ (>6yrs) during summer 2009, whereas in soils of conventional farming system it ranged from 15.75 (0-3yrs) to 18.23 C mol (p⁺) kg⁻¹ (3-6yrs) during *kharif* 2008 and 14.49 (0-3yrs) to 17.56 C mol (p⁺) kg⁻¹ (3-6yrs) during summer 2009. An increasing trend was observed in Cation Exchange Capacity of soils from 0-3 years to over 6 years of organic farming practice, and it was not so with the conventional farming at both the depths during both the seasons.

There was no significant differences, in CEC of soils were observed among farming systems with depth and periods with depths interactions (Table 59b). However, cation exchange capacity of soils showed significant difference in farming systems and periods of practice interactions during *kharif* 2008 and summer 2009.

Southern Transition zone

In Southern Transition zone of Karnataka, cation exchange capacity (Table 60a) of soils differed significantly among farming systems in all the three periods (0-3, 3-6 and >6 years) of practice, at two depths during *kharif* 2008 and summer 2009.

The cation exchange capacity of surface soils under organic farming system ranged from 16.63 (0-3yrs) to 27.35 C mol (p⁺) kg⁻¹ (over 6yrs) during *kharif* 2008 and 19.73 (0-3yrs) to 29.55 C mol (p⁺) kg⁻¹ (over 6yrs) during summer 2009, whereas in conventional farming it ranged from 16.86 (3- 6yrs) to 17.46 C mol (p⁺) kg⁻¹ (over 6yrs) during *kharif* 2008 and 15.30 (3-6yrs) to 17.34 C mol (p⁺) kg⁻¹ (0-3yrs) during summer 2009. An increasing trend was recorded in CEC of soils from 0-3 years to over 6 years of organic farming practice, but it was not so with the conventional farming in both the depths and both the seasons.

For farming systems with depth and periods with depths interactions (Table 60b), soil CEC was not significant. However, CEC differed significantly in farming systems and periods interactions during both the seasons.

4.4. Carbon fractions

4.4.1 Soil Microbial Biomass Carbon (SMB-C)

The data on comparative changes in Soil Microbial Biomass Carbon (SMB-C) during different periods of organic and conventional farming practices under three selected agroclimatic zones of Southern Karnataka are presented in tables 61, 62 and 63.

Central Dry zone (CDZ)

The Microbial biomass carbon content ($\mu\text{g g}^{-1}$) of soils under Central Dry zone of Karnataka differed significantly among organic and conventional farming systems during different periods of practice at two depths during *kharif* 2008 and summer 2009.

The SMB-C (Table 61a.) of surface soils sourced from organic farming system ranged from 329.25 (0-3yrs) to 486.75 $\mu\text{g g}^{-1}$ (>6yrs) during *kharif* 2008 and 296.50 (0-3yrs) to 530.25 $\mu\text{g g}^{-1}$ (>6yrs) during summer 2009, whereas in conventional farming system it ranged from 176.25 (3-6yrs) to 273.25 $\mu\text{g g}^{-1}$ (>6yrs) during *kharif* 2008 and 118.00 (3-6yrs) to 153.00 $\mu\text{g g}^{-1}$ (0-3yrs) during summer 2009. SMB-C content increased in soils from 0-3 yrs to > 6yrs of organic farming practice, but was not true with the conventional farming system.

The interaction studies (Table 61b), between farming systems and depth, SMB-C did not show any variation. However, it varied significantly among farming systems with period's of practice interactions during both *kharif* 2008 and summer 2009

Table 61 (a). Soil microbial biomass carbon ($\mu\text{g g}^{-1}$) content of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	329.25	227.25	296.50	220.50	381.00	238.50	390.25	265.50	486.75	363.00	530.25	356.25
F2:CON	196.50	160.75	153.00	137.25	176.25	121.00	118.00	102.00	273.25	170.25	152.00	133.25
				Kharif,2008		Summer, 2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem $\pm$				10.82	13.25	10.82	8.48	10.39	8.48			
CD @ 5%				31.14	38.13	31.14	24.41	29.90	24.41			

Table 61 (b). Interactions showing soil microbial biomass carbon ($\mu\text{g g}^{-1}$) content of soils in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	278.25	258.50	P1 x D1	262.87	224.75	F1 x D1	399.00	405.66
F1 x P2	309.75	327.87	P1 x D2	194.00	178.67	F1 x D2	215.33	141.00
F1 x P3	424.87	443.25	P2 x D1	278.62	254.12	F2 x D1	276.25	280.75
F2 x P1	178.62	145.12	P2 x D2	179.75	183.75	F2 x D2	150.66	124.16
F2 x P2	148.62	110.00	P3 x D1	380.00	341.12			
F2 x P3	221.75	142.62	P3 x D2	266.62	244.75			
F-test	*	*		NS	*		NS	NS
Sem $\pm$	18.74	14.69		15.30	12.20		18.74	14.69
CD @ 5%	53.93	42.28		-	34.52		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant ($p=0.05$)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 61 (a). Soil microbial biomass carbon ($\mu\text{g g}^{-1}$) content of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	329.25	227.25	296.50	220.50	381.00	238.50	390.25	265.50	486.75	363.00	530.25	356.25
F2:CON	196.50	160.75	153.00	137.25	176.25	121.00	118.00	102.00	273.25	170.25	152.00	133.25
				Kharif,2008		Summer, 2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem $\pm$				10.82	13.25	10.82	8.48	10.39	8.48			
CD @ 5%				31.14	38.13	31.14	24.41	29.90	24.41			

Table 61 (b). Interactions showing soil microbial biomass carbon ($\mu\text{g g}^{-1}$) content of soils in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	278.25	258.50	P1 x D1	262.87	224.75	F1 x D1	399.00	405.66
F1 x P2	309.75	327.87	P1 x D2	194.00	178.67	F1 x D2	215.33	141.00
F1 x P3	424.87	443.25	P2 x D1	278.62	254.12	F2 x D1	276.25	280.75
F2 x P1	178.62	145.12	P2 x D2	179.75	183.75	F2 x D2	150.66	124.16
F2 x P2	148.62	110.00	P3 x D1	380.00	341.12			
F2 x P3	221.75	142.62	P3 x D2	266.62	244.75			
F-test	*	*		NS	*		NS	NS
Sem $\pm$	18.74	14.69		15.30	12.20		18.74	14.69
CD @ 5%	53.93	42.28		-	34.52		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant ($p=0.05$)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 62 (a). Soil microbial biomass carbon ($\mu\text{g g}^{-1}$) content of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	282.50	207.75	253.00	200.50	483.25	331.50	494.25	422.00	622.50	455.00	510.00	494.75
F2:CON	244.00	159.00	177.75	136.75	318.75	231.00	196.00	187.50	388.75	291.00	204.50	201.75
				Kharif,2008		Summer, 2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem $\pm$				13.81	16.92	13.81	10.14	12.42	10.14			
CD @ 5%				39.75	48.69	39.75	29.18	35.73	29.18			

Table 62 (b). Interactions showing soil microbial biomass carbon ($\mu\text{g g}^{-1}$) content of soils in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	245.12	226.71	P1 x D1	263.25	215.37	F1 x D1	462.75	499.75
F1 x P2	407.37	484.12	P1 x D2	183.37	168.62	F1 x D2	317.16	192.75
F1 x P3	538.75	597.37	P2 x D1	401.00	371.12	F2 x D1	331.41	372.41
F2 x P1	201.50	157.25	P2 x D2	281.25	304.75	F2 x D2	227.00	175.33
F2 x P2	274.87	191.75	P3 x D1	505.62	452.25			
F2 x P3	339.87	203.12	P3 x D2	373.00	348.25			
F-test	*	*		NS	*		NS	NS
Sem $\pm$	23.93	17.56		19.54	14.34		23.93	17.56
CD @ 5%	68.86	50.54		-	41.26		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant ($p=0.05$)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 62 (a). Soil microbial biomass carbon ($\mu\text{g g}^{-1}$) content of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	282.50	207.75	253.00	200.50	483.25	331.50	494.25	422.00	622.50	455.00	510.00	494.75
F2:CON	244.00	159.00	177.75	136.75	318.75	231.00	196.00	187.50	388.75	291.00	204.50	201.75
				Kharif,2008		Summer, 2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem $\pm$				13.81	16.92	13.81	10.14	12.42	10.14			
CD @ 5%				39.75	48.69	39.75	29.18	35.73	29.18			

Table 62 (b). Interactions showing soil microbial biomass carbon ($\mu\text{g g}^{-1}$) content of soils in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	245.12	226.71	P1 x D1	263.25	215.37	F1 x D1	462.75	499.75
F1 x P2	407.37	484.12	P1 x D2	183.37	168.62	F1 x D2	317.16	192.75
F1 x P3	538.75	597.37	P2 x D1	401.00	371.12	F2 x D1	331.41	372.41
F2 x P1	201.50	157.25	P2 x D2	281.25	304.75	F2 x D2	227.00	175.33
F2 x P2	274.87	191.75	P3 x D1	505.62	452.25			
F2 x P3	339.87	203.12	P3 x D2	373.00	348.25			
F-test	*	*		NS	*		NS	NS
Sem $\pm$	23.93	17.56		19.54	14.34		23.93	17.56
CD @ 5%	68.86	50.54		-	41.26		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant ($p=0.05$)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 63 (a). Soil microbial biomass carbon ($\mu\text{g g}^{-1}$) content soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	387.75	295	410.75	331.5	539	384	600	440	702.25	490.25	813.25	501.25
F2:CON	321.5	250.5	260.25	206.75	313.5	207	221.25	174.25	417.25	262.25	245.5	212
				<i>Kharif,2008</i>		<i>Summer, 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem $\pm$				14.53	17.81	14.53	14.53	17.81	14.53			
CD @ 5%				41.84	51.24	41.84	41.84	51.24	41.84			

Table 63 (b). Interactions showing soil microbial biomass carbon ($\mu\text{g g}^{-1}$) content of soils in organic and conventional farming systems in Southern Transition Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	341.37	371.13	P1 x D1	354.62	335.5	F1 x D1	543	608
F1 x P2	461.5	520.00	P1 x D2	272.75	269.12	F1 x D2	350.75	242.33
F1 x P3	596.25	657.25	P2 x D1	426.25	410.62	F2 x D1	389.75	424.25
F2 x P1	286	233.5	P2 x D2	295.50	307.12	F2 x D2	239.91	197.66
F2 x P2	260.25	197.75	P3 x D1	559.75	529.37			
F2 x P3	339.75	228.75	P3 x D2	376.25	356.62			
F-test	*	*		NS	NS		NS	*
Sem $\pm$	25.18	22.36		25.18	22.36		20.56	18.26
CD @ 5%	72.46	64.34		-	-		-	52.54

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Southern Dry zone (SDZ)

The Microbial Biomass Carbon content of soils under Southern Dry zone of Karnataka (Table 62a) showed significant difference among organic and conventional farming systems during all the three different periods of practice and at two depths during *kharif* 2008 and summer 2009.

The Microbial Biomass -C of surface soils collected from organic farming system ranged from 282.50 (0-3yrs) to 622.50 $\mu\text{g g}^{-1}$ (> 6yrs) during *kharif* 2008 and 253 (0-3 yrs) to 510 $\mu\text{g g}^{-1}$ (>6yrs) during summer 2009, whereas in conventional farming system it ranged from 177.75 (3-6yrs) to 273.25 $\mu\text{g g}^{-1}$ (>6yrs) during *kharif* 2008 and 118 (3-6yrs) to 204.5 $\mu\text{g g}^{-1}$ (>6yrs) during summer 2009.

The interactions between farming systems & depth (Table 62b), for SMB-C recorded non significant variation. However, the interactions among farming systems & period's of practice was significant during both the seasons.

Southern Transition zone

During *kharif* 2008 and summer 2009, the soil microbial biomass carbon recorded significant variation in soils of organic and conventional farming systems under Southern Transition zone of Karnataka (Table 63a) during different periods of practice at two depths.

The SMB-C of soils sourced from organic farming system ranged from 387.75 (0-3yrs) to 702.25 $\mu\text{g g}^{-1}$ (>6yrs) and from 410.75 (0-3yrs) to 813.25 $\mu\text{g g}^{-1}$ (>6yrs) during *kharif* 2008 and summer 2009, respectively. In conventional farming system it ranged from 313.5 (3- 6yrs) to 417.25 $\mu\text{g g}^{-1}$ (> 6yrs) during *kharif* 2008 and from 221.25 (3-6yrs) to 260.25 $\mu\text{g g}^{-1}$ (0-3yrs) during summer 2009. An increasing trend was observed in SMB-C from 0-3 yrs to > 6yrs of organic farming practice, whereas it was not so with the conventional farming.

SMB-C did not show any variation in interaction (Table 63b), among farming systems and depths. However, it showed significant difference in interactions among farming systems and periods of practice during *kharif* 2008 and summer 2009.

4.4.2 Soil Microbial Biomass Nitrogen (SMB-N)

Soil microbial biomass nitrogen (SMB-N) contents during different periods of organic and conventional farming practices were compared under three selected agroclimatic zones of Karnataka, and the results are presented in tables 64, 65 and 66.

Central Dry zone (CDZ)

The SMB-N (Table 64a) content differed significantly in organic and conventional farming systems during the three different periods of practice, at two depths during *kharif* 2008 and summer 2009.

The microbial biomass nitrogen content of surface soils of organic farming system ranged from 38.02 (0-3yrs) to 62.55 $\mu\text{g g}^{-1}$ (>6yrs) during *kharif* 2008 and 35.38 (0-3yrs) to 65.62 $\mu\text{g g}^{-1}$ (>6yrs) during summer 2009, whereas in conventional farming system it ranged from 26.60 (3-6yrs) to 39.10 $\mu\text{g g}^{-1}$ (>6yrs) during *kharif* 2008 and from 14.70 (3-6yrs) to 24.90 $\mu\text{g g}^{-1}$ (>6yrs) during summer 2009. An increasing trend was observed in SMB-N from 0-3 yrs to > 6yrs of organic farming practice, and was not true with the conventional farming at both the depths and in both the seasons.

The interactions among farming systems & depth w.r.t SMB-N varied non significantly. However, it differed significantly with interactions among farming systems & periods of practice, and periods of practice & depths of soil sampling during both the seasons (Table 64b).

Table 64 (a). Soil microbial biomass nitrogen ($\mu\text{g g}^{-1}$) content of soils as influenced by Organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	38.02	24.75	35.38	23.08	49.35	33.85	52.70	34.42	62.55	44.62	65.62	47.53
F2:CON	34.12	29.35	16.38	13.62	26.60	21.65	14.70	13.92	39.10	27.80	24.90	18.97
				Kharif '2008		Summer ' 2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem $\pm$				1.39	1.71	1.39	1.42	1.74	1.42			
CD @ 5%				4.00	4.91	4.00	4.09	5.01	4.09			

Table 64 (b). Interactions showing SMB-N ($\mu\text{g g}^{-1}$) content of soils in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	31.38	29.23	P1 x D1	36.07	25.88	F1 x D1	49.97	51.23
F1 x P2	41.60	43.56	P1 x D2	27.05	18.35	F1 x D2	33.27	18.66
F1 x P3	53.58	56.58	P2 x D1	37.97	33.70	F2 x D1	34.40	35.01
F2 x P1	31.73	15.00	P2 x D2	27.35	24.17	F2 x D2	26.26	15.50
F2 x P2	24.12	14.31	P3 x D1	50.82	45.26			
F2 x P3	33.45	21.93	P3 x D2	36.21	33.25			
F-test	*	*		*	*		NS	NS
Sem $\pm$	2.41	2.46		1.96	2.01		2.41	2.46
CD @ 5%	6.93	7.09		5.66	5.78		-	-

F: Farming Systems (2)
 F1- ORG: Organic Farming
 F2- CON: Conventional Framing
 # :Mean of 4 farmers

P: Years (3)
 P1 :0-3 Years
 P2: 3-6 Years & P3: > 6 Years
 * : Significant ($p=0.05$)

D: Depth (cm) (2)
 D 1:0-15
 D 2: 15-30
 NS: Non Significant

Table 65 (a). Soil microbial biomass nitrogen ($\mu\text{g g}^{-1}$) content of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	37.50	26.95	33.22	23.60	86.30	48.07	90.77	58.95	154.62	111.82	166.75	124.37
F2:CON	31.65	22.40	19.37	15.42	35.42	28.07	20.75	17.12	46.57	33.50	34.90	30.20
				Kharif '2008		Summer ' 2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem $\pm$				4.22	5.16	4.22	3.44	4.22	3.44			
CD @ 5%				12.14	14.87	12.14	9.92	12.15	9.92			

Table 65 (b). Interactions showing soil microbial biomass nitrogen ($\mu\text{g g}^{-1}$) content of soils in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	32.22	28.41	P1 x D1	34.57	26.13	F1 x D1	92.80	96.91
F1 x P2	67.18	74.86	P1 x D2	24.67	19.51	F1 x D2	37.88	25.01
F1 x P3	133.22	145.56	P2 x D1	60.86	57.76	F2 x D1	62.28	68.97
F2 x P1	27.02	17.40	P2 x D2	38.07	38.03	F2 x D2	27.99	20.91
F2 x P2	31.75	18.93	P3 x D1	100.60	100.82			
F2 x P3	40.03	32.55	P3 x D2	72.66	77.28			
F-test	*	*		NS	*		NS	NS
Sem $\pm$	7.13	5.97		5.96	4.87		7.30	5.97
CD @ 5%	21.03	17.18		-	14.03		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant ($p=0.05$)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 66 (a). Soil microbial biomass nitrogen ($\mu\text{g g}^{-1}$) content of soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	50.30	38.07	47.85	35.97	70.32	50.07	75.72	52.20	94.20	60.45	100.00	65.80
F2:CON	42.30	32.75	30.62	26.92	42.15	29.82	28.45	23.95	50.75	34.80	40.65	28.50
				Kharif '2008		Summer ' 2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem $\pm$				1.67	2.05	1.67	1.75	2.15	1.75			
CD @ 5%				4.82	5.90	4.82	5.05	6.19	5.05			

Table 66 (b). Interactions showing soil microbial biomass nitrogen ($\mu\text{g g}^{-1}$) content of soils in organic and conventional farming systems in Southern Transition Zone

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	44.18	41.91	P1 x D1	46.30	39.23	F1 x D1	71.60	74.52
F1 x P2	60.20	63.96	P1 x D2	35.41	31.45	F1 x D2	45.06	33.24
F1 x P3	77.32	82.90	P2 x D1	56.22	52.08	F2 x D1	49.53	51.32
F2 x P1	37.52	28.77	P2 x D2	39.95	38.07	F2 x D2	32.45	26.45
F2 x P2	35.98	26.20	P3 x D1	72.47	70.32			
F2 x P3	42.77	34.57	P3 x D2	47.62	47.15			
F-test	*	*		NS	*		NS	NS
Sem $\pm$	2.90	3.04		2.37	2.48		2.90	3.04
CD @ 5%	8.35	8.75		-	7.14		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant ($p=0.05$)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Southern Dry zone (SDZ)

The Soil Microbial Biomass Nitrogen (Table 65a) showed significant variations among organic and conventional farming systems during *kharif* 2008 and summer 2009.

The SMB-N of surface soils sampled from organic farming system ranged from 37.50 (0-3yrs) to 154.62 $\mu\text{g g}^{-1}$ (>6yrs) in 0-15 cm depth during *kharif* 2008 and 33.22 (0-3yrs) to 166.75 $\mu\text{g g}^{-1}$ (>6yrs) during summer 2009, whereas in conventional farming system it ranged from 31.65 (0-3yrs) to 46.57 $\mu\text{g g}^{-1}$ (>6yrs) during *kharif* 2008 and from 19.37 (3-6yrs) to 34.90 $\mu\text{g g}^{-1}$ (>6yrs) during summer 2009.

SMB-N varied significantly among farming systems and period's of practice interactions (Table 65b) during *kharif* 2008 and summer 2009.

Southern Transition zone (STZ)

During *kharif* 2008 and summer 2009, the SMB-N (Table 66a) differed significantly among organic and conventional farming systems during different periods of practice, and at two depths.

The SMB-N of surface soils of organic farming system ranged from 50.30 (0-3yrs) to 94.20 $\mu\text{g g}^{-1}$ (>6yrs) during *kharif* 2008 and 47.85 (0-3yrs) to 100.00 $\mu\text{g g}^{-1}$ (>6yrs) during summer 2009, whereas in conventional farming system it ranged from 42.15 (3-6yrs) to 50.75 $\mu\text{g g}^{-1}$ (>6yrs) during *kharif* 2008 and from 28.45 (3-6yrs) to 40.65 $\mu\text{g g}^{-1}$ (>6yrs) during summer 2009. There was an increasing trend noticed in SMB-N from 0-3 yrs to > 6yrs of organic farming practice, and was not true with the conventional farming.

Interaction studies did not show any variation for farming systems & depth of sampling (Table 66b). However, SMB-N significantly varies among farming systems & period's of practice interactions during *kharif* 2008 and summer 2009.

4.4.3 Light Fraction Carbon (LF-C)

The data on comparative changes of light fraction carbon (mg kg^{-1}) content in soils sampled from organic and conventional farming systems over three different periods of practice under three selected agroclimatic zones of Southern Karnataka are presented in tables 67, 68 and 69.

Central Dry zone

Significant changes were recorded in farming systems with respect to light fraction carbon content in soils of organic and conventional farming under Central Dry zone of Karnataka (Table 67a.) in different periods of practice and at two depths during *kharif* 2008 and summer 2009.

During *kharif* 2008, LF-C content in surface soils of organic farming system ranged from 730.46 (0-3yrs) to 1143.00 mg kg^{-1} (> 6yrs) and during summer 2009 it ranged from 647.07 (0- 3yrs) to 1069.90 mg kg^{-1} (>6yrs). For conventional farming, LF-C (mg kg^{-1}) content ranged from 396.37 (0-3yrs) to 626.25 mg kg^{-1} (> 6yrs) during *kharif* 2008 and from 341.03 (0-3yrs) to 527.32 mg kg^{-1} (> 6 yrs) during summer 2009. An increasing trend was observed in soil LF-C from 0-3 yrs to >6 yrs in organic and conventional farming systems. However, it was significantly higher in organic farming than in conventional farming.

Interaction studies (Table 67b), showed that there was no variation in LF-C during both the seasons as revealed by non significant interactions between farming systems with periods (except during summer, 2009), periods with depths and farming systems with depths.

Table 67 (a). Light fraction carbon (mg kg⁻¹) content of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	730.46	513.40	647.07	464.11	896.55	736.12	835.22	686.35	1143	885	1069.90	834.75
F2:CON	396.37	328.42	341.03	277.05	492.65	334.10	386.11	269.92	626.65	479.40	527.32	405.77
				Kharif,2008		Summer, 2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				29.90	36.62	29.90	28.24	34.58	28.24			
CD @ 5%				86.05	105.39	86.05	81.26	99.52	81.26			

Table 67 (b). Interactions showing light fraction carbon (mg kg⁻¹) content of soils in organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	621.93	555.59	P1 x D1	563.41	494.05	F1 x D1	923.61	850.72
F1 x P2	816.33	760.78	P1 x D2	420.91	370.38	F1 x D2	505.22	418.15
F1 x P3	1014.52	952.32	P2 x D1	694.60	610.66	F2 x D1	711.58	661.73
F2 x P1	362.40	309.04	P2 x D2	535.11	478.13	F2 x D2	380.64	317.58
F2 x P2	413.37	328.01	P3 x D1	885.24	798.61			
F2 x P3	553.02	466.55	P3 x D2	682.31	620.26			
F-test	NS	*		NS	NS		NS	NS
Sem±	51.97	48.91		42.29	39.93		51.97	48.91
CD @ 5%	-	140.75		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 68 (a). Light fraction carbon (mg kg⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	736.13	543.58	648.25	461.17	1183.45	945.62	1131.13	874.10	1345.75	1094.72	1277.61	1068.92
F2:CON	592.70	443.55	482.62	341.42	753.15	594.57	616.66	514.90	739.90	503.95	582.72	414.70
				Kharif,2008		Summer, 2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				30.34	37.16	30.34	30.49	37.34	30.49			
CD @ 5%				87.33	106.95	87.33	87.74	107.46	87.74			

Table 68 (b). Interactions showing light fraction carbon (mg kg⁻¹) content of soils in organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	639.86	555.21	P1 x D1	664.41	565.93	F1 x D1	1088.44	1019.33
F1 x P2	1064.53	1002.65	P1 x D2	493.56	401.30	F1 x D2	695.25	560.67
F1 x P3	1220.23	1173.26	P2 x D1	968.30	873.89	F2 x D1	861.31	801.40
F2 x P1	518.12	412.02	P2 x D2	770.10	694.50	F2 x D2	514.02	423.67
F2 x P2	673.86	565.78	P3 x D1	1042.82	930.16			
F2 x P3	621.92	498.71	P3 x D2	799.33	741.81			
F-test	*	*		NS	NS		NS	NS
Sem±	52.56	52.81		42.92	43.12		52.56	52.81
CD @ 5%	151.26	151.97		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 69 (a). Light fraction carbon (mg kg⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	713.45	613.45	576.45	498.61	1138.07	877.62	1077.86	831.10	1466.57	1024	1351.35	1004.60
F2:CON	639.85	492.27	465.52	365.87	475.62	339.70	359.27	268.08	804.00	385.02	670.33	296.71
				<i>Kharif,2008</i>		<i>Summer, 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				43.82	53.67	43.82	33.37	40.87	33.37			
CD @ 5%				126.11	154.45	126.11	96.04	117.62	96.04			

Table 69 (b). Interactions showing light fraction carbon (mg kg⁻¹) content of soils in organic and conventional farming systems in Southern Transition Zone

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	663.45	537.53	P1 x D1	676.65	520.98	F1 x D1	1106.03	1001.88
F1 x P2	10007.85	954.48	P1 x D2	552.86	432.54	F1 x D2	639.82	498.38
F1 x P3	1245.70	1177.97	P2 x D1	806.85	718.56	F2 x D1	838.63	778.10
F2 x P1	566.06	411.70	P2 x D2	608.66	449.59	F2 x D2	405.66	310.22
F2 x P2	407.66	313.68	P3 x D1	1135.28	1010.84			
F2 x P3	594.51	483.52	P3 x D2	704.92	650.64			
F-test	*	*		NS	NS		NS	NS
Sem±	75.90	57.85		61.98	47.20		75.90	57.81
CD @ 5%	218.42	166.32		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Southern Dry zone

The light fraction carbon content in soils sampled under Southern Dry zone of Karnataka (Table 68a) showed significant variations in organic and conventional farming systems.

LF-C in organic farming system ranged from 736.13 (0-3yrs) to 1345.75 mg kg⁻¹ (> 6yrs) in 0-15 cm depth during *kharif* 2008 and 648.25 (0-3 yrs) to 1277.61 mg kg⁻¹ (> 6yrs) during summer 2009, whereas in conventional farming it ranged from 592.70 (0-3yrs) to 753.15 mg kg⁻¹ (3-6yrs) in 0-15 cm depth during *kharif* 2008 and 482.62 (0-3yrs) to 616.66 mg kg⁻¹ (3-6yrs) in summer 2009.

LF-C of soils has shown significant variations in farming systems with periods interactions (Table 68b), in both seasons. However, for farming systems with depth and periods with depth interactions it varied not significantly.

Southern Transition zone

During both during *kharif* 2008 and summer 2009, the LF-C of soils under Southern Transition zone of Karnataka (Table 69a) was differ significantly in organic and conventional farming systems, during three different periods of practice and in two depths.

The light fraction carbon content in surface soils in organic farming system ranged from 713.45 (0-3yrs) to 1466.57 mg kg⁻¹ (>6yrs) and from 576.45 (0-3yrs) to 1351.35 mg kg⁻¹ (> 6yrs) during *kharif* 2008 and summer 2009, respectively, whereas in conventional farming it ranged from 475.62 (3-6yrs) to 804.00 mg kg⁻¹ (> 6yrs) during *kharif* 2008 and 359.27 (3-6yrs) to 670.33 mg kg⁻¹ (> 6yrs) during summer 2009. An increasing trend was observed in LF-C from 0-3 yrs to > 6yrs of organic farming, and was not with conventional farming in both the depths and in both the seasons.

LF-C (mg kg^{-1}) content varied significantly in farming systems and periods interactions (Table 69b), in both *kharif* 2008 and summer 2009. However, for farming systems with depth and periods with depth interactions, it varied non significantly.

4.4.4 Water Soluble Carbon (WS-C)

The water soluble carbon content of soils under organic and conventional farming systems was compared over three different periods of practice under three selected agroclimatic zones of Southern Karnataka. The results are presented in Tables 70, 71 and 72.

Central Dry zone

The water soluble carbon in soils of Central Dry zone of Karnataka (Table 70a.) recorded significant changes among the farming systems in three different periods of practice, at two depths during *kharif* 2008 and summer 2009.

WS-C in surface soils of organic farming system ranged from 36.76 (0-3yrs) to 57.57 mg kg^{-1} (> 6yrs) during *kharif* 2008 and 32.19 (0- 3yrs) to 55.04 mg kg^{-1} (>6yrs) during summer 2009, whereas in conventional farming it ranged from 20.37 (0-3yrs) to 31.54 mg kg^{-1} (> 6yrs) during *kharif* 2008 and 16.95 (0-3yrs) to 27.08 mg kg^{-1} (> 6 yrs) during summer 2009. An increasing trend observed in soil WS-C from 0-3 periods to >6 years of organic and conventional farming systems. However, the increase in WS-C was significantly higher in organic farming than the conventional farming.

The interaction studies shown that there was no significant variation in WS-C (mg kg^{-1}) (Table 70b), irrespective of the farming systems, periods of practice or depths during *kharif* 2008 and summer 2009.

