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Study on the Characteristics of Coconut Plantation in the Western Zone of Tamil Nadu - as a Source of Carbon Sink to Mitigate Climate Change

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A B S T R A C T

Capturing of atmospheric carbon (C) and storing it in the terrestrial biosphere is one of the mitigation options for greenhouse gas reduction. Perennial systems like plantation crops can also be suitable candidates for carbon sequestration. Coconut plantations, for example, not only give sustainable production, but also serve as a good system for biomass production and carbon accumulation. Coconut as a perennial tree crop with 50 to 60 years of lifespan, has a great potential as a carbon sink for mitigating climate change. The objective of this study is to identify the main characteristics of coconut plantation (area of coverage, size of holding, Type and Age of coconut plantation, Management aspects etc.) in the western zone of Tamil Nadu. This study was conducted in the Agro Climatic Research Centre during 2016-17. The western zone (Coimbatore, Tirupur and Erode districts) of Tamil Nadu was divided into 5 km grid and area of coconut is worked out for each grid namely <25%, 25-50%, 50-75% and >75% using coconut area map developed by the Dept. of remote sensing & GIS, TNAU, Coimbatore. A field survey was conducted by Agro Climate Research Centre, TNAU, Coimbatore in the western zone of Tamil Nadu during 2016-17. Out of 61 coconut growers selected in this study, nearly 37% of lands were classified under the category of 6 -10 acres, followed by 32% by 0-5 acres. 13%, 10% and 8% classified under the category 11-15, >=20 and 15-20 acres respectively. As per the Coconut survey, 91% of the coconut plantation is tall type and 9% is dwarf type. Out of tall type, 36% coconut plantation was with an age of 20 - 30 years followed by 27% with an age of 10 - 20 years followed by 22% with age of 30-40 years. Remaining 15% came under the category 0-10, 40-50 and 50-60 years 9%, 2% and 4% respectively. Out of dwarf type, 70% of coconut plantation was with age of 5-10 years followed by 19% with 0-5year and 11% with 10-15 years. Out of total coconut palms surveyed, 95% coconut plantation was cultivated with conventional method whereas 5% was cultivated with organic method.

Introduction

Capturing of atmospheric carbon (C) and storing it in the terrestrial biosphere is one of the mitigation options for greenhouse gas reduction. Agroforestry as a land-use system is receiving wider recognition not only in terms of agricultural sustainability but also in the perspective of climate change. Perennial systems like plantation crops can be suitable candidates for carbon sequestration. Coconut plantations, for example, not only give sustainable production, but also serve as a good system for biomass production and

carbon accumulation. Coconut plantations provide economic yield for about 60 years and endosperm is the richest source of oil. Three major strategies of coconut plantation can be qualified for clean development mechanism. (i) Coconut plantations as carbon sequestration and carbon sink agent (ii) coconut oil as a bio-diesel under renewable energy and (iii) using coconut products viz. husk, coir and shell for bio-geo-engineering replacing other high energy requiring products. Even though some literature on coconut oil as renewable energy is available (Tan *et al.,* 2004).

The net primary production estimation of coconut mono crop in different agro climatic zones indicated carbon sequestration potential of coconut above ground biomass ranged from 8 Mg CO_2/ha/year to 32 Mg CO2/ha/year depending on cultivar, agro-climatic zone, soil type and management. (Naresh Kumar, 2007). These calculations are assuming that the entire coconut biomass produced in the system is used for recycling into the system for enhancing the soil organic carbon storage. Estimates indicate long term (~60 years) carbon stocking in stem is around 120 Mg CO_2/ha. That is equivalent to an average sequestration of about 2.0 Mg CO_2/ha/year. Recent publications indicate that net ecosystem productivity of 20-year-old coconut plantation is about 8 Mg C/ha/year (~29 Mg CO_2/ha/year) at optimum fertilizers and irrigation (Roupsard *et al.,* 2006). Further, if amount of copra taken out of plantations is considered, a net sequestration is ranged from 3 to 5 Mg C/ha/year (~11-18.4 Mg CO_2/ha/year) (Roupsard *et al.,* 2008a and b). The coconut plantations sequester carbon into stem (long-term) at about 2.0 Mg CO_2/ha/year. Coconut stem has a vertical density gradation with bottom being denser than the top. (Naresh Kumar *et al.,* 2008a). Info crop simulations indicated that the nut yield stored carbon in short to medium duration (~2 to 5 years) and is estimated to be around 1,350 Mg CO_2/ha during the entire economic life span of coconut (Naresh Kumar *et al*., 2008). Around 50% of this is husk, which can be recycled into the soil and around 22% is shell, which stores carbon for longer duration. Remaining 28% is removed as copra, which is rich in oil (~65%) (Naresh Kumar and Balakrishnan, 2009). Besides, carbon storage in leaf and inflorescence, which again is for short to medium duration, is estimated to be around 1000 Mg CO_2/ha in entire span of coconut economic life of 60 years. Currently, many value added products are made out of husk, shell and leaves. Husk and leaves will be recycled into the system in a scenario where the carbon credit rates are more remunerative than processing for value addition. If litter is recycled into the system for improving the soil organic carbon content, the improvement in soil organic carbon over a period of time will also qualify for the inclusion in carbon sequestration estimations. Apart from these, coconut oil can be exploited as a biofuel. Studies conducted in Vanuatu islands indicated possibilities of at least 9 % more profit, if covered under clean development mechanism over copra sales for coconut plantations (Roupsard *et al.,* 2004).

