

Organic Farming in Tamil Nadu (a State in India) Evidence From the Field

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Research Article

Keywords: Tamil Nadu, organic farming, green economy

Posted Date: September 30th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-927125/v2>

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Abstract

The green economy is defined by the UNEP as one that results in improved human wellbeing and social equity, while significantly reducing environmental risks and ecological scarcities. The green economy also refers to a resilient economy that provides a better quality of life for all within the ecological limits of the planet. Major countries and agencies are looking towards a green economy that provides path ways for sustainable development and poverty eradication. While discussing the concept of the green economy, it is also important to look at the concept of green growth. The key economic indicator that is used to measure the green economy's growth is referred as "Green GDP". The potential economic and social impacts of environmental degradation are particularly important for developing countries to tackle many growth and development issues without impeding future growth and poverty reduction. The concept of green growth has emerged as a new approach replacing the conventional economic growth model. GDP refers to the gross domestic product generation in agriculture, industrial and service sectors. As of 2019, in addition to ensuring food security, agriculture contributed 15.9% to Indian GDP and employed 42.3% of its population despite its dependence on vagaries of monsoons. Agriculture continues to be the largest provider of livelihood in rural India, and the livelihood of farmers is influenced by the demand and supply of agricultural products in the country thereby influencing the economy. During 1950s India was straggling to produce sufficient food grains to feed its population. So it embarked on the green revolution by introducing high quality seeds, improved irrigation and subsidised chemical inputs. While the country has now become exporter of food grains, second generation problems, arisen due to large scale use of chemical fertilizers and pesticides, are visible now. So the transition to organic farming have started happening.

Organic products are priced with a premium on the market in the country. The demand for organic products across the globe, especially in developed countries, has been growing rapidly. Globally, organic farming is practiced in 162 countries, and 37 million ha of land is managed organically by 1.8 million agricultural households. The sale of organic food and drink was estimated to be 63 billion US dollars in 2011 internationally. The organic-farmland area increased by three percent compared to 2010. The countries with large-scale organic farmland are Australia, Argentina and United States in that order. The main contributor to the expansion of cultivated area under organic agriculture in Asia is India. The cultivated area under certified organic farming has grown 17 times in the last decade in the country. In India, certified organic farming is undertaken in all states and Union territories.

States such as Uttarakhand, Karnataka, Madhya Pradesh, Maharashtra, Gujarat, Rajasthan, Tamil Nadu, Kerala, Nagaland, Mizoram and Sikkim have been promoting organic farming. Organic produce is increasingly preferred by major urban centers in India. A large demand for Indian organic products, especially tea, coffee, cotton, etc., exists on the international market. Organic products such as tea, herbs, and species from Tamil Nadu are widely sought globally.

The Tandon H.L.S et al. (2007) ^[1] reviewed fertilizer consumption in Indian agriculture for the past five decades and concluded that integrated nutrient management would be the solution for the problems

faced by Indian agriculture. Gahukar R.T et al. (2009) ^[2], in his paper, discussed sustainable agriculture in India at that time and brought up the future needs of sustainable agriculture in India with a series of recommendations. Jaganathan.D et al. (2012) ^[4] conducted a sample survey to assess the knowledge level farmers on organic farming in India. Amarnath J.S et al. (2012)^[5] examined the economic aspects of organic farming in Tamil Nadu. Panneerselvam.P et al. (2013) studied the impact of large-scale organic conversion and food production and food security in Tamil Nadu and Madhya Pradesh. Amarnath J.S et al. (2013) ^[5] developed indicators for comparing sustainability in crop and dairy production in Tamil Nadu. Vandana Tyagi et al. (2017) ^[8] discussed in detail the prospects and challenges of the green economy in India. Kalyani.V et al. (2018) ^[10] concentrated briefly on various issues and prospects for organic farming in Tamil Nadu. Krishnaprabu.S et al. (2019) ^[11] focused on the concept, application and prospects of organic farming in India. Jothi Sivagnanam.K et al. (2019) ^[12] dwelt on fertilizer consumption and soil health status in Tamil Nadu. Dr V. Bail Hans et al. (2019) studied the relationship between sustainable agriculture and economic growth, especially in state governments. Murugan.D et al. (2020) ^[13] studied the greening status of organic farming in wet and dry land in Nagapattinam and Erode District of Tamil Nadu under various crops. Hinz et al. (2020) concentrated on land consumption dynamics in Tamil Nadu under various scenarios. Amit Khurana et al. (2020) ^[15] studied the challenges and possibilities of organic and natural farming in India. Delabre et al. (2021) deliberated on how sustainable food production and consumption will impact the post 2020 global biodiversity framework.

The State of Tamil Nadu is one of the agriculturally intensive states of India. This paper attempts to examine the data on consumption of inputs from a sample survey for evidence regarding the adaption of organic farming in the State.

Introduction

The green economy refers to an economy (William Hynes et al.2012) ^[6] that results in improved human wellbeing and social equity, while significantly resulting in a reduction in environmental risks and ecological scarcity. Thus, the green economy will be low carbon, resource efficient and socially inclusive (Vandana, 2017) ^[8]. The concept of a green economy has some underlying principles, namely, planet integrity, polluter payments, dignity, justice, resilience, governance and the many principles. Many countries are looking forward to the green economy framework that provides a visible policy framework for sustainable development and poverty reduction. To study the green economy, it is necessary to evolve databases and parameters that measure changes in the green economy. The concept of green growth has evolved for this purpose. Key features of green growth are adoptability, desirability and measurability.

The effect of greenhouse gases and climate change mitigation has changed the way governments think of the development paradigm. The economic and social cost of development has been very large, and the result has been environmental degradation and climate change disasters. The climate and environmental impacts have introduced a whole new set of development issues without compromising positive economic growth and poverty reduction. Hence, the concept of the green economy has become

the buzzword, and green growth has emerged as a new approach to development in place of the conventional economic growth model.

Greening the Economy with Agriculture

Currently a large volume of literature is available on the theoretical framework of the green economy. However, putting this abstract concept into practice has remained largely unexplored due to a lack of literature on green economy implementation. Evidently, there is a knowledge gap between theory and practice. Therefore, there is an urgent need to build a database required to track the changes in the green economy, at least in important sectors.