Table 70 (a). Water soluble carbon (mg kg⁻¹) content of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	36.76	25.45	32.19	23.14	45.12	37.05	40.96	33.83	57.57	44.55	55.04	42.97
F2:CON	20.37	16.39	16.95	13.79	24.79	16.81	18.92	13.19	31.54	24.13	27.08	20.83
				Kharif,2008		Summer, 2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				1.50	1.84	1.50	1.48	1.81	1.48			
CD @ 5%				4.32	5.29	4.32	4.27	5.23	4.27			

Table 70 (b). Interactions showing water soluble carbon (mg kg⁻¹) content of soils under of soils under organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	31.10	27.66	P1 x D1	28.57	24.57	F1 x D1	46.48	42.73
F1 x P2	41.08	37.40	P1 x D2	20.92	18.47	F1 x D2	25.57	20.98
F1 x P3	51.06	49.01	P2 x D1	34.96	29.94	F2 x D1	35.68	33.31
F2 x P1	18.38	15.37	P2 x D2	26.93	23.51	F2 x D2	19.11	15.94
F2 x P2	20.80	16.06	P3 x D1	44.55	41.06			
F2 x P3	27.83	23.96	P3 x D2	34.34	31.90			
F-test	NS	NS		NS	NS		NS	NS
Sem±	2.60	2.57		2.12	2.10		2.60	2.57
CD @ 5%	-	-		-			-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
#: Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
*: Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 71(a). Water soluble carbon (mg kg⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	37.05	27.36	32.67	23.22	59.56	47.59	55.81	43.10	67.73	55.10	64.35	53.82
F2:CON	30.21	22.32	24.30	17.19	37.90	29.92	30.39	25.37	37.24	25.36	29.34	20.88
				Kharif,2008		Summer, 2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				1.53	1.87	1.53	1.54	1.89	1.54			
CD @ 5%				4.40	5.38	4.40	4.44	5.44	4.44			

Table 71 (b). Interactions showing water soluble carbon (mg kg⁻¹) content of soils under of soils under organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	32.20	27.94	P1 x D1	33.63	28.48	F1 x D1	54.78	50.94
F1 x P2	53.58	49.46	P1 x D2	24.84	20.20	F1 x D2	35.11	28.01
F1 x P3	61.41	59.08	P2 x D1	48.73	43.10	F2 x D1	43.35	40.04
F2 x P1	26.26	20.74	P2 x D2	38.76	34.23	F2 x D2	25.87	21.14
F2 x P2	33.91	27.88	P3 x D1	52.48	46.84			
F2 x P3	31.30	25.11	P3 x D2	40.23	37.35			
F-test	*	*		NS	NS		NS	NS
Sem±	2.64	2.67		2.16	2.18		2.64	2.67
CD @ 5%	7.62	7.69		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 72(a). Water soluble carbon (mg kg⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	35.91	30.87	33.44	29.07	57.28	44.17	54.27	41.85	73.81	51.58	69.93	52.72
F2:CON	32.20	24.79	26.88	21.56	23.94	17.10	18.09	13.50	40.47	29.38	34.68	25.35
				<i>Kharif,2008</i>				<i>Summer, 2009</i>				
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				2.20	2.70	2.20	2.09	2.56	2.09			
CD @ 5%				6.35	7.77	6.35	6.03	7.38	6.03			

Table 72 (b). Interactions showing water soluble carbon (mg kg⁻¹) content of soils under organic and conventional farming systems in Southern Transition Zone

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	33.39	31.25	P1 x D1	34.05	30.16	F1 x D1	55.67	52.54
F1 x P2	50.73	48.06	P1 x D2	27.83	25.31	F1 x D2	32.20	26.55
F1 x P3	62.70	61.32	P2 x D1	40.61	36.18	F2 x D1	42.21	41.21
F2 x P1	28.50	24.22	P2 x D2	30.63	27.67	F2 x D2	20.42	16.80
F2 x P2	20.52	15.79	P3 x D1	57.14	52.30			
F2 x P3	34.92	30.02	P3 x D2	35.48	34.04			
F-test	*	*		NS	NS		NS	NS
Sem±	3.82	3.63		3.11	2.96		3.82	3.63
CD @ 5%	10.99	10.44		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Southern Dry zone

The water soluble carbon content in soils collected from Southern Dry zone of Karnataka (Table 71a) differed significantly with farming systems in different periods of practice, at two depths during *kharif* 2008 and summer 2009.

In organic farming system, WS-C content in surface soils ranged from 37.05 (0-3yrs) to 67.73 mg kg⁻¹ (> 6yrs) during *kharif* 2008 and 32.67 (0-3 yrs) to 64.35 mg kg⁻¹ (> 6yrs) during summer 2009, whereas in conventional farming it ranged from 30.21 (0-3yrs) to 37.90 mg kg⁻¹ (3-6yrs) during *kharif* 2008 and 24.30 (0-3yrs) to 30.39 mg kg⁻¹ (3-6yrs) during summer 2009. There was an increasing trend was observed in WS-C from 0-3 yrs to > 6yrs of organic farming, and was not so with the conventional farming.

WS-C content showed variation among farming systems and periods of practice interactions (Table 71b), during both the seasons. However, for farming systems with depth and periods with depth interactions, it was non significant.

Southern Transition zone

There were significant changes recorded in WS-C content in soils collected from organic and conventional farming systems under Southern Transition zone of Karnataka (Table 72a) in three different periods of practice and in two depths during *kharif* 2008 and summer 2009.

The water soluble carbon content in surface soils in organic farming system ranged from 35.91 (0-3yrs) to 73.81 mg kg⁻¹ (>6yrs) during *kharif* 2008 and 33.44 (0-3yrs) to 69.93 mg kg⁻¹ (> 6yrs) during summer 2009. In conventional farming WS-C (mg kg⁻¹) content ranged from 23.94 (3-6yrs) to 40.47 mg kg⁻¹ (> 6yrs) and from 18.09 (3-6yrs) to 34.68 mg kg⁻¹ (> 6yrs) during *kharif* 2008 and summer 2009, respectively. An increasing trend was observed in WS-C from 0-3 yrs to > 6yrs of organic farming, whereas it was not true with the conventional farming in both the depths and in both the seasons.

WS-C content showed significant variations in farming systems with periods interactions (Table 72b), during *kharif* 2008 and summer 2009. However, for farming systems with depth and periods with depth interactions, varied not significantly.

4.4.5 Soil Total Carbon (Tot-C)

The total carbon content of soils from organic and conventional farming systems was compared over three different periods of practice under three selected agroclimatic zones of Southern Karnataka. The results are presented in Tables 73, 74 and 75.

Central Dry zone

The total carbon of soils collected from Central Dry zone of Karnataka (Table 73a.) differ significantly among organic and conventional farming systems in three different periods of practice at two depths during *kharif* 2008 and summer 2009.

Tot-C content in surface soils of organic farming system ranged from 17.10 (0-3yrs) to 26.72 g kg⁻¹ (> 6yrs) during *kharif* 2008 and 15.77 (0-3yrs) to 26.42 g kg⁻¹ (>6yrs) during summer 2009, whereas in conventional farming it ranged from 9.40 (0-3yrs) to 14.65 g kg⁻¹ (> 6yrs) and from 8.52 (0-3yrs) to 13.00 g kg⁻¹ (> 6 yrs) during *kharif* 2008 and summer 2009, respectively. An increasing trend was observed in total carbon from 0-3yrs to > 6yrs in both organic and conventional farming systems. However, was significantly higher in organic farming than in conventional farming.

The total carbon content in soils did not show any variation in farming systems and periods of practice interaction (Table 73b) during both the seasons as revealed by non significant interactions.

Table 73 (a). Total C (g kg⁻¹) content of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	17.10	12.02	15.77	11.37	21.08	17.25	20.57	16.92	26.72	20.72	26.42	20.60
F2:CON	9.40	7.82	8.52	20.60	11.55	7.82	9.50	6.60	14.65	11.22	13.00	9.97
				<i>Kharif '2008</i>		<i>Summer '2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.68	0.84	0.68	0.69	0.85	0.69			
CD @ 5%				1.98	2.42	1.98	2.00	2.44	2.0			

Table 73 (b). Interactions showing total C (g kg⁻¹) content of soils under organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	14.56	13.57	P1 x D1	13.25	12.15	F1 x D1	21.63	20.92
F1 x P2	19.16	18.75	P1 x D2	9.92	9.10	F1 x D2	11.86	10.34
F1 x P3	23.72	23.51	P2 x D1	16.31	15.03	F2 x D1	16.66	16.30
F2 x P1	8.61	7.67	P2 x D2	12.53	11.76	F2 x D2	8.95	7.80
F2 x P2	9.68	8.05	P3 x D1	20.68	19.71			
F2 x P3	12.93	11.48	P3 x D2	15.97	15.58			
F-test	*	*		NS	NS		NS	NS
Sem±	1.19	1.20		0.97	0.98		1.19	1.20
CD @ 5%	3.38	3.46		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 74 (a) Total C (g kg⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	17.22	12.72	15.97	11.30	27.70	22.15	27.85	21.47	31.55	25.65	31.17	26.07
F2:CON	14.05	10.37	11.85	8.35	17.65	13.90	15.17	12.65	17.32	11.77	14.20	10.07
				<i>Kharif '2008</i>		<i>Summer ' 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.71	0.86	0.71	0.74	0.91	0.74			
CD @ 5%				2.04	2.50	2.04	2.14	2.62	2.14			

Table 74 (b). Interactions showing total C (g kg⁻¹) content of soils under organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	14.87	13.63	P1 x D1	15.63	13.91	F1 x D1	25.49	25.00
F1 x P2	24.92	24.66	P1 x D2	11.55	9.82	F1 x D2	16.34	13.74
F1 x P3	28.60	28.62	P2 x D1	22.67	21.51	F2 x D1	20.17	19.61
F2 x P1	12.21	10.10	P2 x D2	18.02	17.06	F2 x D2	12.01	10.35
F2 x P2	15.77	13.91	P3 x D1	24.43	22.68			
F2 x P3	14.55	12.13	P3 x D2	18.71	18.07			
F-test	*	*		NS	NS		NS	NS
Sem±	1.23	1.29		1.01	1.05		1.23	1.29
CD @ 5%	3.53	3.71		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 75 (a). Total C (g kg⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	16.70	14.35	15.45	13.40	26.70	20.55	26.46	20.40	34.37	24.02	33.17	24.65
F2:CON	14.97	11.52	12.37	9.95	11.10	7.92	8.82	6.52	18.82	9.00	16.42	7.25
				Kharif '2008		Summer ' 2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				1.03	1.26	1.03	0.96	1.18	0.96			
CD @ 5%				2.96	3.62	2.96	2.78	3.41	2.78			

Table 75 (b). Interactions showing total C (g kg⁻¹) content of soils under Organic and conventional farming systems in Southern Transition Zone

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	15.52	14.42	P1 x D1	15.83	13.91	F1 x D1	25.92	25.03
F1 x P2	23.62	23.43	P1 x D2	12.93	11.67	F1 x D2	14.96	12.54
F1 x P3	29.20	28.91	P2 x D1	18.90	17.65	F2 x D1	19.64	19.48
F2 x P1	13.24	11.16	P2 x D2	14.23	13.46	F2 x D2	9.48	7.90
F2 x P2	9.51	7.67	P3 x D1	26.60	24.80			
F2 x P3	13.91	11.83	P3 x D2	16.51	15.95			
F-test	*	*		NS	NS		NS	NS
Sem±	1.78	1.67		1.45	1.37		1.78	1.67
CD @ 5%	5.13	4.83		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Southern Dry zone

In soils sampled under Southern Dry zone of Karnataka, the total carbon content (Table 74a) varied significantly in both organic and conventional farming systems.

The Tot-C content in surface soils of organic farming system ranged from 17.22 (0-3yrs) to 31.55 g kg⁻¹ (> 6yrs) during *kharif* 2008 and 15.97 (0-3 yrs) to 31.17 g kg⁻¹ (> 6yrs) during summer 2009, whereas in conventional farming it ranged from 14.05 (0-3yrs) to 17.65 g kg⁻¹ (3-6yrs) and from 11.85 (0-3yrs) to 15.17 g kg⁻¹ (> 6yrs) during *kharif* 2008 and summer 2009 respectively.

In the interactions between farming systems & periods interactions (Table 74b), the Tot-C content differed significantly during *kharif* 2008 and summer 2009. However, for farming systems with depth and periods with depth interactions, it varied non significantly.

Southern Transition zone

The total carbon content of soils has shown significant changes in organic and conventional farming systems under Southern Transition zone of Karnataka (Table 75a) in three different periods of practice at two depths during *kharif* 2008 and summer 2009.

During *kharif* 2008, total carbon content in surface soils of organic farming system ranged from 16.70 (0-3yrs) to 34.37 g kg⁻¹ (>6yrs) and during summer 2009 it ranged from 15.45 (0-3yrs) to 33.17 g kg⁻¹ (> 6yrs). In conventional farming Tot-C ranged from 11.10 (3-6yrs) to 18.82 g kg⁻¹ (> 6yrs) during *kharif* 2008 and from 8.82 (3-6yrs) to 16.42 g kg⁻¹ (>6yrs) during summer 2009. An increasing trend was observed in soil total carbon from 0-3 years to > 6 years of organic farming practice, whereas it was not so with the conventional farming at both the depths during *kharif* 2008 and summer 2009.

The Tot-C content varied significantly in farming systems with periods interactions (Table 75b), during the seasons. However, for farming systems with depth and periods with depth interactions, it varied non significantly.

4.4.6 Soil Total Nitrogen (Tot-N)

The soil total nitrogen content under organic and conventional farming systems was compared over three different periods of practice under three selected agroclimatic zones of Southern Karnataka. The results are presented in Tables 76, 77 and 78.

Central Dry zone

The total nitrogen content of soils under Central Dry zone of Karnataka (Table 76a.) differed significantly in organic and conventional farming in all the three different periods of practice and in two depths during *kharif* 2008 and summer 2009.

The tot-N content in surface soils of organic farming system ranged from 0.75 (0-3yrs) to 1.28 g kg⁻¹ (> 6yrs) during *kharif* 2008 and 0.74 (0- 3yrs) to 1.21 g kg⁻¹ (>6yrs) in summer 2009, whereas in conventional farming it ranged from 0.52 (3-6yrs) to 0.57 g kg⁻¹ (> 6yrs) during *kharif* 2008 and 0.44 (3-6yrs) to 0.51 g kg⁻¹ (> 6 yrs) during summer 2009. An increasing trend was observed in total nitrogen content from 0-3 yrs to > 6yrs of organic farming, and it not so with the conventional farming in both the depths and in both the seasons.

Interaction studies (Table 76b), has shown a significant difference, in tot-N content between farming systems and periods, and periods of practice and depth of sampling during *kharif* 2008 and summer, 2009.

Table 76 (a). Total N (g kg⁻¹) content of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	0.75	0.49	0.74	0.44	0.97	0.67	1.00	0.66	1.28	0.87	1.21	0.85
F2:CON	0.54	0.44	0.47	0.40	0.52	0.42	0.44	0.36	0.57	0.52	0.51	0.44
				<i>Kharif '2008</i>		<i>Summer ' 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.02	0.03	0.02	0.02	0.03	0.02			
CD @ 5%				0.08	0.09	0.08	0.08	0.10	0.08			

Table 76 (b). Interactions showing total N (g kg⁻¹) content of soils under organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	0.62	0.59	P1 x D1	0.64	0.61	F1 x D1	1.00	0.98
F1 x P2	0.82	0.83	P1 x D2	0.46	0.42	F1 x D2	0.54	0.47
F1 x P3	1.07	1.03	P2 x D1	0.75	0.72	F2 x D1	0.67	0.65
F2 x P1	0.49	0.43	P2 x D2	0.54	0.51	F2 x D2	0.46	0.40
F2 x P2	0.47	0.40	P3 x D1	0.93	0.86			
F2 x P3	0.55	0.47	P3 x D2	0.69	0.65			
F-test	*	*		*	*		NS	NS
Sem±	0.04	0.05		0.04	0.04		0.04	0.05
CD @ 5%	0.14	0.14		0.11	0.11		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 77 (a). Total N (g kg⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	0.74	0.54	0.69	0.47	1.64	0.96	1.73	0.90	2.04	1.22	1.89	1.18
F2:CON	0.63	0.44	0.49	0.34	0.69	0.56	0.56	0.45	0.93	0.67	0.81	0.57
				<i>Kharif '2008</i>		<i>Summer ' 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.07	0.09	0.07	0.08	0.09	0.08			
CD @ 5%				0.22	0.27	0.22	0.23	0.28	0.23			

Table77 (b). Interactions showing total N (g kg⁻¹) content of soils under organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	0.64	0.58	P1 x D1	0.68	0.59	F1 x D1	1.81	1.84
F1 x P2	1.29	1.31	P1 x D2	0.48	0.41	F1 x D2	0.75	0.62
F1 x P3	1.63	1.53	P2 x D1	1.16	1.14	F2 x D1	1.23	1.21
F2 x P1	0.53	0.42	P2 x D2	0.75	0.67	F2 x D2	0.55	0.45
F2 x P2	0.62	0.50	P3 x D1	1.98	1.96			
F2 x P3	0.80	0.69	P3 x D2	1.44	1.42			
F-test	*	*		NS	*		NS	NS
Sem±	0.13	0.13		0.11	0.11		0.13	0.13
CD @ 5%	0.39	0.40		-	0.32		-	-

F: Farming Systems (2)
 F1- ORG: Organic Farming
 F2- CON: Conventional Framing
 # :Mean of 4 farmers

P: Years (3)
 P1 :0-3 Years
 P2: 3-6 Years & P3: > 6 Years
 * : Significant (p=0.05)

D: Depth (cm) (2)
 D 1:0-15
 D 2: 15-30
 NS: Non Significant

Table 78 (a). Total N (g kg⁻¹) content of soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	1.05	0.81	0.99	0.79	1.41	0.99	1.45	0.91	1.94	1.36	1.93	1.20
F2:CON	0.90	0.69	0.79	0.62	0.84	0.59	0.75	0.55	1.01	0.69	0.69	0.63
				<i>Kharif '2008</i>				<i>Summer ' 2009</i>				
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem±				0.03	0.04	0.03	0.03	0.04	0.03			
CD @ 5%				0.10	0.13	0.10	0.09	0.11	0.09			

Table 78 (b). Interactions showing total N (g kg⁻¹) content of soils under organic and conventional farming systems in Southern Transition Zone

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	0.93	0.89	P1 x D1	0.97	0.89	F1 x D1	1.46	1.46
F1 x P2	1.20	1.18	P1 x D2	0.75	0.70	F1 x D2	0.92	0.74
F1 x P3	1.64	1.57	P2 x D1	1.12	1.10	F2 x D1	1.05	0.97
F2 x P1	0.80	0.17	P2 x D2	0.79	0.73	F2 x D2	0.66	0.60
F2 x P2	0.71	0.65	P3 x D1	1.47	1.31			
F2 x P3	0.85	0.66	P3 x D2	1.02	0.91			
F-test	*	*		NS	*		NS	NS
Sem±	0.06	0.05		0.05	0.04		0.06	0.05
CD @ 5%	0.18	0.16		-	0.13		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Southern Dry zone

During both the seasons, the total nitrogen content in soils of Southern Dry zone of Karnataka (Table 77a) differed significantly in organic and conventional farming systems.

The tot-N content in surface soils in organic farming system ranged from 0.74 (0-3yrs) to 3.04 g kg⁻¹(> 6yrs) during *kharif* 2008 and 0.69 (0-3 yrs) to 3.12 g kg⁻¹ (> 6yrs) during summer 2009, whereas in conventional farming it ranged from 0.63 (0-3yrs) to 0.93 g kg⁻¹ (> 6yrs) during *kharif* 2008 and 0.49 (0-3yrs) to 0.81 g kg⁻¹ (> 6yrs) during summer 2009. Tot-N content increased from 0-3yrs to > 6yrs of organic and conventional farming. However, it was significantly higher in organic farming than in conventional farming.

Tot-N varied significantly in farming systems and periods interactions (Table 77b).

Southern Transition zone

The Tot-N content in soils under Southern Transition zone of Karnataka (Table 78a) has varied significantly varied with organic and conventional farming systems in different periods of practice at two depths during *kharif* 2008 and summer 2009.

The tot-N of surface soils of organic farming system ranged from 1.05 (0-3yrs) to 1.94 g kg⁻¹ (>6yrs) and from 0.99 (0-3yrs) to 1.93 g kg⁻¹ (> 6yrs) during *kharif* 2008 and summer 2009 respectively, whereas in conventional farming it ranged from 0.84 (3-6yrs) to 1.01 g kg⁻¹ (> 6yrs) during *kharif* 2008 and 0.69 (> 6yrs) to 0.79 g kg⁻¹ (0-3yrs) during summer 2009. An increasing trend was observed in soil Tot-N from 0-3 yrs to > 6yrs of organic farming practice, and was not true with the conventional farming in both the depths during both the seasons.

Interaction studies showed significant variations in Tot-N between farming systems and periods (Table 78b). However, it did not show any variation for farming systems with depth of sampling during *kharif* 2008 and periods with depths interactions during *kharif* 2008 and summer 2009.

4.5 Soil Biological Parameters

4.5.1 Dehydrogenase activity (DHA)

The data on comparative changes in dehydrogenase activity in soils over three different periods of practice of organic and conventional farming systems under three selected agroclimatic zones of Karnataka are presented in Table 79,80 and 81.

Central Dry zone

The dehydrogenase activity ($\mu\text{g TPF g}^{-1} \text{ h}^{-1}$) differed significantly with organic and conventional farming systems in all the three different periods of practice and in two depths during *kharif* 2008 and summer 2009.

The dehydrogenase activity (Table 79a) in organic farming system ranged from 413 (0-3yrs) to 922 $\mu\text{g TPF g}^{-1} \text{ h}^{-1}$ (>6yrs) in 0-15 cm depth during *kharif* 2008 and from 388 (0-3yrs) to 848 $\mu\text{g TPF g}^{-1} \text{ h}^{-1}$ (>6yrs) during summer 2009. In conventional farming DHA ranged from 337 (0-3yrs) to 497 $\mu\text{g TPF g}^{-1} \text{ h}^{-1}$ (>6yrs) in 0-15 cm depth during *kharif* 2008 and 298 (3-6yrs) to 455 $\mu\text{g TPF g}^{-1} \text{ h}^{-1}$ (>6yrs) during summer 2009.

The interactions between periods & depth and farming systems & depth not varied significantly w.r.t the dehydrogenase activity. However, it showed variation in interactions between farming systems & periods during both the seasons (Table 79b).

Table 79 (a). Dehydrogenase ($\mu\text{g TPF g}^{-1} \text{h}^{-1}$) activity of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	413	313	388	296	499	353	484	362	922	508	848	542
F2:CON	337	274	311	258	338	214	298	224	497	292	455	284
				Kharif '2008		Summer ' 2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem $\pm$				23.69	29.03	23.69	20.68	26.44	20.68			
CD @ 5%				68.18	83.51	68.18	61.22	78.62	61.22			

Table 79 (b). Interactions showing dehydrogenase ($\mu\text{g TPF g}^{-1} \text{h}^{-1}$) activity of soils under organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	363	350	P1 x D1	375	350	F1 x D1	611	573
F1 x P2	426	423	P1 x D2	293	277	F1 x D2	391	400
F1 x P3	715	695	P2 x D1	418	391	F2 x D1	391	355
F2 x P1	306	285	P2 x D2	284	293	F2 x D2	260	255
F2 x P2	276	261	P3 x D1	709	652			
F2 x P3	395	370	P3 x D2	400	413			
F-test	*	*		NS	NS		NS	NS
Sem $\pm$	41.04	36.44		33.51	29.98		41.04	36.44
CD @ 5%	118.10	108.64		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
* : Significant ($p=0.05$)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 80 (a). Dehydrogenase ($\mu\text{g TPF g}^{-1} \text{h}^{-1}$) activity of soils as influenced by organic and conventional farming systems in Southern dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	677	523	612	488	690	433	624	484	1093	601	984	684
F2:CON	528	278	474	289	435	266	388	245	547	298	488	264
				Kharif '2008			Summer ' 2009					
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem $\pm$				27.35	33.23	27.13	22.24	28.34	22.24			
CD @ 5%				78.08	95.62	78.08	65.22	82.22	65.22			

Table 80 (b). Interactions showing dehydrogenase ($\mu\text{g TPF g}^{-1} \text{h}^{-1}$) activity of soils under organic and conventional farming systems in Southern dry Zone

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	599	550	P1 x D1	603	543	F1 x D1	820	740
F1 x P2	562	554	P1 x D2	401	388	F1 x D2	503	552
F1 x P3	847	834	P2 x D1	562	506	F2 x D1	519	450
F2 x P1	403	450	P2 x D2	349	364	F2 x D2	281	266
F2 x P2	351	316	P3 x D1	820	736			
F2 x P3	422	376	P3 x D2	449	474			
F-test	*	*		NS	NS		NS	NS
Sem $\pm$	46.99	39.64		48.37	42.84		46.99	39.64
CD @ 5%	135.23	117.82		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant ($p=0.05$)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 81 (a). Dehydrogenase ($\mu\text{g TPF g}^{-1} \text{h}^{-1}$) activity of soils as influenced by organic and conventional farming systems in Southern transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	1101	527	984	485	1415	734	1368	844	1565	961	1498	1042
F2:CON	679	297	594	312	856	700	754	682	874	360	794	348
				<i>Kharif '2008</i>		<i>Summer ' 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem $\pm$				40.50	49.60	40.50	34.24	45.22	34.24			
CD @ 5%				116.54	142.73	116.54	101.22	134.42	101.22			

Table 81 (b). Interactions showing dehydrogenase ($\mu\text{g TPF g}^{-1} \text{h}^{-1}$) activity of soils under organic and conventional farming systems in Southern transition Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	813	735	P1 x D1	890	789	F1 x D1	1361	1283
F1 x P2	1074	1106	P1 x D2	412	399	F1 x D2	803	790
F1 x P3	1263	1270	P2 x D1	1136	1061	F2 x D1	740	714
F2 x P1	488	453	P2 x D2	717	763	F2 x D2	452	447
F2 x P2	778	718	P3 x D1	1220	1146			
F2 x P3	617	571	P3 x D2	660	695			
F-test	*	*		NS	NS		NS	NS
Sem $\pm$	70.15	61.24		57.29	54.12		70.15	61.24
CD @ 5%	201.86	182.12		164.82	161.22		-	-

F: Farming Systems (2)
 F1- ORG: Organic Farming
 F2- CON: Conventional Framing
 # :Mean of 4 farmers

P: Years (3)
 P1 :0-3 Years
 P2: 3-6 Years & P3: > 6 Years
 * : Significant (p=0.05)

D: Depth (cm) (2)
 D 1:0-15
 D 2: 15-30
 NS: Non Significant

Southern Dry zone

The dehydrogenase activity differed significantly in organic and conventional farming systems in all the three different periods of practice and in two depths during *kharif* 2008 and summer 2009.

The dehydrogenase activity (Table 80a) in surface soils of organic farming system ranged from 677 (0-3yrs) to 1093 $\mu\text{g TPF g}^{-1} \text{ h}^{-1}$ (>6yrs) during *kharif* 2008 and 612 (0-3yrs) to 984 $\mu\text{g TPF g}^{-1} \text{ h}^{-1}$ (>6yrs) during summer 2009, whereas in conventional farming it ranged from 435 (0-3yrs) to 547 $\mu\text{g TPF g}^{-1} \text{ h}^{-1}$ (3-6yrs) during *kharif* 2008 and 388 (3-6yrs) to 488 $\mu\text{g TPF g}^{-1} \text{ h}^{-1}$ (>6yrs) during summer 2009.

The interactions between farming systems & periods varied significantly in case of dehydrogenase activity. However, it varied not varied with farming systems & depth and periods & depths interactions during both the seasons (Table 80b).

Southern Transition zone

The dehydrogenase activity showed significant changes in soils of organic and conventional farming systems in all the three different periods of practice, in two depths during *kharif* 2008 and summer 2009.

The DH activity (Table 81a) in surface soils of organic farming system ranged from 1101 (0-3yrs) to 1565 $\mu\text{g g}^{-1}$ (>6yrs) during *kharif* 2008 and 984 (0-3yrs) to 1498 $\mu\text{g g}^{-1}$ (>6yrs) during summer 2009, whereas in conventional farming it ranged from 679 (0-3yrs) to 874 $\mu\text{g g}^{-1}$ (>6yrs) during *kharif* 2008 and 594 (3-6yrs) to 794 $\mu\text{g g}^{-1}$ (>6yrs) during summer 2009.

Variations among periods of practice & depths and farming systems & depth interactions were on par (Table 81b) during both the seasons. However, the interactions for farming systems & periods of practice it showed significant difference.

4.5.2 Urease activity (UA)

The urease activity (UA) of soils of organic and conventional farming systems compared over three different periods of practice under three selected agroclimatic zones of Karnataka, and the results are presented in table 82,83 and 84.

Central Dry zone (CDZ)

The urease activity showed significant difference among organic and conventional farming systems during different periods of practice at two depths during *kharif* 2008 and summer 2009.

The Urease activity (Table 82a) of surface soils sourced from organic farming system ranged from 57.96 (0-3yrs) to 102.39 $\mu\text{g NH}_4 \text{ g}^{-1} \text{ h}^{-1}$ (>6yrs) during *kharif* 2008 and 53.48 (0-3yrs) to 108.72 $\mu\text{g NH}_4 \text{ g}^{-1} \text{ h}^{-1}$ (>6yrs) during summer 2009. In conventional farming system it ranged from 48.64 (3-6yrs) to 51.59 $\mu\text{g NH}_4 \text{ g}^{-1} \text{ h}^{-1}$ (0-3yrs) and 32.79 (3-6yrs) to 46.33 $\mu\text{g NH}_4 \text{ g}^{-1} \text{ h}^{-1}$ (0-3yrs) during *kharif* 2008 and summer 2009, respectively. An increasing trend was observed in UA from 0-3 yrs to > 6yrs of organic farming, whereas it was not with conventional farming practice at both the depths during both the seasons.

Urease activity showed significant difference among farming systems & periods of practice and periods of practice & depths interactions (Table 82b) during *kharif* 2008 and summer 2009. However, for farming systems and depth interactions, it varied non significantly.

Southern Dry zone (SDZ)

During *kharif* 2008 and summer 2009, the soil urease activity differed significantly among organic and conventional farming systems during three different periods of practice at two depths.

Table 82 (a). Urease ($\mu\text{g NH}_4 \text{ g}^{-1} \text{ h}^{-1}$) activity of soils as influenced by Organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	57.96	37.50	53.48	36.49	85.93	58.11	80.96	59.12	102.39	78.52	108.72	80.51
F2:CON	51.59	35.47	46.33	30.54	48.64	37.06	32.79	25.28	50.42	42.84	36.90	30.42
				<i>Kharif '2008</i>		<i>Summer ' 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem $\pm$				1.36	1.67	1.36	1.88	2.31	1.88			
CD @ 5%				3.93	4.82	3.93	5.42	6.64	5.42			

Table 82 (b). Interactions showing urease ($\mu\text{g NH}_4 \text{ g}^{-1} \text{ h}^{-1}$) activity of soils under organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	47.73	45.04	P1 x D1	54.77	49.90	F1 x D1	82.09	81.05
F1 x P2	72.02	70.04	P1 x D2	36.48	33.56	F1 x D2	49.55	38.67
F1 x P3	90.45	94.61	P2 x D1	66.28	56.87	F2 x D1	48.04	58.74
F2 x P1	43.53	38.43	P2 x D2	47.58	42.20	F2 x D2	38.45	28.75
F2 x P2	41.85	29.03	P3 x D1	76.40	72.81			
F2 x P3	46.63	33.66	P3 x D2	60.68	55.46			
F-test	*	*		*	*		NS	NS
Sem $\pm$	2.37	3.26		1.93	2.66		2.37	3.26
CD @ 5%	6.82	9.39		5.56	7.66		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 83 (a). Urease ($\mu\text{g NH}_4 \text{ g}^{-1} \text{ h}^{-1}$) activity of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	61.03	45.93	57.66	48.82	112.43	75.46	114.48	86.01	168.19	145.67	150.55	137.66
F2:CON	56.95	40.01	45.75	37.59	61.30	49.99	44.07	41.27	71.51	54.20	57.91	48.09
				<i>Kharif,2008</i>		<i>Summer, 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem $\pm$				3.71	4.53	3.70	4.06	4.97	4.06			
CD @ 5%				10.65	13.04	10.65	11.69	14.31	11.69			

Table 83 (b). Interactions showing urease ($\mu\text{g NH}_4 \text{ g}^{-1} \text{ h}^{-1}$) activity of soils under organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	53.48	53.24	P1 x D1	58.99	51.71	F1 x D1	126.22	127.56
F1 x P2	93.95	100.25	P1 x D2	42.97	43.20	F1 x D2	63.25	49.24
F1 x P3	156.96	144.10	P2 x D1	86.87	79.27	F2 x D1	89.02	100.83
F2 x P1	48.48	41.67	P2 x D2	62.73	63.64	F2 x D2	48.06	43.31
F2 x P2	55.64	42.67	P3 x D1	138.35	134.23			
F2 x P3	62.85	53.00	P3 x D2	99.93	107.88			
F-test	*	*		*	NS		NS	NS
Sem $\pm$	6.41	7.03		5.23	5.74		6.41	7.03
CD @ 5%	18.45	20.25		15.06	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 84 (a). Urease ($\mu\text{g NH}_4 \text{ g}^{-1} \text{ h}^{-1}$) activity of soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	78.27	63.68	74.61	64.72	110.25	84.37	101.75	82.31	150.50	98.38	132.81	86.06
F2:CON	73.75	57.13	55.24	55.58	73.10	53.28	45.24	41.63	73.56	57.38	65.28	53.31
				<i>Kharif '2008</i>		<i>Summer ' 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem $\pm$				2.51	3.07	2.51	3.48	4.27	3.48			
CD @ 5%				7.23	8.85	7.23	10.03	12.28	10.03			

Table 84 (b). Interactions showing urease ($\mu\text{g NH}_4 \text{ g}^{-1} \text{ h}^{-1}$) activity of soils under organic and conventional farming systems in Southern Transition Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	70.97	69.67	P1 x D1	76.01	64.93	F1 x D1	113.01	126.39
F1 x P2	97.31	92.03	P1 x D2	60.40	60.15	F1 x D2	73.47	48.59
F1 x P3	124.44	109.43	P2 x D1	91.68	83.29	F2 x D1	82.14	99.69
F2 x P1	65.44	55.41	P2 x D2	68.83	72.97	F2 x D2	55.93	49.17
F2 x P2	63.19	43.44	P3 x D1	112.03	114.04			
F2 x P3	65.47	58.29	P3 x D2	77.88	90.18			
F-test	*	*		NS	*		NS	NS
Sem $\pm$	4.35	6.03		3.55	4.93		4.35	6.03
CD @ 5%	12.52	17.37		-	14.18		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant (p=0.05)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

The soil urease activity (Table 83a) of surface soils of organic farming system ranged from 61.03 (0-3yrs) to 168.19 $\mu\text{g NH}_4 \text{ g}^{-1} \text{ h}^{-1}$ (>6yrs) during *kharif* 2008 and 57.66 (0-3yrs) to 150.55 $\mu\text{g NH}_4 \text{ g}^{-1} \text{ h}^{-1}$ (>6yrs) during summer 2009, whereas in conventional farming system it ranged from 56.95 (0-3yrs) to 71.51 $\mu\text{g NH}_4 \text{ g}^{-1} \text{ h}^{-1}$ (>6yrs) during *kharif* 2008 and 44.07 (3-6yrs) to 57.91 $\mu\text{g NH}_4 \text{ g}^{-1} \text{ h}^{-1}$ (>6yrs) during summer 2009.

