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Economic implications of shifting from paddy to maize cultivation in north-eastern Haryana: A macro-level assessment

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Abstract

This study evaluates the macro-level viability of substituting water intensive paddy with maize across Kurukshetra and Yamunanagar districts in Haryana. Secondary data were used for the study. Secondary data related export and import details of maize and paddy exchequer available, ground water table, carbon footprint, market and industrial demand for the maize etc were collected from various published and unpublished sources. At the macro level, scaling maize cultivation offers profound sustainability benefits. Diversifying just 50,000 hectares from paddy to maize at the state level can save approximately 0.361 billion cubic meters of water. Furthermore, maize requires less fertilizer (448.31 kg/ha vs. 485.39 kg/ha) and presents a substantially lower carbon footprint. Paddy releases 6.72 tCO₂-eq/ha due to methane emissions from flooded fields, whereas maize emits only 1.29 tCO₂-eq/ha. This 50,000-hectare shift alone would mitigate nearly 271,500 tCO₂-eq of greenhouse gases, while simultaneously feeding thriving poultry, starch, and biofuel industries.

Keywords: Paddy, maize, fertilizer, methane, macro-level

Introduction

Agriculture plays a vital role in the Indian economy by supporting food security, reducing poverty and promoting sustainable economic development. For rural populations, it is their main source of income. Agriculture provides a direct or indirect source of income for around 60 per cent of the population (FAO, 2022) [6]. Agricultural sustainability and resource conservation have become critical focal points for global food systems, particularly in regions dominated by intensive cereal monoculture. For decades, the paddy-wheat cropping system has been the backbone of food security in many developing economies. However, the prolonged and intensive cultivation of paddy (*Oryza sativa* L.) has triggered severe environmental and ecological repercussions. Chief among these are the alarming depletion of groundwater tables, soil degradation, high carbon footprints due to methane emissions, and escalating production costs driven by diminishing returns on inputs. In response to these pressing challenges, crop diversification is widely advocated as a strategic intervention. Transitioning from water-intensive paddy to climate-resilient alternatives like maize (*Zea mays* L.) stands out as a highly viable alternative. Maize requires significantly less water, offers high yield potential, and serves as a critical raw material for diverse industries, including animal feed, starch, and biofuels. The production of food grains is being adversely affected by climate change, and agricultural activities are leading to the emission of GHGs.

Rice fields are a major source of GHGs mainly CH₄ and N₂O and around 30 and 11 per cent of global agricultural CH₄ and N₂O, respectively, are emitted from rice fields (Gupta *et al.* 2021) [9]. According to Jahangir *et al.* (2025) [10], CH₄ dominates in rice systems accounting for 50–80 per cent of total GHG emissions. Unlike rice, maize is an aerobic crop and does not require puddling and submergence for its cultivation. As a result, less energy is needed for tillage operations as well as less water is required for its production, and fewer CH₄ emissions are recorded in comparison to rice fields. Pariharet *et al.* (2018) [19] and Kumar *et al.* (2018) [13] reported that maize-based cropping systems had lower GHG emissions compared to the RW system. Hence, maize is a better option for minimizing groundwater depletion, soil degradation, and GHG emissions in northwestern India. It is recognized that diversification of RW with MW system is vital for the sustainable food production and nutritional security in India (Mukherjee, 2015; Gora *et al.* 2022) [15, 8], particularly in the northwestern Indian region. In recent years, the introduction of single-cross high-yielding and energy-use-efficient maize hybrids provided genotypic options for crop diversification in RW systems. Felix and Ramappa (2023) [7] explored the economic feasibility of crop diversification in India and find that macro-level indicators such as regional policy alignment, input cost rationalization and output price stability play a decisive role in farmers' decisions to switch from paddy to maize. They observed that

maize is both economically and ecologically viable when supported by procurement, logistics and credit systems. However, any large-scale agricultural transition hinges on economic viability. Evaluating the shift from paddy to maize necessitates a comprehensive economic assessment operationalized at two distinct scales. The macro level analysis focuses on water conservation by crops, industrial advantages of maize over paddy, differences in nutrient use pattern and carbon foot print of maize and paddy cultivation in Haryana. Understanding the interplay between these two levels is crucial. A transition that makes environmental sense at the macro level cannot succeed unless it translates into financial profitability and stability for the individual farmer at the micro level. Keeping this in view, the present study was undertaken to determine the macro level of transitioning from paddy to maize cultivation in Haryana.