Coconut- area, production and productivity

Coconut palm is mainly a crop of humid tropics and is distributed between 23_ north and 23_ south of the equator and up to altitudes of about 600 m from the mean sea level for nut production. At global scale, coconut is grown in about 12 M ha in over 90 countries, with an annual production of about 70 billion nuts. India, Indonesia, Philippines and Sri Lanka play a major role contributing 80% of the world's coconut production. India occupies the first position in the world with an annual production of 21.7 billion nuts of coconut and second position (10119 nuts/ha)

in productivity and third position (2.14 M ha) in area (CDB, 2015). The four southern States put together account for 90% of the total coconut production in the country (Kerala 33%, Tamil Nadu 28%, Karnataka 23%, Andhra Pradesh 6% and other States 10%). Kerala stands first in area 7.7 lakh ha and stands first in production 7430 million nuts. Karnataka stands second in area 5.3 lakh ha and third in production 5129 million nuts as per the all India final estimates of area and production of coconut during 2015-16 by Horticulture Division. Among the three major coconut growing states, Tamil Nadu has the highest productivity of 13423 nuts/ha. Tamil Nadu ranks first with regards to the expansion of area and production. Higher productivity in Tamil Nadu can be attributed to big size of coconut farms under irrigated conditions and better management practices on commercial scale.

This study was located in the coconut plantations of the western zone of Tamil Nadu. Three districts namely Coimbatore, Tirupur and Erode come under western zone of Tamil Nadu. The objective of this study was to identify the main characteristics of coconut plantation (area of coverage, size of holding, Type and Age of coconut plantation, Management aspects etc.) in the western zone of Tamil Nadu. They will influence the carbon sequestration potential of coconut plantation in the western zone of Tamil Nadu. A field survey was conducted by Agro Climate Research Centre, TNAU, Coimbatore in the western zone of Tamil Nadu during 2016-17.

Materials and Methods

The present study was carried out in western zone of Tamil Nadu. Area of coconut plantations of western zone were worked out from the coconut area map of Tamil Nadu, developed by the Department of remote sensing and GIS of Tamil Nadu Agricultural University, Coimbatore. A field survey was conducted by Agro Climate Research Centre, TNAU, Coimbatore with 61 coconut growers of western zone of Tamil Nadu during 2016-17. The survey covered a wide range of major coconut growing areas located in the western zone of Tamil Nadu. The characteristics of coconut plantations of western zone were collected directly from the owners (or) managers of the coconut farm.

Data collection and analysis

The western zone of Tamil Nadu is divided into 5 km grid and area of coconut is worked out for each grid namely <25%, 25-50%, 50-75% and >75% (Fig. 1–3) using coconut area map developed by the Department of remote sensing and GIS, TNAU, Coimbatore. The district wise coconut area map was prepared for Coimbatore, Tirupur and Erode. Area of coconut in each block of these districts was also worked out. A field survey was conducted manually by the Agro Climate Research Centre, TNAU, Coimbatore in the field of 61 coconut growers from the western zone of Tamil Nadu. GPS data were recorded and marked on the western zone of Tamil Nadu. 50% of the of the survey points are selected from Anamalai block which have highest coconut area and 50% from the remaining blocks where coconut plantations are more as per the 5km grid map prepared by the Department of remote sensing and GIS.

The size of the coconut plantation was recorded with categories like 0-5, 6-10, 11-15, 16-20 and >20 acres. The coconut plantation was generally categorized in to tall type or dwarf type. The percentage of the tall and dwarf types were worked out. The age of tall type and dwarf type was studied. The tall type of coconut plantation was categorized into six groups depend on their age namely 0-10, 10-20, 20-30, 30-40, 40-50 and 50-60 years. The

dwarf type of coconut plantation was categorized into three groups depends on their age namely 0-5, 5-10 and 10-15 acres. The management of coconut palms in western zone of Tamil Nadu was also surveyed and classified into conventional and organic cultivation.

