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Assessment on Distinct types of Crops in Kanchipuram District using Organic, Fertilizers, Pesticides and Plastic Mulching at Different Seasons

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Abstract: ***Our nation is a major economic player, providing a significant source of revenue for more than half of India's population. The country's financial sector relies on rural activities that play a crucial role in the public's well-being. The region selected for the review is Kanchipuram Locale in Tamil Nadu, which heavily relies on agricultural income from various crops. The contribution of farming to the economy, as well as the monetary state of the ranchers, has been overlooked in this period of innovation. With 47% of the population working in agriculture, it is the most common occupation. Paddy is the major crop developed in the Kanchipuram district. Other important crops include Millets like ragi, Maize, Cumbu, and samai; pulses like Black gram, Green gram, Red gram, horse gram, and cowpea; oilseeds like groundnut, Gingelly, sunflower, and Castor; and sugarcane. Brinjal and Watermelon Farmers started using plastic mulching, which yields a 3-4% profit in the Kanchipuram district. This assessment aims to study the major crops of Kanchipuram district's agricultural sector in various climatic environments, including Navarai, Samba, and Sornawari. However, agricultural pollution has already begun as a result of contemporary farm practices, such as the use of plastic mulching. Comparisons between organic mulching and plastic mulching materials are challenging, as outcomes depend on the selected strategy, growth techniques, and environmental factors. Due to the current agricultural byproducts like plastic mulching, this process promotes damage to the ecology, land, and environment. To overcome agricultural pollution, organic mulching and greenhouse technology are suggested.***

Keywords: ***Organic mulching, Greenhouse technology, Plastic mulching***

I. INTRODUCTION

The advancement of farming and agricultural techniques has enabled people to exist in the world today. Agricultural pollution is the contamination of the environment and related surroundings as a result of using natural and chemical products for farming.

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This contamination is ruinous to all living organisms that depend on the food produced in agriculture [1]. Since the need for food has grown in tandem with population growth, agricultural practices in the Kanchipuram district have become increasingly polluting.

On Tamil Nadu's north-eastern coast, the district of Kanchipuram is bordered in the west by Vellore and Tiruvannamalai, in the north by Thiruvallur and Chennai District, in the south by Villupuram District, and the east by the Bay of Bengal. It is also close to Chennai City and the Bay of Bengal. It is located between latitudes 77° 28' and 78° 50' East and longitudes 11° 00' and 12° 00' North. The district has a shoreline of 57 km and a total geographic area of 4,43,210 hectares. The district headquarters are in the temple town of Kanchipuram. This district has a good chance of forming an indentured farming system for groundnuts and pulses. Organic farming is popular in this district. In the Kanchipuram district, agriculture mainly depends on tank irrigation. During the north-east monsoon, the maximum (700–800 mm) rain is received, and the rainwater is stored in the tanks. By utilising tank irrigation, the paddy crop has been successfully raised in two consecutive seasons, and the groundnut crop has been successfully raised under both rain-fed and irrigated conditions. The water table in this district is typically only 100–200 feet deep. Hence, this water is a significant strength in Agriculture [2].

Low productivity exists in the soil. The amount of salt in the soil increases significantly as precipitation from remote locations is absorbed into the soil. This will result in a decrease in the availability of plant nutrients, including phosphorus, zinc, copper, and boron, which will impact the soil's productivity. Furthermore, because the district's surface is mainly flat, drainage is an issue in the paddy-growing regions. Because of this, highland paddy farming is particularly challenging. In the Kanchipuram district, there are five taluks: Uthiramerur, Kundrathur, Kanchipuram, Sriperumbudur, and Walajabad. Each taluk has 130, 89, 128, 99, and 79 villages separately.

However, farming is the backbone of our country, and nowadays, farmers are adopting modern technologies, such as plastic mulching. Environmental pollution and food safety are challenging criteria for our country. Fertilisers, pesticides, and plastic mulching play a vital role in agricultural pollution. In this work, the use of plastic mulching is increasing the yield of food crops, but it is also creating serious problems for the future ecosphere.

To overcome this agricultural pollution without posing a serious hazard to human health, organic mulching and greenhouse technology are needed. This paper is organised as follows: Segment 2 summarises the literature review of crop yields, Segment 3 illustrates the root causes and solutions of agricultural pollution, Segment 4 discusses crop yields and productivity in the Kanchipuram district, and Segment 5 presents the conclusion and future directions.