Methodology

The present study was carried out in Kurukshetra and Yamunanagar districts of Haryana during 2024-25. From both districts, two blocks were purposively selected. Ten farmers were randomly selected for each crop from every selected block. Secondary data related export and import details of maize and paddy exchequer available, ground water table, carbon footprint, market and industrial demand for the maize etc were collected from various published and unpublished sources i.e. Statistical Abstract of Haryana, Agricultural statistics at a glance etc.

The macro level feasibility of replacing paddy with maize extends beyond farm economics and encompasses broader issues such as environmental sustainability, input efficiency and policy alignment. The macro level feasibility of transitioning from paddy to maize cultivation explained in the following which includes the important highlights such as water conservation by the crops at macro level, Nutrients consumed by the crops at macro level, industrial advantages and demand of maize over paddy, Carbon footprint of maize and paddy crop.

Results and Discussion

Comparative water conserved by both the crops

In Haryana, where groundwater depletion has emerged as a major environmental and agronomic concern in recent years, switching from rice to maize production offers enormous possibilities for large-scale water conservation. At the micro level, field data from the research region showed (Table 1) that paddy uses an average of around 9093.67 m³ha⁻¹ of water, but maize only needs about 1,861.8 m³ha⁻¹. This means that growing maize instead of paddy saves 7231.85 m³ of water per hectare. Maize requires only 1,861.8 m³ha⁻¹, compared to 9093.67 m³ha⁻¹ for paddy. This translates to a water savings of 7231.85 m³ha⁻¹ a reduction of nearly 79 per cent in irrigation water use per hectare. These findings are consistent with those reported by Sidhu *et al.* (2019), who noted that water use in maize was significantly lower than that in paddy due to reduced dependence on continuous standing water and flood irrigation methods. When extrapolated to the macro level, the projected water savings are considerable.

When it is scaled at the state level, the implications are profound. In the year 2023–24, the total area under paddy

cultivation was approximately 1.77 million hectares, which resulted in an estimated 16.17 billion cubic meters (m³) of water usage, assuming a standard per hectare water requirement of 9093.67 m³. This massive water footprint has exacerbated the state's groundwater crisis, particularly in overexploited regions of North and Central Haryana. In contrast, maize a crop actively promoted under the “*MeraPaniMeriVirasat*” scheme demands substantially less water. With a per hectare water consumption of just 1,861.8 m³, maize provides an opportunity to drastically reduce irrigation requirements. For the 2024-25 cropping season, the state has set a target of 50,000 hectares for maize, which would use only 93.09 million m³ of water in total. If this area were instead used for paddy, it would require approximately 454 million m³ of water. Therefore, the projected net water savings by substituting maize for paddy on these 50,000 hectares is approximately 0.361 billion m³. This figure aligns with the water-saving estimates reported by Aujla *et al.* (2005) [4], who suggested that substituting paddy with maize or pulses could conserve between 60–80 per cent of irrigation water in northern India. The findings are well aligned with the objectives of the ‘*MeraPaniMeriVirasat*’ (MPMV) scheme launched by the Government of Haryana in 2020, which aims to reduce the area under paddy cultivation in critical water-stressed blocks. Under the MPMV scheme, farmers receive financial support of ₹7,000 per acre for adopting alternative crops like maize, bajra, cotton and pulses. By 2022, 97,000 acres were already diversified under the scheme, with a projected target of 80,000 hectares for 2024–25. This policy has shown promising early results and could serve as a model for other states. The water savings observed in this study also corroborate the projections made by Bassi and Kumar (2012) [5], who argued that replacing paddy with maize in water-stressed states like Punjab and Haryana could lead to substantial improvements in groundwater balance and aquifer recharge rates. In the cropping year 2023–24, Haryana cultivated paddy over an estimated area of 1.77 million hectares, which resulted in a staggering 16.17 BCM of water usage. Replacing even a fraction of this area (*e.g.*, 50,000 ha) with maize, which consumes only 93.09 million m³ for the same area, can result in net savings of 0.361 BCM. These findings affirm the feasibility and effectiveness of targeted crop diversification in achieving the goals outlined in Haryana's State Action Plan on Climate Change (SAPCC) and the “*National Water Mission*” (NWM). These results resonate with the arguments of Kumar *et al.* (2020), who emphasized that even marginal changes in crop choices at the regional level could significantly influence the overall water footprint and resource sustainability of agriculture. The long-term sustainability benefits are also evident. The average groundwater table in Haryana has declined by 10.65 meters between 1974 and 2019 (Aneja, 2017) [1], with some districts witnessing drops below 40 meters. The monoculture of paddy and wheat has directly contributed to this trend. As per the present study, shifting 50,000 ha of paddy to maize could serve as a strategic intervention to curb further depletion. Studies by Sharma and Kumar (2019) [24] support this claim, stating that reducing the area under paddy in favor of less water-consuming crops like maize is critical for reversing the groundwater depletion trend in North India.