Table.1 District and Block wise area of coconut (ha) in western zone of Tamil Nadu

Sl. No	Coimbatore District	Coconut Area(ha)	Sl. No	Tirupur district	Coconut Area(ha)	Sl. No	Erode district	Coconut Area (ha)
1	Anamalai	19501	13	Avinashi	1102	26	Ammapet	
2	Annur	934	14	Dharapuram	3299	27	Anthiyur	357
3	Karamadai	1660	15	Gudimangalam	12200	28	Bhavani	739
4	Kinathukadavu	11455	16	Kangayam	3936	29	Bhavanisagar	155
5	Madukkarai	4834	17	Kundadam	6466	30	Chennimalai	1542
6	Periyanaickenpalayam	1716	18	Madathukulam	4348	31	Erode	708
7	Pollachi north	14922	19	Moolanur	1869	32	Gobichettipalayam	909
8	Pollachi south	10167	20	Palladam	1859	33	Kodumudi	2054
9	Sarkarsamakulam	1296	21	Pongalur	6049	34	Modakurichi	4705
10	Sultanpet	8806	22	Tiruppur	719	35	Nambiyur	438
11	Sulur	3121	23	Udumalaipettai	15520	36	Perundurai	1054
12	Thondamuthur	4358	24	Uthukuli	401	37	Sathyamangalam	474
	Total Coimbatore	82770	25	Vellakoil	2636	38	T.N. Palayam	513
				Total Tirupur	60403	39	Thalavadi	473
							Total Erode	14472