Urease activity showed significant variations among farming systems and period's of practice interactions during *kharif* 2008 and summer 2009. However, it did not show any variation for farming systems and depth interactions (Table 83b).

Southern Transition zone (STZ)

The urease activity recorded significant changes among organic and conventional farming systems over three different periods of practice at two depths during *kharif* 2008 and summer 2009.

In organic farming system, the urease activity (Table 84a) ranged from 78.27 (0-3yrs) to 150.50 $\mu\text{g NH}_4 \text{ g}^{-1} \text{ h}^{-1}$ (>6yrs) soil at 0-15 cm depth during *kharif* 2008 and 74.61 (0-3yrs) to 132.81 $\mu\text{g NH}_4 \text{ g}^{-1} \text{ h}^{-1}$ (>6yrs) during summer 2009. In conventional farming it ranged from 73.10 (3-6yrs) to 73.56 $\mu\text{g NH}_4 \text{ g}^{-1} \text{ h}^{-1}$ (>6yrs) at 0-15 cm depth and 45.24 (3-6yrs) to 55.24 $\mu\text{g NH}_4 \text{ g}^{-1} \text{ h}^{-1}$ (0-3yrs) during *kharif* 2008 and summer 2009 respectively. An increasing trend was observed in UA from 0-3 yrs to > 6yrs of organic farming practice, whereas it was not so with the conventional farming at both the depths and during both the seasons.

The interactions between farming systems & depth showed that the urease activity varied non significantly. However, it showed significant variations among farming systems and period's of practice during both the seasons (Table 84b).

4.5.3 Acid Phosphatase activity

The data on comparative changes in acid phosphatase activity of soils collected from organic and conventional farming systems over three different periods of practice under three selected agroclimatic zones of Southern Karnataka are presented in tables 85, 86 and 87.

Central Dry zone (CDZ)

The acid phosphatase activity ($\mu\text{g p-NP g}^{-1} \text{ h}^{-1}$) in soils of Central Dry zone of Karnataka (Table 85a.) differed significantly among organic and conventional farming systems during three different periods of practice at two depths during *kharif* 2008 and summer 2009.

The acid phosphatase activity in surface soils of organic farming system ranged from 20.67 (0-3yrs) to 47.58 $\mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ (>6yrs) and 15.94 (0-3yrs) to 44.81 $\mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ (>6yrs) during *kharif* 2008 and summer 2009, respectively, whereas in soils from conventional farming system it ranged from 16.37 (0-3yrs) to 24.01 $\mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ (3-6yrs) during *kharif* 2008 and from 11.60 (0-3yrs) to 15.33 $\mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ (3-6 yrs) during summer 2009. An increasing trend was observed in acid phosphatase activity from 0-3 yrs to > 6yrs of organic farming, and the same was not so with the conventional farming practice.

Acid phosphatase activity showed significant difference among farming systems and period's of practice interactions (Table 85b). However, for farming systems and depth, and periods and depth of sampling, the acid phosphatase activity did not show any variation as revealed by not significant interactions during *kharif* 2008 and summer 2009.

Southern Dry zone (SDZ)

During *kharif* 2008 and summer 2009, the Acid phosphatase activity of soils under Southern Dry zone of Karnataka (Table 86a) differed significantly among organic

Table 85 (a). Acid Phosphatase ($\mu\text{g p-NP g}^{-1} \text{h}^{-1}$) activity of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	20.67	18.53	15.94	13.84	40.00	26.54	36.98	30.33	47.58	33.22	44.81	32.33
F2:CON	16.37	15.61	11.60	11.22	24.01	15.08	15.53	10.51	26.19	15.09	23.96	19.64
				Kharif '2008		Summer ' 2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem $\pm$				1.65	2.02	1.65	1.55	1.90	1.55			
CD @ 5%				4.75	5.81	4.75	4.48	5.48	4.48			

Table 85 (b). Interactions showing acid Phosphatase ($\mu\text{g p-NP g}^{-1} \text{h}^{-1}$) activity of soils under organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	19.60	14.89	P1 x D1	18.52	13.77	F1 x D1	36.08	32.58
F1 x P2	33.27	33.65	P1 x D2	17.07	12.53	F1 x D2	20.86	13.70
F1 x P3	40.40	38.57	P2 x D1	32.01	26.25	F2 x D1	26.10	25.50
F2 x P1	15.99	11.41	P2 x D2	20.81	20.42	F2 x D2	15.26	10.45
F2 x P2	19.55	13.02	P3 x D1	34.89	29.39			
F2 x P3	18.64	11.80	P3 x D2	24.15	20.98			
F-test	*	*		NS	NS		NS	NS
Sem $\pm$	2.86	2.69		2.33	2.20		2.86	2.69
CD @ 5%	8.22	7.76		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming
F2- CON: Conventional Framing
#: Mean of 4 farmers

P: Years (3)

P1 :0-3 Years
P2: 3-6 Years & P3: > 6 Years
*: Significant ($p=0.05$)

D: Depth (cm) (2)

D 1:0-15
D 2: 15-30
NS: Non Significant

Table 86 (a). Acid Phosphatase ($\mu\text{g p-NP g}^{-1} \text{h}^{-1}$) activity of soils as influenced by organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	19.71	13.90	15.99	12.76	38.36	33.42	34.58	29.09	56.14	45.09	59.74	44.09
F2:CON	17.41	13.85	13.82	14.02	17.57	10.53	17.68	6.80	37.09	31.78	32.26	28.89
				Kharif '2008		Summer ' 2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem $\pm$				0.92	1.13	0.92	1.00	1.23	1.00			
CD @ 5%				2.66	3.26	2.66	2.89	3.54	2.89			

Table 86 (b). Interactions showing acid phosphatase ($\mu\text{g p-NP g}^{-1} \text{h}^{-1}$) activity of soils under organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	16.81	14.37	P1 x D1	18.56	14.91	F1 x D1	38.07	36.77
F1 x P2	35.89	31.83	P1 x D2	13.87	13.39	F1 x D2	17.35	14.59
F1 x P3	50.61	51.91	P2 x D1	27.96	26.13	F2 x D1	30.80	28.64
F2 x P1	15.63	13.92	P2 x D2	21.97	17.94	F2 x D2	12.05	9.90
F2 x P2	14.05	12.24	P3 x D1	36.61	36.00			
F2 x P3	34.43	30.57	P3 x D2	28.43	26.49			
F-test	*	*		NS	NS		NS	NS
Sem $\pm$	1.60	1.74		1.30	1.42		1.60	1.74
CD @ 5%	4.61	5.01		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant ($p=0.05$)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 87 (a). Acid Phosphatase ($\mu\text{g p-NP g}^{-1} \text{h}^{-1}$) activity of soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	35.33	26.17	32.60	24.24	42.12	26.64	48.99	33.32	51.76	28.66	62.24	44.36
F2:CON	24.11	28.38	21.09	16.94	24.95	19.09	13.32	12.97	31.81	19.38	17.46	14.80
				Kharif '2008		Summer ' 2009						
				F	P	D	F	P	D			
F-test				*	NS	*	*	*	*			
Sem $\pm$				1.53	1.88	1.53	1.05	1.29	1.05			
CD @ 5%				4.42	-	4.42	3.04	3.72	3.04			

Table 87 (b). Interactions showing acid phosphatase ($\mu\text{g p-NP g}^{-1} \text{h}^{-1}$) activity of soils under organic and conventional farming systems in Southern Transition Zone

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	30.75	28.42	P1 x D1	29.72	26.85	F1 x D1	43.07	47.94
F1 x P2	34.38	41.15	P1 x D2	27.28	20.59	F1 x D2	26.96	17.29
F1 x P3	40.21	53.30	P2 x D1	33.54	31.15	F2 x D1	27.16	33.97
F2 x P1	26.25	19.02	P2 x D2	22.86	23.15	F2 x D2	22.28	14.91
F2 x P2	22.02	13.15	P3 x D1	41.79	39.85			
F2 x P3	25.60	16.13	P3 x D2	24.02	29.58			
F-test	NS	*		*	*		*	NS
Sem $\pm$	2.66	1.83		2.17	1.49		2.66	1.83
CD @ 5%	-	5.27		6.25	4.30		7.66	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant ($p=0.05$)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

and conventional farming systems during different periods (0-3, 3-6 and >6 years) of practice at two depths (0-15 and 15-30cm).

In organic farming system, the Acid phosphatase activity in surface soils ranged from 19.71 (0-3yrs) to 56.14 $\mu\text{g p-NP g}^{-1} \text{h}^{-1}$ (> 6yrs) during *kharif* 2008 and from 15.99 (0-3 yrs) to 59.74 $\mu\text{g p-NP g}^{-1} \text{h}^{-1}$ (>6yrs) during summer 2009. In conventional farming it ranged from 17.09 (> 6yrs) to 17.57 $\mu\text{g p-NP g}^{-1} \text{h}^{-1}$ (3-6yrs) during *kharif* 2008 and 12.26 (> 6yrs) to 17.68 $\mu\text{g p-NP g}^{-1} \text{h}^{-1}$ (3- 6yrs) during summer 2009.

Acid phosphatase activity showed significant difference among farming systems & periods of practice interactions (Table 86b), during *kharif* 2008 and summer 2009. However, for farming systems & depth and periods of practice & depth of sampling interactions it varied not significantly.

Southern Transition zone (STZ)

The Acid phosphatase activity of soils under Southern Transition zone of Karnataka (Table 87a) showed significant difference among organic and conventional farming systems during three different periods of practice at two depths during *kharif* 2008 and summer 2009.

Acid phosphatase activity in surface soils of organic farming system ranged from 35.33 (0-3yrs) to 51.76 $\mu\text{g p-NP g}^{-1} \text{h}^{-1}$ (>6yrs) during *kharif* 2008 and 32.60 (0-3yrs) to 62.24 $\mu\text{g p-NP g}^{-1} \text{h}^{-1}$ (>6yrs) during summer 2009, whereas in conventional farming it ranged from 24.11 (0-3yrs) to 31.81 $\mu\text{g p-NP g}^{-1} \text{h}^{-1}$ (> 6yrs) and 13.32 (3-6yrs) to 21.09 $\mu\text{g p-NP g}^{-1} \text{h}^{-1}$ (0-3yrs) during *kharif* 2008 and summer 2009, respectively. Acid phosphatase activity increased from 0-3 yrs to > 6yrs of organic farming, and the same was not true with the conventional farming practice at both the depths and during both the seasons.

For farming systems & periods of practice (*kharif* 2008) and farming systems & depth (summer 2009) interactions (Table 87b), acid phosphatase activity did not show any variation. However, it differed significantly with periods of practice and depth of sampling interactions during both *kharif* 2008 and summer 2009.

4.5.4 Alkaline Phosphatase activity

The alkaline phosphatase activity among organic and conventional farming systems was compared over three different periods of practice under three selected agroclimatic zones of Southern Karnataka. The results are presented in Tables 88, 89 and 90.

Central Dry zone (CDZ)

The alkaline phosphatase activity ($\mu\text{g p-NP g}^{-1} \text{ h}^{-1}$) in soils of Central Dry zone of Karnataka (Table 88a.) differed significantly among organic and conventional farming systems during *kharif* 2008 and summer 2009. However, it showed no significant variation during three different periods of practice of organic or conventional farming.

The alkaline phosphatase activity in soils sourced from organic farming system ranged from 37.78 (> 6yrs) to 45.32 ($\mu\text{g p-NP g}^{-1} \text{ h}^{-1}$) (3-6yrs) at 0-15 cm depth during *kharif* 2008 and 33.73 (0-3yrs) to 48.93 $\mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ (3-6yrs) during summer 2009, whereas in conventional farming it ranged from 21.46 (> 6yrs) to 24.53 ($\mu\text{g p-NP g}^{-1} \text{ h}^{-1}$) (0- 3yrs) at 0-15 cm depth during *kharif* 2008 and 14.06 (> 6yrs) to 20.71 ($\mu\text{g p-NP g}^{-1} \text{ h}^{-1}$) (3-6 yrs) during summer 2009.

Alkaline phosphatase activity (Table 88b) did not show any variation among farming systems and depth of sampling, and periods of practice and depth of sampling as revealed by non significant interactions during *kharif* 2008 and summer 2009. However, it showed significant variation among farming systems and periods of practice interactions during summer 2009.

Table 88 (a). Alkaline Phosphatase ($\mu\text{g p-NP g}^{-1} \text{h}^{-1}$) activity of soils as influenced by organic and conventional farming systems in Central Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	38.89	30.67	33.73	25.42	45.32	33.74	48.93	39.44	37.78	31.59	42.81	35.95
F2:CON	24.53	20.67	18.76	16.57	23.35	18.94	20.71	14.01	21.46	19.26	14.06	7.90
				Kharif '2008		Summer ' 2009						
				F	P	D	F	P	D			
F-test				*	NS	*	*	NS	*			
Sem $\pm$				1.89	2.31	1.89	1.98	2.43	1.98			
CD @ 5%				5.44	-	5.44	5.72	-	5.72			

Table 88 (b). Interactions showing alkaline phosphatase ($\mu\text{g p-NP g}^{-1} \text{h}^{-1}$) activity of soils under organic and conventional farming systems in Central Dry Zone of Karnataka

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	34.78	29.57	P1 x D1	31.71	26.24	F1 x D1	40.66	41.82
F1 x P2	39.53	44.19	P1 x D2	25.67	20.99	F1 x D2	23.11	17.84
F1 x P3	34.69	39.38	P2 x D1	34.33	34.82	F2 x D1	32.07	33.60
F2 x P1	22.60	17.66	P2 x D2	26.34	26.73	F2 x D2	16.29	12.83
F2 x P2	21.14	17.36	P3 x D1	29.62	28.43			
F2 x P3	15.36	10.98	P3 x D2	20.43	21.93			
F-test	NS	*		NS	NS		NS	NS
Sem $\pm$	3.27	3.44		2.67	2.81		3.27	3.44
CD @ 5%	-	9.90		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant ($p=0.05$)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 89 (a). Alkaline Phosphatase ($\mu\text{g p-NP g}^{-1} \text{h}^{-1}$) activity of soils as influenced by Organic and conventional farming systems in Southern Dry Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>		<i>Kharif '2008</i>		<i>Summer ' 2009</i>	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	26.44	18.15	19.51	19.30	44.27	32.56	38.86	33.61	63.13	54.08	61.36	50.06
F2:CON	23.88	15.19	15.84	12.88	21.38	13.18	13.80	10.37	31.63	25.24	27.85	24.63
				<i>Kharif '2008</i>		<i>Summer ' 2009</i>						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem $\pm$				0.83	1.01	0.83	1.05	1.28	1.05			
CD @ 5%				2.39	2.92	2.39	3.02	3.70	3.02			

Table 89 (b). Interactions showing alkaline phosphatase ($\mu\text{g p-NP g}^{-1} \text{h}^{-1}$) activity of soils under organic and conventional farming systems in Southern Dry Zone of Karnataka

F x P			P x D			F x D		
	<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>		<i>Kharif '2008</i>	<i>Summer '2009</i>
F1 x P1	22.29	19.41	P1 x D1	25.16	17.68	F1 x D1	44.61	46.58
F1 x P2	38.41	35.93	P1 x D2	16.67	16.09	F1 x D2	22.29	15.86
F1 x P3	58.60	55.71	P2 x D1	32.82	31.33	F2 x D1	34.93	37.32
F2 x P1	19.53	14.36	P2 x D2	22.87	21.99	F2 x D2	14.53	12.63
F2 x P2	17.28	12.08	P3 x D1	42.38	44.60			
F2 x P3	28.43	26.24	P3 x D2	34.66	36.84			
F-test	*	*		NS	*		NS	NS
Sem $\pm$	1.43	1.82		1.17	1.48		1.43	1.82
CD @ 5%	4.14	5.24		-	4.28		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant ($p=0.05$)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Table 90 (a). Alkaline Phosphatase ($\mu\text{g p-NP g}^{-1} \text{h}^{-1}$) activity of soils as influenced by organic and conventional farming systems in Southern Transition Zone of Karnataka

Periods (P)	P 1 (0-3 Years)				P2 (3-6 Years)				P3 (>6 Years)			
Season	Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009		Kharif '2008		Summer ' 2009	
F: Farming Systems	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)	D1 (0-15cm)	D 2 (15-30cm)
F1:ORG #	38.05	30.59	38.09	27.09	29.89	19.07	34.94	27.31	33.79	27.85	42.32	35.27
F2:CON	19.34	13.41	15.55	9.30	15.55	13.41	11.79	9.55	27.15	18.66	17.89	14.53
				Kharif '2008		Summer ' 2009						
				F	P	D	F	P	D			
F-test				*	*	*	*	*	*			
Sem $\pm$				1.52	1.86	1.52	1.41	1.72	1.41			
CD @ 5%				4.38	5.37	4.38	4.06	4.97	4.06			

Table 90 (b). Interactions showing alkaline phosphatase ($\mu\text{g p-NP g}^{-1} \text{h}^{-1}$) activity of soils under organic and conventional farming systems in Southern Transition Zone

F x P			P x D			F x D		
	Kharif '2008	Summer '2009		Kharif '2008	Summer '2009		Kharif '2008	Summer '2009
F1 x P1	34.32	32.59	P1 x D1	28.69	26.82	F1 x D1	33.91	38.45
F1 x P2	24.48	31.13	P1 x D2	22.00	18.19	F1 x D2	20.68	15.08
F1 x P3	30.82	38.79	P2 x D1	22.72	23.37	F2 x D1	25.84	29.89
F2 x P1	16.37	12.43	P2 x D2	15.93	18.43	F2 x D2	14.95	11.13
F2 x P2	14.17	10.67	P3 x D1	30.47	30.10			
F2 x P3	22.19	16.21	P3 x D2	23.25	24.90			
F-test	NS	NS		NS	NS		NS	NS
Sem $\pm$	2.64	2.44		2.15	1.99		2.64	2.44
CD @ 5%	-	-		-	-		-	-

F: Farming Systems (2)

F1- ORG: Organic Farming

F2- CON: Conventional Framing

:Mean of 4 farmers

P: Years (3)

P1 :0-3 Years

P2: 3-6 Years & P3: > 6 Years

* : Significant ($p=0.05$)

D: Depth (cm) (2)

D 1:0-15

D 2: 15-30

NS: Non Significant

Southern Dry zone (SDZ)

In soils sampled under Southern Dry zone of Karnataka (Table 89a), the alkaline phosphatase activity differed significantly among organic and conventional farming systems during *kharif* 2008 and summer 2009.

The alkaline phosphatase activity in surface soils sourced from organic farming system ranged from 26.44 (0-3yrs) to 63.13 $\mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ (> 6yrs) during *kharif* 2008 and 19.51 (0-3 yrs) to 71.36 $\mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ (>6yrs) during summer 2009, whereas in conventional farming system it ranged from 21.38 (3- 6yrs) to 23.88 $\mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ (0-3yrs) during *kharif* 2008 and 13.80 (3-6yrs) to 17.85 $\mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ (> 6yrs) during summer 2009.

The alkaline phosphatase activity varied significantly among farming systems and periods interactions (Table 89b), during both the seasons.

Southern Transition zone (STZ)

During *kharif* 2008 and summer 2009, the alkaline phosphatase activity in soils of Southern Transition zone of Karnataka (Table 90a) differed significantly among organic and conventional farming systems during three different periods of practice at two depths.

Alkaline phosphatase activity in surface soils collected from organic farming system ranged from 29.89 (3-6yrs) to 38.05 $\mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ (0-3yrs) and from 34.94 (3-6yrs) to 42.32 $\mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ (>6yrs) during *kharif* 2008 and summer 2009 respectively, whereas in conventional farming it ranged from 15.55 (3-6yrs) to 27.15 $\mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ (> 6yrs) during *kharif* 2008 and 11.79 (3-6yrs) to 17.89 $\mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ (> 6yrs) during summer 2009.

Interaction studies (Table 90b), did not show any significant variations in alkaline phosphatase activity irrespective of farming systems, periods of practice or depth of sampling during both the seasons.

4.6 Morphological, physical, physico-chemical, biological properties and carbon distribution in soil profiles of organic and conventional farming systems in CDZ,SDZ and ST zones of Southern Karnataka

The morphological, physical, physico-chemical and biological properties along with the carbon distribution were analyzed horizon wise in the pedons representing different periods of practice of organic and conventional farming systems under Central dry zone, Southern dry zone and Southern transition zone of Southern Karnataka. The results are presented in the following sections.

4.6.1 Central dry zone (CDZ)

CDZ -Pedon 1: Organic Farming (0-3 yrs)

Pedon 1 of studied in Babbur farm, where organic farming is being practiced for over two years. The land was gently sloping plain with 1 to 3 per cent slope. The soil developed from weathered schist (Table. 4). The surface horizon (12 cm thick) was clay with moderate subangular blocky structure, Consistence was dry hard, moist friable and wet sticky and plastic. The soil recorded strong alkaline reaction which was exhibited by strong effervescence with dilute acid. Subsoil horizons from 12 to 70 cm were dark brown clay with moderate subangular blocky structure. Other features were similar to surface horizon. Below 70 cm weathered rock was found.

Particle size distribution indicated 47.68 per cent clay in surface horizon and was 46.06 per cent in sub soil (Table 91). Gravel content increased sharply in the lower two layers. Bulk density of the surface soil was 1.12 Mg m^{-3} and in the subsoil layers it ranged from 1.18 to 1.21 Mg m^{-3} . Soil reaction was strongly alkaline with pH range of 8.5 to 8.7. Electrical conductivity varied from 0.22 to 0.32 dS m^{-1} . Available phosphorus content of the surface soil was 8.57 kg ha^{-1} and in subsoil ranged it from 3.5 to 5.2 kg ha^{-1} .

Table 91. Physical, Chemical and biological characteristics of pedons of organic and conventional farming systems under Central Dry zone of Karnataka

Horizon	Depth (cm)	Sand (%)	Silt (%)	Clay (%)	BulkDensity (Mg m ⁻³)	pH	EC (dSm ⁻¹)	Available P (kg ha ⁻¹)	Available K (kg ha ⁻¹)	Dehydrogenase (µg TPFg ⁻¹ h ⁻¹)	Urease (µg NH4g ⁻¹ h ⁻²)	Acid Phosphatase (µg p-NP g ⁻¹ h ⁻¹)	Alkaline Phosphatase (µg p-NP g ⁻¹ h ⁻¹)
Pedon -1: (Organic farming 0-3yrs)								Fine,mixed,iso hyper thermic,lithic Haplustepts					
Ap	0-12	47.92	5	47.08	1.12	8.5	0.32	8.57	202	524	72.24	49.78	44.92
BW1	12-24	46.12	6.2	47.68	1.18	8.6	0.25	5.2	168	419	58.65	37.12	43.32
BW2	24-70	49.64	4.3	46.06	1.21	8.7	0.22	3.47	39	154	24.34	14.62	17.63
C	70-100	Weathered parent material											
Pedon-2: (Organic farming 3-6 yrs)								Fine, mixed,iso hyper thermic, Typic Paleustalfs					
Ap	0-19	50.43	7.5	42.08	0.98	7.8	0.18	15.85	448	1048	90.54	54.57	56.69
BW1	19-34	51.64	4.3	44.06	1.12	8.2	0.16	10.34	385	606	64.55	43.63	50.39
BW2	34-52	47.26	4.5	48.24	1.16	8.3	0.17	5.71	189	343	41.64	30.05	40.25
BW3	52-76	54.92	5.2	39.88	1.26	8.7	0.22	2.25	133	264	12.56	22.3	29.53
BW4	76-100	45.72	4.2	50.08	1.45	8.65	0.21	1.84	81	163	8.45	6.88	25.04
Pedon-3: (Organic farming >6yrs)								Fine, mixed, isohyperthermic, Typic Haplustepts					
Ap	0-14	51.25	2.5	46.25	1.28	7.2	0.12	16.54	322	1194	88.84	57.12	59.12
BW1	14-35	46.34	4.4	49.2	1.38	7.85	0.1	12.22	207	701	64.58	48.39	57.64
BW2	35-60	50.23	3.8	45.97	1.45	8.15	0.14	11.42	172	354	32.52	38.41	57.01
BW3	60-80	53.44	2.5	43.76	1.48	8.35	0.12	6.08	81	304	14.34	24.39	41.33
C	80-100	Weathered parent material											
Pedon -4: (Conventional farming)								Clayey-skeletal, mixed, isohyperthermic, Typic Haplustepts					
Ap	0-15	47.92	7.5	44.58	1.04	7.9	0.27	6.14	206	347	51.24	53.12	55.06
BW1	15-28	52.14	6.2	41.66	1.08	8.12	0.28	5.71	102	214	38.66	37.18	37.55
BW2	28-58	54.24	5.5	40.24	1.22	8.4	0.3	5.2	63	52.4	16.32	31.03	19.05
BC	58-75	68.56	4.6	26.84	1.26	8.74	0.28	2.85	42	14.2	7.42	12.96	14.75
C	75-100	Weathered parent material											

¹. Potassium content of the surface layer was 202 kg ha⁻¹ and in the subsoil it ranged from 39 to 168 kg ha⁻¹.

The biological activity of soil was measured by the activity of the enzymes dehydrogenase, urease, alkaline phosphatase and acid phosphatase. Dehydrogenase activity in the surface soil layer was 5245 µg TPF g⁻¹ h⁻¹, it declined to 154 in subsoil. Urease activity in surface soil was 72.24 µg NH₄-N g⁻¹h⁻² but declined to 24.34 in subsoil. Acid phosphatase activity was 49.78 µg p-NP g⁻¹ h⁻¹ in surface soil and in subsoil it was 14.62 µg p-NP g⁻¹ h⁻¹. Alkaline phosphatase activity in the surface soil was 44.92 µg p-NP g⁻¹ h⁻¹ and in subsoil layer 17.63 µg p-NP g⁻¹ h⁻¹.

Organic carbon content (Table 92) of the surface soil was 11.7 g kg⁻¹ and in the subsoil horizons it ranged from 0.9 to 10.2 g kg⁻¹. The soil microbial biomass carbon and nitrogen contents in the surface horizon of the pedon was 362 and 52.24 µg g⁻¹ respectively and decreased with the increase in depth of the pedon. The total carbon stock in the surface soil horizon was 26.75 Mg ha⁻¹ and a total carbon stock in the entire pedon was of the order 57.73 Mg ha⁻¹. Total nitrogen stock in the surface horizon was 1.06 Mg ha⁻¹ and in the entire pedon (100cm) recorded 4.12 Mg ha⁻¹.

CDZ -Pedon 2: Organic Farming (3-6 yrs)

Pedon 2 studied at Sultanipura village of Chitradurga region where the farmer is practicing organic farming system for the past five years. The well drained soil developed from weathered gneiss (Table 4) with a slope of 1-3% and was cultivated to maize-cotton rotation. The 19 cm thick surface horizon was sandy clay in texture. Soil structure was moderately subangular blocky and consistence slightly hard, firm, sticky and plastic. Subsoil horizons from 34 to 76 cm were clay with medium subangular blocky structure. Thick patchy clay cutans were observed on ped surfaces.

Particle size distribution in the soil profile (Table 91) indicated clay movement down the solum. Bulk density of the whole soil for surface horizon was 0.98 Mg m⁻³ and

Table 92. Carbon distribution in pedons of organic and conventional farming systems under Central Dry zone of Karnataka

Horizon	Depth	Organic-C	MB-C	MB-N	Tot-C	Tot-N	Tot-C Stocks	Tot-N Stocks
	(cm)	(g kg ⁻¹)	(µg g ⁻¹)	(µg g ⁻¹)	(g kg ⁻¹)	(g kg ⁻¹)	(Mg ha ⁻¹)	(Mg ha ⁻¹)
Pedon -1: (Organic farming 0-3yrs) Fine,mixed,iso hyper thermic,Lithic Haplustepts								
A	0-12	11.7	362	52.24	19.9	0.79	26.75	1.06
BW1	12-24	10.2	241	34.2	16.8	0.67	23.79	0.95
BW2	24-70	0.9	126	19.26	3.3	0.38	18.37	2.11
C	70-100	Weathered parent material			TOTAL STOCKS		57.73	4.12
Pedon -2: (Organic farming 3-6 yrs) Fine, mixed,iso hyper thermic, Typic Paleustalfs								
A	0-19	14.1	364	56.9	24.9	1.12	46.36	2.08
BW1	19-34	10.8	285	38.4	19.3	0.76	32.42	1.28
BW2	34-52	9.6	176	26.5	16.2	0.52	33.83	1.08
BW3	52-76	7.5	98	18.6	11.8	0.36	35.68	1.08
BW4	76-100	5.7	41	9.2	7.9	0.18	27.49	0.62
					TOTAL STOCKS		138.83	6.16
Pedon -3: (Organic farming >6yrs) Fine, mixed, isohyperthermic, Typic Haplustepts								
A	0-14	15.5	482	54.3	27	1.07	48.38	1.92
BW1	14-35	12.6	352	38.2	19.8	0.75	57.38	2.17
BW2	35-60	11.4	199	26.5	16.8	0.52	60.9	1.88
BW3	60-80	9.6	102	21.2	13.4	0.41	39.66	1.21
BC	80-100	Weathered parent material			TOTAL STOCKS		150.31	7.19
Pedon -4: (Conventional farming) Clayey-skeletal, mixed, isohyperthermic, Typic Haplustepts								
AP	0-15	9.6	284	36.24	17.8	0.88	27.77	1.37
BW1	15-28	8.1	214	28.45	14.3	0.72	20.08	1.01
BW2	28-58	5.1	141	26.2	8.8	0.51	32.21	1.86
BC	58-75	4.8	62	19.4	7.6	0.38	16.28	0.81
C	75-100	Weathered parent material			TOTAL STOCKS		96.33	5.06

in subsoil bulk density ranged from 1.12 to 1.45 Mg m⁻³. Soil reaction ranged from slightly to moderately alkaline. Electrical conductivity of saturation extract ranged from 0.16 to 0.22 dS m⁻¹. The phosphorus content of the surface soil was 15.85 kg ha⁻¹ and in subsoil ranged from 1.84 to 10.34 kg ha⁻¹. Potassium (K) content of the surface layer was 448 kg ha⁻¹ and in the subsoil ranged from 81 to 385 kg ha⁻¹.