Akin to the conventional economic growth model, green GDP may be assumed to have three sectors, namely the agriculture and allied sector (primary) industry sector (secondary) and service sector (tertiary). The concept of greening the three sectors refers to the adoption of various environmentally and climate friendly strategies specific to each sector without compromising economic growth and poverty reduction. The focus of this paper will be to discuss a tracking strategy with regard to the greening of agricultural production. Activities related to agriculture are resource intensive and result in environmental degradation. Greening agriculture is not simple and straightforward, as it has a major impact on the livelihoods of a large number of farmers and people living in rural areas. Greening of agriculture may be achieved by adopting ecosystem approach to agriculture, forestry and allied sectors using eco-friendly activities.

Sustainable Consumption and Production

The major factors that indicate the growth of the agricultural sector are agricultural production and consumption. In recent years governments have focused on increasing agricultural production using nutrients, pesticides and other chemical inputs. The consumption of chemical products aimed at increasing agricultural yield and to ensure food conservation, are detrimental to environmental and consumer health, such as biodiversity, soil fertility, water consumption and water pollution, energy, climate change, chemicals, food safety, food security and biotechnology. Sustainable production and consumption is one of the important priorities identified at the Rio earth summit in 1992. Sustainable development also requires changes in production and consumption patterns worldwide.

Green economy in Indian context

India is one of the fastest growing economies in the world. It is also signatory to the 2030 Sustainable Development Agenda adopted in September 2015. The Constitution of India contains enough provisions (Articles 48A and 51A) for protection of the environment. India's National Action Plan on Climate Change along with State Action Plans form the basic framework for bringing the environment and climate to the main stream of development discourse. The Indian government under the Copenhagen Accord has committed to reducing emission intensity by 20 to 25 percent. India also announced a plan to reduce emission intensity by 30 to 35 percent by 2030. India recently ratified the Paris Agreement to ensure the

welfare of its citizens without crossing the limits of the environment. India has also undertaken structural reforms in the form of rationalization of taxes. The rapid urbanization of the country has placed larger cities as the engines of economic growth, and at the same time, the country faces several pressures on infrastructure, such as power, telecoms, roads, water supply and mass transportation. Experts believe that the green economic transition has the potential to grow in India. However, the transformation is happening ever slowly, and the progress made thus far is not commensurate with what it is needed. Fortunately, the agriculture sector provides livelihood to two thirds of the population of the country. The greening of the agriculture sector as such, has a large bearing on sustainable production, consumption, economic growth and poverty reduction.

Green Economy and Agriculture in India

The development of sustainable agriculture is becoming increasingly favorable in India. New opportunities beckon stakeholders in the form of fresh markets and business opportunities. On the other hand, agriculture is also facing the crisis. Long term vision is needed for the inclusive growth of farmers and rural communities. Organic agriculture holds the key for sustainable agriculture in the future. Some experts believe that organic and natural farming are necessary for making agriculture self-reliant. In India, organic farming movements have been largely led by farmer communities and civil societies. The Government of India has increased efforts towards popularizing organic farming by launching PARAMBARGAT KRISHI VIKAS YOJONA in 2015-16. State governments, on their part, have come forward with strategies to become 100% organic states.

The organic farming movement in India is in the nascent stage rather than a mass movement. Only two percent of the net sown area is organically farmed, and approximately 1.3% of farmers in India are registered for organic farming. Few policy makers and businessmen of the country also believe that environmental protection is a hindrance to economic growth and development. Financial instruments for green investment and systems for direct funding of green projects are miniscule and inadequate. The business community also believes green technology to be unreliable and cost intensive. On the brighter side, organic products are priced at a premium on urban markets and with organic product retailers.

State of Tamil Nadu

The state of Tamil Nadu is located on the southeastern tip of the Indian Peninsula. It has a geographical area of 130 thousand square kilometers and is the 11th largest state in the country. The state has been divided into 38 districts and 385 blocks. It has a long coastline of 1076 kilometers and a tropical climate. The state has a wide range of biospheres extending from southwestern Ghats, in east to rainforests in the Western Ghats; and the south Deccan Plateau to dry forests. The state has approximately 2000 species of native wild life. The state has a population of approximately 8 billion in 2021. It is one of the most urbanized states with a population intensity of 555 persons per square kilometer and one of the comparatively better developed states in the country. The state has a wide network of national and state

highways supported by a good railway network. The production of food grains in the state was 7.5 million tons in 2009-10 and increased to 11.5 million tons in 2019-20.

Fertilizer consumption

Fertilizers play a pivotal role in maintaining soil fertility. They are used to increase crop production. India is second in fertilizer consumption, next to China. Here, fertilizer consumption increased over a period of four decades. It is one of the largest producers and consumers of fertilizers in the world. There is an increase in production because of efficient technologies used in the agricultural sector leading to economic and social development. During 2010, Egypt (368.7 kg/ha.), Korea (269.7 kg/ha.), Malaysia (265.4 kg/ha.), Vietnam (223.9 kg/ha.), Japan (212.5 kg/ha.) and India (156.3 kg/ha.) were the leading fertilizer consumers in the agricultural sector in the world. Among them, Egypt topped the list, while, India was consuming the lowest level of fertilizers compared to other large consumers in the world.

India was struggling to feed its population during the early 1950s and so the country introduced Green Revolution during the first half of 1960s to increase its food grain production. The country was able to achieve higher food grain production from 53.8 million tons in the year of 1960 to 296.65 million tons in 2019-2020. This increase was possible due to quality seeds and wide spread consumption of chemical fertilizers and pesticides. Thus fertilizer consumption increased from 95.6 thousand tons in 1950-51 to 25.84 million tons in 2012-13. Notably food grain production always increases at a lower rate than fertilizers consumption indicating that higher dose of chemical fertilizers is required for increasing food grain production. The higher consumption of fertilizers resulted in soil degradation. Agricultural production started plateauing along with the increase in the cost of cultivation. Wide spread use of fertilizers and consequent degradation are noted across the agriculturally intensive regions of India and districts of Tamil Nadu as well.