Table 1: Estimated total water savings in Haryana by replacing paddy with maize cultivation

S. N.	Particulars	Unit	Maize	Paddy	Difference (Water Saved)
1	Water consumption per hectare	m ³ /ha	1,861.8	9093.67	7231.85
2	Area under cultivation in 2023-24	Ha	4980	17,77,700	-
3	Total water used in 2023-24	m ³	9.27 Million	16.17 billion	-
4	Target area under maize for the year 2024–25	Ha	50,000	-	-
5	Projected water use in 2024–25	m ³	93.09 Million	-	-
6	Projected water saved by maize	m ³	-	-	0.361 billion

Source: Department of agriculture and farmers welfare Haryana

Disclaimer: Results were obtained by field survey of 80 sample size. So, user discretion is intended in using the results

Comparative Market and industrial demand and trade scenario of maize and paddy

Table 2 showed that the industrial demand of maize is higher as compared to the paddy in Indian scenario. Maize has emerged as a pivotal industrial crop in India, with its utilization spanning various sectors. Maize is used as food, feed and fodder and serves as source of basic raw material for the number of industrial products, viz. starch, oil, protein, alcoholic beverages, food, sweeteners, cosmetics, bio-fuel, etc. Globally, maize is primarily used for feed 64 per cent, followed by human food 11–14 per cent (Popp *et al.* 2016) [20]. Starch, Beverages and Bioplastics 5–8 per cent (Shiferawet *al.* 2011) [25]. Thus, maize has attained an important position as an industrial crop because 83 per cent of its produces used in starch and feed industries. It is understood that with the increasing demand for value added

foods & industrial requirements, maize will hold its share as an important cereal crop. In India, maize is used as human food (25–30%), livestock feed 55–60 per cent in which poultry feed industry alone consumes for 49 per cent. Starch, Beverages and Bioplastics 10–15 per cent (Malhotra, S. K. 2017) [16]. This contrasts sharply with paddy, which is primarily consumed as food, with only 10–15 per cent of its total output used in industrial applications such as breweries, bran oil extraction and starch production (ICAR, 2023) [2]. The findings are consistent with Mohanty and Swain (2019) [17], who emphasized the rising domestic consumption of maize in diversified processed food products. Moreover, the poultry feed sector especially in southern and western states like Tamil Nadu, Karnataka and Maharashtra the single largest consumer of maize, accounting for nearly half of the national output (Wadhwani *et al.* 2016) [27].

Table 2: Sector-wise Share of Maize Utilization (%) globally

S. N.	Sector	Share (%)	Reference
1	Feed (Livestock)	~64	Malhotra (2017) [16]
2	Biofuels (Ethanol):	~16–20	Kurowska <i>et al.</i> (2020) [14]
3	Food (Human Consumption):	~11–14	Popp <i>et al.</i> (2016) [20]
4	Industrial (Starch, Beverages, Bioplastics)	~5–8	Shiferawet <i>al.</i> (2011) [25]

Table 3: Sector-wise Share of Maize Utilization (%) India

S. N.	Sector	Share (%)	Details	Reference
1	Feed (Livestock)	55–60	Maize is the primary energy source in poultry and livestock feed	Malhotra (2017) [16]
2	Biofuels (Ethanol):	<5	Under India's ethanol blending program (E20 target).	Jaleta <i>et al.</i> (2022) [11]
3	Food (Human Consumption):	25–30	Consumed as flour (Makkiatta), roasted maize and corn-based snacks.	Mohanty & Swain (2019) [17]
4	Industrial (Starch, Beverages, Bioplastics)	10–15	Brewing and distilling industries use maize for alcohol production. Starch; Used in textiles, paper, adhesives and food processing.	Malhotra (2017) [16]