Microbial activity in soil was measured by the activity of dehydrogenase, Urease, acid and alkaline phosphatases. Dehydrogenase activity in the surface soil layer was 1048 µg TPF g⁻¹ h⁻¹ of soil day⁻¹ which declined to 163 in subsoil. Urease activity in surface soil was 90.54 µg NH₄-N g⁻¹ h⁻² but declined to 8.45 in subsoil. Acid phosphatase activity was 54.57 µg p-NP g⁻¹ h⁻¹ in surface soil and in subsoil it was 6.88 µg p-NP g⁻¹ h⁻¹. Alkaline phosphatase activity in the surface soil was 56.69 µg p-NP g⁻¹ h⁻¹ and in subsoil layer it was 25.04 µg p-NP g⁻¹ h⁻¹.

Organic carbon content of the surface layer was 14.1 g kg⁻¹ and decreased gradually with depth (Table 92). The SMB-C and SMB-N contents in the surface horizon of the studied pedon were 364 and 56.9 µg g⁻¹ respectively and decreased gradually with the depth. The total carbon stock in the surface soil horizon was 46.36 Mg ha⁻¹ and a total carbon stock in the entire pedon was of the order 138.83 Mg ha⁻¹. Total nitrogen stock in the surface horizon was 2.08 Mg ha⁻¹ and in the entire pedon (100cm) it was 6.16 Mg ha⁻¹.

Pedon 3: Organic Farming (>6 yrs)

Pedon 3 was located in nearly leveled land in M.N.hally village of Chitradurga region in which the farmer was practicing organic farming for more than 7 years. The soil was developed from alluvium of granite gneiss origin (Table 4). The poorly drained soil on land with 0 to 1 per cent slope was very slightly eroded. The crops raised were maize and ragi in rotation with sunflower. The surface soil horizon was 14 cm thick, sandy clay in texture with moderate subangular blocky structure. Consistency was hard when dry, moist friable, sticky and plastic. The subsoil horizons to a depth of 80 cm were with

sandy clay structure. Other features were similar to the surface soil. Below 80 cm weathered rock with 30% soil was found.

Bulk density of the surface soil layer was 1.28 Mg m^{-3} and in subsoil the values ranged from 1.38 to 1.48 Mg m^{-3} . Soil reaction was neutral in surface horizon and was slightly alkaline to alkaline in sub soil horizons in the soil profile. Electrical conductivity of saturation extract was 32.01 dS m^{-1} for the surface soil and the value ranged from 6.08 to 16.27 dS m^{-1} in the subsoil horizons. The phosphorus (P) content of the surface soil was 16.54 kg ha^{-1} and in subsoil ranged from 6.08 to 12.22 kg ha^{-1} . Potassium (K) content of the surface layer was 322 kg ha^{-1} and in the subsoil ranged from 81 to 207 kg ha^{-1} .

Dehydrogenase activity in the surfaces soil layer was $1194 \text{ } \mu\text{g TPF g}^{-1} \text{ h}^{-1}$ which declined to 304 in subsoil (Table 91). Urease activity in surface soil was $88.84 \text{ } \mu\text{g NH}_4\text{-N g}^{-1}\text{h}^{-2}$ but decreased to 14.34 in subsoil. Acid phosphatase activity was $57.12 \text{ } \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ in surface soil and in subsoil it was $24.39 \text{ } \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$. Alkaline phosphatase activity in the surface soil was $59.12 \text{ } \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ and in subsoil layer it was $41.33 \text{ } \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$.

Organic carbon content of the surface layer was 15.5 g kg^{-1} and which decreased gradually with depth (Table 92). The SMB-C and SMB-N contents in the surface horizon of the studied pedon were 482 and $54.3 \text{ } \mu\text{g g}^{-1}$ respectively and were decreased gradually with the depth. The total carbon stock in the surface soil horizon was 48.38 Mg ha^{-1} and a total carbon stock in the entire pedon was of the order $150.31 \text{ Mg ha}^{-1}$. Total nitrogen stock in the surface horizon was 1.92 Mg ha^{-1} and in the entire pedon (100cm) it was 7.19 Mg ha^{-1} .

Pedon 4: Conventional Farming

The pedon 4 studied for evaluating properties of conventional farming system is exposed in Babbur farm of Agricultural Research station, Babbur. The land parcel in which soil profile was exposed was cultivated with field crops like maize and sunflower.

It had very gently sloping plain with 1 to 3 per cent slope (Table 4). The soils were developed from weathered schist. The 15 cm thick surface horizon was sandy clay with moderate subangular blocky structure and the consistence dry hard, moist friable and wet sticky and plastic. Subsoil horizons from 28 to 58 cm were gravel clay. Soil structure was moderate fine subangular blocky and consistence dry hard, moist friable and wet sticky and slightly plastic.

The sandy clay surface soil contained 44.58 per cent clay which decreased to 26.84 per cent in the subsoil horizons (Table 91). Bulk density of the surface soil was 1.04 Mg m^{-3} . In the subsoil horizons bulk density ranged from 1.08 to 1.26 Mg m^{-3} . Reaction of the surface soil was 7.9 (slightly alkaline) which increased to 8.74 in the subsoil horizons. Electrical conductivity of saturation extract was in the range of 0.10 to 0.14 dS m^{-1} . Plant available phosphorus (P) content of the surface soil was 6.14 kg ha^{-1} and in subsoil ranged from 2.85 to 5.71 kg ha^{-1} . Potassium (K) content of the surface layer was 206 kg ha^{-1} and in the subsoil ranged from 42 to 102 kg ha^{-1} .

Dehydrogenase activity in the surfaces soil layer was $347 \text{ } \mu\text{g TPF g}^{-1} \text{ h}^{-1}$ which declined to 14.22 in subsoil. Urease activity in surface soil was $51.24 \text{ } \mu\text{g NH}_4\text{-N g}^{-1} \text{ h}^{-2}$ but declined to 7.42 in subsoil. Acid phosphatase activity was $53.12 \text{ } \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ in surfaces soil and in subsoil $12.96 \text{ } \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$. Alkaline phosphatase activity in the surface soil was $55.06 \text{ } \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ and in subsoil layer $14.75 \text{ } \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$.

Organic carbon content of the surface horizon was 9.6 g kg^{-1} and in the subsoil it ranged from 4.8 to 8.1 per cent (Table 92). The SMB-C and SMB-N contents in the surface horizon of the studied pedon were 284 and $36.24 \text{ } \mu\text{g g}^{-1}$ respectively and were decreased gradually with the depth. The total carbon stock in the surface soil horizon was 27.77 Mg ha^{-1} and a total carbon stock in the entire pedon was of the order 96.33 Mg ha^{-1} . Total nitrogen stock in the surface horizon was 1.37 Mg ha^{-1} and in the entire pedon (100cm) it was 5.06 Mg ha^{-1} .

4.6.2 Southern dry zone

SDZ - Pedon 1: Organic Farming (0-3 yrs)

Pedon 1 of Southern dry zone was exposed at Badanaguppe of Chamrajnagar taluk where organic farming was under practice for the past two years. The gently sloping plain soil had 1 to 3 per cent slope (Table 5) and was poorly drained and very slightly eroded. The soils were developed from granite. The surface horizon (12 cm thick) was with clay in texture, medium subangular blocky structure. The consistence was slightly hard, moist friable and wet sticky and plastic. The subsoil horizons to a depth of 75 cm ranged, the texture was sandy clay. The soil structure was moderate subangular blocky. However, weathered rock was appeared after 75cm.

Particle size distribution in the pedon indicated clay movement down the solum to a depth of 39 cm with clay surface and sandy clay subsoil layers (Table 93). Bulk density of the surface soil was 1.08 Mg m^{-3} and in the subsoil it ranged from 1.12 to 1.56 Mg m^{-3} . Soil reaction was very strongly alkaline throughout the solum. Electrical conductivity of surface soil was 0.08 dS m^{-1} and it ranged from 0.11 to 0.12 dS m^{-1} in the subsoil layers. Plant available phosphorus (P) content of the surface soil was 8.84 kg ha^{-1} and in subsoil ranged from 1.22 to 6.24 kg ha^{-1} . Potassium (K) content of the surface layer was 179 kg ha^{-1} and in the subsoil ranged from 45 to 126 kg ha^{-1} .

Biological activity in soil was measured by the activity of enzymes dehydrogenase, urease, acid phosphatase and alkaline phosphatase. Dehydrogenase activity in the surfaces soil layer was $1256 \mu\text{g TPF g}^{-1} \text{ h}^{-1}$ which declined to 505 in subsoil. Urease activity in surface soil was $68.54 \mu\text{g NH}_4\text{-N g}^{-1} \text{ h}^{-2}$ but declined to 9.44 in subsoil. Acid phosphatase activity was $8.32 \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ in surface soil and in subsoil $5.16 \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ and alkaline phosphatase activity in the surface soil was $38.54 \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ and in subsoil layer $15.42 \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$.

Organic carbon content of the surface soil was 10.2 g kg^{-1} and decreased gradually to 6.9 g kg^{-1} in the lowest layer (Table 94). The SMB-C and SMB-N contents

Table 93. Physical, Chemical and biochemical characteristics of pedons of organic and conventional farming systems under Southern Dry zone of Karnataka

Southern Dry Zone of Karnataka													
	Depth	Sand	Silt	Clay	BulkDensity	pH	EC	Available P	Available K	Dehydrogenase	Urease	Acid Phosphatase	Alkaline Phosphatase
Horizon	(cm)	(%)	(%)	(%)	(Mg m ⁻³)		(dSm ⁻¹)	(kg ha ⁻¹)	(kg ha ⁻¹)	(µg TPFg ⁻¹ h ⁻¹)	(µg NH4g ⁻¹ h ⁻²)	(µg p-NP g ⁻¹ h ⁻¹)	(µg p-NP g ⁻¹ h ⁻¹)
Pedon -1: (Organic farming 0-3yrs) Fine-loamy, mixed, iso hyperthermic, Typic Haplustalfs													
Ap	0-15	46.72	5	48.28	1.08	7.95	0.08	8.84	179	1256	68.54	8.32	38.54
BW1	15-39	43.67	4.8	51.53	1.12	8.25	0.11	6.24	126	1034	42.22	7.03	26.25
BW2	39-56	53.45	2.8	43.75	1.23	8.2	0.12	3.32	66	783	18.45	5.99	19.25
BC	56-75	50.3	9.8	39.9	1.56	8.5	0.12	1.22	45	505	9.44	5.16	15.42
C	75-100	Weathered parent material											
Pedon -2: (Organic farming 3-6 yrs) Very fine, mixed, isohyper thermic, Vertic Haplustepts													
Ap	0-20	38.75	5	56.25	1.08	7.8	0.24	25.45	314	1409	161.52	13.7	42.44
BW1	20-49	44.25	4.8	50.95	1.13	8.2	0.18	20.58	206	1141	98.55	12.81	28.54
BW2	49-64	24.05	4.6	71.35	1.25	8.11	0.16	8.36	108	835	104.24	9.85	16.22
BW3	64-100	26.32	5.4	68.28	1.34	7.95	0.16	2.96	66	491	15.54	6.54	8.12
Pedon -3: (Organic farming >6yrs) Fine, mixed, iso hyperthermic, Typic Haplustepts													
Ap	0-15	39.5	5	55.5	1.09	8.2	0.26	19.79	484	1965	212.34	13.21	34.51
BW1	15-28	50	6.4	43.6	1.12	8.1	0.26	13.16	428	1648	168.56	8.51	22.45
BW2	28-60	36.8	5.2	58	1.32	8.7	0.35	6.94	224	1139	99.28	6.23	15.96
BW3	60-100	40.2	5.4	54.4	1.33	8.75	0.44	2.24	124	635	32.24	3.45	8.54
Pedon -4: (Conventional farming) Very fine, mixed, iso hyperthermic, Typic Haplustepts													
Ap	0-22	26.25	7.5	66.25	1.16	7.62	0.18	12.26	315	1224	62.44	6.54	37.62
BW1	22-48	25.92	5.8	68.28	1.23	8.14	0.26	7.64	214	948	42.66	4.36	26.54
BW2	48-64	30.28	5.2	64.52	1.25	8.62	0.41	2.88	63	604	14.36	3.52	18.42
BW3	64-100	Weathered parent material											

in the surface horizon of the studied pedon were 352 and 46.2 $\mu\text{g g}^{-1}$ respectively and were decreased gradually with the depth. A total carbon stock in the surface horizon was 31.43 Mg ha^{-1} and was recoded total carbon stock in the whole pedon to the extent of 141.84 Mg ha^{-1} . Soil total nitrogen stocks in the surface horizon was 1.47 Mg ha^{-1} and in the whole pedon (100cm) it was of 6.09 Mg ha^{-1} .

SDZ - Pedon 2: Organic Farming (3-6 yrs)

Pedon 2 of southern dry zone was exposed on very gently sloping plain in Komaranpura village. The land with 0-1 per cent slope is very slightly eroded and the drainage is poor cultivated to Sugarcane. The soils have developed from granitic gneiss (Table 5). The 20cm thick surface horizon of the pedon was clay with medium subangular blocky structure. Consistence was slightly hard when dry, moist friable and wet slightly sticky and plastic. The subsoil horizons between depth of 20 and 100 cm had clay texture. Soil structure was moderate to strong subangular blocky and consistence hard when dry, moist firm, wet sticky and plastic.

Particle size distribution indicated clay texture from surface to a depth of 100 cm (Table 93). Read with the presence of clay cutans on the peds in the lower layers of soil particle size distribution confirms movement of clay down the soil. Bulk density of soil was 1.08 Mg m^{-3} for surface soil and in the subsoil layers it ranged from 1.25 to 1.34 Mg m^{-3} . Soil reaction was moderately alkaline throughout the solum. Electrical conductivity of saturation extract ranged from 0.16 to 0.24 dS m^{-1} among various soil layers. The phosphorus (P) content of the surface soil was 25.45 kg ha^{-1} and in subsoil ranged from 2.96 to 20.58 kg ha^{-1} . Potassium (K) content of the surface layer was 314 kg ha^{-1} and in the subsoil ranged from 66 to 206 kg ha^{-1} .

Dehydrogenase activity in the surfaces soil layer was 1409 $\mu\text{g TPF g}^{-1} \text{h}^{-1}$ which declined to 491 in subsoil. Urease activity in surface soil was 161 $\mu\text{g NH}_4\text{-N g}^{-1}\text{h}^{-2}$ but declined to 15.54 in subsoil. Acid phosphatase activity was 13.7 $\mu\text{g p-NP g}^{-1} \text{h}^{-1}$ in

Table 94. Carbon distribution in pedons of organic and conventional farming systems under Southern Dry zone of Karnataka

Horizon	Depth	Organic-C	MB-C	MB-N	Tot-C	Tot-N	Tot-C Stocks	Tot-N Stocks
	(cm)	(g kg-1)	(µg g-1)	(µg g-1)	(g kg-1)	(g kg-1)	(Mg ha ⁻¹)	(Mg ha ⁻¹)
Pedon -1: (Organic farming 0-3yrs) Fine-loamy, mixed, iso hyperthermic, Typic Haplustepts								
AP	0-15	10.2	352	46.2	19.4	0.91	31.43	1.47
BW1	15-39	9.5	284	38.4	18.1	0.76	48.65	2.04
BW2	39-56	8.4	169	31.2	14.8	0.61	30.95	1.28
BC	56-75	6.9	122	22.6	10.4	0.44	30.83	1.30
C	>75	Weathered parent material			TOTAL STOCKS		141.84	6.09
Pedon -2: (Organic farming 3-6 yrs) Very fine, mixed, isohyper thermic, Vertic Haplustepts								
AP	0-20	15.3	544	132.4	27.7	1.12	59.83	2.41
BW1	20-49	13.1	384	98.2	20.2	0.94	66.05	3.07
BW2	49-64	12.6	162	48.3	18.8	0.85	35.25	1.59
BW3	64-10	3.8	69	14.2	7.4	0.28	34.63	1.31
					TOTAL STOCKS		195.76	8.38
Pedon -3: (Organic farming >6yrs) Fine, mixed, iso hyperthermic, Typic Haplustepts								
AP	0-15	18	680	148.5	30.12	2.39	49.09	3.89
BW1	15-28	14.1	525	125.2	24.28	2.12	35.21	3.07
BW2	28-60	10.4	365	98.6	19.62	1.62	82.79	6.83
BW3	60-100	7	128	25.6	12.54	0.51	66.71	2.71
					TOTAL STOCKS		233.80	16.50
Pedon -4: (Conventional farming) Very fine, mixed, iso hyperthermic, Typic Haplustepts								
AP	0-22	11.2	314	38.2	23.1	1.24	58.90	2.79
BW1	22-48	6.8	198	26.4	14.8	0.52	47.21	1.66
BW2	48-64	4.7	112	19.3	9.7	0.38	19.40	0.76
Cr	64-100	Weathered parent material			TOTAL STOCKS		125.43	5.21

surface ol and in subsoil $6.54 \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$. Alkaline phosphatase activity in the surface soil was $42.44 \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ and in subsoil layer $8.12 \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$.

Organic carbon content of the surface soil was 15.3 g kg^{-1} . In the subsoil layers it gradually decreased and reached the level of 8.4 g kg^{-1} in the lowest layer (Table 94). The soil microbial biomass carbon and nitrogen contents in the surface horizon of the studied pedon were 544 and $132.4 \mu\text{g g}^{-1}$ respectively and were decreased gradually with the depth. Soil total carbon stocks in the surface horizon was 59.83 Mg ha^{-1} and was recoded total carbon stocks in the whole pedon to the tune of $195.76 \text{ Mg ha}^{-1}$. Soil total nitrogen stocks in the surface horizon was 2.41 Mg ha^{-1} and in the whole pedon (100cm) it was of 8.38 Mg ha^{-1} .

SDZ - Pedon 3: Organic Farming (>6 yrs)

Pedon 3 was located in nearly level low land in Kadahalli village under southern dry zone in which organic farming was being practiced for more than seven years. The soil was developed from alluvium of granite gneiss origin (Table 5). The poorly drained soil on land with 0 to 1 per cent slope was very slightly eroded. The crops raised were turmeric and maize. The surface soil horizon was 15 cm thick, clay in texture with strong moderate subangular blocky structure. Consistency was hard when dry, moist friable and wet sticky in plastic. The immediate subsoil horizon to a depth of 28 cm was clay and other features were similar to the surface soil. The subsoil layers below 28 cm to a depth of 100 cm with clay texture and the structure was strong medium subangular blocky and consistency hard, friable, sticky and plastic.

The particle size distribution confirmed that the texture was clay throughout the solum (Table 93). Bulk density of the surface soil layer was 1.09 Mg m^{-3} and in subsoil the values ranged from 1.12 to 1.33 Mg m^{-3} . Soil reaction was very strongly alkaline throughout the soil profile. Electrical conductivity of saturation extract was 0.26 dS m^{-1} for the surface soil and the value reached up to 0.44 dS m^{-1} in the subsoil horizons. Plant available phosphorus (P) content of the surface soil was 19.79 kg ha^{-1} and in subsoil

ranged from 2.24 to 13.16 kg ha⁻¹. Potassium (K) content of the surface layer was 484 kg ha⁻¹ and in the subsoil ranged from 124 to 428 kg ha⁻¹.

Soil biochemical activity was measured by the activity of dehydrogenase, urease, acid phosphatase and alkaline phosphatase. Dehydrogenase activity in the surface soil layer was 1965 µg TPF g⁻¹ h⁻¹ which declined to 635 in subsoil. Urease activity in surface soil was 212.34 µg NH₄-N g⁻¹ h⁻² but decreased to 32.24 in subsoil. Acid phosphatase activity was 13.21 µg p-NP g⁻¹ h⁻¹ in surface soil and in lowest layer it was 3.45 µg p-NP g⁻¹ h⁻¹. Alkaline phosphatase activity in the surface soil was 34.51 µg p-NP g⁻¹ h⁻¹ and in subsoil layer 8.54 µg p-NP g⁻¹ h⁻¹.

Organic carbon content of the surface soil was 18 g kg⁻¹ and in the subsoil layers it ranged from 9 to 14.1 g kg⁻¹ (Table 94). The SMB-C and SMB-N contents in the surface horizon of the studied pedon were 680 and 148.5 µg g⁻¹ respectively and were decreased gradually with the depth. A total carbon stock in the surface horizon was 49.09 Mg ha⁻¹ and was recorded total carbon stocks in the whole pedon to the extent of 238.80 Mg ha⁻¹. Soil total nitrogen stocks in the surface horizon was 3.89 Mg ha⁻¹ and in the whole pedon (100cm) it was of 16.50 Mg ha⁻¹.

SDZ- Pedon 4: Conventional Farming

Pedon 4 was studied for evaluating properties of conventional farming system was located at Komaranpura village in Chamrajnagar region. The land parcel in which soil profile was exposed was cultivated to sugarcane. Very gently sloping plain with slope of 1 to 3 per cent was moderately eroded. The soils were developed from weathered granite gneiss (Table 5). The surface horizon (22 cm thick) was clay with moderate medium subangular blocky structure and consistence dry slightly hard, moist friable and wet sticky and plastic. Subsoil horizons from 22 to 100 cm were clay with strong medium subangular blocky structure and consistence dry hard, moist friable and wet sticky and plastic.

The surface soil horizon contained 66.25 per cent clay (Table 93). Bulk density of the surface soil was 1.16 Mg m^{-3} . In the subsoil horizons bulk density ranged from 1.22 to 1.25 Mg m^{-3} . Reaction of the surface soil was 7.7 (slightly alkaline) which increased to 8.6 in the subsoil horizons. Electrical conductivity of saturation extract was in the range of 0.18 to 0.46 dS m^{-1} . Plant available phosphorus (P) content of the surface soil was 12.26 kg ha^{-1} and in subsoil ranged from 1.42 to 7.64 kg ha^{-1} . Potassium (K) content of the surface layer was 315 kg ha^{-1} and in the subsoil ranged from 42 to 214 kg ha^{-1} .

Dehydrogenase activity in the surfaces soil layer was $1224 \mu\text{g TPF g}^{-1} \text{ h}^{-1}$ which declined to 228 in subsoil. Urease activity in surface soil was $62.44 \mu\text{g NH}_4\text{-N g}^{-1} \text{ h}^{-2}$ but declined to 6.84 in subsoil. Acid phosphatase activity was $6.54 \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ in surfaces soil and in subsoil $1.24 \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$. Alkaline phosphatase activity in the surface soil was $37.62 \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ and in subsoil layer $8.36 \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$.

Organic carbon content of the surface horizon was 8.4 g kg^{-1} and in the subsoil it declined to 2.6 g kg^{-1} (Table 94). The SMB-C and SMB-N contents in the surface horizon of the studied pedon were 314 and $38.2 \mu\text{g g}^{-1}$ respectively and were decreased gradually with the depth. Soil total carbon stocks in the surface horizon was 58.90 Mg ha^{-1} and was recoded total carbon stocks in the whole pedon to the tune of $125.43 \text{ Mg ha}^{-1}$. Soil total nitrogen stocks in the surface horizon was 2.79 Mg ha^{-1} and in the whole pedon (100cm) it was of 5.21 Mg ha^{-1} .

4.6.3 Southern transition zone (STZ)

STZ - Pedon 1: Organic Farming (0-3 yrs)

Pedon 1 was located on very gently sloping plain in Holabagere village under southern transition zone of southern Karnataka. The land with 1 to 3 per cent slope was slightly eroded and the drainage is poor. The soils have developed from weathered granite gneiss. The land was cultivated to ginger-beans in organic farming system for the past two years. The surface horizon (25 cm thick) of the pedon was clay with moderate medium subangular blocky structure (Table 6). Consistence was slightly hard when dry,

Table 95. Physical, Chemical and biochemical characteristics of pedons of organic and conventional farming systems under Southern Transition zone of Karnataka

Southern Transition Zone of KwaZulu-Natal													
	Depth	Sand	Silt	Clay	BulkDensity	pH	EC	Available P	Available K	Dehydrogenase	Urease	Acid Phosphatase	Alkaline Phosphatase
Horizon	(cm)	(%)	(%)	(%)	(Mg m ⁻³)		(dSm ⁻¹)	(kg ha ⁻¹)	(kg ha ⁻¹)	(µg TPFg ⁻¹ h ⁻¹)	(µg NH4g ⁻¹ h ⁻²)	(µg p-NP g ⁻¹ h ⁻¹)	(µg p-NP g ⁻¹ h ⁻¹)
Pedon -1: (Organic farming 0-3yrs) Fine,mixed, isohyper thermic, Typic Haplustepts													
AP	0-25	42.18	5	52.83	1.14	7.95	0.16	34.24	224	894	84.88	52.61	44.92
BW1	25-55	36.54	6.45	57.01	1.19	8.02	0.12	20.21	189	778	52.35	48.18	38.35
BW2	55-75	49.26	5.4	45.34	1.25	8.15	0.13	16.3	144	419	18.44	29.03	30.61
Cr	75-100	Weathered parent material											
Pedon -2: (Organic farming 3-6 yrs) Fine,mixed, isohyper thermic, Typic Haplustepts													
Ap	0-10	44.4	5	50.6	1.12	6.6	0.07	36.85	242	1160	112.34	54.39	55.06
BW1	10-20	50	6.4	43.6	1.18	6.5	0.07	23.31	196	837	98.45	44.55	51.74
BW2	20-54	50.23	3.8	45.97	1.22	5.8	0.03	8.88	84	539	64.22	38.41	19.29
BW3	54-75	46.64	4.3	49.06	1.32	6.5	0.04	3.33	70	372	42.34	15.97	17.45
Cr	75-100	Weathered parent material											
Pedon -3: (Organic farming >6yrs) Fine,mixed, isohyper thermic, Typic Haplustepts													
Ap	0-10	46.5	5	48.5	1.12	6.85	0.16	43.29	320	1568	194.54	58.04	60.38
BW1	10-30	31.76	5.8	62.44	1.15	6.55	0.08	27.19	245	984	178.32	46.83	48.98
BW2	30-50	24.25	4.8	70.95	1.18	6.45	0.06	19.98	196	606	114.65	29.53	29.62
BW3	50-80	38.67	5	56.33	1.21	7.11	0.04	9.99	151	309	84.85	15.18	17.51
BW4	80-100	44.22	4.8	50.98	1.21	7.12	0.04	4.44	140	212	26.56	13.21	11.35
Pedon -4: (Conventional farming) Fine,mixed, isohyper thermic, Typic Haplustepts													
Ap	0-20	42.2	5.6	52.2	1.12	4.9	0.11	22.75	193	388	52.54	45.23	17.45
BW1	20-48	50	6.4	43.6	1.16	4.82	0.05	18.87	168	286	43.35	33.18	15.33
BW2	48-71	44.44	4.3	51.26	1.33	5.21	0.04	7.22	98	209	15.42	21.08	12.78
BW3	71-100	49.64	4.3	46.06	1.33	5.52	0.03	2.78	46	68	8.84	17.51	10.75

moist friable and wet sticky and plastic. The moderately alkaline soil exhibited violent effervescence with dilute acid. The subsoil horizon immediately underlying the surface horizon was also clay with similar properties as in first layer.

Particle size distribution indicated clay texture from surface to a depth of 75 cm, (Table 95). Read with the presence of clay cutans on the peds in the lower layers of soil particle size distribution confirms movement of clay down the soil. Bulk density of soil was 1.14 Mg m^{-3} for surface soil and in the subsoil layers it ranged from 1.19 to 1.25 Mg m^{-3} . Soil reaction was moderately alkaline throughout the solum with pH increasing to lower layers. Electrical conductivity of saturation extract ranged from 0.12 to 0.16 dS m^{-1} among various soil layers. Plant available phosphorus (P) content of the surface soil was 34.24 kg ha^{-1} and in subsoil ranged from 16.3 to 20.21 kg ha^{-1} . Potassium (K) content of the surface layer was 224 kg ha^{-1} and declined to 144 kg ha^{-1} in the subsoil.

Dehydrogenase activity in the surfaces soil layer was $894 \text{ } \mu\text{g TPF g}^{-1} \text{ h}^{-1}$ which declined to 419 in subsoil. Urease activity in surface soil was $84.88 \text{ } \mu\text{g NH}_4\text{-N g}^{-1} \text{ h}^{-2}$ but declined to 18.44 in subsoil. Acid phosphatase activity was $52.61 \text{ } \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ in surface soil and in subsoil $29.03 \text{ } \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$. Alkaline phosphatase activity in the surface soil was $44.92 \text{ } \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ and in subsoil layer $30.61 \text{ } \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$.

Organic carbon content of the surface soil was 11.2 g kg^{-1} . In the subsoil layers it gradually decreased and reached the level of 4.8 g kg^{-1} in the lowest layer (Table 96). The soil microbial biomass carbon and nitrogen contents in the surface horizon of the studied pedon were 495 and $72.3 \text{ } \mu\text{g g}^{-1}$ respectively and were decreased gradually with the depth. The total carbon stock in the surface soil horizon was 59.85 Mg ha^{-1} and a total carbon stock in the entire pedon was of the order $123.85 \text{ Mg ha}^{-1}$. Total nitrogen stock in the surface horizon was 2.96 Mg ha^{-1} and in the pedon (100cm) recorded 7.48 Mg ha^{-1} .

Table 96. Carbon distribution in pedons of organic and conventional farming systems under S T Zone of Karnataka

Horizon	Depth	Organic-C	MB-C	MB-N	Tot-C	Tot-N	Tot-C Stocks	Tot-N Stocks
	(cm)	(g kg-1)	(µg g-1)	(µg g-1)	(g kg-1)	(g kg-1)	(Mg ha ⁻¹)	(Mg ha ⁻¹)
Pedon -1: (Organic farming 0-3yrs) Fine,mixed, isohyper thermic, Typic Haplustepts								
AP	0-25	11.2	495	72.3	21	1.04	59.85	2.96
BW1	25-55	7.4	362	55.6	16.6	0.96	39.5	3.42
BW2	55-75	4.8	159	39.5	9.8	0.44	24.5	1.10
Cr	75-10	Weathered parent material			TOTAL STOCKS		123.85	7.48
Pedon -2: (Organic farming 3-6 yrs) Fine,mixed, isohyper thermic, Typic Haplustepts								
AP	0-10	12.6	585	73.2	26.2	1.44	29.34	1.61
BW1	20-Oct	11.2	428	55.6	21.4	0.94	25.25	1.01
BW2	20-54	9.2	268	41.6	14.6	0.82	60.59	3.40
BW3	54-75	6.6	155	36.2	10.2	0.71	28.25	1.96
Cr	75-100	Weathered parent material			TOTAL STOCKS		143.43	7.98
Pedon -3: (Organic farming >6yrs) Fine,mixed, isohyper thermic, Typic Haplustepts								
AP	0-10	16.2	885	106.2	36	1.85	40.32	2.07
BW1	30-Oct	14.4	698	86.5	32.8	1.42	37.72	1.63
BW2	30-50	13.1	467	68	26.8	1.26	63.25	2.97
BW3	50-80	8.4	285	49	17.1	0.84	62.07	3.05
BW4	80-100	7.2	124	24	15	0.49	36.3	1.13
					TOTAL STOCKS		239.66	10.85
Pedon -4: (Conventional farming) Fine,mixed, isohyper thermic, Typic Haplustepts								
AP	0-20	12.1	462	66.2	20.9	1.31	58.02	2.93
BW1	20-48	8.2	285	36.8	16.6	0.72	56.19	2.34
BW2	48-71	6	164	22.6	8.4	0.44	31.2	1.43
BW3	71-100	2.2	98	8.98	4.6	0.17	30.32	0.65
					TOTAL STOCKS		157.73	7.35

STZ - Pedon 2: Organic Farming (3-6 yrs)

Pedon 2 is located in nearly level low land in Yedur village where the land was cultivated to maize-potato-ginger-maize rotation in organic farming system for more than four years. The soil was developed from alluvium of granite gneiss origin. The poorly drained soil on land with 1-3 per cent slope was very slightly eroded (Table 95). The surface soil horizon was 10 cm thick, clay in texture with moderate medium subangular blocky structure. Consistency was hard when dry, moist friable and wet sticky in plastic. The immediate subsoil horizons to a depth of 75 cm were sandy clay. Structure was moderate medium subangular blocky and consistency slightly hard, friable, sticky and plastic. Weathered granite was observed below the depth of 75 cm.