II. LITERATURE REVIEW

The review of literature presented in this chapter encompasses earlier research studies on the use of plastic mulching for food and nonfood crops to enhance crop yields.

In V. Navaneetha Pandian et.al [2017], the author shows that in combination with drip irrigation, chillies were observed to respond with greater moisture retention, high yields, maximum water use efficiency, maximum fertilizer use efficiency, and greater weed control [3].

K. Indumathi et.al [2020], the researchers, conducted an analytical study of plastic mulching in Tuberose and Melons in the Dharmapuri district of Tamil Nadu. They analyzed about a 15-20% increase in the melons and 18–22% in the tuberose [4].

Vinoth Kumar M et.al [2021], the authors analysed that plastic residues were identified in four regions of Tamil Nadu, India: Sulur, Nagondapalli, Royakottah, and Krishnagiri. In Sulur in the Coimbatore District, where plastic film mulching has been used for growing the tomato (Lycopersicum esculentus L.) crop for ten years, the percentage distribution of plastic residues was found to be greater. In comparison to other places, the distribution of plastic residues in Sulur was 37.97%, 35.07%, and 36.99% at three different depths, namely 0–10, 11–20, and 21–30 cm. It was discovered that as the depth increased, the spread of plastic residues decreased. In the 0–10 cm depth range, more plastic debris was found [5].

M. Jayalalitha et al. [2020] found that Tomatoes were grown on Black on silver, silver on black, white on black, and Mulch with etc. of 100, 80 and 60 %. From the results, white on black was observed, and it recorded the highest yield by 80% compared to other mulches [7].

Plastic mulching is currently limited in its use in Tamil Nadu to improve both food and non-food crops. However, farmers have still had to use more chemical fertilisers, pesticides, weed killers, animal hormone treatments, nutrient-rich feed, and other practices to boost the productivity of their farms and fields, which has altered the way farming has historically been done.

III. AGRICULTURE POLLUTION ROOT CAUSES AND SOLUTIONS

In Kanchipuram district, 47% of the population works in agriculture, making it their primary occupation. Its total cropped area is 1,99,001 hectares. Paddy, groundnut, sugarcane, millets, and pulses are the main crops grown. The primary irrigation sources are canals and tanks. Low soil productivity and a lack of resources hinder farmers from implementing agricultural modernisation and mechanisation. Problematic soils cover almost 50,000 hectares of land. There are numerous ongoing initiatives, including Seed Minikit, Integrated Cereal Development Program, ISOPOM, and organic farming.

A. Agricultural Pollution's Root Causes

a. Synthetic fertilizers

Ammonia and nitrates, which are mostly nitrogen- and phosphorus-based compounds, improve soil fertility when used in the proper proportions. However, chemicals are frequently used more than necessary and often remain in the soil rather than improving it.

b. Synthetic pesticides

There are negative financial repercussions for the farmers when pests and insects cause significant losses. Pests are harmful to insecticides and pesticides like organo chlorines, organophosphates, and carbonates. They also tend to bioaccumulate, meaning they accumulate in an organism's body and cause chronic poisoning. The food chain can spread it. Additionally, certain herbicides are naturally absorbed by plants. In this chapter, solutions to agricultural pollution and methods for preventing it are discussed. In prevention, the benefits of organic mulching and the implementation of greenhouse technology were deliberated.

B. Agricultural Pollution Solutions

a. Government Regulation

Controlling agricultural pollution is much more difficult than it sounds. Water, soil, and industrial pollution must be managed to restore the farm to a clean state. Over the past decade, governments have tightened enforcement of regulations.

b. Awareness of farmers

Farmers often unknowingly damage environmental systems. We should teach them that the overuse of fertilisers and pesticides has a substantial negative impact on entire ecosystems. Agricultural pollution can be reduced to some extent by improving farmers' knowledge and awareness.

Appropriate amounts of pesticides and fertilizers are required for proper crop yield. Using a cover crop prevents the soil from being exposed after harvest, thereby reducing soil erosion and protecting waterways. Plant grass, trees, and fences on the edges of fields bordering water bodies. They may act as buffers, filtering out nutrients before they enter the groundwater, thus avoiding nutrient loss. Reduce tillage to reduce runoff, soil compaction and erosion.