As said earlier, the fertilizers consumption in the country increased from 65.6 thousand tons 1950-51 to 25.84 million tons in 2012-13. The rapid expansion of irrigation, introduction of high yield variety seeds, introduction of the retention prices scheme, distribution of fertilizers at lower prices, and expansion of dealer network are the major reasons for the increase in the fertilizers consumption. Higher consumption of fertilizers and pesticides led to second generation problems. It resulted in depleting soil fertility, deficient soil and micro nutrients, depleting water table and water quality deduction in organic carbon content and complete imbalance in soil health. The Indian Council of Agriculture Research has estimated that 120.40 million hectare of land is degraded in the country in 2010. While there are various estimates on the amount of degradation, the problems faced due to degraded land are evident. The agriculturally progressive states like Punjab, Bihar, Haryana, West Bengal, Andhra Pradesh, Uttar Pradesh, Tamil Nadu, Jharkhand and Uttarakhand, used to consume high amount of fertilizers. On the other hand the North and Eastern State like Arunachal Pradesh, Nagaland, Mizoram and Meghalaya consume less chemical fertilizers.

The average consumption of fertilizer in Tamil Nadu is (197 kg/ha). (Jothi Sivagnanam et al 2019) ^[12]. In that, the Nitrogen consumption (109 kg/ha), is maximum followed by Phosphate (54 kg/ha) and Potash (34 kg/ha). In terms of the consumption of fertilizers (NPK pattern), the Thanjavur, Nagapattinam, Villupuram, Tiruchirapalli and Tirunelveli districts consume high of nitrogen due to soil deficiency. The consumption of phosphate fertilizers is more in Cuddalore, Thanjavur, Villupuram, Tiruchirapalli and Dindigul districts due to soil deficiency. As far as potash is concerned Tirunelveli, Villupuram, Tiruchirapalli and Salem districts has the highest consumption.

The main reason for the higher consumption of NPK fertilizers among different districts of Tamil Nadu is due to varied soil conditions. The NPK deficiency ratio is found highest in Thanjavur, Nagapattinam, Villupuram, Tiruchirapalli and Tirunelveli districts. Soil is deficient not only in NPK, but also in secondary nutrients such as sulfur, calcium and magnesium and micronutrients such as zinc, copper and iron in most Indian states. Due to lack of soil fertility, every year India loses 10 million tons of food grains. Declining water quality and organic carbon compound the problems faced.

Review Of Literature

The Tandon H.L.S et al. (2007), ^[1] reviewed fertilizer consumption in Indian agriculture for the past five decades and concluded that integrated nutrient management would be the solution for the problems faced by Indian agriculture. Gahukar R.T et al. (2009) ^[2] in his paper, discussed sustainable agriculture in India at that time and brought up the future needs of sustainable agriculture in India with a series of recommendations. Jaganathan.D et al. (2012) ^[4] conducted a sample survey to assess the knowledge level of farmers on organic farming in India. Amarnath J.S et al. (2012) ^[5] examined the economic aspects of organic farming in Tamil Nadu. Panneerselvam. P et al. (2013) studied the impact of large-scale organic conversion and food production and food security in Tamil Nadu and Madhya Pradesh. Amarnath J.S et al. (2013) ^[7] developed indicators for comparing sustainability in crop and dairy production in Tamil Nadu. Vandana Tyagi et al. (2017) ^[8] discussed in detail the prospects and challenges of the green economy in India. Kalyani.V et al. (2018) ^[10] concentrated briefly on various issues and prospects for organic farming in Tamil Nadu. Krishnaprabu.S et al. (2019) ^[11] focused on the concept, application and prospects of organic farming in India. Jothi Sivagnanam.K et al. (2019) ^[12] dwelt on fertilizer consumption and soil health status in Tamil Nadu. Dr V.Bail Hans et al. (2019) studied the relationship between sustainable agriculture and economic growth, especially in state governments. Murugan.D et al. (2020) ^[13] studied the greening status of organic farming in wet and dry land in Nagapattinam and Erode District of Tamil Nadu under various crops. Hinz et al. (2020) ^[14] concentrated on land consumption dynamics in Tamil Nadu under various scenarios. Amit Khurana et al. (2020) ^[15] studied the challenges and possibilities of organic and natural farming in India. Delabre et al. (2021) ^[16] deliberated on how sustainable food production and consumption will impact the post 2020 global biodiversity framework. In the literature, we could see articles studying organic farming and related issues and strategies. Few articles are available looking for clear evidence from the field. This paper tries

to put focus on that front. Any policy or strategy will be considered a success if stakeholder participation is spontaneous and clearly evident. This stands as proof about viability for sustainable agriculture and there by contributing to green the green economy.

Evidence for consumption of organic fertilizers

In this paper, the input data are collected as part of the ongoing General Crop Estimation Survey on paddy crop conducted by the Department of Economics and Statistics formed the database for the analysis.

Paddy is the staple food grain of the State. Chemical and organic inputs are largely used for paddy cultivation. The total consumption of chemical and organic inputs are converted into per hectare consumption and used for analysis. The data collected for the period 2010-2020 are used for analysis to study the consumption pattern over the decade. During the last decade, the consumption of both organic and chemical inputs either independently or in combination varied widely in the randomly selected fields.

The paddy crop is grown in the state during three seasons namely (in vernacular) Kuruvai, Samba and Kodai seasons.

Pesticides and Fertilizers consumption

Pesticides are chemicals designed to kill or control insects, weeds, fungi, rodents and microbes. However, many pesticides have been found to be harmful to human and animal health or to the environment, which influences the persistence of pesticide residues in or on food. As a result of a series of measures undertaken by the State Government for judicious consumption of pesticides and the “Grow Safe Food” campaign initiated to create awareness and minimize the consumption of pesticides (Table 1), the per hectare consumption of pesticides has declined by 92% over the decade. The per hectare consumption of the pesticides was 720 kl per hectare in 2010-11, reached a high of 1024 kl per hectare in 2011-12 and recorded a minimum of 56 kl per hectare during 2019-20. While analyzing the fertilizer data set (Table-1) it is clear that the consumption of chemical fertilizers has also increased by 47% during the past 10 years.