Bulk density of the surface soil layer was 1.12 Mg m^{-3} and in subsoil the values ranged from 1.18 to 1.32 Mg m^{-3} . Soil reaction was slightly acidic throughout the soil profile. Electrical conductivity of saturation extract was 0.07 dS m^{-1} for the surface soil and the value declined to 0.03 dS m^{-1} in the subsoil horizons. The phosphorus (P) content of the surface soil was 36.85 kg ha^{-1} and in subsoil ranged from 3.33 to 23.31 kg ha^{-1} . Potassium (K) content of the surface layer was 242 kg ha^{-1} and declined to 70 kg ha^{-1} in subsoil.

Biological parameters in soil were measured by the activity of dehydrogenase, urease, acid and alkaline phosphatases. Dehydrogenase activity in the surfaces soil layer was $1160 \text{ } \mu\text{g TPF g}^{-1} \text{ h}^{-1}$ which declined to 372 in subsoil. Urease activity in surface soil was $112.34 \text{ } \mu\text{g NH}_4\text{-N g}^{-1} \text{ h}^{-2}$ but decreased to 42.34 in subsoil. Acid phosphatase activity was $54.39 \text{ } \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ in surface horizon and in subsoil it was $15.97 \text{ } \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$. Alkaline phosphatase activity in the surface soil was $55.06 \text{ } \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ and in subsoil layer it was $17.45 \text{ } \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$.

Organic carbon content of the surface soil was 20.4 g kg^{-1} and in the subsoil layers it ranged from 9.9 to 18.8 g kg^{-1} (Table 96). The SMB-C and SMB-N contents in the surface horizon of the studied pedon were 585 and $73.2 \text{ } \mu\text{g g}^{-1}$ respectively and were

decreased gradually with the depth. Soil total carbon stocks in the surface horizon was 29.34 Mg ha⁻¹ and was recoded total carbon stocks in the whole pedon to the tune of 143.43 Mg ha⁻¹. Soil total nitrogen stocks in the surface horizon was 1.61 Mg ha⁻¹ and in the whole pedon (100cm) it was of 9.18 Mg ha⁻¹.

STZ- Pedon 3: Organic Farming (>6 yrs)

Pedon 3 was studied in a field cultivated to organic coffee for over 8 years at Hosaganur village near Hemavathi river banks. The gently sloping plain with land slope of 1 to 3 per cent was very slightly eroded and drainage was poor (Table 6). The 10 cm surface horizon was sandy clay. The soil structure was moderate medium subangular blocky and consistence dry hard moist friable and wet sticky and plastic. The subsoil horizons from the depth of 10 cm were clay. All the other features were similar to that of surface horizon.

Particle size distribution of soil indicated clay movement to sub soil with soil texture being uniformly clay to a depth of 100 cm (Table 95). Bulk density of the surface soil was 1.12 Mg m⁻³, and increased to 1.15 Mg m⁻³ in the immediate subsoil horizon. In the lower subsoil horizons bulk density ranged from 1.18 to 1.21 Mg m⁻³. Soil reaction was neutral in all the layers (pH 6.45 to 7.12). Electrical conductivity of saturation extract ranged from 0.04 to 0.16 dS m⁻¹. Plant available phosphorus (P) content of the surface soil was 43.29 kg ha⁻¹ and in subsoil ranged from 4.44 to 27.19 kg ha⁻¹. Potassium (K) content of the surface layer was 320 kg ha⁻¹ and in the subsoil ranged from 140 to 245 kg ha⁻¹.

Dehydrogenase activity in the surfaces soil layer was 1568 µg TPF g⁻¹ h⁻¹ and declined to 212 in subsoil. Urease activity in surface soil was 194.54 µg NH₄-N g⁻¹h⁻² but declined to 26.56 in subsoil .Acid phosphatase activity was 58.04 µg p-NP g⁻¹ h⁻¹ in surface soil and in subsoil it was 13.21 µg p-NP g⁻¹ h⁻¹. Alkaline phosphatase activity in the surface soil was 60.38 µg p-NP g⁻¹ h⁻¹ and in subsoil layer it was 11.3 µg p-NP g⁻¹ h⁻¹.

The organic carbon content of the surface soil was 27 g kg^{-1} (Table 96). In the subsoil horizons the organic carbon content ranged from 12.9 to 18.6 g kg^{-1} , gradually declining with depth. The soil microbial biomass carbon and nitrogen contents in the surface horizon of the studied pedon were 885 and $106.2 \text{ } \mu\text{g g}^{-1}$ respectively and were decreased gradually with the depth. The total carbon stock in the surface soil horizon was 40.32 Mg ha^{-1} and a total carbon stock in the entire pedon was of the order 239.6 Mg ha^{-1} . Total nitrogen stock in the surface horizon was 2.07 Mg ha^{-1} and in the entire pedon (100cm) recorded 10.85 Mg ha^{-1} .

STZ - Pedon 4: Conventional Farming

Pedon 4 was located on very gently sloping plain in Hosaganur village, studied for evaluating properties of conventional farming system. The land with 1 to 3 per cent slope is slightly eroded and the drainage is poor. The soils have developed from weathered granite gneiss. The land was cultivated to coffee in organic farming. The 20 cm thick surface horizon of the pedon was sandyclay with moderate medium subangular blocky structure (Table 6). Consistence was hard when dry, moist friable and wet sticky and plastic. The subsoil horizons immediately underlying the surface horizon were sandy clay with similar other properties as in first layer.

Particle size distribution indicated clay texture in the surface soil, (Table 95). Bulk density of soil was 1.12 Mg m^{-3} for surface soil and in the subsoil layers it ranged from 1.16 to 1.33 Mg m^{-3} . Soil reaction was moderately acidic in surface and immediate sub surface layers with pH decreasing to strongly acidic in lower layers. Electrical conductivity of saturation extract ranged from 0.03 to 0.11 dS m^{-1} among various soil layers. Plant phosphorus (P) content of the surface soil was 22.75 kg ha^{-1} and in subsoil ranged from 2.78 to 18.87 kg ha^{-1} . Potassium (K) content of the surface layer was 193 kg ha^{-1} and declined to 46 kg ha^{-1} in the subsoil.

Dehydrogenase activity in the surfaces soil layer was $388 \text{ } \mu\text{g TPF g}^{-1} \text{ h}^{-1}$ and declined to 68 in subsoil. Urease activity in surface soil was $52.54 \text{ } \mu\text{g NH}_4\text{-N g}^{-1}\text{h}^{-2}$ but

declined to 8.84 in subsoil. Acid phosphatase activity was $45.23 \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ in surface soil and in subsoil $17.51 \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$. Alkaline phosphatase activity in the surface soil was $17.45 \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$ and in subsoil layer it was $10.75 \mu\text{g p-NP g}^{-1} \text{ h}^{-1}$.

Organic carbon content of the surface soil was 12.1 g kg^{-1} . In the subsoil layers it gradually decreased and reached the level of 2.2 g kg^{-1} in the lowest layer (Table 96). The soil microbial biomass carbon and nitrogen contents in the surface horizon of the studied pedon were 462 and $66.2 \mu\text{g g}^{-1}$ respectively and were decreased gradually with the depth. Soil total carbon stocks in the surface horizon was 58.02 Mg ha^{-1} and was recorded total carbon stocks in the whole pedon was $157.73 \text{ Mg ha}^{-1}$. Soil total nitrogen stocks in the surface horizon was 2.93 Mg ha^{-1} and in the whole pedon (100cm) it was 7.35 Mg ha^{-1} .

4.7 Correlation matrix of soil physico chemical and biological properties as influenced by organic and conventional farming systems

In the present study the physical, chemical and biological properties were considered as variables for correlations so as to study the influence of one another. These entities were selected out of the results of soil analysis which were sampled from organic and conventional farming systems from three selected agroclimatic zones (Central dry zone, Southern dry zone and Southern transition zone) of Southern Karnataka. The results are presented in tables 97, 98 and 99.

4.7.1 Central dry zone

Organic farming system

Bulk density showed significantly negative correlation with all the parameters measured in soils under organic farming system in this zone (Table. 97a).

Soil reaction exhibited significant and positive correlation with alkaline phosphatase ($r = 0.943^{**}$) and available potassium ($r = 0.649^{*}$).

Table.97a. Correlation matrices of physico chemical and biological properties of soils under organic farming in Central dry zone of Karnataka

	Bulk density	pH	Organic carbon	Available N	Avail .P	Available K	Tot C	Tot N	MBC	DHA	urease	Acid Phos.	Alkaline Phos.
Bulk density	-												
pH	-0.825**	-											
Organic carbon	-0.665*	0.126	-										
AvailableN	-0.761**	0.261	0.991**	-									
AvailableP	-0.888**	0.472	0.934**	0.974**	-								
AvailableK	-0.966**	0.649*	0.836**	0.904**	0.977**	-							
Tot C	-0.648*	0.104	0.994**	0.987**	0.926**	0.824**	-						
Tot N	-0.649*	0.106	0.992**	0.987**	0.927**	0.825**	0.995**	-					
MBC	-0.572	0.008	0.993**	0.967**	0.886**	0.766**	0.995**	0.995**	-				
DHA	-0.426	-0.161	0.959**	0.911**	0.794**	0.646*	0.965**	0.964**	0.986**	-			
urease	-0.815**	0.345	0.975**	0.996**	0.990**	0.938**	0.969**	0.970**	0.941**	0.871**	-		
Acid Phos.	-0.868**	0.436	0.948**	0.983**	0.999**	0.967**	0.941**	0.941**	0.904**	0.818**	0.995**	-	
Alkaline Phos.	-0.589*	0.943**	-0.212	-0.076	0.150	0.358	-0.234	-0.232	-0.326	-0.481	0.012	0.110	-

Table.97 b. Correlation matrices of physico chemical and biological properties of soils under conventional farming in Central dry zone of Karnataka

	Bulk density	pH	Organic carbon	Available N	Available P	Available K	Tot C	Tot N	MBC	DHA	urease	Acid P	Alkaline P.
Bulk density	-												
pH	-0.115	-											
Organic carbon	-0.766**	0.551	-										
AvailableN	0.870**	-0.589*	0.350	-									
AvailableP	-0.888**	-0.129	0.757**	0.877**	-								
AvailableK	0.784**	0.527	0.704*	0.377	0.775**	-							
Tot C	0.861**	0.407	0.987**	0.498	0.853**	0.991**	-						
Tot N	0.657*	-0.397	0.547*	0.976**	0.961**	0.571	0.676*	-					
MBC	0.696*	-0.198	0.709*	0.909**	0.998**	0.729**	0.815**	0.978**	-				
DHA	0.493	0.005	0.837**	0.805**	0.991**	0.853**	0.915**	0.915**	0.979**	-			
urease	0.232	-0.993**	-0.448	0.681*	0.245	-0.422	-0.296	0.503	0.313	0.113	-		
Acid Phos	0.582*	0.741**	0.969**	0.107	0.571	0.961**	0.915**	0.322	0.512	0.676*	-0.656*	-	
Alkaline Phos.	-0.875**	-0.381	-	-0.523	-0.868**	-0.987**	-	-	-	-	-	-	-

* significant at 5 %
Alkaline phos- Alkaline phosphatase

** significant at 1%
DHA- Dehydrogenase activity

Acid phos- Acid phosphatase
MBC- Microbial biomass carbon

The organic carbon in soils showed a positive and significant correlation with total carbon ($r = 0.994^{**}$), microbial biomass carbon ($r = 0.993^{**}$), total nitrogen ($r = 0.992^{**}$), nitrogen ($r = 0.991^{**}$), urease ($r = 0.975^{**}$), dehydrogenase ($r = 0.959^{**}$) and other soil attributes in organically managed soils (Table a).

Available nitrogen was positively and significantly correlated with urease ($r = 0.996^{**}$), total C and total N ($r = 0.987^{**}$), acid phosphatase ($r = 0.983^{**}$), available phosphorus ($r = 0.974^{**}$), microbial biomass carbon ($r = 0.967^{**}$), dehydrogenase ($r = 0.911^{**}$) and available potassium ($r = 0.904^{**}$).

The microbial biomass carbon was positively and significantly correlated with dehydrogenase ($r = 0.986^{**}$), urease ($r = 0.941^{**}$) and acid phosphatase ($r = 0.904^{**}$).

The dehydrogenase activity in organically amended soils showed positive and significant correlations with urease ($r = 0.871^{**}$) and acid phosphatase ($r = 0.818^{**}$). Urease activity showed positively and significantly correlated to acid phosphatase ($r = 0.995^{**}$).

Conventional farming

Bulk density showed significantly positive correlations with available N ($r = 0.870^{**}$), total carbon ($r = 0.861^{**}$) and available potassium ($r = 0.784^{**}$).

The organic carbon in soils exhibited a positive and significant correlation with total carbon ($r = 0.987^{**}$), acid phosphatase ($r = 0.969^{**}$), dehydrogenase ($r = 0.837^{**}$), available phosphorus ($r = 0.757^{**}$), microbial biomass carbon ($r = 0.709^{**}$) and total nitrogen ($r = 0.547^{*}$) (Table. 97b).

Available nitrogen positively and significantly correlated with total N ($r = 0.976^{**}$), microbial biomass carbon ($r = 0.909^{**}$), available phosphorus ($r = 0.877^{**}$), dehydrogenase ($r = 0.805^{**}$) and urease ($r = 0.681^{**}$).

Total carbon content in soils of conventional farming system was positively and significantly correlated to dehydrogenase($r = 0.915^{**}$), acid phosphatase ($r = 0.915^{**}$), microbial biomass carbon ($r = 0.815^{**}$) and total N ($r = 0.676^*$).

The microbial biomass carbon was positively and significantly correlated to dehydrogenase($r = 0.979^{**}$).

The dehydrogenase activity in conventionally managed soils showed positive and significant correlations with the activity of acid phosphatase ($r = 0.676^*$).

4.7.2 Southern dry zone

Organic farming

Bulk density showed significantly negative correlations with all the parameters measured in soils under organic farming in this zone (Table. 98 a).

Soil pH exhibited significant and positive correlation with available phosphorus ($r = 0.981^{**}$) and dehydrogenase($r = 0.952^{**}$).

The organic carbon in soils showed a positive and significant correlation with microbial biomass carbon ($r = 0.999^{**}$), total carbon ($r = 0.994^{**}$), total nitrogen ($r = 0.998^{**}$), avail. nitrogen ($r = 0.994^{**}$), available potassium ($r = 0.974^{**}$), acid phosphatase ($r = 0.969^{**}$), urease ($r = 0.959^{**}$), dehydrogenase($r = 0.725^{**}$).

Available nitrogen was positively and significantly correlated with microbial biomass carbon ($r = 0.999^{**}$), total N ($r = 0.998^{**}$), total C ($r = 0.994^{**}$) available potassium ($r = 0.993^{**}$), urease ($r = 0.984^{**}$), acid phosphatase ($r = 0.983^{**}$), dehydrogenase($r = 0.796^{**}$) and available phosphorus ($r = 0.721^{**}$).

The microbial biomass carbon was positively and significantly correlated to acid phosphatase ($r = 0.996^{**}$), alkaline phosphatase ($r = 0.993^{**}$), urease ($r = 0.992^{**}$) and dehydrogenase($r = 0.825^{**}$).

Table.98 a. Correlation matrices of physico chemical and biological properties of soils under organic farming in Southern dry zone of Karnataka

	Bulk density	pH	Organic carbon	Available N	Available P	Available K	Tot C	Tot N	MBC	DHA	urease	Acid P	Alkaline P.
Bulk density	-												
pH	-0.084	-											
Organic carbon	-0.915**	0.479	-										
AvailableN	-0.865**	0.572	0.994**	-									
AvailableP	-0.277	0.981**	0.642*	0.721*	-								
AvailableK	-0.798**	0.667*	0.974**	0.993**	0.799**	-							
Tot C	-0.914**	0.482	1.000**	0.994**	0.643*	0.974**	-						
Tot N	-0.895**	0.518	0.999**	0.998**	0.675*	0.983**	0.999**	-					
MBC	-0.839**	0.613*	0.987**	0.999**	0.755**	0.998**	0.988**	0.993**	-				
DHA	-0.385	0.952**	0.725**	0.796**	0.993**	0.863**	0.727**	0.755**	0.825**	-			
urease	-0.763**	0.708*	0.959**	0.984**	0.832**	0.998**	0.960**	0.971**	0.992**	0.890**	-		
Acid Phos	-0.786**	0.681*	0.969**	0.990**	0.811**	0.456	0.970**	0.979**	0.996**	0.873**	0.999**	-	
Alkaline Phos.	-0.767**	0.703*	0.961**	0.985**	0.828**	0.546	0.962**	0.973**	0.993**	0.887**	0.991**	0.514	-

Table.98b Correlation matrices of physico chemical and biological properties of soils under conventional farming in Southern dry zone

	Bulk density	pH	Organic carbon	Available N	Available P	Available K	Tot C	Tot N	MBC	DHA	urease	Acid P	Alkaline P.
Bulk density	-												
pH	0.486	-											
Organic carbon	0.595*	-0.413	-										
AvailableN	0.682*	0.970**	-0.181	-									
AvailableP	-0.508	0.506	-0.994**	0.283	-								
AvailableK	-0.136	-0.932**	0.715**	-0.817**	-0.785**	-							
Tot C	0.590*	-0.419	0.947**	-0.188	-0.995**	0.720**	-						
Tot N	-0.848**	0.486	0.595*	0.682*	-0.508	-0.136	0.590*	-					
MBC	0.439	0.154	0.836**	0.388	-0.774**	0.215	0.832**	0.939**	-				
DHA	0.473	0.748**	-0.426	0.967**	0.519	-0.937**	-0.433	0.473	0.140	-			
urease	0.594*	0.391	0.676*	0.602*	-0.595*	-0.031	0.671*	0.994**	0.970**	0.378	-		
Acid Phos	0.583*	0.637*	0.439	0.804**	-0.342	-0.314	0.433	0.983**	0.860**	0.625*	0.959**	-	
Alkaline Phos.	0.611*	0.804**	0.210	0.924**	-0.106	-0.533	0.203	0.911**	0.712**	0.795**	0.862**	0.412	-

* significant at 5 %

Alkaline phos- Alkaline phosphatase

** significant at 1%

DHA- Dehydrogenase activity

Acid phos- Acid phosphatase

MBC- Microbial biomass carbon

The dehydrogenase activity of organically amended soils showed positive and significant correlations with urease ($r = 0.890^{**}$) alkaline phosphatase ($r = 0.887^{**}$) and acid phosphatase ($r = 0.873^{**}$).

Urease activity showed positively and significantly correlated to acid and alkaline phosphatases ($r = 0.999^{**}$).

Conventional farming

The organic carbon in soils exhibited a positive and significant correlation with total carbon ($r = 0.947^{**}$), and microbial biomass carbon ($r = 0.836^{**}$) . (Table. 98 b).

Available nitrogen was positively and significantly correlated with dehydrogenase ($r = 0.967^{**}$) and acid phosphatase ($r = 0.804^{**}$)

Total carbon content in soils of conventional farming system was positively and significantly correlated to microbial biomass carbon ($r = 0.832^{**}$) .

The microbial biomass carbon was positively and significantly correlated to urease ($r = 0.970^{**}$) , acid phosphatase ($r = 0.860^{**}$) and alkaline phosphatase ($r = 0.712^{**}$) .

4. 7.3 Southern transition zone

Organic farming

Bulk density showed significantly negative correlations with all the parameters measured in soils under organic farming in this zone (Table. 99 a).

Soil reaction exhibited significant and positive correlation with alkaline phosphatase ($r = 0.997^{**}$) .

Table.99 a. Correlation matrices of physico chemical and biological properties of soils under organic farming in Southern transition zone of Karnataka

	Bulk density	pH	Organic carbon	AvailableN	AvailableP	AvailableK	Tot C	Tot N	MBC	DHA	urease	Acid P	Alkaline P.
Bulk density	-												
pH	-0.103	-											
Organic carbon	-0.827**	-0.644*	-										
AvailableN	-0.884**	-0.556	0.994**	-									
AvailableP	0.370	-0.341	0.939**	0.971**	-								
AvailableK	0.831**	0.468	0.375	0.475	0.671*	-							
Tot C	-0.826**	-0.646*	0.998**	0.994**	0.938**	0.372	-						
Tot N	-0.916**	-0.494	0.983**	0.997**	0.986**	0.537	0.983**	-					
MBC	-0.877**	-0.569	0.995**	0.998**	0.967**	0.461	0.995**	0.996**	-				
DHA	0.749**	-0.737**	0.992**	0.972**	0.887**	0.253	0.992**	0.952**	0.975**	-			
urease	-0.897**	-0.532	0.990**	0.998**	0.978**	0.500	0.990**	0.999**	0.999**	0.964**	-		
Acid Phos	-0.912**	-0.503	0.985**	0.968**	0.984**	0.529	0.985**	1.000**	0.997**	0.955**	0.994**	-	
Alkaline Phos.	-0.025	0.997**	-0.583*	-0.489	-0.267	0.535	-0.585*	-0.425	-0.503	-0.682*	-0.464	-0.434	-

Table. 99 b. Correlation matrices of physico chemical and biological properties of soils under conventional farming in Southern transition zone

	Bulk density	pH	Organic carbon	Available N	Available P	Available K	Tot C	Tot N	MBC	DHA	urease	Acid P	Alkaline P.
Bulk density	-												
pH	0.459	-											
Organic carbon	0.542	0.637*	-										
AvailableN	0.474	0.721**	0.993**	-									
AvailableP	-0.597*	0.923**	0.291	0.399	-								
AvailableK	0.123	0.614*	-0.218	-0.105	0.870**	-							
Tot C	0.493	0.913**	0.896**	0.941**	0.686*	0.238	-						
Tot N	0.599*	0.831**	0.958**	0.985**	0.553	0.070	0.986**	-					
MBC	0.643*	0.640*	0.924**	0.994**	0.296	-0.214	0.898**	0.959**	-				
DHA	0.197	-0.332	0.516	0.414	-0.669*	-0.949**	0.082	0.249	0.512	-			
urease	0.600*	0.925**	0.296	0.404	1.000**	0.868**	0.689*	0.557	0.300	-0.666*	-		
Acid Phos	0.574*	0.502	0.986**	0.961**	0.131	-0.375	0.811**	0.898**	0.986**	0.649*	0.135	-	
Alkaline Phos.	0.647*	0.814**	0.966**	0.989**	0.529	0.041	0.980**	1.000**	0.967**	0.277	0.532	0.411**	-

* significant at 5 %

Alkaline phos- Alkaline phosphatase

** significant at 1%

DHA- Dehydrogenase activity

Acid phos- Acid phosphatase

MBC- Microbial biomass carbon

The organic carbon showed a positive and significant correlation with total carbon ($r = 0.998^{**}$), microbial biomass carbon ($r = 0.995^{**}$), avail. nitrogen ($r = 0.994^{**}$), dehydrogenase($r = 0.992^{**}$), urease ($r = 0.990^{**}$), acid phosphatase ($r = 0.985^{**}$), total nitrogen ($r = 0.983^{**}$) and available phosphorus ($r = 0.939^{**}$).

Available nitrogen was positively and significantly correlated with urease ($r = 0.998^{**}$), microbial biomass carbon ($r = 0.998^{**}$), total N ($r = 0.997^{**}$), total C ($r = 0.994^{**}$), dehydrogenase($r = 0.972^{**}$), available phosphorus ($r = 0.971^{**}$) and acid phosphatase ($r = 0.968^{**}$).

Total carbon content in soils of organic farming system was positively and significantly correlated to microbial biomass carbon ($r = 0.995^{**}$), dehydrogenase ($r = 0.992^{**}$), urease ($r = 0.990^{**}$), acid phosphatase ($r = 0.985^{**}$) and total N ($r = 0.983^{**}$).

The microbial biomass carbon was positively and significantly correlated to urease ($r = 0.999^{**}$), acid phosphatase ($r = 0.997^{**}$) and dehydrogenase($r = 0.975^{**}$).

The dehydrogenase activity in organically amended soils showed positive and significant correlations with urease ($r = 0.964^{**}$) and acid phosphatase ($r = 0.955^{**}$).

Conventional farming

Bulk density showed significantly positive correlations with alkaline phosphatase ($r = 0.647^{*}$), microbial biomass carbon ($r = 0.643^{*}$), total N ($r = 0.599^{**}$), and acid phosphatase ($r = 0.574^{**}$) (Table. 99 b).

Soil pH exhibited significant and positive correlation with urease ($r = 0.925^{**}$), available phosphorus ($r = 0.923^{**}$), total C ($r = 0.913^{**}$), total N ($r = 0.831^{**}$), alkaline phosphatase ($r = 0.814^{**}$), and available nitrogen ($r = 0.721^{**}$).

The organic carbon in soils exhibited a positive and significant correlation with available nitrogen ($r = 0.993^{**}$), acid phosphatase ($r = 0.986^{**}$), alkaline phosphatase

($r = 0.966^{**}$), total nitrogen ($r = 0.958^{*}$), microbial biomass carbon ($r = 0.924^{**}$) and total carbon ($r = 0.896^{**}$).

Available nitrogen was positively and significantly correlated with microbial biomass carbon ($r = 0.994^{**}$), alkaline phosphatase ($r = 0.989^{**}$), total N ($r = 0.985^{**}$), acid phosphatase ($r = 0.961^{**}$), and total C ($r = 0.941^{**}$).

Total carbon content in soils of conventional farming system was positively and significantly correlated to total N ($r = 0.986^{**}$), alkaline phosphatase ($r = 0.980^{**}$), microbial biomass carbon ($r = 0.898^{**}$) and acid phosphatase ($r = 0.811^{**}$).

The microbial biomass carbon was positively and significantly correlated to acid phosphatase ($r = 0.986^{**}$) and alkaline phosphatase ($r = 0.967^{**}$).

The dehydrogenase activity in conventionally managed soils showed positive and significant correlations with the activity of acid phosphatase ($r = 0.649^{*}$).



Discussion

V. DISCUSSION

Soil physical, chemical and biological parameters are sensitive to treatment effects on soil process is that indicate nutrient flow in agroecosystems. It has been well established that the more dynamic characteristics such as microbial biomass and soil enzyme activity respond more quickly to changes in crop management practices than characteristics such as total SOM (Doran *et al.*, 1996). Soil enzymes integrate soil chemical, physical, and biological characteristics and may be used to monitor the effects of soil management on long-term productivity. In part, enzymatic activities in soil are controlled by physical and chemical conditions, although the major limiting factors for microorganisms are temperature and water content. Quantification of these characteristics is important to understand the effects of crop management practices on soil quality and crop yield.

A study on the “Comparative assessment of soil properties and organic carbon distribution under organic and conventional farming systems in selected agroclimatic zones of southern Karnataka” was carried out and this includes study of the soil physical, chemical and biological/biochemical parameters in both organic and conventional farming systems in surface (0-15cm) and sub surface (15-30cm) soils. The distributions of carbon in different diagnostic horizons of the pedons were studied under Central dry zone, Southern dry zone and Southern transition agroclimatic zones of Karnataka. The results obtained in these studies are discussed in this chapter under the different heads in the light of earlier findings.

5.1 Soil Physical Properties

5.1.1 Soil texture

The texture of soils collected from organic and conventional farming systems was sandy clay to clay in Central dry zone, Southern dry and Southern transition zones of Southern Karnataka (Tables 1,2 and 3). It was observed that the long term organic or conventional farming practices had no effect on texture of soil. It is a well known fact

that the proportion of soil separates in a given soil is not affected by crops or cultivation practices during a small period of time.

5.1.2 Bulk density and Particle density

In the present study, the bulk density differed significantly with organic and conventional farming systems at two depths (0-15 and 15-30cm) during *kharif* 2008 and summer 2009. Bulk density was relatively low in soils sampled from fields under organic farming than in soils sampled from conventional farming system during 0-3, 3-6 and >6 years of practice of organic farming under three selected agroclimatic zones of Karnataka (Tables 7,8 and 9; Fig 2). Interaction studies revealed that the soil bulk density showed no significant variation irrespective of farming systems, periods of their practice and depth of sampling during *kharif* 2008 and summer 2009 seasons. The SOC content is inversely proportional to bulk density (Baur and Black, 1994). Sharma *et al.* (2000) attributed the reduction in bulk density in residue and FYM incorporated soils to build up of soil organic matter and better soil structure. Srikanth *et al.* (2000) and Surekha and Rao (2009) also observed a significant decrease in bulk density of soil amended with compost compared to the inorganic fertilizer. Decrease in bulk density due to incorporation of organic manures into the soil have also been reported by several earlier workers (Bellakki and Badanur, 1994; Itnal, 1997 Bonde *et al.*, 2004 and Valpassos *et al.*, 2009).

Particle density did not show any variations among the farming systems over three different periods of organic or conventional practice at two depths and their interactions in soils sampled from three selected agroclimatic zones of Karnataka during *kharif* 2008 and summer 2009 (Tables 10,11 and 12).

It is to pointed out that such studies would provide information on the influence of organic matter additions on physical properties which will facilitate indepth studies relating physical formations in soil.



5.1.3 Maximum water holding capacity

The data on maximum water holding capacity (MWHC) of soils (Table 13,14 and 15) indicated that its values were higher in soils under organic farming than conventional farming over three different periods of practice of organic or conventional farming systems under three selected agroclimatic zones of southern Karnataka. Soil water holding capacity (%) showed no significant difference among farming systems and periods of practice of organic or conventional farming interactions under Central dry and Southern transition zones of Karnataka. A longer period of organic farming and/or application of larger quantities of organic manures in above farms were responsible for higher increase in MWHC of soil. Sharma *et al.*, (2000) observed improvement in water holding capacity of soil due to addition of organic manures compared to only inorganic fertilizer application. The build up of soil organic matter and improvement in soil structure by application of residue and FYM to soil were responsible for significant increase in water holding capacity of soil. Similar results were also reported by Yunchen Zhao *et al.*, (2009).