Animal and livestock manure are significant sources of agricultural pollution. Dealing with these contaminants is very important. Several fertiliser treatment processes should be implemented to mitigate the negative environmental impact of fertilisers.

c. Changes in farming practices

Many farms are returning to traditional fertilisers, direct irrigation from local water sources, and organic methods to control pest populations. But the process of agricultural pollution needs to be stopped entirely.

C. Prevention of Agricultural Pollution

a. Organic mulching

- Preventing nitrogen- and phosphorus-rich nutrients from entering

water sources near fields and livestock farms is a priority.

- Prevention can never stand alone. State governments, agricultural organisations, collectives and cooperatives, educational institutions, and conservation groups must collaborate to regulate and reduce water pollution caused by agriculture.
- Plant certain grasses and shamrocks that can absorb and utilise excess nutrients and prevent soil erosion. Planting rows of trees and shrubs around fields and along the edges of rivers and lakes can help as well.
- Over-tillage should be avoided to prevent soil erosion and compaction.
- Proper disposal of animal waste and keeping livestock out of water reduces nitrogen pollution in water.
- Composting, solid-liquid separation, anaerobic digestion and lagooning are manure management methods for different types of animals. Of these, anaerobic digestion is the most effective. Utilizes anaerobic bacteria and heat. The products of this process are nutrient-rich liquids used as fertilizer and methane gas, which can be burned to produce electricity and heat. Anaerobic digestion is the preferred method for odour control associated with fertiliser management.

b. Greenhouse technology

- 10-12% yield increase depending on nursery type, product type and nature reserve
- Consistent quality of crop increments in greenhouse development
- Extend development time
- Expand product variations
- Limit external threats to harvest

In this connection, high labour costs, poor pollination, and the need for great care to eliminate pests and diseases, ensuring that the next harvest is not spoiled, are the shortcomings of greenhouse technology. Even though plastic mulching produces more growth in food and nonfood crops, it has some drawbacks, like debris that releases potentially carcinogenic phthalates into the soil, which can be ingested by crops and pose a hazard to human health if ingested. Plastic debris left in fields can also lead to the accumulation of pesticides and other toxins used on crops. This poses a hazard to sheep, goats and other animals that graze the plant stalks, as they can ingest the plastic material and the chemicals it emits. By organising training programs and providing farmers with exposure, these programs help introduce new crop varieties, increase production of paddy, millets, pulses, oilseeds, and maize, and enhance farmers' knowledge and skills. Farmers should also learn about the root causes of agricultural pollution and how to utilise natural resources efficiently. Organic mulching, efficient use of natural resources, and greenhouse technology may be suggested. Our government should formulate comprehensive development plans in agriculture to address agricultural pollution, thereby raising the level of income and standard of living of farmers within a definite framework.

IV. DISCUSSIONS

Our primary food crop is paddy, which is cultivated and harvested three times during the Navaratri season, according to statistics provided by the Joint Director of Agriculture for the last three years (2020-2021, 2021-2022, and 2022-2023). Table 4.1 shows the different sowing seasons in Kanchipuram district [6]. Table 4.2 shows the Paddy yield area coverage details from the last three years. Paddy crops are cultivated, and productivity doubles in the years 2021 and 2022. However, in 2023, only 14% of the target was achieved. It shows the usage of fertilizers and pesticides, which leads to soil contamination and low productivity during the Navarai season. In Millet's crop category, Ragi cultivated and raised its growth by 0.5% among other millets, such as maize, at both the Kharif and Rabi seasons. Table 4.3 shows the pulse yield area coverage details from the last three years. In the pulse crop category, Black gram and green gram's growth is decreased by 1/2 times compared to other pulses like horse gram at the Rabi season, when compared to the Kharif season. Table 4.4 shows the pulse yield area coverage details for the last three years.

In the oilseed non-food crop category, the growth of Groundnut and Gingelly decreased by half compared to other pulses, such as Sunflower, during the Kharif season, when compared to the Rabi season. Sugarcane's growth is reduced by ¾ times during the Kharif season. Table 4.5 shows the Oil seeds and sugarcane yield area coverage details from the last three years. In this study, the suitable seasons for some food crops are as follows: Navarai, millet's suitable seasons are both Kharif and Rabi, while pulses' suitable season is Rabi. Non-food crops, such as oilseeds, are ideal for the Kharif season.