District and Block wise area of coconut (ha) in western zone of Tamil Nadu

Fig.1 Coconut area in Coimbatore

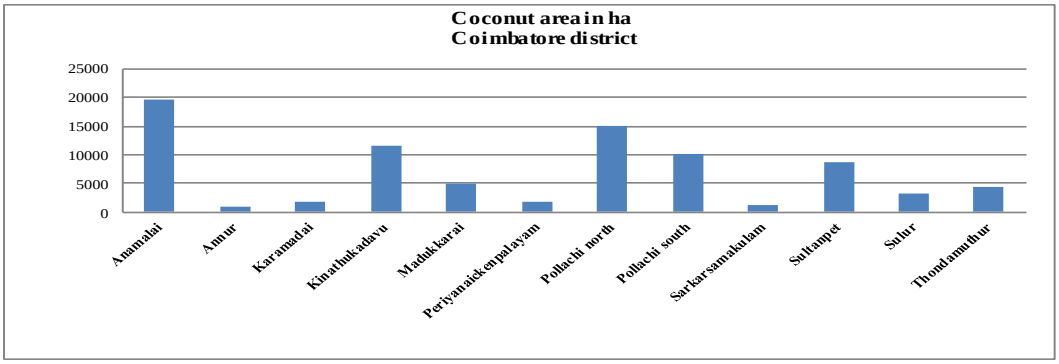


Fig.2 Coconut area in Tirupur

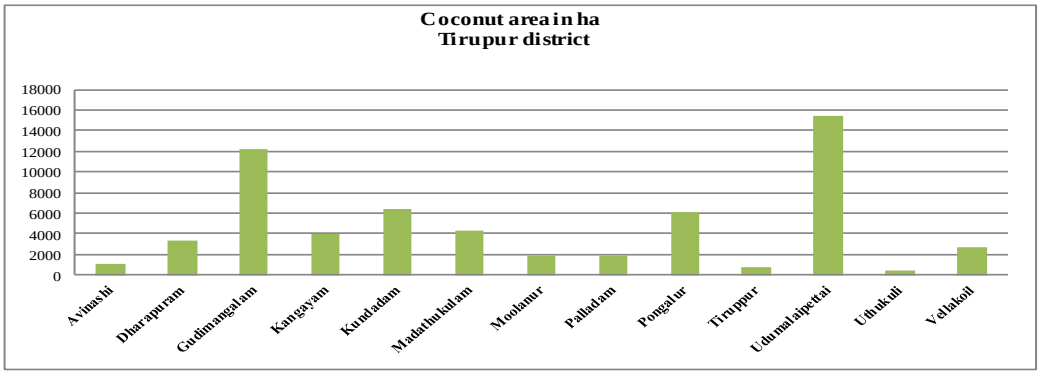
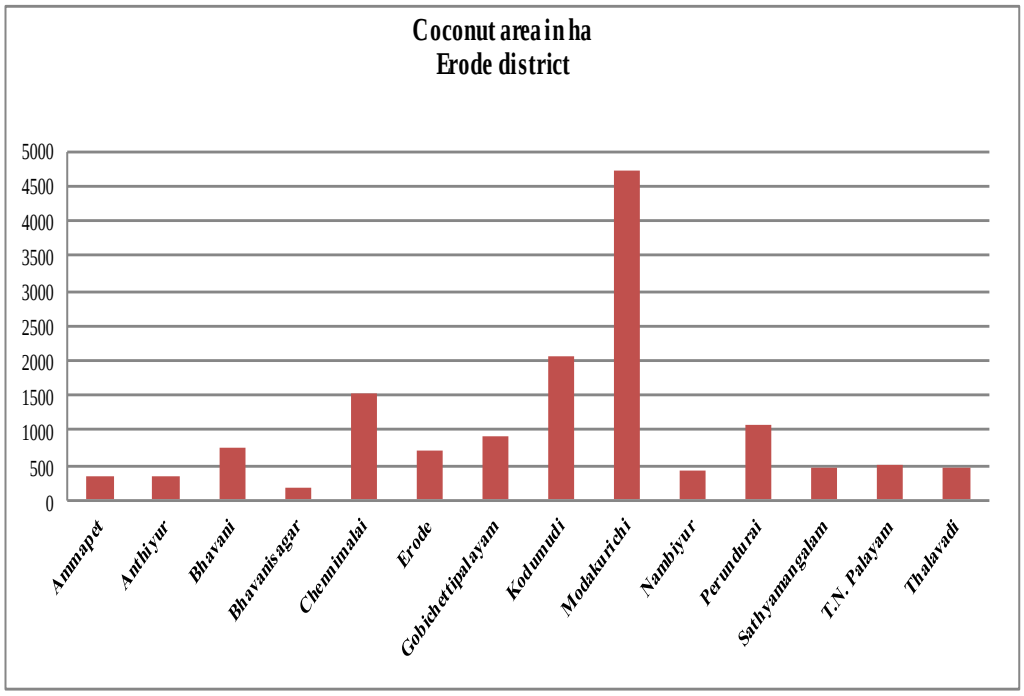
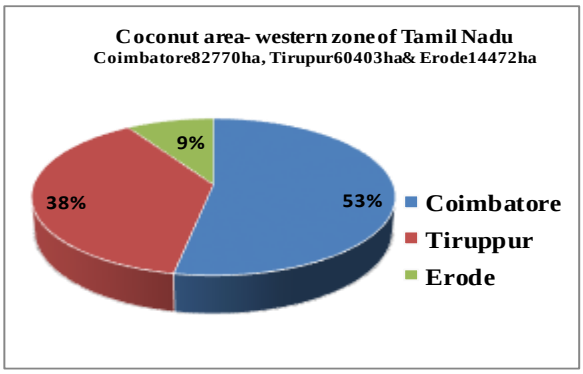


Fig.3 Coconut area in Erode



Details of coconut survey

Fig. 4 and Fig. 5



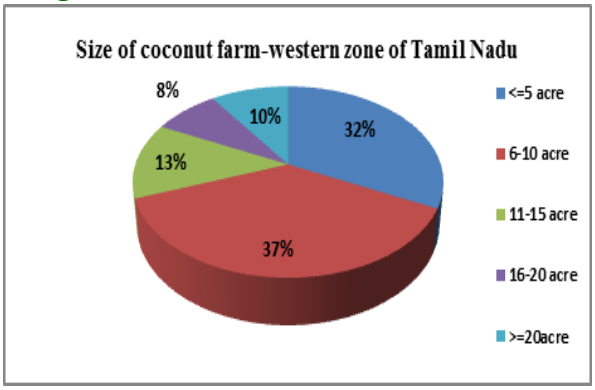
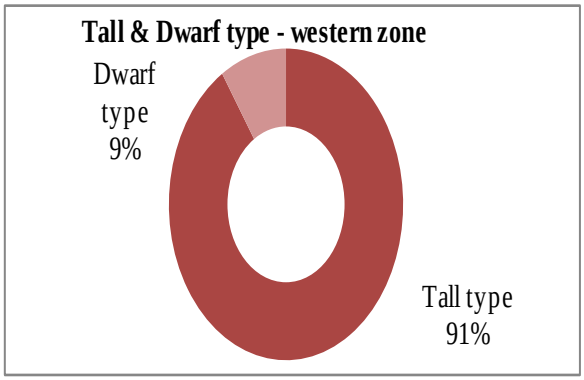