Table: 1 Pesticides and Fertilizers – Per hectare Average Consumption

YEAR	Pesticides (kl/ha.)	Chemical Fertilizers (kg/ha.)	Leafy (kg/ha.)	Oil cake (kg/ha.)	Farmyard (kg/ha.)
2010-11	721	257	246	6	2261
2011-12	1024	347	727	22	4564
2012-13	458	335	506	126	3147
2013-14	259	317	537	257	3630
2014-15	159	454	802	18	6116
2015-16	298	831	1205	56	11570
2016-17	57	406	685	64	6148
2017-18	101	303	618	62	5560
2018-19	104	314	612	62	5641
2019-20	56	376	543	14	4273

A reduction in per hectare consumption of pesticides (Fig. 2) was seen across all districts. Tiruppur, Karur, Thiruchirappalli, Perambalur, Dindigul and Ramanathapuram districts were able to achieve near complete reduction in the consumption of pesticides. Except for Erode, all other districts have reduced the consumption of pesticides by over 80%.

The consumption of chemical fertilizers was 257 kg per hectare in 2010-11 (Table-1), and it reached a high of 831 kg per hectare in 2015-16. During 2019-20, the consumption was 376 kg per hectare. The consumption of chemical fertilizers hovered around an average of 350 kg per hectare, excluding the peak in 2015-16.

In the districts of Nagapattinam, Ramanathapuram, Dharmapuri and Madurai (Fig-3), the consumption of chemical fertilizer decreased by more than 50%, whereas it increased by more than five-fold in the districts of Erode, Salem and Namakkal. Perambalur consumed less chemical fertilizer among the Cauvery delta districts from 2010-11 to 2018-19, but notably increased the consumption of chemical fertilizers in 2019-2020 in the samba season.

Organic Fertilizers

When analyzing the organic fertilizer data set (Table-1 and Fig.4), it is clear that the consumption of farmyard manure is comparatively higher than that of the other two manures, namely, oil cake and leafy manure, and the consumption of farmyard manure has increased by 108% over the decade.

NPK- Leafy Manure

Some districts (Fig.5) showed a substantial increase in the consumption of NPK-leafy manure during, 2010-2020. From 2010-11 to 2019-2020, Villupuram District used more NPK (fertilizer) than the Cauvery Delta. Differences in the pattern of consumption in Villupuram and Dharmapuri Districts have been noticed during some of the mid years, when compared with the Cauvery delta districts in consumption of NPK-Leafy Manure. Regarding the consumption of leafy manure has increased by more than 100% in the Thoothukudi, Krishnagiri, Vellore, Villupuram and Ramanathapuram districts. Consumption was reduced by more than 90% in the Thiruvannamalai, Perambalur and Thajavur districts. During 2017-18, 2018-19, and 2019-20 (fig.5), NPK-Leafy Manure consumed by Dharmapuri District alone was greater than that was consumed by Villupuram.

The per hectare consumption of NPK-Leafy Manure was phenomenally high across all districts, and many districts reported an increase of more than 100 percent. A clear increase in the consumption of NPK-Leafy Manure fertilizer by Villupuram is seen from 2010 to 2020.

Oil cake
Here, again, the consumption of oil cake was high across all the districts, with many districts reporting an increase of more than 100 percent. The consumption of oil cake has dramatically increased over the decade, which helps to reduce the consumption of chemical fertilizers, while the consumption of leafy manure has also increased by 76%. The consumption of oil cake (Fig 6) has increased by more than five times in Tiruvannamalai, Tiruchirapalli, Tirunelveli and Vellore districts. However, consumption was reduced significantly in Villupuram, Kanniyakumari, Nagapattinam, Karur and Erode districts.

Farmyard Manure

The per hectare consumption of farmyard manure was consistently high in all districts, with some of the delta districts (Thanjavur and Tiruvarur) reporting higher consumption of more than 250 percent. Farmyard Manure (Fig.7). Consumption has increased in most of the districts. In the districts of Krishnagiri, Thanjavur, Thiruvarur, Kanyakumari and Erode, farmyard manure consumption has increased extensively over the decade, whereas, in the districts of Namakkal and Dindigul, consumption has decreased.

Conclusion

From the above discussion, it could be seen that the consumption of organic inputs for the staple crop, paddy of Tamil Nadu has increased significantly, while the consumption of chemical fertilizers is inelastic. Similarly, the consumption of pesticides has decreased significantly, and changes have occurred across all districts of the state during the past decade. There are variations among districts in the

consumption of fertilizers and pesticides. In some districts the opposite trend is also noted. While the reasons for these changes have to be examined, it is evident that the concept of organic farming has caught up with farmers largely due to the efforts of the state and central governments and farmers' willingness to embrace changes towards green agriculture, thereby enabling a smoother transition towards green economy. Evidence shows that farmers have not completely done away with the use of chemical fertilizers, unlike pesticides, but they are cautious on this front. It should be remembered that the transition to a green economy, especially in the agricultural sector, has to happen gradually to avoid economic shocks. The recent experience of Sri Lanka is to be recollected here, as the total switch to organic farming in one stroke resulted in a declaration of an economic emergency. The study does not cover the period of Covid-19, i.e., after 2020, as data are also not available for these periods and such data require different types of analysis.

Declarations

Acknowledgement: The authors would like to acknowledge with thanks Dr. K. Vijayakumar and N. Rekha of Centre for Development of Advance Computing (CDAC) India for their contribution to the computations.

Data Availability: The data that support the findings of this study are available on reasonable request from the corresponding author P.Balasubramanian. The data are not publicly available due to state government restrictions on privacy.