Table 4.1 Shows the Sowing Seasons in Kanchipuram District

Cropping season	Sowing period	Harvesting period	Duration	Crops
Navarai	Nov- Jan	Feb-March	<120 days	Fruits(Banana, Mango), vegetables, cucumber and watermelon
Sornavari (Chithirai Pattam)	April – May	August – September	<120 days	Millets (Ragi and Maize)
Samba (Adipattam)	July – August	January – February	>145 days	Paddy and sugarcane
Kharif (Monsoon/Autumn)	July-October	3rd week of September-October	>300 days	Groundnut, Paddy, Gingelly, Sugarcane
Rabi(Spring)	October-March	April and May	>300 days	BlackGram, Groundnut, Greengram, Gingelly, Sugarcane, Ragi

Table 4.2 Kanchipuram District- Paddy Crop Area Coverage Details

Sl.No.	Name of the crop	Season	Normal area	2020-21		2021-22		2022-23	
				Target	Achievement	Target	Achievement	Target	Achievement
Unit			Ha.	Ha.	Ha.	Ha.	Ha.	Ha.	Ha.
1	Paddy								
		Sornawari	10137	9800	6412	9800	8455	8000	10415
		Samba	16894	21600	14235	20100	15100	15000	13383
		Navarai	10512	8100	27091	8100	27357	19000	28150
	Total		37543	39500	47738	38000	50912	42000	51948

Table 4.3 Kanchipuram District- Millets Crop Area Coverage Details

Sl.No	Name of the crop	Season	Normal area	2020-21		2021-22		2022-23	
				Target	Achievement	Target	Achievement	Target	Achievement
Unit			Ha.	Ha.	Ha.	Ha.	Ha.	Ha.	Ha.
2	Millets								
a.	Ragi	Kharif	50	100	37	0	7	39	20
		Rabi	39	100	15	100	20	120	12
b.	Maize	Kharif	0	100	0	0	7	0	2
		Rabi	0	0	0				0
c.	Cumbu	Kharif	0	0	1				
		Rabi	0	0	0	0	20	10	0
d.	Samai	Kharif	0	100	0			0	1
		Rabi	0	0	0			0	0
	Total		89	400	53	100	54	169	35

Table 4.4 Kanchipuram District- Pulses Crop Area Coverage Details

Sl. No.	Name of the crop	Season	Normal area	2020-21		2021-22		2022-23	
				Target	Achievement	Target	Achievement	Target	Achievement
Unit			Ha.	Ha.	Ha.	Ha.	Ha.	Ha.	Ha.
3	Pulses								
a.	Blackgram	Kharif	110	96	186	300	124	200	127
		Rabi	823	1264	554	650	352	600	364
b.	Greengram	Kharif	107	300	5	0	1	100	5
		Rabi	426	190	475	400	451	500	385
c.	Redgram	Kharif	0	16	0	0	1	0	2
		Rabi	0	32	7	50	0	0	0
d.	Cow pea	Kharif	0	0	0	0	2	0	2
		Rabi	0	32	91	100	25	100	66
e.	Horse Gram	Kharif	0	0	0	0	0	0	0
		Rabi	0	0	1	0	0	0	1
	Total		1466	1930	1319	1500	956	1500	952

Table 4.5 Kanchipuram District- Oilseeds and Sugarcane Area Coverage Details

Sl. No.	Name of the crop	Season	Normal area	2020-21		2021-22		2022-23	
				Target	Achievement	Target	Achievement	Target	Achieve ment
Unit			Ha.	Ha.	Ha.	Ha.	Ha.	Ha.	Ha.
4	Oilseeds								

a.	Groundnut	Kharif	1020	930	1040	630	762	1200	558
		Rabi	2229	3500	1381	3800	1357	2800	1212
b.	Gingelly	Kharif	168	500	117	200	39	200	29
		Rabi	264	250	260	550	251	800	219
c.	Sunflower	Kharif	0	0	0	0	0	0	0
		Rabi	0	50	0	50	0	50	0
d.	Castor	Kharif	0	0	0	30	0	30	0
		Rabi	0	30	0	0	0	0	0
	Total			**5260**	**2798**	**5260**	**2409**	**5080**	**2018**
5	**Sugarcane**								
a.	Sugarcane	Kharif	670	780	522	750	557	750	418
		Rabi	344	170	111	150	128	150	79
	Total		**1014**	**950**	**633**	**900**	**685**	**900**	**497**

Table 4.6 Kanchipuram District (Uthiramerur)- Increase in Yield of Crops through Plastic Mulching Area Coverage Details