Maize in Poultry Sector

Maize has emerged as a vital crop in animal nutrition, particularly for the poultry industry. Its high energy content, digestibility and broad availability make it a staple ingredient in poultry feed, especially for broilers and layers. The grain's starch-rich composition ensures efficient energy delivery, while its moderate protein level supports growth and egg production. Globally and within India, maize contributes significantly to the feed sector, with poultry alone consuming over 50–60 per cent of total maize produced in some regions (Malhotra, 2017; Wadhwani *et al.* 2016) [16, 27]. India's poultry sector consumes over half of national maize output. Demand is driven by rapid expansion of broiler production, especially in southern and western states. Over 50 per cent of maize produced in India is consumed by the poultry sector, mainly broiler chicken farms. The southern states (Tamil

Nadu andhra Pradesh, Karnataka, Telangana) and parts of Maharashtra are major demand centres. (Malhotra, 2017) [16]. Globally around 40 per cent of maize is utilised as poultry feed alone (Popp *et al.* 2016) [20] (Table 3).

This demand creates a strategic opportunity for states like Haryana, where a transition from water-intensive paddy to maize cultivation is being explored. The feasibility of this shift is supported not only by agro-ecological suitability maize requires significantly less water and matures earlier than paddy but also by its growing market demand from the feed and poultry processing industries in North India. Haryana is geographically well-positioned to supply maize to poultry hubs in Punjab, Himachal Pradesh and even Rajasthan, where integrated poultry operations rely on timely and affordable feed inputs. By switching to maize, farmers in Haryana can reduce dependence on paddy, which depletes

groundwater and diversify into a market-driven, remunerative crop.

And also, the government's push for ethanol blending in gasoline has led to increased maize utilization in biofuel production. In 2024, around 3.5 million tons of maize were used to produce 1.35 billion liters of ethanol, a fourfold increase from the previous year (Reuters, 2024) ^[21]. Per cent share of different sectors utilising maize in global and India presented in Table 1 and Table 2.

Compared to maize, paddy is primarily a food grain, with very limited industrial applications. Direct consumption (staple food for a major part of the Indian population) Minimal industrial uses such as broken rice in breweries, bran oil extraction from rice bran, in starch and glucose industries in a small quantity. According to Indian council of agricultural research, only ~10–15 per cent (ICAR, 2023) ^[2] of total paddy output is used industrially, the rest is used as direct human consumption.

Hence it clearly shows that maize is having highest industrial demand as compared to paddy and has highest potential for the industrial usage. Rice utilization is mainly restricted to the consumption and have less industrial demand as compared to paddy in India and also in Haryana. India's domestic maize production has faced challenges in meeting the rising industrial demand of maize as per the statistics India produced approximately 36 million tons of maize in 2023-24, but the demand for the maize for the industries has surged due to the increased ethanol production and poultry feed requirements (Reuters, 2024) ^[21]. To bridge the supply-demand gap, India imported approximately 1 million tons of maize in 2024, primarily from Myanmar and Ukraine. Import prices ranged between ₹ 23000–25000 per metric ton, compared to domestic prices of approximately ₹ 24,600 per metric ton(S&P Global Annual Report, 2024). For this the government allowed imports of feed-grade maize at a concessional duty of 15 per cent to alleviate the scarcity in the poultry sector (AgroPages, 2019). Due to the low cost of imported maize and higher industrial demand of maize most of the industries are reliant on import of maize from the countries like Ukraine and Myanmar, if this total demand met by domestic production of maize the industries can shift from using imported maize to domestic grown maize. If the MSP

implemented effectively the farmers can fetch higher prices for their produce and cater the demands of the several industries whose main raw material is maize. Maize is in greater demand from various industries. Farmers benefit from more buyers from ethanol companies, feed manufacturers and starch industries.