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Figures

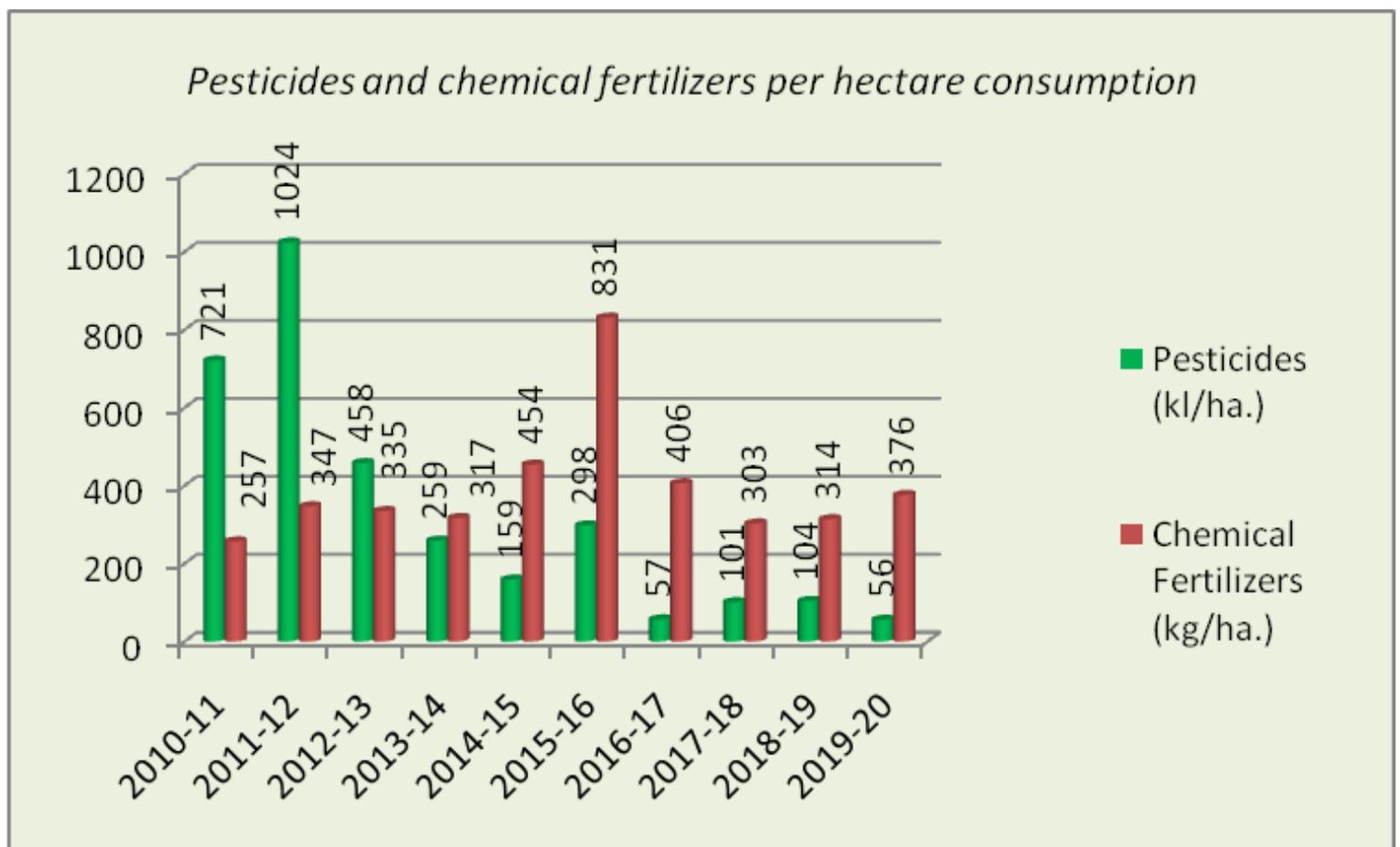


Figure 1

Pesticides and chemical fertilizers per hectare consumption during 2010-2020