5.1.4 Pore space (%)

The data on pore space (%) of soils indicated that the values were higher in soils under organic farming than conventional farming in all the periods of practice of organic or conventional farming systems under three selected agroclimatic zones of Karnataka (Tables 16,17 and 18) . Soil pore space (%) showed significant difference among farming systems and periods of practice of organic or conventional farming interactions under Central dry, Southern dry and Southern transition zones of Karnataka. Soil pore space (%) differed significantly in farming systems and periods interactions during *kharif* 2008 and summer 2009. The results concerning soil bulk density and total porosity indicated that the increase in soil porosity was accomplished by decrease in soil bulk density, as reported by Werner (1997) in organic systems. The results of the present study confirmed the same. This effect under organic farming is important and may have implications for plant root growth and nutrient availability to crops. Similar results were mentioned by

Swezey *et al.*, (1998) and Glover *et al.* (2000) in comparison between organic and conventional apple orchards .

5.2 Soil Physico- Chemical properties

5.2.1 Soil reaction (pH) and electrical conductivity (EC)

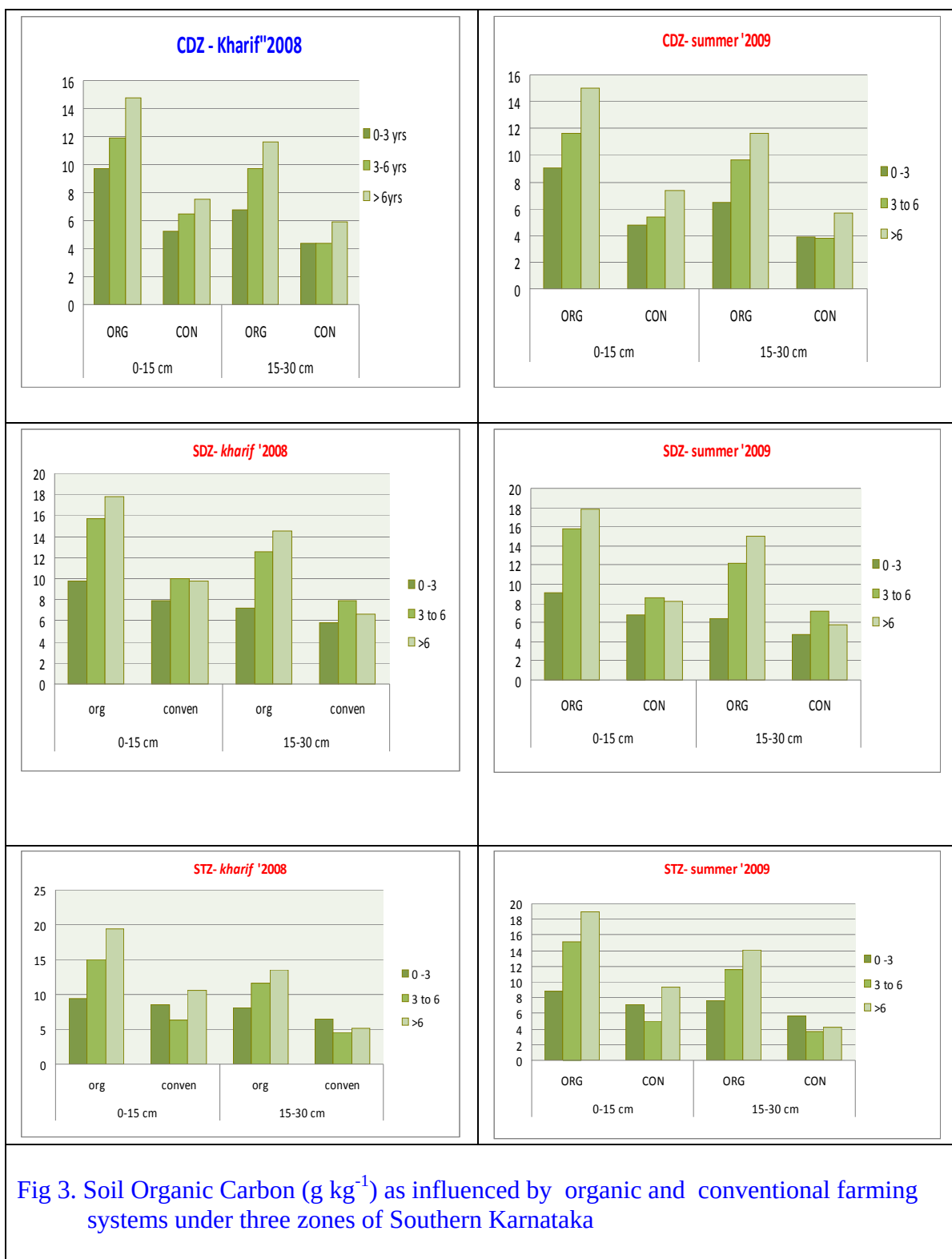
There was no significant difference in pH of soils under Central dry zone and Southern dry zone of Karnataka by the practice of organic or conventional farming systems (Tables 19, 20 and 21). However, the soil reaction recorded significant changes under Southern transition zone among farming systems over three different periods of practice (0-3, 3-6 and >6 years) during *kharif* 2008 and *summer* 2009. Relatively higher values of pH were recorded in soils of organic farming over soils of conventional farming system under Southern transition zone. This may be due to buffering action by the added organic manures. Clark *et al.*, (1998) and Lal *et al.*, (2000) reported that the organic systems recorded higher pH values in mildly acidic soils than their conventional counterparts. This illustrates the important role that organic manures and other organic matter inputs can have in buffering the pH of the soil and these results are in accordance with the findings of Gopinath *et al.*, (2008) and Melero *et al.*, (2008).

The EC of soil samples collected from organic and conventional farming systems under Central Dry zone and Southern dry zone of Karnataka (Table 22,23 and 24)) showed no significant difference among farming systems, at two depths (0-15 and 15-30cm) during different periods (0-3, 3-6 and >6 years) of practice during *kharif* 2008 and *summer* 2009. However, electrical conductivity differed significantly among farming systems during three different periods of their practice in soils under Southern transition zone. EC did not show any variations in interactions between farming systems, periods of practice and depths of sampling from three selected zones. Badanur *et al.*, (1990) and Herencia *et al.*, (2007) also found that there were no significant differences in electrical conductivity (EC) between organic and mineral fertilizations.

5.3 Soil Chemical properties

5.3.1 Soil Organic Carbon (SOC)

SOC influences a wide range of physical, chemical and biological properties of soils and is considered to be the most important indicator of soil quality (O'Donnell, 1996 and Carter *et al.*, 1999). The soil samples collected from organic and conventional farming systems under Central dry, Southern dry and Southern transition zones of Karnataka recorded significantly higher organic carbon (g kg^{-1}) content in organic farming fields compared to their conventionally managed nearby fields of different periods (0-3, 3-6 and >6 years) of organic farming practice at two depths (0-15 and 15-30cm) during both *kharif* 2008 and summer 2009 seasons. The results of the present study indicated that the organic carbon content of soils increased due to organic matter additions in all the zones irrespective of cropping systems compared to conventional farming (Tables 25, 26 and 27; Fig. 3). The increase in organic carbon content of soils under organic farming was quite obvious since the carbonaceous materials contribute to soil organic carbon after their decomposition. These observations are in agreement with the findings of Bhandari *et al.* (1992) and Marriott and Wander (2006) who pointed out that the surface soil accounted for higher organic carbon content than sub surface soils. Addition of higher quantity of organic manures and/or longer period of organic farming practice in the above farms was responsible for increased build up of organic carbon in soil. In a long term study, Rabindra and Honnegowda (1986) recorded enhanced organic carbon content of sandy loam soil due to regular use of FYM. A significant increase in organic carbon content of a Vertisol after four years of application of organic manures over fertilizer application was observed by Bellakki and Badanur (1994). The organic carbon content on organic farming for a period of 0-3 years was similar to that of soils of conventional farming practice. This could be due to shorter period of organic farming (< 3 years), indicating the requirement of longest duration for build up of organic carbon in soil. The results are in agreement with other studies on several long-term experiments that have shown the effects on soil organic carbon after addition of organic amendments (Andrews *et al.* 2002; Marschner *et al.*, 2003; Bohme *et al.*, 2005; Kaur *et al.*, 2005).



Interaction studies revealed that soil organic carbon content varied significantly between farming systems and periods of practice of organic or conventional farming interactions during *kharif* 2008 and summer 2009. The reason for such variations could be due to organic carbon buildup in organic farming systems with increase in number of years of practice of organic matter additions. Contrastingly, the soil samples of conventional systems collected adjacent to the organic farming plots recorded lower values, most likely due to the degradation of organic matter due to temperatures conducive for microbial activity in these regions.

5.3.2 Soil Available Nitrogen

Comparative changes in soil available nitrogen during different periods of organic or conventional farming system in three selected agroclimatic zones of Southern Karnataka are presented in tables 28, 29 and 30, and Fig. 4.

In the present study, significant increase in available nitrogen content was observed in the soils sampled from organically managed plots compared to the conventionally managed plots during 0-3, 3-6 and >6 years of practice under three selected agroclimatic zones of Karnataka at two depths (0-15 and 15-30cm) during *kharif* 2008 and summer 2009.

Soil available nitrogen showed significant difference between farming systems and periods of practice interactions in soils in all the zones during *kharif* 2008 and summer 2009. The N content of organic plots is about one and half times the N content of the conventional farming plots. In the organic-amended soils, a strong relationship between the content of N and OM was found and was in agreement with the findings of Drinkwater *et al.*, (1995). It is necessary to indicate that the N applied through the organic amendment is not immediately available for plant use and must be mineralized. Soil organic N content may increase slightly because the N in organic amendment will not fully decompose in one single year (Sims, 1995). Therefore, the higher N contents in organically managed plots could be partly due to the nutrient supply by organic manures.

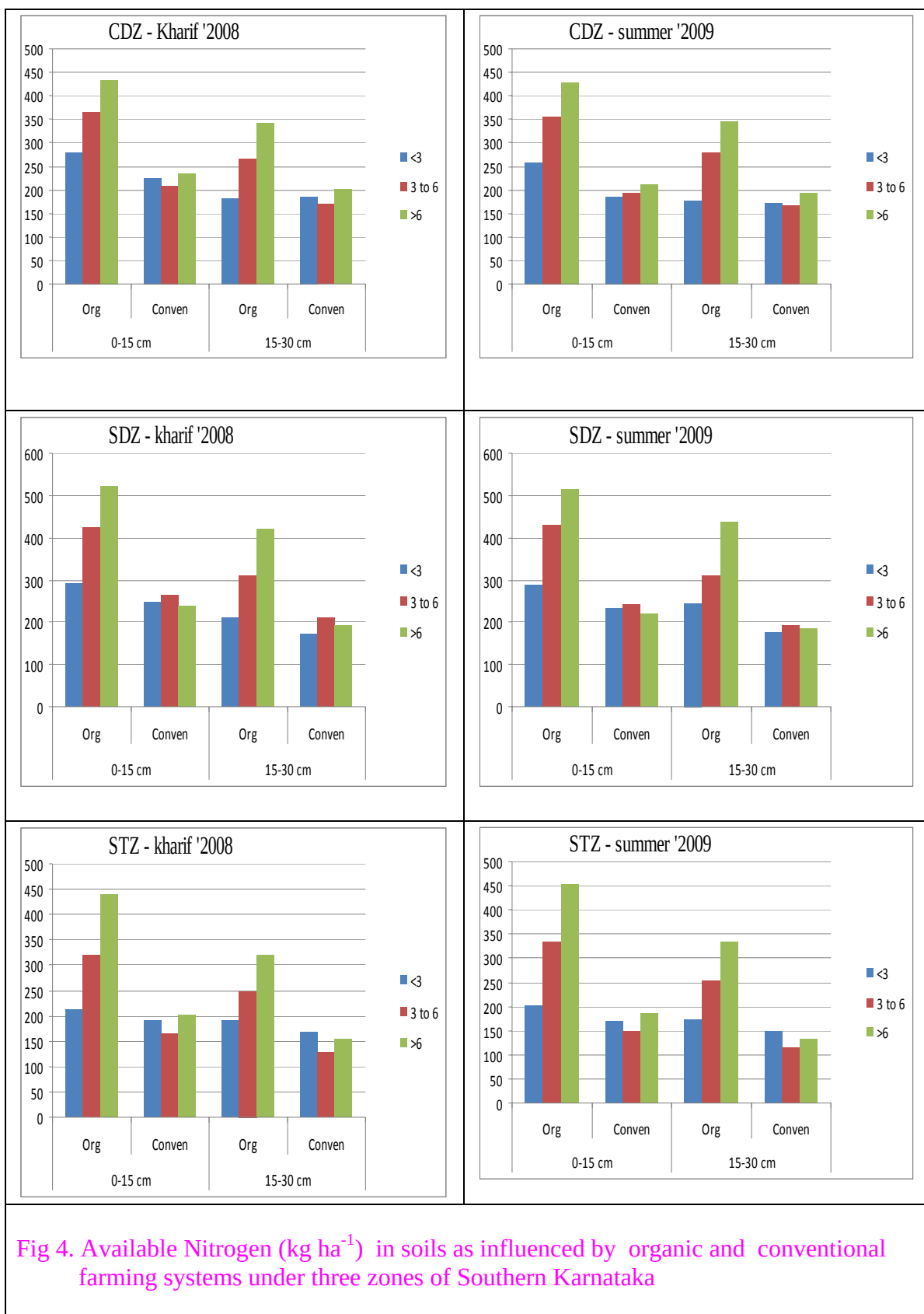


Fig 4. Available Nitrogen (kg ha⁻¹) in soils as influenced by organic and conventional farming systems under three zones of Southern Karnataka

Organically amended soils are characterized by higher levels of microbial activity compared with chemical fertilizers applied soils (Melero *et al.*, 2006), and the N mineralization in soil is closely linked to labile soil OM pools and is largely mediated by soil microorganisms (Scheller & Vogtmann, 1995 and Kannan *et al.*, 2005).

5.3.3 Available Phosphorus

The available phosphorus content of soils from Central dry and Southern Transition zones of Karnataka (Tables 31, 32 and 33) differed significantly among soils collected from organic and conventional farming systems at three different periods (0-3, 3-6 and >6 years) of practice and at two depths (0-15 and 15-30cm) during *kharif* 2008 and summer 2009. However, soil available phosphorus from Southern Dry zone of Karnataka did not show any variation during different periods (0-3, 3-6 and >6 years) of practice of organic or conventional farming during both the seasons. The available phosphorus content in the organically managed plots was significantly higher compared to the conventional ones. In a 3-yr study, Gliessman *et al.* (1996) observed higher P content in organic plots after the second year following annual applications of 18.5 and 37 Mg ha⁻¹ yr⁻¹ of compost. Similar results were drawn by Clark *et al.* (1998) and Edmeades (2003). There is considerable evidence in the literature to suggest that the application of organic matter to soil increases P solubility (Sanyal and De Datta, 1991 and Guppy *et al.* 2005).

5.3.4 Available Potassium

The available potassium content differed significantly during different periods of organic and conventional farming systems under three selected agroclimatic zones of Southern Karnataka (Tables 34, 35 and 36). The available K was higher in the soils of organic farming practice than those under conventional farming. The results obtained from the present study indicate that the increase of available K was due to the K released from organic sources. Several authors namely Mathur (1997) and Andrews *et al.* (2002) also found higher K in soils treated with organic matter and attributed the result to the

high K content of the compost and increase of exchange sites due to organic matter added, which do not fix K strongly (Gliessman *et al.*, 1996; Bulluck *et al.*, 2002; Edmeades, 2003 and Nalatwadmath *et al.* 2003).

5.3.5 Secondary nutrients

The calcium , magnesium and sulphur contents (Tables 37-45) of soils from Central dry, Southern dry and Southern transition zones of Karnataka differ significantly with periods of practice of organic and conventional farming systems during *kharif* 2008 and summer 2009. Interaction studies showed that exchangeable calcium, magnesium and available sulphur varied between farming systems and periods of practice during both *kharif* 2008 and summer 2009 seasons as revealed by significant interactions. Calcium concentrations of soils from organic systems which were treated with natural sources such as lime or rock phosphate recorded higher exch. calcium values compared to the soils of conventional farming. Similarly, a higher magnesium and sulphur concentrations were observed in soils amended with natural and organic sources compared to those treated with synthetic fertilizers over the same time period. Ceccanti *et al.*, (1994) attributed the increase in available S content to the release of organic bound sulphur through mineralization. Clark *et al.* (1998) found that concentrations of calcium, and magnesium were greater in soils with incorporated manures and cover crops. Continuous annual applications of compost are typically required to cause significant enhancements in these soil properties. Some authors have also shown an increase in calcium, magnesium and sulphur contents after organic amendment addition (Shiralipour *et al.*, 1992; Bulluck *et al.*, 2002).

5.3.6 DTPA extractable Micro nutrients

The trends were similar in respect of the contents of DTPA extractable Fe Mn, Zn and Cu (Tables 46 to 57) in organic and conventional farming systems over three different periods practice under three selected agroclimatic zones of Southern Karnataka. The soils under organic farming recorded much higher concentration of micronutrients

than soils under conventional farming. Addition of large quantities of organic manures every year under organic farming practice was the cause for such marked increase in the DTPA-extractable micronutrients.

Interactions studies showed that DTPA extractable Cu and Mn contents varied significantly between farming systems and periods practice. Slightly higher levels of Cu and Mn in organically managed plots could be due to the formation of Cu and Mn organic complexes with the organic amendments.

The higher values of DTPA extractable Fe and Zn of soils from organically managed plots indicate that organic matter significantly influences micronutrient availability (Wei *et al.* 2006). The DTPA extractable Fe and Zn in soils treated with organic matter recorded significantly higher (Katyal and Sharma 1991; Mathur 1997; Sharma *et al.* 2000). The oxidation and reduction of iron is characterized by the conditions of the soil. An increase in soil organic matter provides reduced condition thereby converting the oxidized iron to reduced forms (Kabata-Pendias 2000). Bellakki and Badanur (1997) attributed the increase in micronutrients in soils to addition of organics which enhanced microbial activity and consequent release of complex organic substances (chelating agents) besides addition of these nutrients to the available pool on decomposition of organics. In a study conducted by Herencia *et al.* (2008) over six years, it was also found that the addition of organic amendments influenced the distribution of DTPA extractable Fe Mn, Zn and Cu in the different fractions by moving from the less soluble fractions to more plant-available forms. The results in the present study suggest that by yielding soluble complexes, the supply of organic composts could give rise to a more Cu, Mn, Fe and Zn after 3-6 years, and in over 6 years period.

5.3.7 Cation Exchange Capacity (CEC)

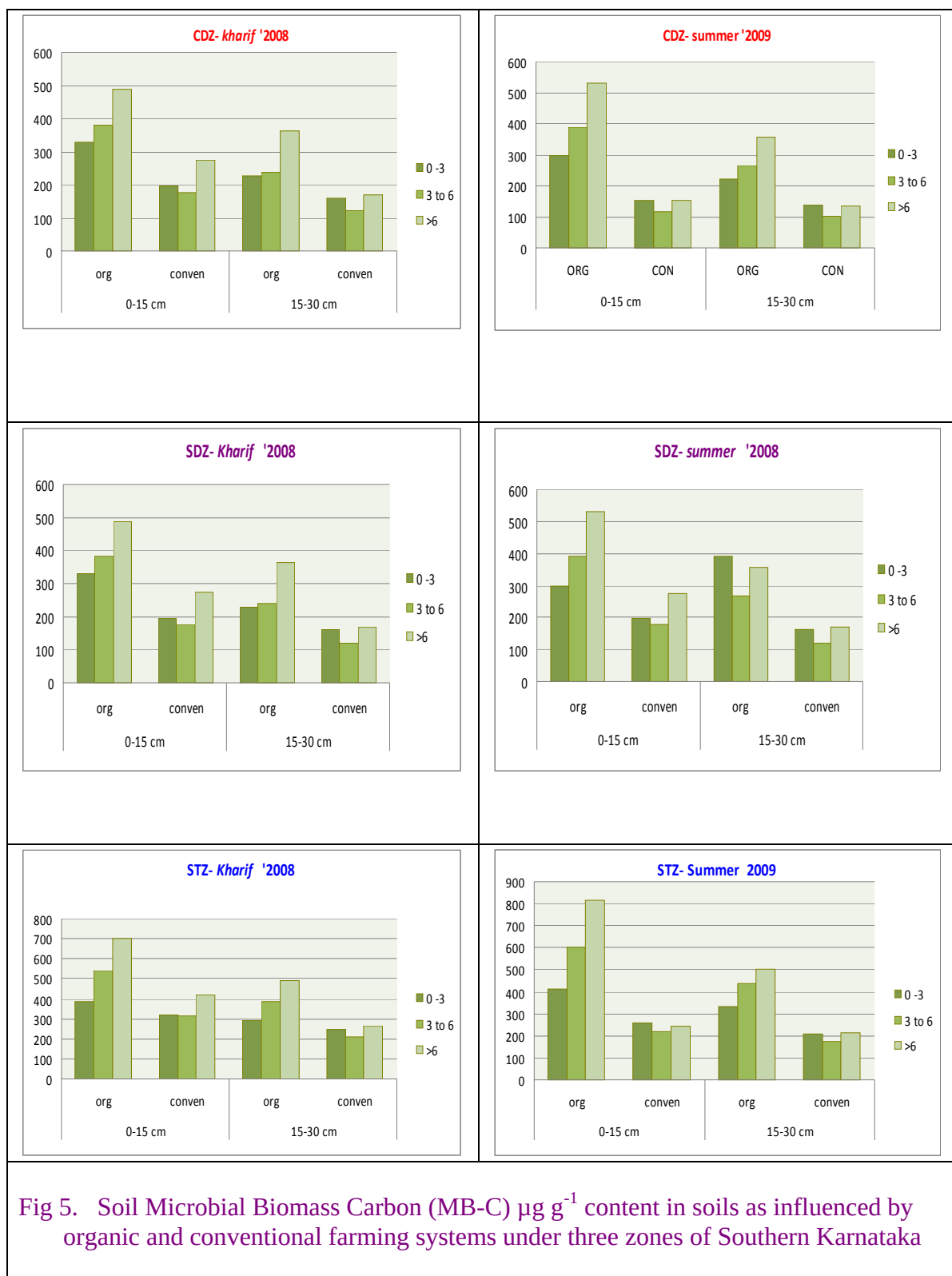
The results on comparative changes in soil cation exchange capacity [$\text{C mol (p}^+) \text{ kg}^{-1}$] during different periods of organic and conventional farming systems under three selected agroclimatic zones of Southern Karnataka are presented in tables 58, 59 and 60.

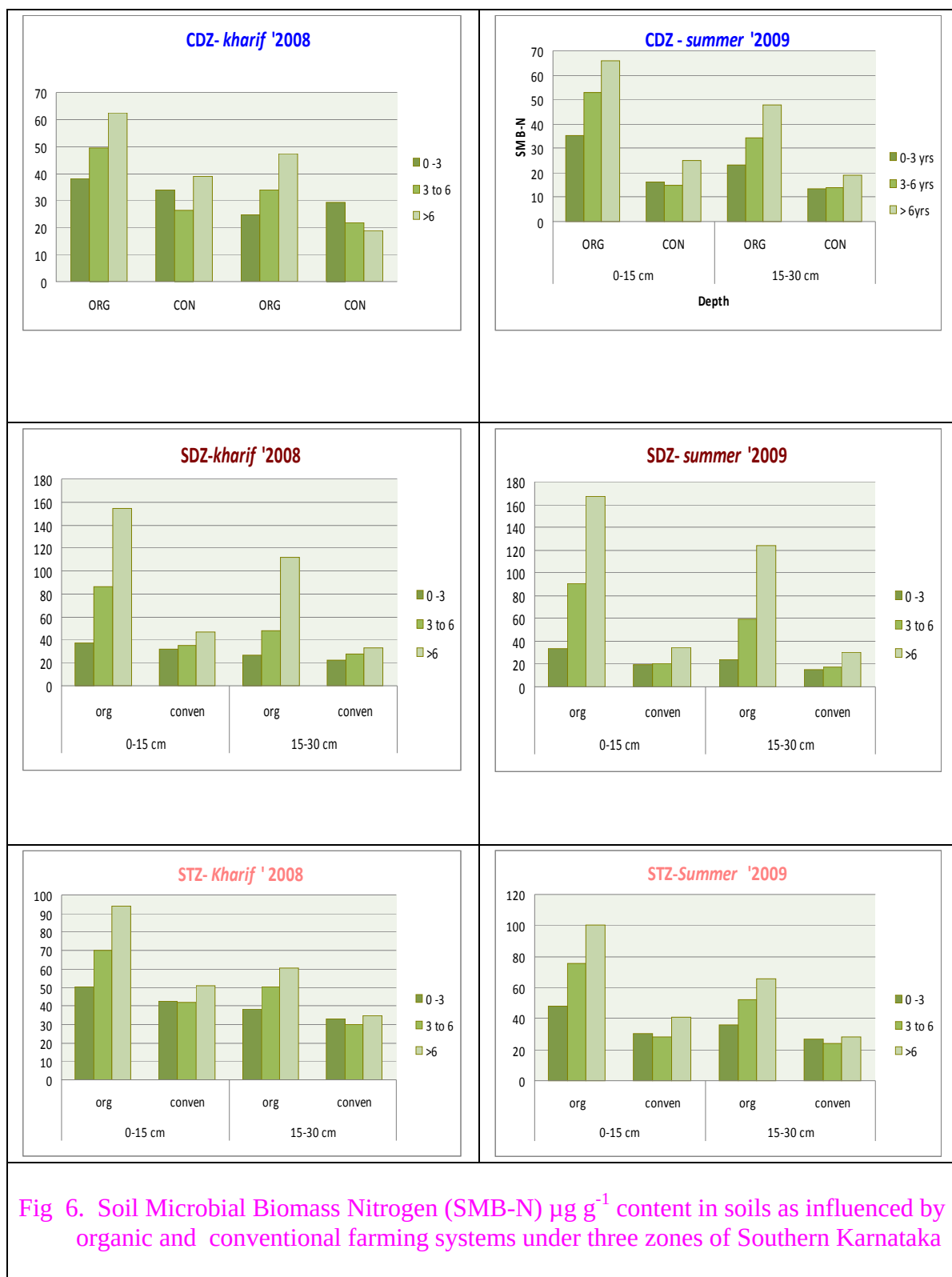
The cation exchange capacity of soils collected from organic and conventional farming systems under Central Dry, Southern dry and Southern transition zones of Karnataka differed significantly among farming systems during the three different periods of practice (0-3, 3-6 and >6 years) at two depths (0-15 and 15-30cm) during both *kharif* 2008 and summer 2009. The soils under organic farming recorded higher values of cation exchange capacity (CEC) than soils under conventional farming irrespective of cropping system followed in three zones. An increase in CEC from 0-3 years to over 6years practice of organic farming, where as it was not with conventional practice. CEC showed significant difference in interactions among farming systems with periods of practice of organic or conventional farming during *kharif* 2008 and summer 2009. The increase in CEC was due to the addition of soil organic matter which posses several functional groups which enhance the CEC. A significant increase in CEC of soil was due to application of farmyard manure as observed by Singh *et al.* (1998), which is attributed it to organic matter.

A higher increase in organic carbon content in surface soil than in sub surface soil was probably responsible for increased CEC in the former than latter. The increase in CEC of soils due to organic farming vary from soil to soil within the same zone, which could be due to variation in clay content of soil and quantity of organic matter added. The increase in CEC due to incorporation of organic manures into the soil has also been reported by several workers (Yaduvanshi *et al.*, 1985 and Patiram and Singh, 1993; Bulluck *et al.*, 2002).

5.4 Soil Carbon fractions

Several forms of soil carbon such as Soil Microbial Biomass Carbon (SMB-C), Soil Microbial Biomass Nitrogen (SMB-N), light fraction carbon (LF-C) and water soluble carbon (WS-C) could be considered as indices of labile carbon in the soil (Gregorich *et al.*, 1994). Changes in soil organic carbon is very slow in the soil, however changes in forms of carbon as indicated above are more rapid. The





5.4.2. Light Fraction Carbon (LF-C)

The 'light fraction' of SOM refers to partially decomposed or non-humified materials made up of residual roots and shoots with high C: N ratio is often found to be very labile. This small fraction of SOM will be most influenced by the rate and regularity of returns of undecomposed organic matter into the soil. Light fraction C is regarded as highly labile and can change rapidly in response to management (Biederbeck *et al.*, 1994). The light fraction carbon content of soils sampled from organic and conventional farming systems are presented in Tables 67 to 68 and in Fig. 7.

The light fraction carbon (LF-C) content differed significantly with organic and conventional farming systems during three different periods (0-3, 3-6 and >6 years) of practice and at two depths (0-15 and 15-30cm). Light fraction carbon (LF-C) content was relatively high in soils sourced from organic farming fields than in soils from conventional farming practice during the different periods. The content increased in soils with increase in number of years of organic farming practice, but it was not so with the conventional farming. The organic manures have been subjected to partial decomposition due to microbial action as indicated by the activity of enzymes referred in the table above. Further the organic matter serve as a source of energy and metabolism. The soils sourced from Central dry zone recorded lower Light Fraction Carbon content compared to Southern dry zone and Southern transition zone. Significant interactions existed between farming systems and periods of practice with regard to LF-C.

Janzen *et al.*(1992) and Berry *et al.*, (2002) reported an increase in LF-C which was strongly correlated to soil respiration rates , suggesting that the light fraction may be an important C and energy source for soil microorganisms. This fraction of carbon is not protected by clay minerals or other mechanisms, and hence it is readily accessible to microbial and enzyme activities.



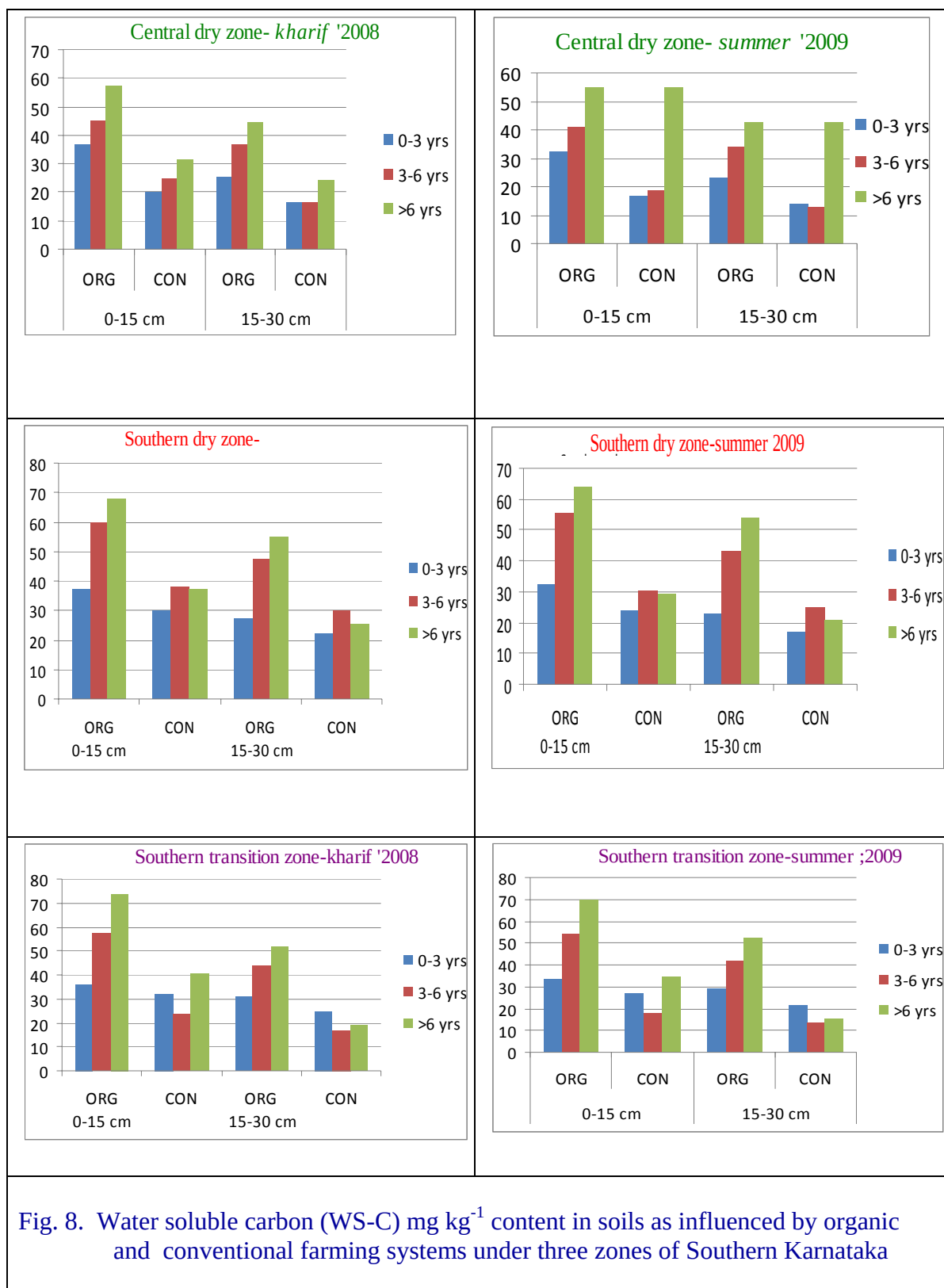
5.4.3. Water Soluble Carbon (WS-C)

The water soluble carbon is considered to be the most active component of soil organic matter. It is the main source of energy for soil microorganisms and is a primary source of mineralisable N, P and S and it influences the availability of metal ions by forming soluble complexes (Stevenson, 1994). Understanding the role of WS-C in nutrient cycling is an important factor for sustainable ecosystem management (Silveira, 2005).