Comparative nutrient utilization by maize and paddy crop in Haryana

Table 4 showed that fertilizer consumption is a key metric in evaluating the macro-level feasibility of crop diversification, especially in the context of sustainable input use and agro-environmental impact. In 2023–24, paddy was cultivated on approximately 1.78 million hectares in Haryana, with an average fertilizer application rate of 485.39 kg per hectare. This resulted in an estimated total fertilizer usage of 862.87 million kilograms, reflecting the high input intensity of paddy cultivation. By comparison, maize requires only 448.31 kg of fertilizer per hectare a reduction of about 7.6 per cent per hectare compared to paddy. For the upcoming 2024–25 season, the government has targeted 50,000 hectares for maize cultivation. This would translate into a total fertilizer use of approximately 22.42 million kilograms a significantly lower input burden at the macro level. From a policy and environmental standpoint, these figures underscore the benefits of transitioning toward lower-input crops like maize. Reduced fertilizer use helps mitigate problems such as soil nutrient imbalance, groundwater nitrate contamination and nitrous oxide emissions, all of which are associated with intensive paddy cultivation. Moreover, from an economic perspective, the fertilizer cost for maize is ₹ 688 per hectare lower than for paddy, contributing to input cost savings for both farmers and the state subsidy system.

Therefore, even on a limited scale of 50,000 hectares, maize offers a financially and environmentally sustainable alternative, supporting the broader goals of the *MeraPaniMeriVirasat* scheme. At the macro level, if maize cultivation continues to expand in subsequent years, the potential for system-wide reductions in agrochemical usage and enhanced resource-use efficiency becomes both realistic and scalable.

Table 4: Estimated total amount of fertilizer consumed by the respective crops in Haryana

S. N.	Particulars	Unit	Maize	Paddy
1	Chemical fertilizers applied	kg/ha	448.31	485.39
2	Fertilizer cost	₹/ha	7,384.37	8,072.27
3	Area under cultivation in 2023–24	ha	-	17,77,700
4	Total fertilizers applied in 2023-24	million kg	-	862.87
3	Targeted area under maize Cultivation 2024–25	ha	50,000	-
4	Projected total fertilizers applied	million kg	22.42	-

Source: Department of agriculture and farmers welfare Haryana

Disclaimer: Results were obtained by field survey of 80 sample size. So, user discretion is intended in using the results

Carbon footprint comparison of maize and paddy in Haryana

Over the past five decades, greenhouse gas emissions from Indian agriculture have surged by 161 per cent, rising from 14.81 to 38.71 TgCE/year. This increase is primarily attributed to intensified use of nitrogen fertilizers and a 22 per cent expansion in rice cultivation, which emits significantly more methane than maize (DikshaSah& A.S. Devakumar

2018) ^[23]. Notably, rice cultivation contributes approximately 18 per cent of India's agricultural GHG emissions, whereas maize's emissions are considerably lower, ranging between 0.86 and 3.0 tCO₂-eq/ha, depending on nitrogen application rates (Kumar *et al.* 2021) ^[12]. Total carbon footprints of rice, maize in India were estimated to be 2.44 and 0.80 tCO₂ equivalent ha⁻¹, respectively (Nayak *et al.* 2023) ^[18]. Several research were conducted to identify and estimate the carbon

foot print of maize and paddy; studies consistently shows that paddy cultivation produces a significantly higher carbon footprint per hectare than maize. Paddy emits 4.9 to 7.2 tonnes of CO₂-equivalent per hectare, primarily due to methane emissions from continuously flooded fields and high electricity usage for irrigation. In contrast, maize cultivation results in much lower emissions typically between 1.4 and 2.9 tCO₂-eq/ha since it doesn't require standing water and involves lower energy inputs, especially from electricity and diesel. Rice in India is the most GHG intensive cereal crop (Rao *et al.*, 2019). Most studies agree that the average carbon savings from switching from paddy to maize range 3.1 to 3.4 tCO₂-eq/ha, which is quite substantial at scale. These savings are primarily attributed to reduced irrigation needs, lower fertilizer inefficiencies and less intensive use of machinery. For instance, Ranguwal *et al.* (2023) ^[22] observed that electricity alone accounted for nearly 47 per cent of paddy's energy-related emissions, while in maize, it was under 16 per cent. Nayak *et al.* (2023) ^[18] estimated the product carbon foot prints of paddy and maize in Haryana and found the product carbon foot prints of 1.206 kgCO₂e/kg⁻¹ for paddy and 0.626 kgCO₂e/kg⁻¹ for maize respectively. Methane emission from the paddy cultivation have been noted as a major contributor of GHG emission (Ranguwal *et al.* 2023) ^[22].