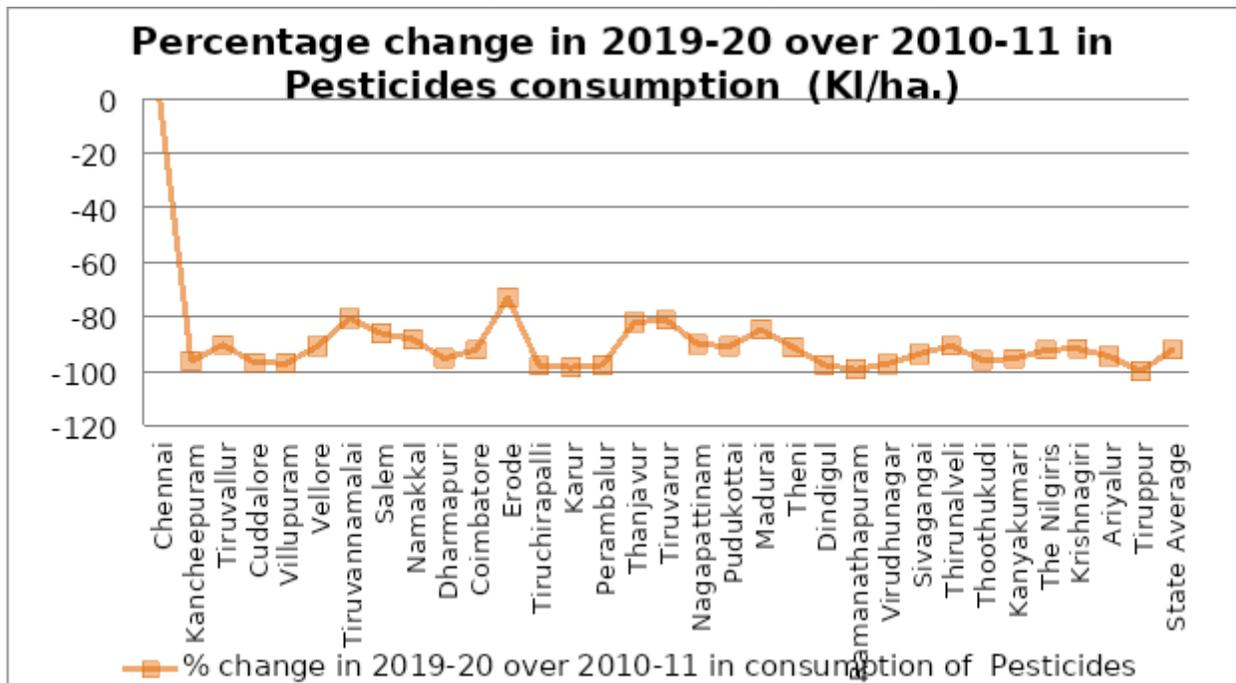


Figure 2

Pesticide consumption in districts during 2010-2020

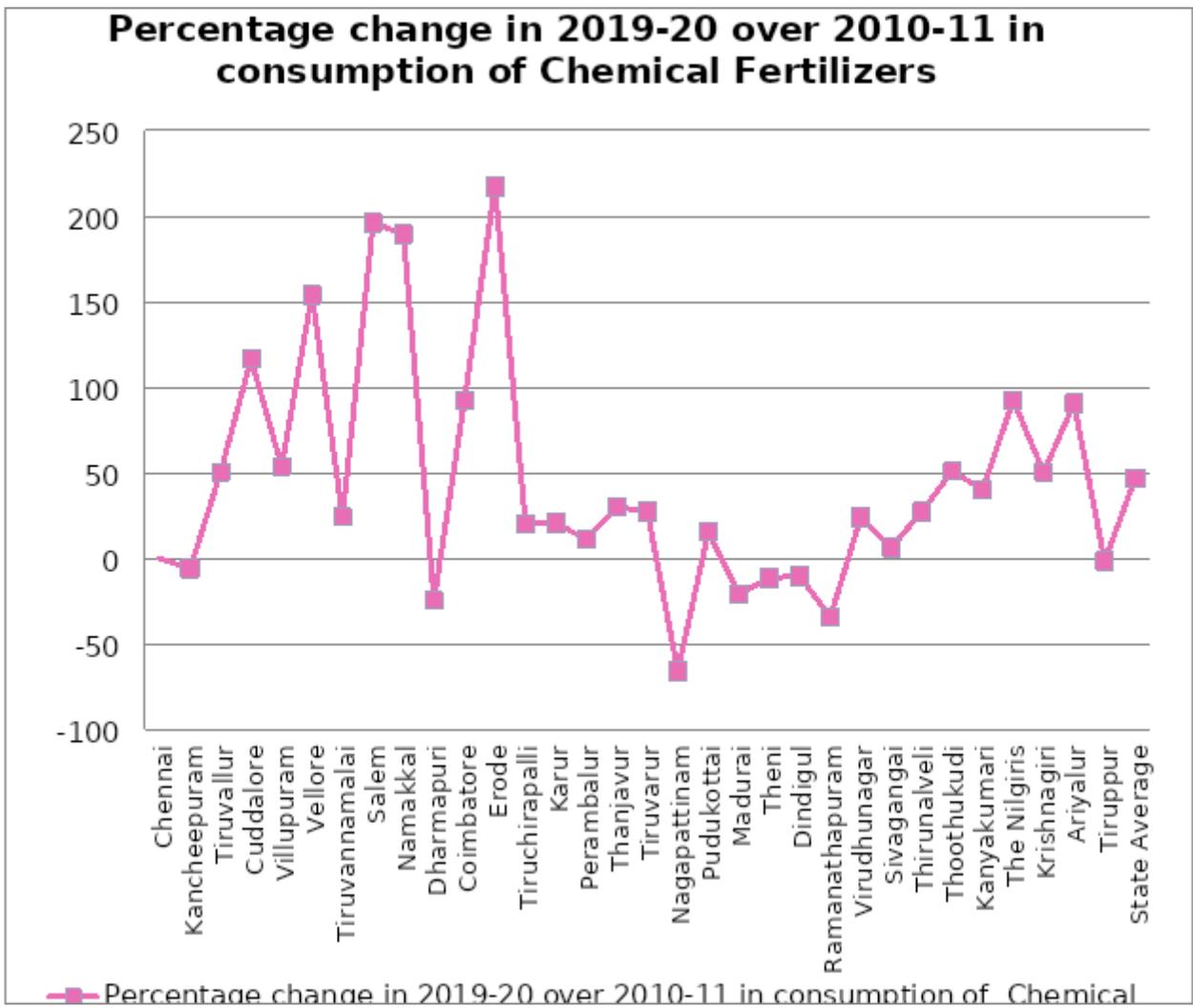


Figure 3

Chemical fertilizer consumption in districts during 2010-2020