WS-C content of soils under organic and conventional farming systems was compared over three different periods of practice under three selected agroclimatic zones of Southern Karnataka (Tables 70,71 and 72 Fig.8). The water soluble carbon in soils differed significantly during different periods of practice. The soil samples from plots of organic farming practice under Southern transition zone recorded higher WS-C content followed by Southern Dry zone. The reason for relatively higher content of WS-C in Southern transition zone soils could be attributed to relatively higher contents of SMBC and LF-C. As in the case of LF-C, SMBC, the WS-C was also found to be higher due to organic farming practice as compared to conventional farming practice. This is in conformity with the findings of Haynes and Swift (1990) and Wander and Traina (1996).

5.4.4 Total Carbon (Tot-C)

The total carbon in soils of three selected agroclimatic zones of Southern Karnataka differed significantly in organic and conventional farming systems in all the three different periods (0-3, 3-6 and >6 years) of practice (Tables 73, 74 and 75). The soil samples from plots of organic farming practice under Southern transition zone recorded higher Tot-C content followed by Southern Dry zone. The reason for the same could be attributed to relatively higher content of organic carbon. Differences between the compositions of soil organic matter in organically and conventionally managed soils have been demonstrated by Elmholt, (1996) and Wander & Traina, (1996).



5.4.5 Total Nitrogen (Tot-N)

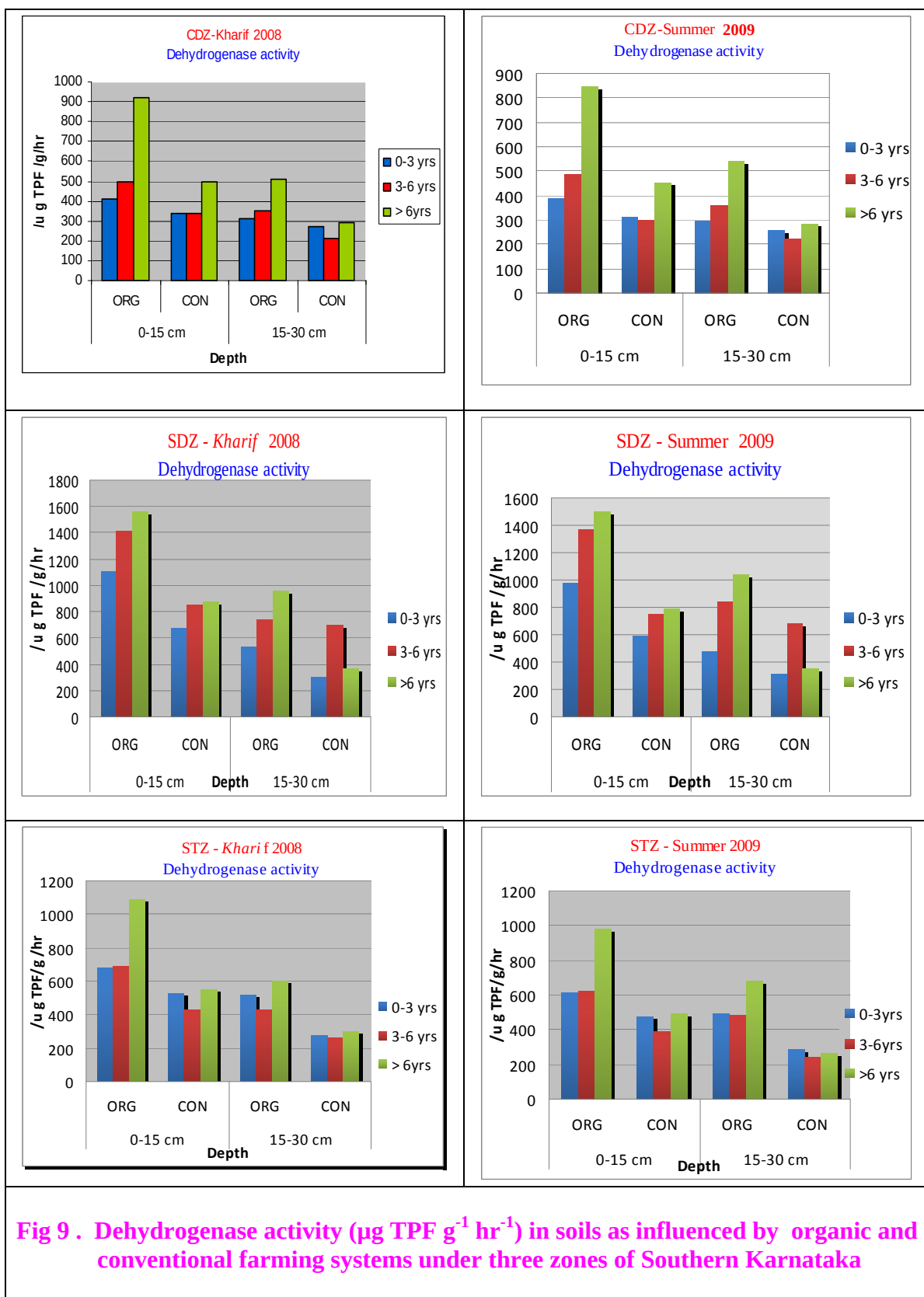
Soils under Central dry, Southern dry and Southern transition zones of Karnataka differed significantly in total nitrogen content in plots of organic and conventional farming practices during three different periods of practice at two depths (Tables 76, 77 and 78). The surface soils under organic farming practice recorded higher Tot-N compared to conventional counterpart irrespective of zone. Drinkwater *et al.*, (1998) and Fliessbach *et al.*, (2007) compared organic farming with conventional farming for different soil parameters and found that the soil organic matter and total N contents were higher in organic practices than in conventional farming practices. An increasing trend was observed in soil total nitrogen from 0-3 yrs to > 6yrs of organic farming, and was not with conventional farming in both the depths and in both the seasons as observed in the present study.

5.5 Soil Biological Parameters - Enzyme activity

Enzymes may respond to changes in soil management more quickly than other soil variables, therefore, enzymes might be useful as early indicators of biological change (Bandick and Dick, 1999). Organic manures, such as animal manure, green manure, and crop residue, significantly increased the activity of a wide range of soil enzymes, as compared to unamended soil (Martens *et al.*, 1992).

5.5.1 Dehydrogenase activity (DHA)

Dehydrogenase is an oxidoreductase that exists only in viable cells and is considered a sensitive indicator of soil quality. Dehydrogenase activity was strongly correlated with soil organic C content (Madejon *et al.*, 2007). Comparative changes in dehydrogenase activity in soils over three different periods of practice of organic and conventional farming systems under three selected agroclimatic zones of Karnataka are presented in Tables 79, 80 and 81 Fig 9.



The dehydrogenase activity differed significantly in organic and conventional farming systems during three different periods of practice and at two depths. Dehydrogenase activity was relatively high in soils sourced from organic farming fields than in soils of conventional farming practice during 3-6 years and >6 years periods. Dehydrogenase activity increased in soils with increase in number of years of organic farming practice, but same was not the case of conventional farming system confirming that organics stimulated greater microbial growth. Goyal *et al.*, (1992) and Okur *et al.*, (2009) also reported lower dehydrogenase activity in conventional farming system.

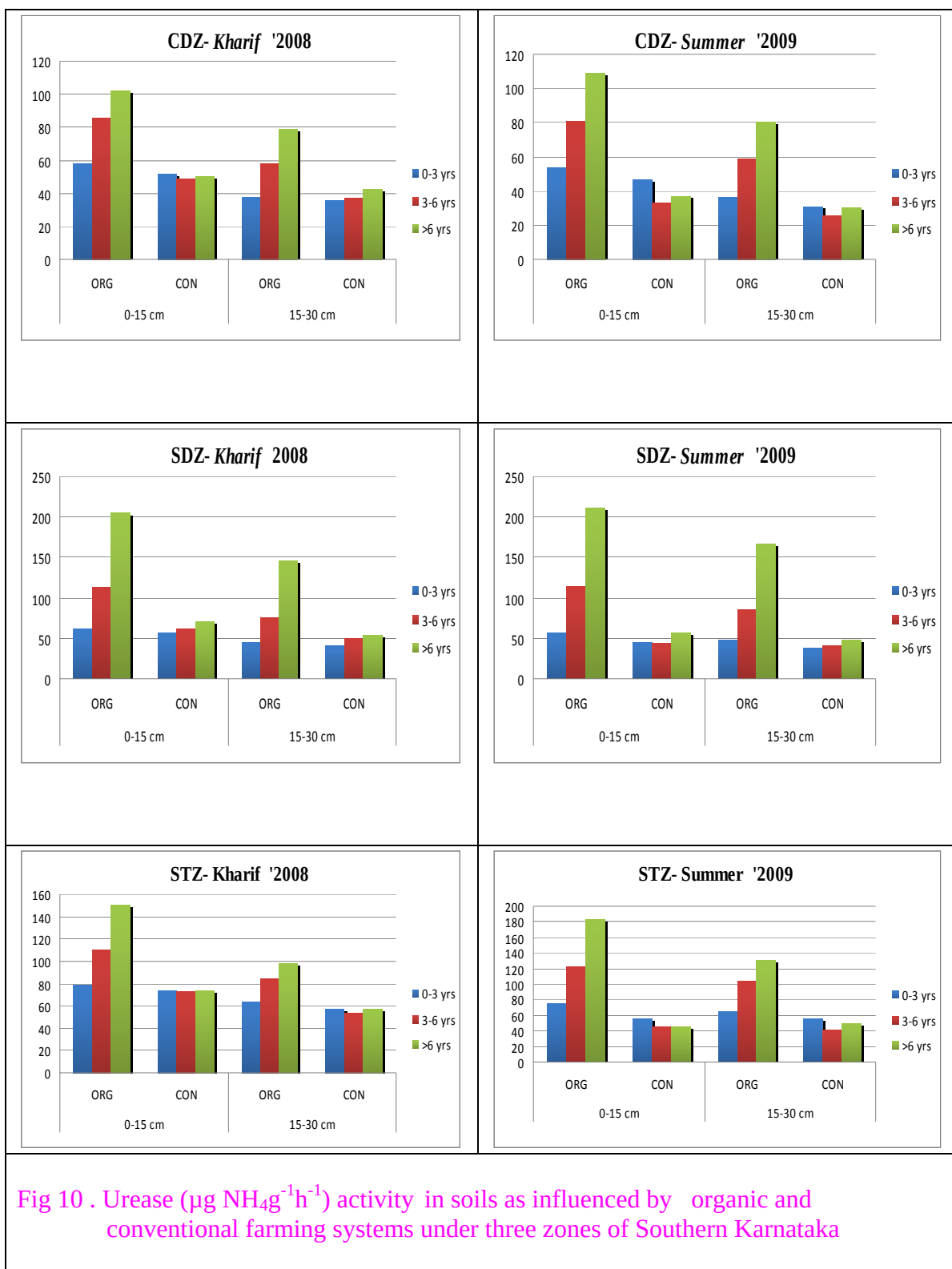
Significant interactions existed between farming systems and periods of practice. Higher levels of dehydrogenase activity in organics amended soils may have been the result of their organic C. Several authors (Parham *et al.*, 2002; Madejón *et al.*, 2003) also observed an increased dehydrogenase activity after incorporation of organic residues, indicating an activation of microorganisms following carbon input.

5.5.2 Urease activity (UA)

The urease activity (UA) in soils of organic and conventional farming systems compared over three different periods of practice under three selected agroclimatic zones of Karnataka, are presented in Tables 82, 83 and 84 and Fig. 10 .

In the present study, Urease activity was relatively high in soils sampled from organic farming practice than from conventional farming practice during 3-6 years and >6 years periods under three selected agroclimatic zones of Karnataka. . Urease activity increased in soils with increase in the number of years of organic farming practice, but was not with conventional farming system indicating that stimulated microbial growth by addition of organics.

Significant interactions existed between farming systems and periods of practice. The organic amendments significantly increased urease activity in the soils. Melero *et al.* (2006) also reported that urease activity in soils under organic management was greater

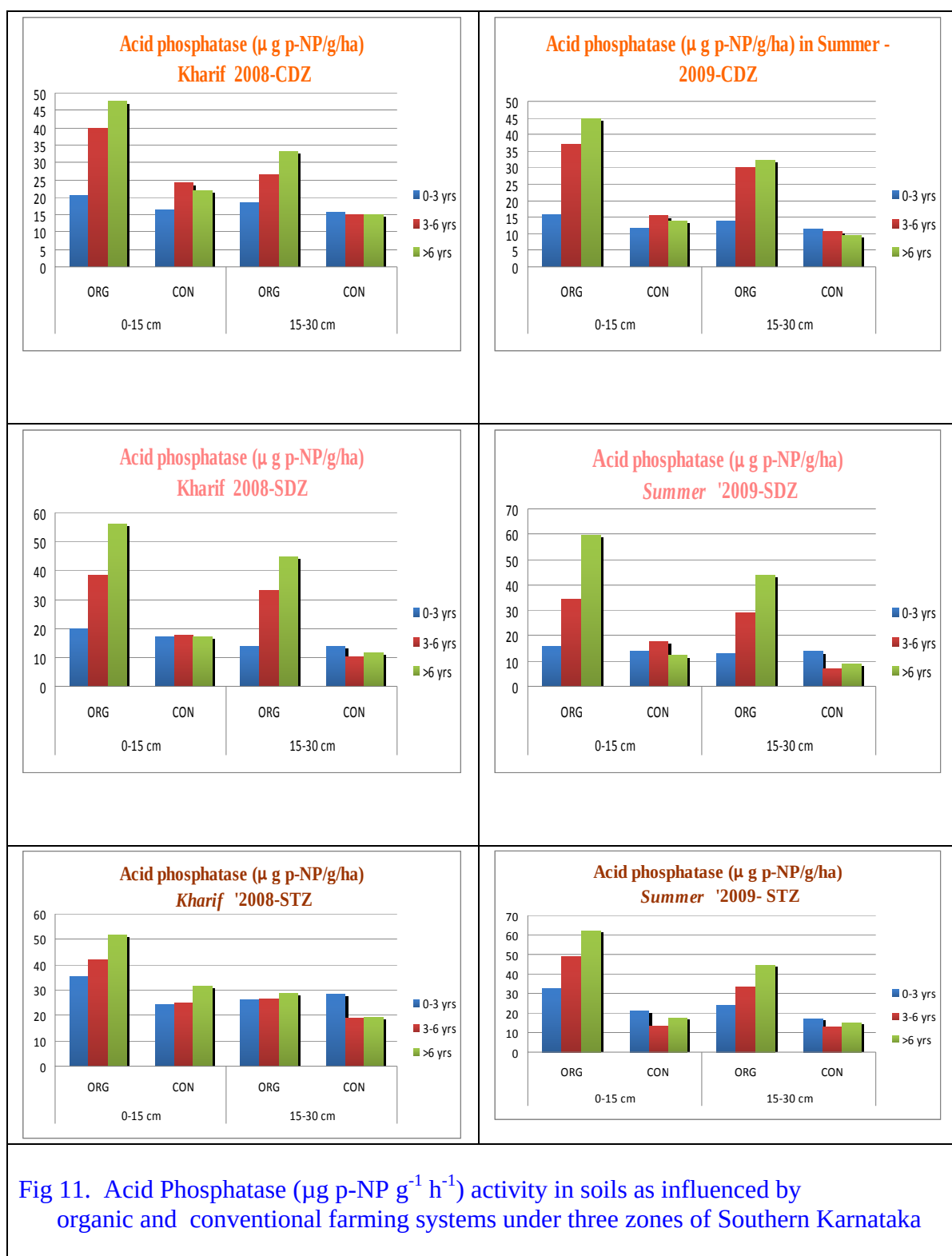


than that in soils under inorganic management. Bohme and Bohme (2006) reported that control (unfertilized) soils exhibited higher activity than NPK soils for spring barley and sugar beet. Similar results for enzymes that are involved in the N cycle were observed by Okur *et al.* (2009), who reported that the increasing rates of ammonia-based N fertilizer decreased amidase and urease activity. .

5.5.3 Acid and Alkaline Phosphatase activity

The acid and alkaline phosphatase activity of soils exhibited significant differences among organic and conventional farming systems during three different periods (0-3, 3-6 and >6 years) of practice at two depths (0-15 and 15-30cm) during *kharif* 2008 and summer 2009 (Tables 85 to 90 and Fig. 11 and 12) under three selected agroclimatic zones of Southern Karnataka.

Soils samples sourced from organic farming practice recorded higher acid and alkaline phosphatase (enzymes associated with hydrolysis of organic esters into inorganic phosphate) enzyme activity than in soils sampled from conventional farming system during 0-3years, 3-6 years and >6 years periods of practice in three selected agroclimatic zones of Karnataka. Increased activity of these enzymes in soils with organic residues is an indicative of enhancement of metabolic activity of the soil microbial population due to organic carbon. Bohme and Bohme (2006) similarly reported that the addition of organic manures to soil served as a C source, and enhanced microbial biomass and phosphatase activity. Conventional soils exhibited lower acid and alkaline phosphatase activity. This may be due to inhibition of enzyme synthesis by inorganic ions. Okur *et al.*, (2009) reported that organic fertilization stimulated alkaline phosphatase activity, while P fertilizers had a negative effect. Southern transition zone soils recorded higher acid phosphatase activity compared to alkaline phosphatase activity, where as Central dry zone and Southern dry zones recorded higher alkaline phosphatase activity. In high pH soils, alkaline phosphatase activity generally exceeds the activity of acid phosphatase and *vice versa* (Kramer and Green 2000).



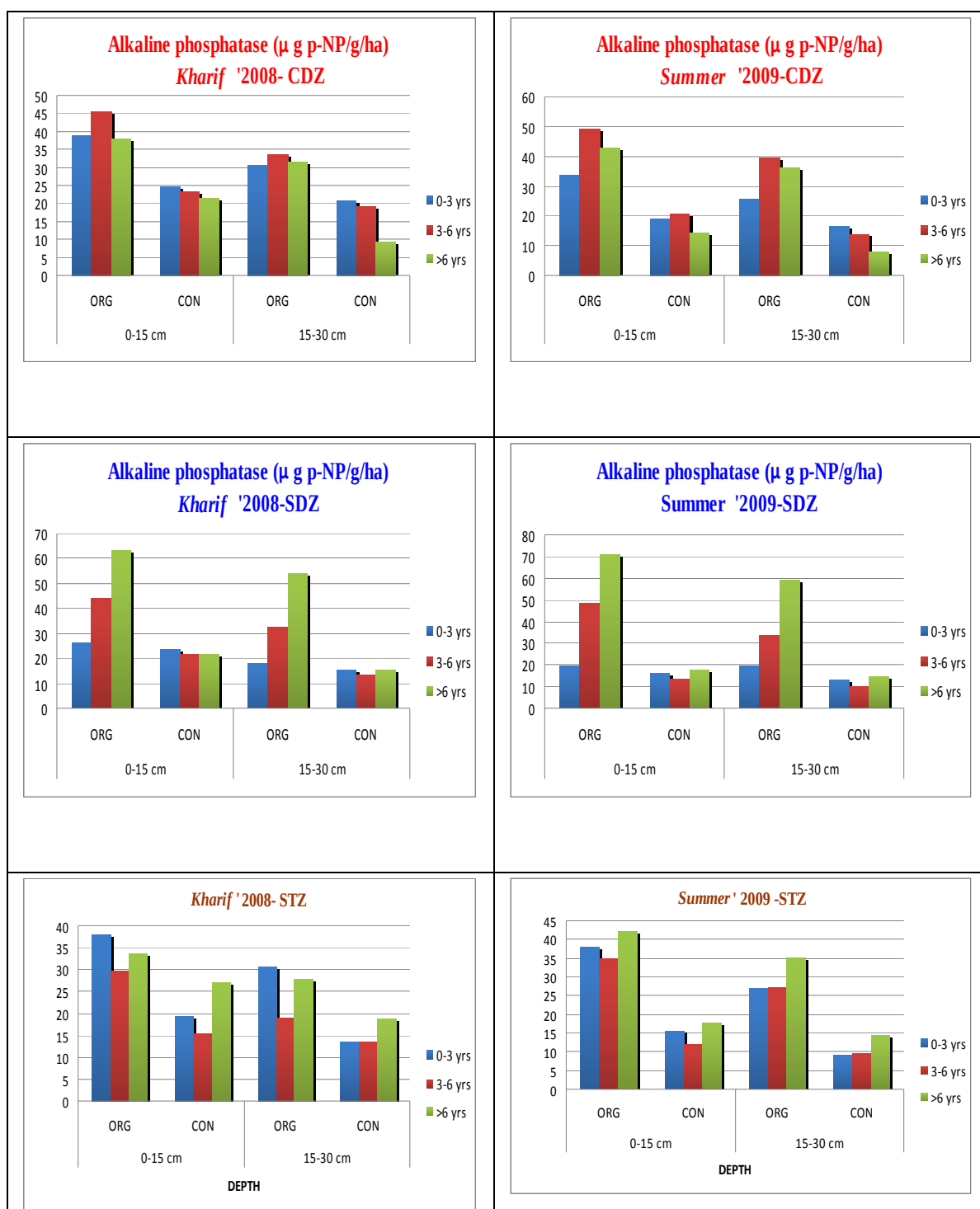


Fig 12. Alkaline Phosphatase (μ g p-NP g⁻¹ h⁻¹) activity in soils as influenced by organic and conventional farming systems under three zones of Southern Karnataka

The present study demonstrated that the organically managed soils exhibited greater biological activity (i.e. assayed soil enzymes) than the conventionally managed soils, which is in agreement with the findings of Shannon *et al.*, (2002), van Diepeningen *et al.*, (2006), Masto *et al.*, (2006) and Ruiz *et al.*, (2008) .

5.6 Vertical distribution of carbon, nitrogen and other soil attributes as influenced by organic and conventional farming

In the past decade, there has been increased scientific interest in organic farming in comparison to conventional agriculture. Recent studies compare these two fundamentally different systems with respect to soil properties. A field study was conducted to determine the vertical distribution of carbon, nitrogen and other soil properties in four representative soil profiles, one each from < 3years, 3-6 years and > 6 years of organic farming practice and one profile representing conventional farming system under Central dry zone , Southern dry zone and Southern transition zone of Karnataka. The results are discussed in the following sections.

Central Dry zone

Three pedons in organically managed systems and one pedon of conventional farming practice were opened in Central dry zone of Karnataka. The morphological description, physico-chemical and biological characteristics are presented in Tables 4 , 91 and 92.

Colour of the soil horizons varied between the hues of 7.5YR and 10YR. The values ranged from 3 to 4, whereas chromas were 3 or less. The pedons exhibited sub-angular blocky structure throughout the depth (100cm) of profile.

Higher values for nutrient and different enzyme activities were recorded in pedon 3 (ORG >6years) followed by pedon 2 (ORG 3-6 years). The values decreased with increase in depth of all the pedons. The soils under organic farming practice had higher



Plate 1. Pedon 1 representing organic farming practice for 0-3 years period under Central dry zone of Karnataka



Plate 2. Pedon 2 representing organic farming practice for 3-6 years period under Central dry zone of Karnataka



Plate 3. Pedon 3 representing organic farming practice for over 6 years period under Central dry zone of Karnataka



Plate 4. Pedon 4 representing conventional farming practice under Central dry zone of Karnataka

OC and N in the surface layers compared to lower layers. Further, in comparison to surface soils of conventional farming practice the organic carbon and other soil attributes were also low. Higher organic carbon content of 15.5 g kg^{-1} was recorded in surface horizon of pedon 3 followed by 14.1 g kg^{-1} in pedon 2 and least was noticed in pedon 4 (9.6 g kg^{-1}) which was sourced from conventional farming practice.

Soil microbial biomass-C (Fig.13) and N also followed similar trend as that of organic carbon. Except bulk density, other parameters registered a decreasing trend with increase in depth of the profiles irrespective of farming systems and periods of practice. Pedon 3 recorded higher total carbon and total nitrogen stocks (Fig. 14 & 15) followed by pedon 2, pedon 4. the least carbon and nitrogen stocks were recorded in pedon 1.

Southern Dry zone

Morphological description and physico-chemical and biological characteristics of the pedons under organic and conventional farming systems representing three pedons from different periods (0-3, 3-6, >6 years) of organic and one from conventional farming practice under Southern dry zone of Karnataka are given in Tables 93 and 94. Colour of the studied soils varied between the hues of 2.5YR and 10YR. The value for all the horizons was 3, whereas chromas ranging from 2 to 6. The pedons exhibited sub-angular blocky structure throughout the depth (100cm) of profile. Higher values for nutrient and different enzyme activities were recorded in pedon 3 (ORG; >6years) followed by pedon 2 (ORG; 3-6 years). The values decreased with increase in depth in all the pedons. The higher organic carbon content of 18.0 g kg^{-1} recorded in surface horizon of pedon 3 followed by 15.3 g kg^{-1} in pedon 2. The pedon 1 (ORG; 0-3years) and pedon 4 which was representing conventional farming practice recorded almost equal values for measured parameters. Soil microbial biomass-C (Fig.13) and N also followed similar trend. Except for bulk density, other parameters registered decreasing trend with increase in depth of the profiles irrespective of farming systems and periods of practice of organic or conventional farming under Southern Dry zone of Karnataka. Pedon 3 recorded higher



Plate 5. Pedon 1 representing organic farming practice for 0-3 years period under Southern dry zone of Karnataka



Plate 6. Pedon 2 representing organic farming practice for 3-6 years period under Southern dry zone of Karnataka

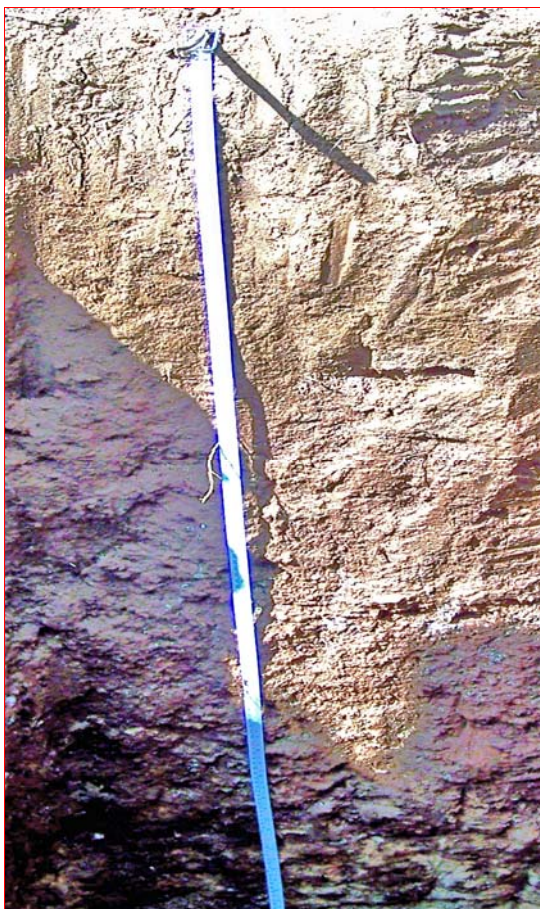


Plate 7. Pedon 3 representing organic farming practice for over 6 years period under Southern dry zone of Karnataka



Plate 8. Pedon 4 representing conventional farming practice under Southern dry zone of Karnataka

total carbon stock (Fig. 14 & 15) and total nitrogen stocks followed by pedon 2 and pedon 4 .

Southern Transition zone

Morphological description and physico-chemical and biological characteristics of the pedons under organic and conventional farming systems representing three pedons from different periods (0-3, 3-6, >6 years) of organic and one from conventional farming practice under Southern transition zone of Karnataka are given in Tables 95 and 96. Colour of the soil horizons of studied pedons are with the hue of 7.5YR and the value for all the horizons ranging between 2 and 4 , whereas chromas ranging from 2 to 4. The pedons exhibited sub-angular blocky structure throughout the depth (100cm) of profile. Higher values for nutrient and different enzyme activities were recorded in pedon 3 (ORG; >6years) followed by pedon 2 (ORG; 3-6 years). The values decreased with increase in depth in all the pedons. The higher organic carbon content of 27.0 g kg^{-1} recorded in surface horizon of pedon 3 followed by 18.4 g kg^{-1} in pedon 2 . The pedon 1 (ORG; 0-3years) and pedon 4 which was representing conventional farming practice recorded almost equal values for measured parameters. Soil microbial biomass-C (Fig.13) and N also followed similar trend. Except for bulk density, other parameters registered decreasing trend with increase in depth of the profiles irrespective of farming systems and periods of practice of organic or conventional farming under Southern Transition zone of Karnataka. Pedon 3 recoded higher total carbon and total nitrogen stocks (Fig. 14 & 15) followed by pedon 4 , pedon 2. Relatively lower carbon and nitrogen stocks in the pedons 2 and 1 are attributed to the weathered parent material noticed from 75 cm onwards.