In sum, the reviewed literature strongly supports maize as a more environmentally sustainable alternative to paddy in Haryana, especially when considering macro-level impacts on greenhouse gas emissions. Transitioning to maize not only reduces the carbon footprint but also conserves energy and water critical considerations for the region's future agricultural resilience. The average emission reduction by transitioning from paddy to maize was observed to be in the range of 3.1 to 3.4 tCO₂-eq/ha. These findings provide strong evidence supporting the macro-level feasibility of crop diversification in Haryana, not only for conserving resources but also for significantly reducing greenhouse gas emissions in the agriculture sector.

In Table 5 the results of the analysis of carbon foot print comparison of maize and paddy at macro level as per estimates by Ranguwal *et al.* (2023) ^[22], the average GHG emissions from paddy cultivation in Haryana are 6.72 tCO₂-equivalent (tCO₂-eq) per hectare, while those from maize stand at only 1.29 tCO₂-eq/ha⁻¹. This implies a reduction of 5.43 tCO₂-eq/ha⁻¹ when maize is grown in place of paddy. The primary contributors to paddy's higher emissions are methane from flooded soils, high electricity consumption for irrigation and emissions from diesel-operated machinery. Conversely, maize cultivation avoids methane emissions and requires significantly less irrigation energy, thus producing lower emissions. This difference, though substantial at the micro level, translates into even more significant environmental benefits when viewed at scale. In the cropping season of 2023–24, Haryana had an estimated 1.78 million hectares under paddy cultivation. Using the per hectare emission value, this corresponds to a total emission of approximately 11.95 million tCO₂-eq from paddy alone. In contrast, for the 2024–25 cropping season, the state has set a target to bring 50,000 hectares under maize. If this land were instead used for paddy, the estimated emissions would have been 336,000 tCO₂-eq. By cultivating maize on this area, the emissions are expected to be only 64,500 tCO₂-eq, resulting in a net emission reduction of 2,71,500 tCO₂-e. The product carbon footprint of paddy in Haryana, estimated at 1.206 kgCO₂e/kg⁻¹, is nearly double that of maize (0.626 kgCO₂e/kg) (Nayak *et al.* 2023) ^[18], reinforcing maize's advantage even at the product output level.

Thus, the environmental superiority of maize over paddy is clear in terms of per hectare, total and per unit output emissions. The adoption of maize under schemes like *MeraPaniMeriVirasat* (MPMV) can therefore serve the dual purpose of resource conservation and climate mitigation, supporting Haryana's commitment to low-emission agriculture under national and international frameworks like the National Action Plan on Climate Change (NAPCC) and the Paris Agreement.

Table 5: Estimated emission of GHG from maize and paddy in Haryana

S. N.	Particulars	Unit	Paddy	Maize	Difference (avoided)
1	*Emission per ha	tCO ₂ -eq	6.72	1.29	5.43
2	Area under the paddy in the year 2023-24	Ha	17,77,700	-	-
3	Total GHGE by paddy	tCO ₂ -eq	11.95 million	-	-
4	Target area under maize for the year 2024–25	Ha	-	50,000	-
5	Total GHGE	tCO ₂ -eq	-	64500	-
6	Projected Total GHGE avoided by growing maize in place of paddy	tCO ₂ -eq	-	-	0.27million

Source: Department of agriculture and farmers welfare Haryana. * Ranguwal *et al.* 2023 ^[22]

Conclusion

This study involved the macro-level viability of transition from paddy to maize cultivation in Haryana unveils high levels of environmental sustainability, inputs efficiency and industrial demand. Maize cultivation demands much less irrigation of only 1,861.8 m³ha⁻¹ as compared to 9,093.67 m³ha⁻¹ needed for paddy leading to a 79 per cent water saving. Substitution of maize on 50,000 hectares at the state level can save approximately 0.361 billion cubic meters of water. Secondly, maize possesses much greater industrial application with use as a raw material in poultry feed, starch, ethanol and biofuel industries, while paddy is mostly confined to direct human use with limited industrial

application. Fertilizer usage is also less in maize (448.31 kg/ha) than in paddy (485.39 kg/ha), resulting in less input and environmental costs. Most importantly, the carbon footprint of maize is much smaller. Paddy releases 6.72 tCO₂-eq/ha⁻¹ because of methane from submerged fields, whereas maize releases just 1.29 tCO₂-eq/ha⁻¹. Replacing 50,000 ha of paddy with maize can prevent nearly 2,71,500 tCO₂-eq of emissions.

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