Sl.No.	Name of the crop	Season	Normal area	2020-21		2021-22		2022-23	
				Unmulched	Mulched	Unmulched	Mulched	Unmulched	Mulched
Unit			**Ha.**	**Ha.**	**Ha.**	**Ha.**	**Ha.**	**Ha.**	**Ha.**
6	**Vegetables**								
a.	Brinjal	Kharif	344	230	260	330	340	430	560
		Rabi	670	470	560	570	760	570	760
b.	Watermelon	Kharif	168	60	80	100	120	160	260
		Rabi	264	250	400	350	500	250	400
	Total		**1446**	**1010**	**1300**	**1350**	**1720**	**1410**	**1980**

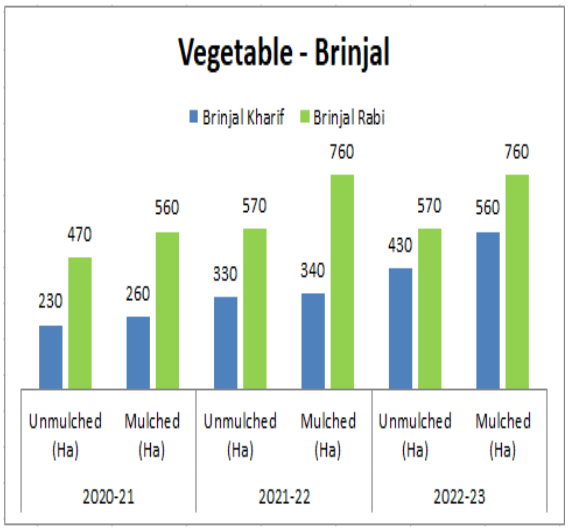

Fig 4.1 (a) Brinjal Crops

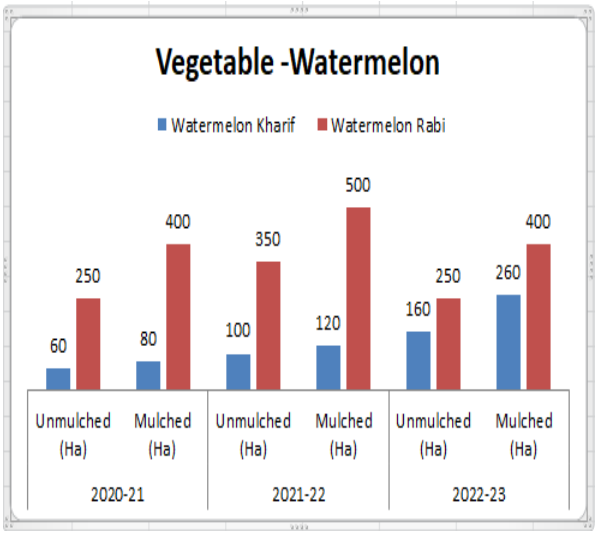

Fig 4.1 (b) Watermelon Crops

Figure 4.1 (a) and (b) show that Brinjal and Watermelon crops achieved the highest productivity at Rabi season using the plastic mulching technique in the years 2020–21 and 2022–22. Since 2020, farmers in Uthiramerur taluk have adopted a plastic mulching method to increase the productivity of Brinjal and Watermelon. Table 4.6 shows the Brinjal and Watermelon yield area coverage details from the last three years.

Provide the recipients with high-quality planting supplies, technical assistance, a comprehensive package of practices, post-harvest technologies, and a marketing strategy as inputs for dense planting. The points mentioned can impart to farmers the benefits of better plant growth and high productivity.

Table 4.7 shows the highest yield of Paddy and Green gram crops of the Navarai and Rabi seasons, respectively, from the years 2020–2021, 2021–2022, and 2022–2023, compared to other crops at different seasons in Kanchipuram district, which was collected from the Joint Director of Agriculture, Kanchipuram.