The enzyme activities (dehydrogenase and phosphatases) were consistently higher in the surface layer (Ap horizon) in all the four representative profiles studied under each zone. Activity of dehydrogenase and Phosphatases of soil increased significantly in the fields subjected to organic farming for three specified time periods irrespective of cropping systems evaluated over conventional farming, with maximum activity being in

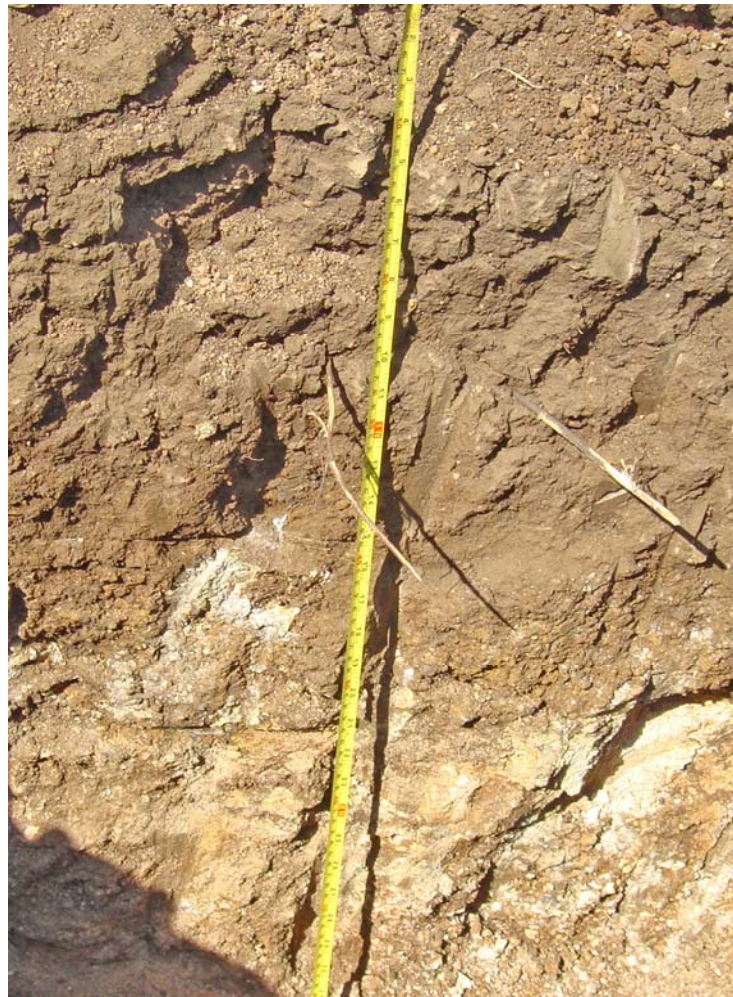


Plate 9. Pedon 1 representing organic farming practice for 0-3 years period under Southern transition zone of Karnataka

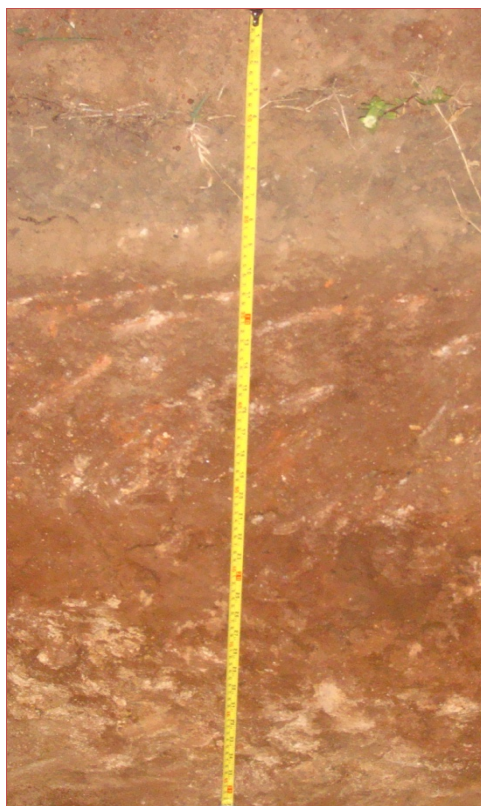


Plate 10. Pedon 2 representing organic farming practice for 3-6 years period under Southern transition zone of Karnataka

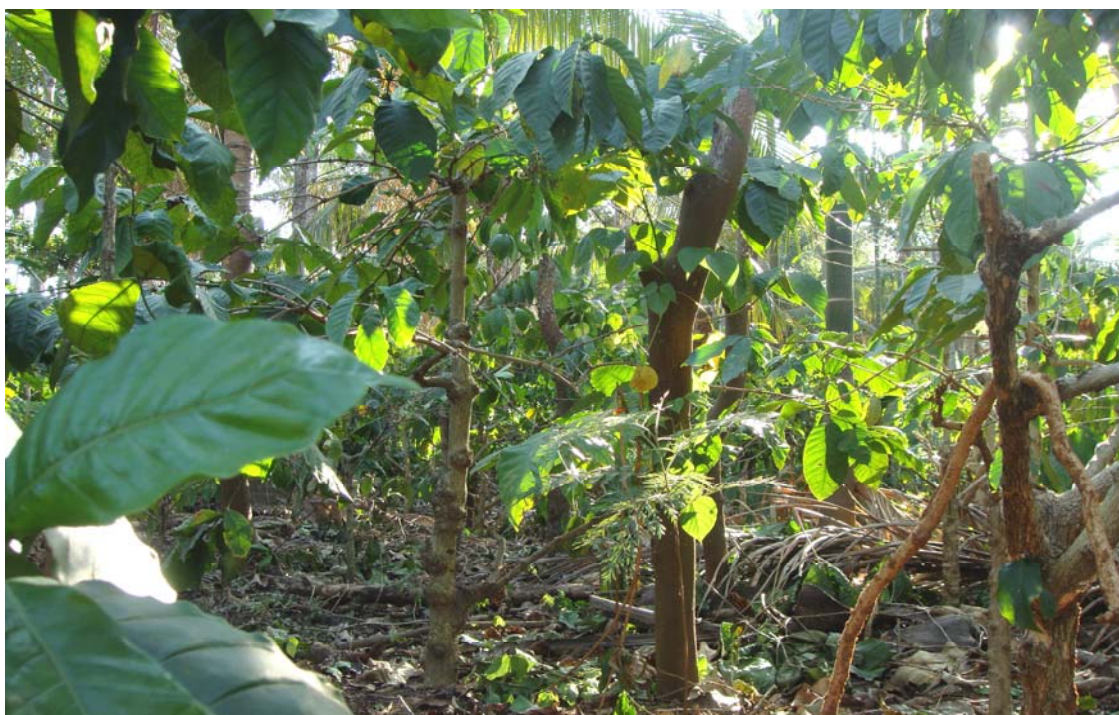


Plate 11. Pedon 3 representing organic farming practice for over 6 years period under Southern transition zone of Karnataka



Plate 12. Pedon 4 representing conventional farming practice under Southern transition zone of Karnataka

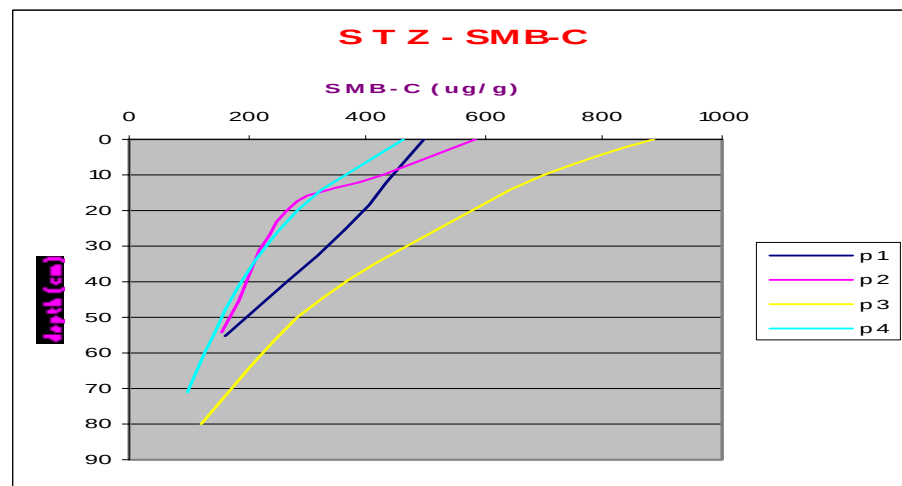
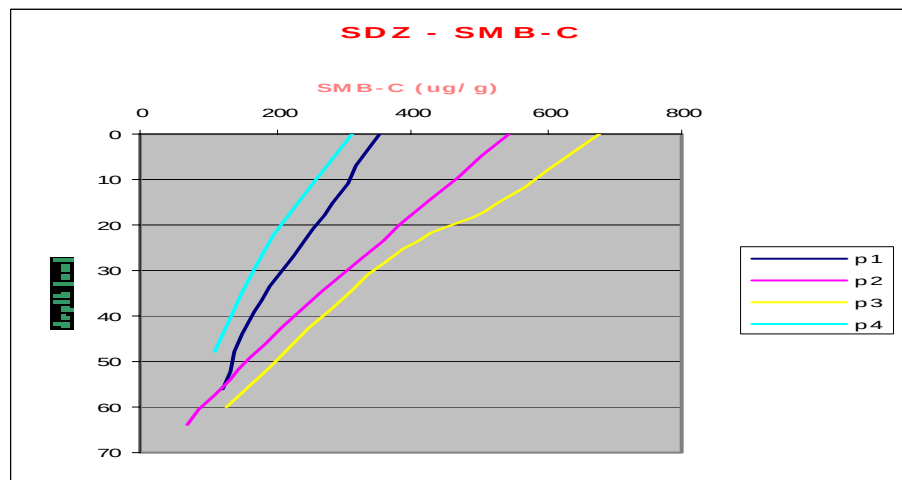
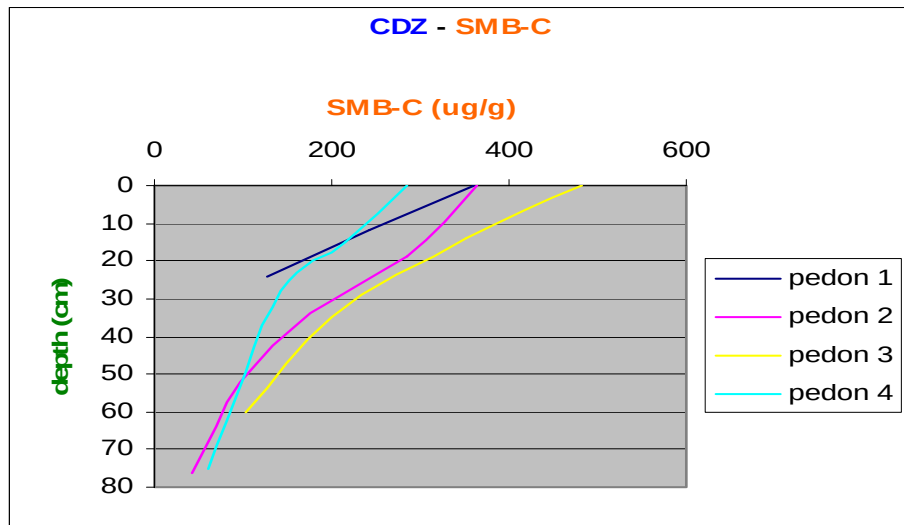


Fig. 13. Vertical distribution of soil microbial biomass carbon ($\mu\text{g g}^{-1}$) as influenced by Organic and Conventional farming systems in CD, SD and ST Zones of Southern Karnataka

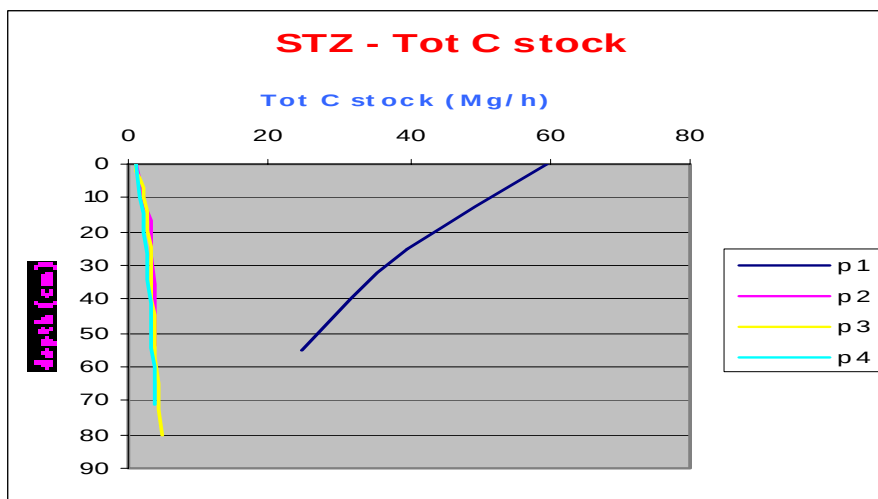
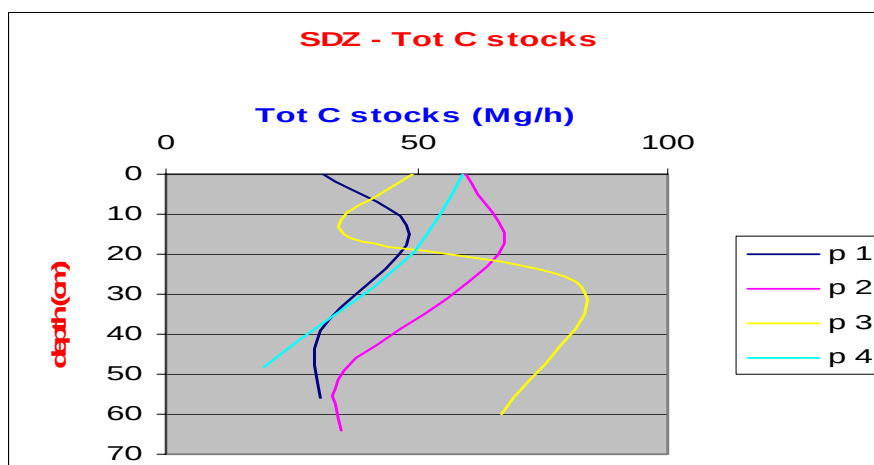
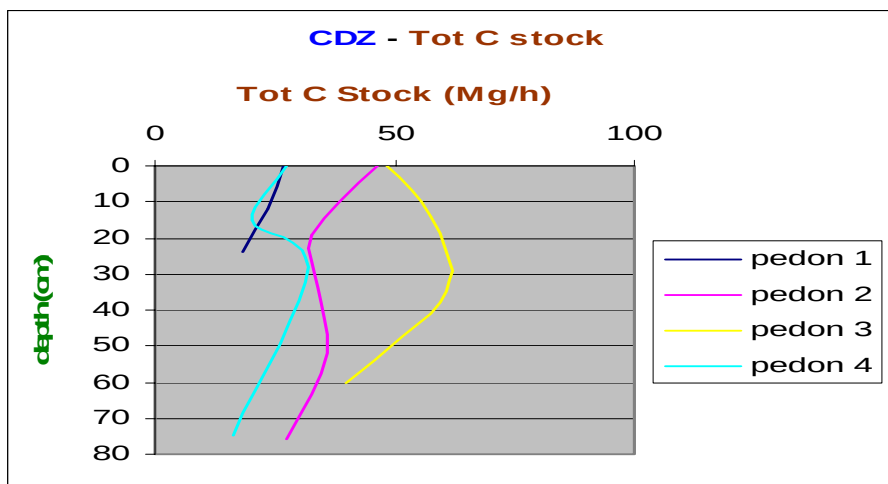
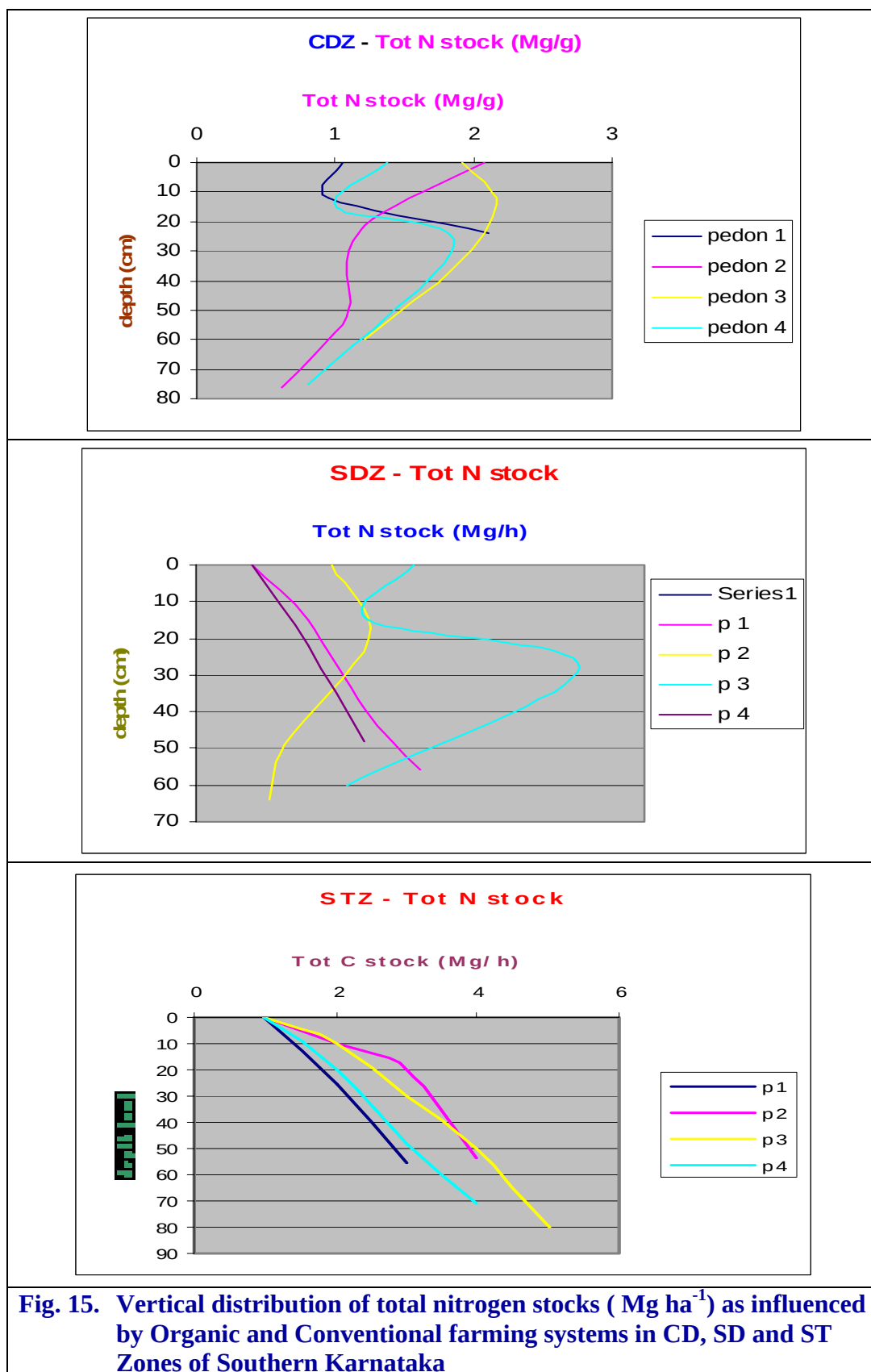


Fig. 14. Vertical distribution of total carbon stocks (Mg ha⁻¹) as influenced by Organic and Conventional farming systems in CD, SD and ST Zones of Southern Karnataka



the profile where organic farming has been practiced for over six years. Soil enzyme activities may be increased by incorporation of organic materials in the soil (Nannipieri *et al.* 1990) and this increased activity has generally been attributed to increased microbial biomass resulting from organic matter enrichment in the soil. The activities of dehydrogenase, acid and alkaline phosphatase in our study decreased markedly with depth in organic as well as conventional farming systems. This decrease in dehydrogenase and phosphatase activities with depth was associated with decrease in organic matter content. The decrease in dehydrogenase and phosphatase activities with depth is of importance because dehydrogenase is considered to be an indicator of total microbial activity and phosphatases are the indicators of rate of hydrolysis of the organic P in the soil (Tarafdar 2001). In the present study, the activity of acid phosphatase was on an average twice that of alkaline phosphatase activity in conventional farming practice under Central dry and Southern dry zones over Southern transition zone of Karnataka. In high pH soils, alkaline phosphatase activity generally exceeds acid phosphatase activity and *vice versa* (Kramer and Green 2000). A healthy soil is defined as a stable system with resilience to stress, high biological diversity, and high levels of internal nutrient cycling (Van Bruggen and Semenov 2000). The increased microbial biomass and enzyme activity in organically managed soils expedited decomposition of organic manures, nutrient cycling, and formation of organic matter and soil structure. As a result, organic management increased soil quality, which is a necessary indicator of land sustainability and management.

5.7 Correlations among soil physical, chemical and biological properties under organic and conventional farming systems

Correlations between three entities namely physical, chemical and biological were carried out. These entities were chosen from out of the soil samples collected from fields under organic and conventional farming systems for three different periods from three selected agroclimatic zones (Central dry zone, Southern dry zone and Southern transition zone) of Southern Karnataka and results are presented in Tables 97, 98 and 99 .

The soil chemical and biological parameters showed significant positive correlations irrespective of agroclimatic zones in soils under organically managed farming systems. The organic carbon in soils exhibited a positive and significant correlation with available nitrogen, acid phosphatase, alkaline phosphatase, total nitrogen, microbial biomass carbon and total carbon. These results are in conformity with the reports of Manna *et al*, (1996) and Singh *et al*, (2003). Field experiments conducted by Melero *et al.*, (2008), to examine the effects of organic and synthetic amendments on soil biological, physical and chemical properties of organic and conventional farming systems indicated significant correlation between soil chemical with biological properties.

The present study indicates a strong influence of chemical properties on biological properties clearly highlighting the fact that practice of organics application over the years influenced soil biological and chemical properties positively.



VI. SUMMARY

A “Comparative assessment of soil properties and organic carbon distribution under organic and conventional farming systems in selected agroclimatic zones of southern Karnataka” was carried out. This included study of the different soil parameters in both organic and conventional farming systems in surface (0-15cm) and sub surface (15-30cm) soils. The distribution of carbon in the pedons under Central dry zone, Southern dry zone and Southern transition agroclimatic zones of Karnataka during both *kharif* 2008 and summer 2009 seasons was studied. The results obtained during the study are summarized in this chapter.

- Bulk density was relatively low in soils sampled from fields under organic farming (1.14, 1.14 and 1.16 Mg m⁻³ in Central dry, Southern dry and Southern transition zones respectively) compared to conventional farming system. Particle density was not influenced by either of the systems during 0-3, 3-6 and >6 years of practice.
- The max. water holding capacity soils of organic farming system ranged from 39.94 to 48.65%, 38.23 to 43.89% and 34.93 to 42.79% of soils under Central dry, Southern dry, and Southern transition zones respectively during *kharif* 2008 .
- The pH of the surface soils sampled from organic farming systems ranged from 7.63 to 8.24 , 7.55 to 8.14 and 7.09 to 7.48 whereas in conventional farming it ranged from 7.89 to 8.23, 7.28 to 8.42 and 6.04 to 7.03 of soils under Central dry, Southern dry and Southern transition zones respectively .
- Electrical conductivity was not affected by organic or conventional management in soil under Central dry and Southern dry zones at p=0.05.
- The soils recorded significantly higher organic carbon (g kg⁻¹) content in organic farming fields compared to conventional counterparts at three different periods (0-3, 3-6 and >6 years) of practice under Central dry (9.67 to 14.75 in organically

amended soils and 5.25 to 7.55 g kg⁻¹ in conventional farming) , Southern dry (9.75 to 17.82 in organic farming and 7.95 to 9.97 g kg⁻¹ under conventional farming) and Southern transition (9.45 to 19.42 g kg⁻¹ in organically managed soils and 6.30 to 10.65 g kg⁻¹ in conventional farming soils) zones of Karnataka .

- Microbial mediated nutrient dynamics were also different between the organic and conventional systems within each growing season. In the organic plots, potential N,P and K supply substantially increased in *Kharif* samples, but in the conventional system, it remained unchanged over time within the season under Central Dry zone, Southern Dry zone and Southern Transition zone of Karnataka. This suggests that nutrient release by microbes and plant needs may be better synchronized in the organic than in the conventional system.
- Higher available nitrogen values in kg ha⁻¹ were recorded in soils with continuous addition of organic matter over six years period (435.75, 520 and 440.25 kg ha⁻¹ under CD, SD and ST zones respectively) compared to conventional farming system.
- Calcium concentrations of soils treated with organic amendments increased in comparison to synthetic fertilizer application. Similarly, a higher magnesium and sulphur concentration was recorded in soils amended with organic amendments, compared to those synthetic fertilizers over the same time period.
- The results of the present study showed the supply of organic matter additions could give rise to a more DTPA extractable Cu, Mn, Fe and Zn after 3-6 years, and over 6 years period.
- The soils under organic farming recorded higher values of cation exchange capacity (21.78 , 25.94 and 27.35 c mol (p⁺) kg⁻¹) than soils under conventional farming irrespective of cropping system followed in three zones.

- The SMB-C of surface soils sourced from organic farming system under Central dry zone ranged from 329.25 (0-3yrs) to 486.75 $\mu\text{g g}^{-1}$ (>6yrs) during *kharif* 2008 and 296.50 (0-3yrs) to 530.25 $\mu\text{g g}^{-1}$ (>6yrs) during summer 2009, whereas in conventional farming system it ranged from 176.25 (3-6yrs) to 273.25 $\mu\text{g g}^{-1}$ (>6yrs) during *kharif* 2008 and 118.00 (3-6yrs) to 153.00 $\mu\text{g g}^{-1}$ (0-3yrs) during summer 2009 .
- An increasing trend was observed in SMB-N from 0-3 yrs (38.02 (0-3yrs) to 62.55 $\mu\text{g g}^{-1}$ to > 6yrs of organic farming practice in Central dry zone, 37.50 (0-3yrs) to 154.62 $\mu\text{g g}^{-1}$ (>6yrs) in Southern dry zone and 50.30 (0-3yrs) to 94.20 $\mu\text{g g}^{-1}$ (>6yrs) in Southern transition zone and was not true with the conventional farming practice.
- Light Fraction Carbon (LF-C) content increased in soils with increase in number of years of organic farming practice, but same was not the case of conventional farming system confirming that organics stimulated greater microbial growth. The soils sourced from Central dry zone (1143.00 mg kg^{-1}) recorded lower light fraction carbon content compared to Southern dry zone (1345.75 mg kg^{-1}) and Southern transition zone (1466.57 mg kg^{-1}) in over six years of organic matter application.
- The soil samples from plots of organic farming practice under Southern transition zone (73.81 mg kg^{-1}) recoded higher WS-C content followed by Southern Dry zone (67.73 mg kg^{-1}). As in the case of LF-C, SMBC, the WS-C was also found to be higher due to organic farming practice as compared to conventional farming practice.
- The present study demonstrated that the organically managed soils exhibited higher soil enzymes than the conventionally managed soils.

- Soil urease activity increased with increase in years of organic manures application. The activity increased from 57.96 to 102.39 in Central dry, 61.03 to 168.19 in Southern dry zone and from 78.27 to 150 $\mu\text{g NH}_4 \text{ g}^{-1}\text{h}^{-2}$ in Southern transition zones of southern Karnataka.
- The current results suggested that 3 years of organic management may be a minimum to significantly and consistently enhance microbial biomass and activities that support nutrient supply for crops in the varied climatic and soil conditions.
- Significant differences were observed in interaction between farming systems and periods (0-3 years, 3-6 years and > 6 years) of organic or conventional practice for most of the measured parameters. However, farming systems and depth, and periods and depth of sampling interactions showed no variations during both *kharif* 2008 and *summer* 2009 seasons.
- The vertical distribution of nutrients and biochemical properties in soil profiles sourced from both systems under three agroclimatic zones recorded decreasing trend with depth.

The enzyme activities (dehydrogenase and phosphatases) were consistently higher in the surface layer (Ap horizon) in all the four representative profiles studied under each zone. Activity of dehydrogenase and Phosphatases of soil increased significantly in the fields subjected to organic farming for three specified time periods irrespective of cropping systems evaluated over conventional farming, with maximum activity being in the profile where organic farming has been practiced for over six years.

- Pedon 3 (>6 years organic practice) of Southern transition zone recorded higher total carbon stock (239.6 Mg h^{-1}) followed by Southern dry (233.8 Mg h^{-1}) and Central dry zone (150.31 Mg h^{-1}).

- The total nitrogen stocks in the pedons were of the order of
CD zone: pedon 3 (7.19Mg h⁻¹) > pedon 2 (6.16 Mg h⁻¹) > pedon 4 (5.06 Mg h⁻¹) > pedon 1 (4.12Mg h⁻¹) ,
SD zone :pedon 3 (16.50Mg h⁻¹) > pedon 2 (8.38 Mg h⁻¹) > pedon 1 (6.09 Mg h⁻¹) > pedon 4 (5.21Mg h⁻¹) and
ST zone: pedon 3 (10.85Mg h⁻¹) > pedon 2 (7.98 Mg h⁻¹) > pedon 1 (7.48 Mg h⁻¹) > pedon 4 (7.35Mg h⁻¹).
- It was found that the strong and positive correlation between soil biological and chemical parameters observed in organically managed soils in three agroclimatic zones of Southern Karnataka.
- The organic carbon showed a positive and significant correlation with total carbon ($r = 0.998^{**}$), microbial biomass carbon ($r = 0.995^{**}$), avail. Nitrogen ($r = 0.994^{**}$), dehydrogenase($r = 0.992^{**}$), urease ($r = 0.990^{**}$), acid phosphatase ($r = 0.985^{**}$), total nitrogen ($r = 0.983^{**}$) and available phosphorus ($r = 0.939^{**}$) in soils under Southern transition zone.
- From the present study it was seen that there is a strong influence of biological properties on chemical properties clearly highlighting the fact that organic matter application over the years has influenced soil biological and chemical properties positively

Special features of investigation

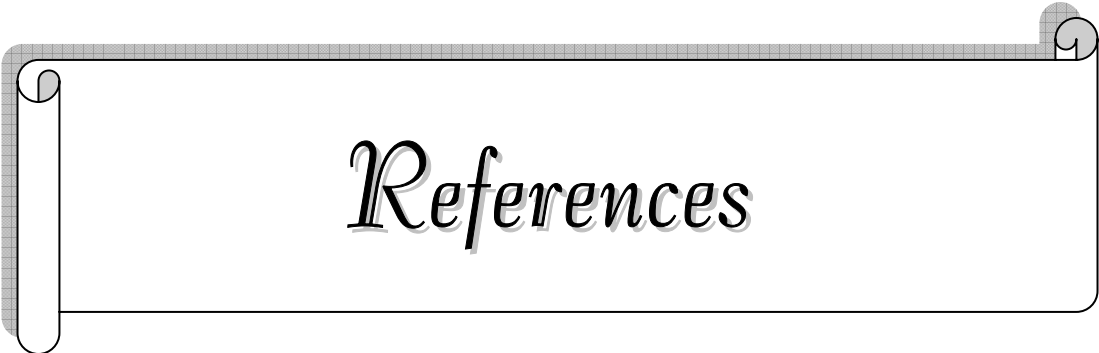
- i. Understanding of soil properties under different farming systems helps in validating the practices being adopted and/or refinement of the practices for improving soil productivity.
- ii. The relevance of practicing organic farming over different periods and the effects on soil physical, chemical and biological properties could be quantified.

Future Research

The management of organic inputs is a critical area for the management of nutrients in organic farming systems. In particular the manipulation of the quality and quantity of organic inputs has implications for the activity of soil microorganisms and the soil food web, biological processes of nutrient transformation and the accumulation of SOM. However, further research is also required to better understand the processes involved so as to optimize the use of these techniques.

Further understanding of nutrient transfer processes (from soil pools to plant uptake) and rates of these processes is particularly important, and is most lacking where biological and chemical processes interact in the regulation of nutrient availability .

Organic farming can enhance soil biodiversity, alleviate environmental concerns and improve food safety through eliminating the applications of synthetic chemicals. However, yield reduction due to nutrient limitation and pest incidence in the early stages of transition from conventional to organic systems is a major concern for organic farmers, and is thus a barrier to implementing the practice of organic farming. Therefore, identifying transition strategies that minimize yield loss is critical for facilitating the implementation of organic practices particularly to countries like India because of the poor economic stature of the farming community.

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