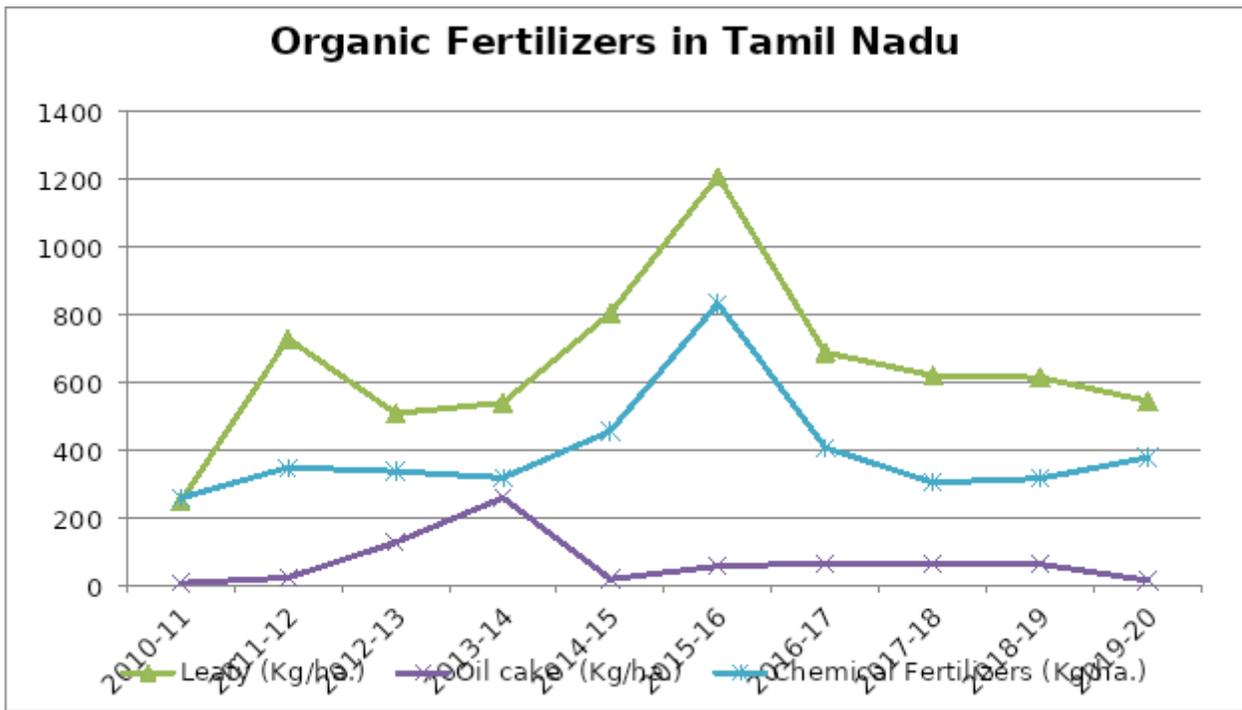


Figure 4

Organic fertilizers consumption in Tamil Nadu

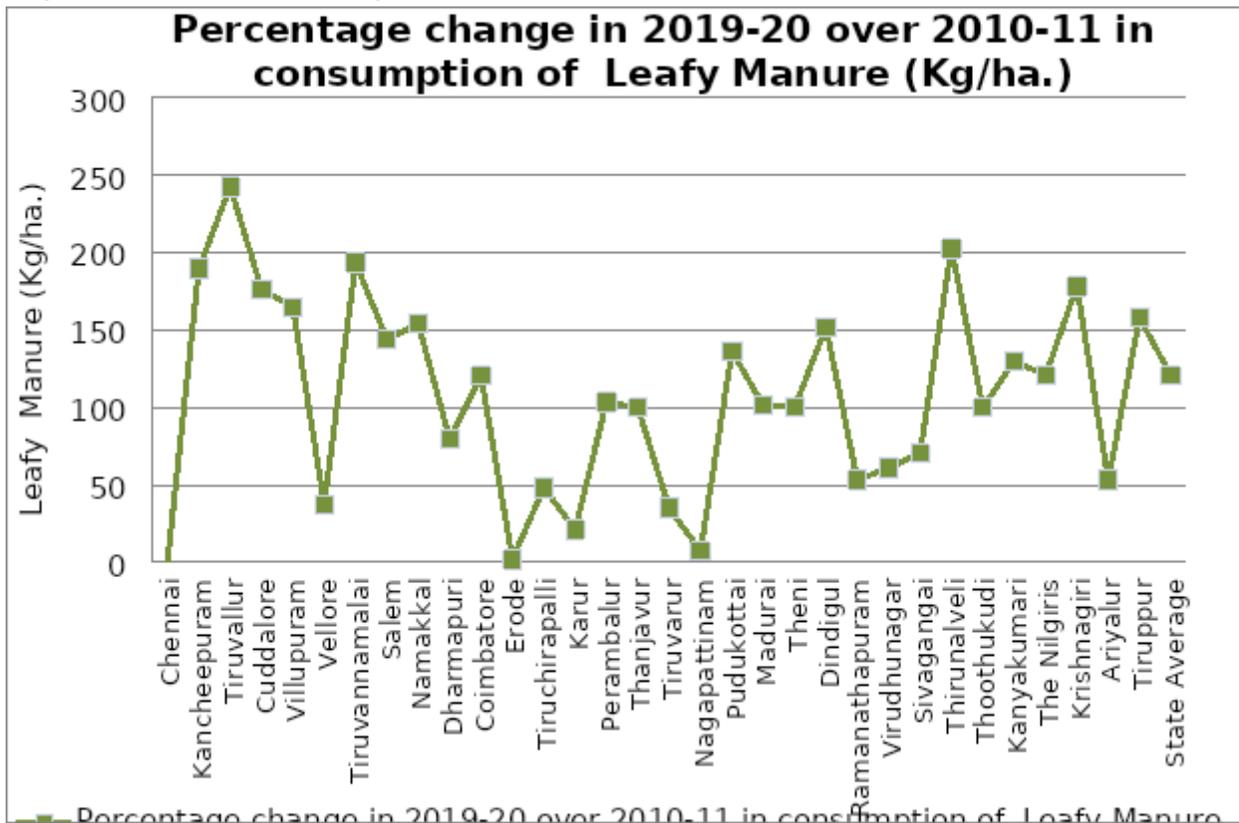


Figure 5

Leafy manure in the districts between 2010 and 2020