Table 4.7 Kanchipuram District- Increase in Yield of Crops Area Coverage Details

SI.No	Name of the crop	Season	2020-21		2021-22		2022-23	
			Target (Ha)	Achievement (Ha)	Target (Ha)	Achievement (Ha)	Target (Ha)	Achievement (Ha)
1.	Paddy	Navarai	8100	27091	8100	27357	19000	28150
2.	Greengram	Rabi	190	475	400	451	500	385

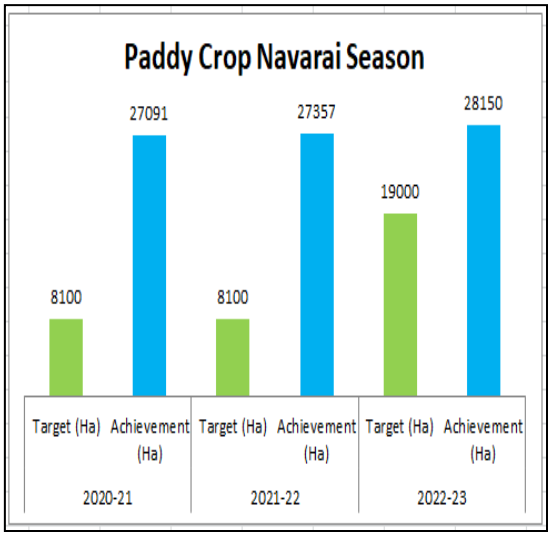

Fig 4.2 (a) Paddy Crops at Navarai Season

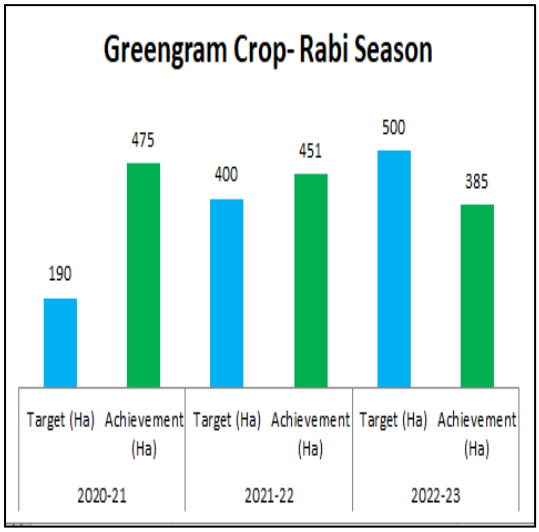

Fig 4.2 (b) Greengram Crops at Rabi Season

Figure 4.2 (a) and (b) show that Paddy crops achieved the highest productivity at the Navarai season, and Green gram crops achieved the highest productivity only at the Rabi season in the years 2020–21 and 2021–22, and productivity dropped in the years 2022–23. To increase crops' sustainable growth in all types of seasons, farmers should adopt government regulation policies to control the soil environment and also know how to measure and improve nutrition and fertiliser management. Priority measures to improve nutrition and fertilizer management

- Increase the circularity of nutrients
- To handle fertilizer and nutrients more effectively, close information and knowledge gaps.
- Strengthen international regulations to encourage fertilizer usage that is both safe and sustainable
- Increase the amount of time spent teaching the necessary parties in fertilizer and nutrient management
- Make sure fertilizers are available that are appropriate and reasonable.
- Ensure thorough national policies for fertilizer quality control.

Additionally, farmers have limited financial opportunities to modernise and mechanise their agriculture. There are good opportunities for contract cultivation of groundnuts and pulses in this region. This area has good market potential as it is closer to Chennai.

V. CONCLUSION

The availability of agricultural labour is a significant issue in our Kanchipuram district. From the assessment, data given by the Joint Director of Agriculture, Kanchipuram district, showed that Paddy crops achieved the highest productivity at Navarai season and Green gram crops achieved the highest productivity only at Rabi season in the years 2020–21 and 2021–22, and productivity dropped in the years 2022–23. Brinjal and Watermelon crops achieved the highest productivity at Rabi season using the plastic mulching technique in the years 2020–21,2021-22. Many large landowners are building in the region, and the availability of farm labour is minimal. This problem can only be solved by mechanizing farm work. Soil salinity also increases due to the poor application of organic fertilizer. Various organic products must replace it. Due to continuous cultivation following the Green Revolution, the use of chemical fertilisers has weakened the soil's structure and texture. To handle fertilizer and nutrients more effectively, close information and knowledge gaps. Strengthen international regulations to encourage fertilizer usage that is both safe and sustainable. It is necessary to renew the soil by adding organic fertilizer. It's very challenging to obtain the required quantity of organic fertilisers, such as cow dung and compost. Green manure crops, such as solar hemp and daincha, are thus recommended to be grown on a large scale, thereby minimising yield variation.

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Availability of Data and Material	Not relevant.
Authors Contributions	All authors have individual partnerships in this article.

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