Fig. 6 and Fig. 7



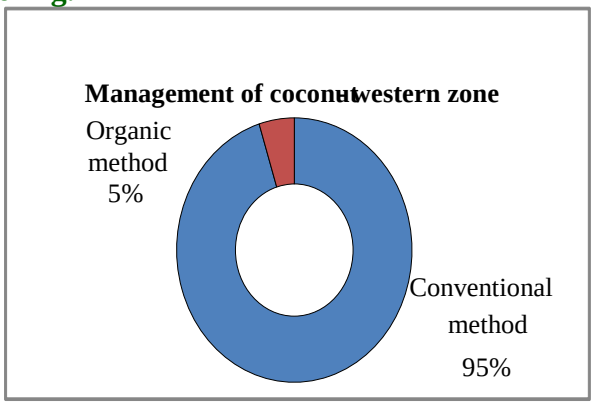
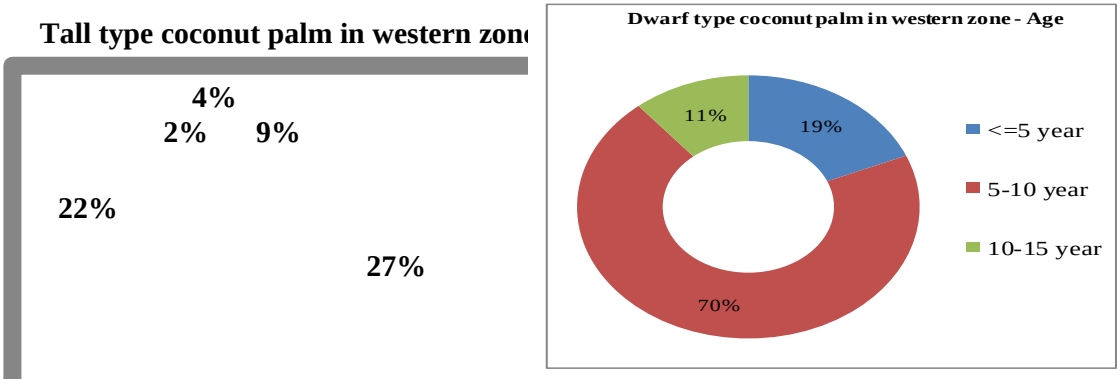


Fig.8 and Fig.9



Results and Discussion

The area of coconut in Coimbatore (82770 ha), Tirupur (60403 ha) and Erode (14472 ha) districts account for 53%, 38% and 9% respectively. Anamalai block (19501 ha) of Coimbatore district has highest area of coconut in western zone, followed by Pollachi North block (14922 ha). Udumalaipettai block in Tirupur district (15520 ha) has highest area followed by Gudimangalam block (12200 ha). Modakurichi block in Erode district (4705ha) has highest area followed by Kodumudi block (2054 ha) (Table 1 and Fig. 4 and 5).

Out of 61 coconut growers selected in this study, nearly 37% of lands were classified under the category of 6 -10 acres, followed by 32% by 0-5 acres. 13%, 10% and 8% classified under the category 11-15, >=20 and 15-20 acres respectively (Fig. 5). As per the Coconut survey conducted in western zone of Tamil Nadu, 91% of the coconut plantation is tall type and 9% is dwarf type (Fig. 6). Out of this, 36% of the tall type of coconut plantation in the western zone of Tamil Nadu was with an age of 20 - 30 years followed by 27% with an age of 10 - 20 years followed by 22% with age of 30-40 years. Remaining 15% came under the category 0-10, 40-50 and 50-60 years 9%, 2% and 4% respectively (Fig. 8). Out of this, 70% dwarf type of coconut plantation in the western zone of Tamil Nadu was with age of 5-10 years followed by 19% with 0-5year and 11% with 10-15 years (Fig. 9). 95% of coconut palms were cultivated with conventional method whereas 5% of coconut palms were cultivated with organic method (Fig. 7).

Perennial systems like plantation crops can be suitable candidates for carbon sequestration which act as an efficient sink of atmospheric carbon like forest plantation. Coconut plantations, for example, not only give sustainable production, but also serve as a good system for biomass production and carbon accumulation. Coconut plantations provide economic yield for about 60 years and endosperm is the richest source of oil. Hence to mitigate climate change through terrestrial carbon sequestration, area suitable for coconut cultivation has to be covered by more number of coconut plantations under organic management.

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