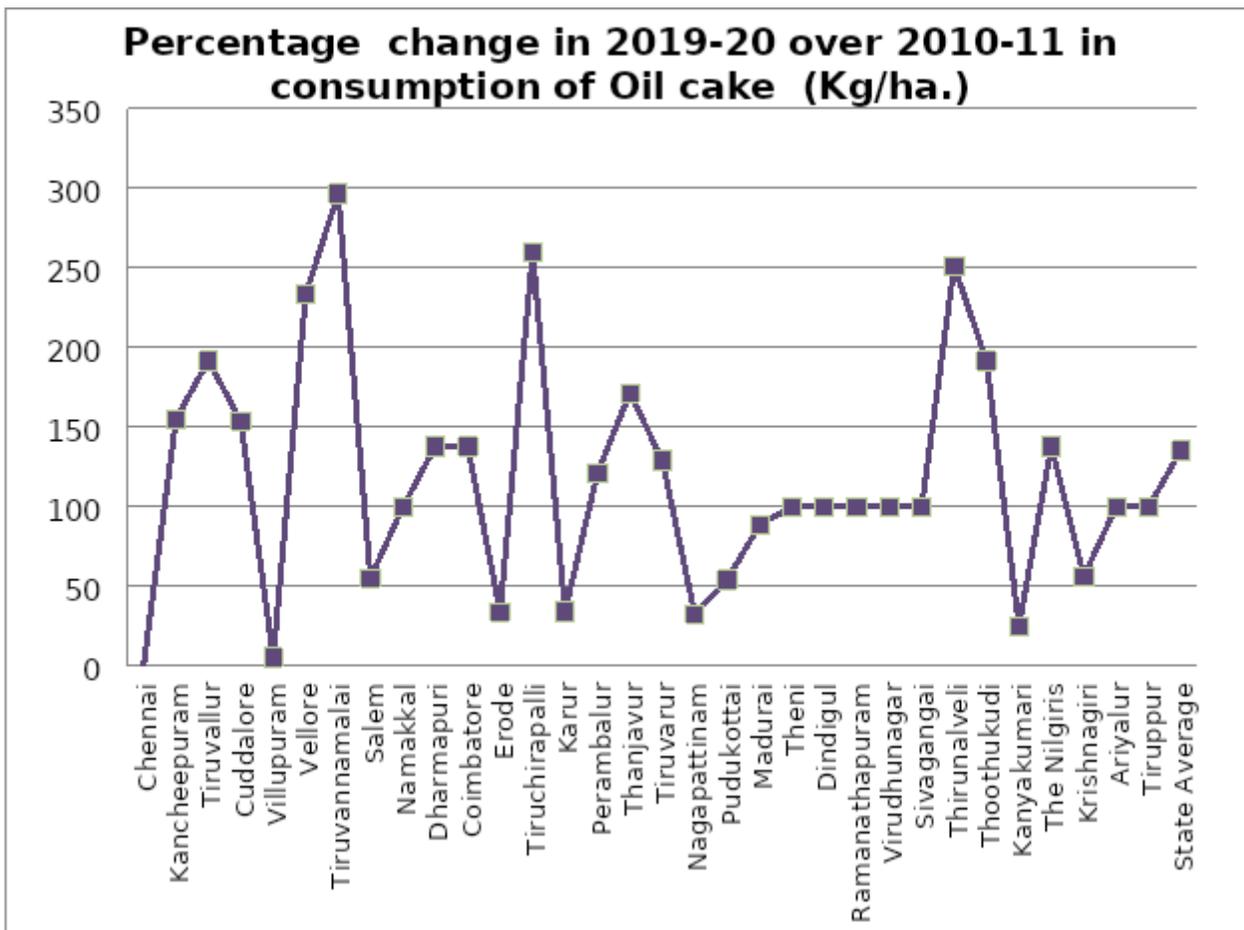


Figure 6

Oil cake usage in the districts between 2010 and 2020

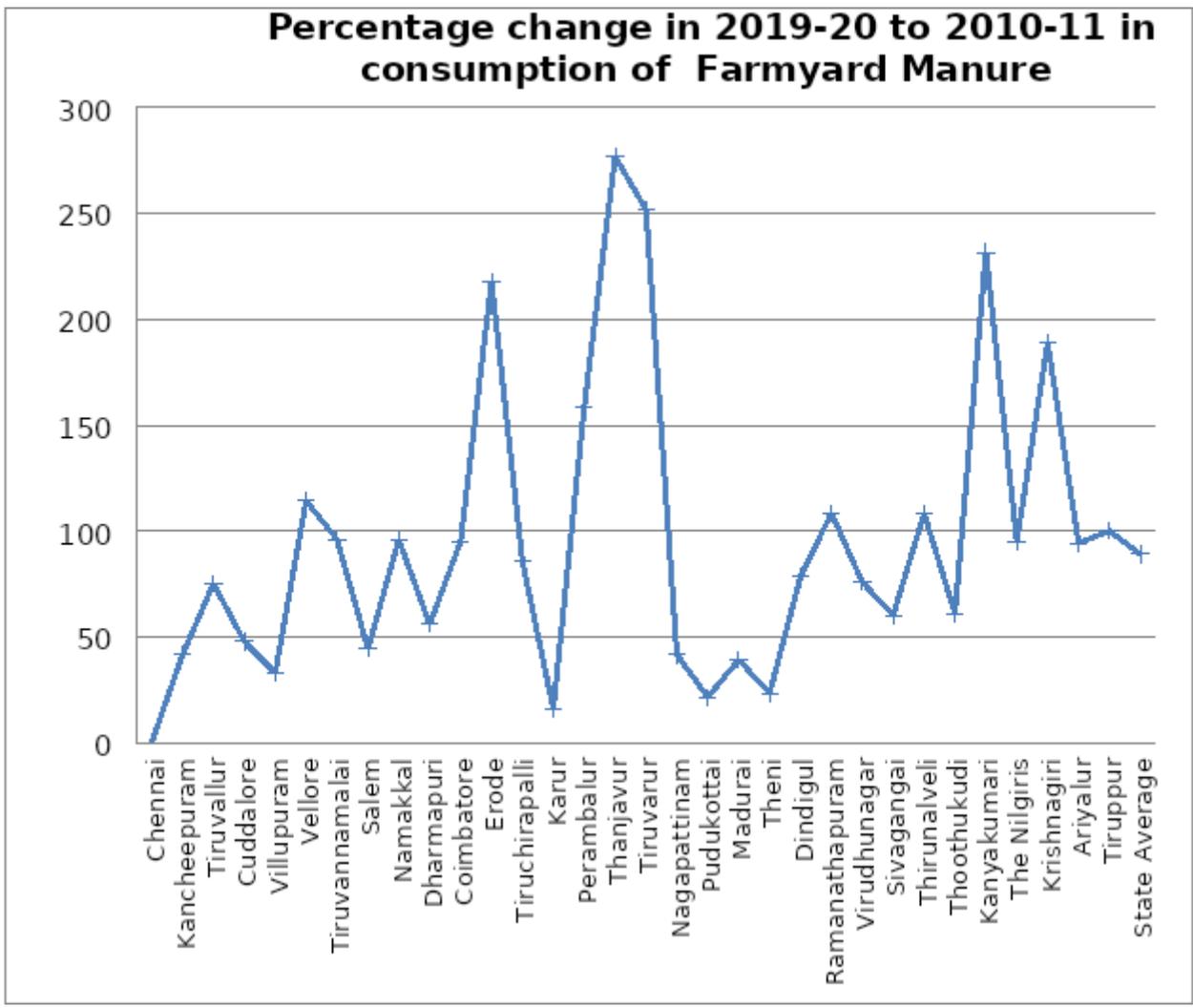


Figure 7
 Change in Farmyard Manure Consumption during the districts