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Dynamics of Cereal Crops in Chitwan: Trends and Issues

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Abstract

This research article studies the present condition of cereal crops production in Chitwan and identifies the issues in cereal crop production and yielding in Chitwan. Chitwan, a district in the central part of Nepal, has a value in agricultural production to the whole country. Chitwan faces many ups and downs in the cereal crops production and yielding time and again. These ups and down have an impact to the total life of Nepal. This study uses the existing archival data and follows the analysis and interpretation approach to reach to the conclusion that land use, productivity, environment and wild-life, and technological, and socio-economic constraints are the issues affecting cereal crop production and yielding in Chitwan. Further, it identifies that lack of farming efficiency, absence of promoting cereals holds potential for enhancing food security, environmental threats and economic instability are the critical issues of cereal crop production and yielding in Chitwan today. Key factors influencing the adoption of organic vegetable farming in the area include farm size, farmers' participation in organic farming training, and the compatibility of organic practices with local conditions. Farmer perception, motivation, and involvement in extension activities are critical determinants of farming adoption. Chitwan's agricultural capacity, coupled with its climate and forest resources, makes it a promising area for cultivating high-yielding varieties of crops such as rice, wheat and maize. This research is meaningful in identifying present condition and major challenges of cereal crops production and yielding in Chitwan and to recommend some ways to cope with those challenges.

Keywords: Cereal crop, cultivation, farming, high-yielding, productivity

Introduction

Chitwan district, located in middle part of Nepal is renowned for its lush landscapes and immensely glorified natural beauty. The rare flora and fauna in its lap of the National Park is a perfect example of its agricultural capability and vibrant biodiversity. The district on one hand is renowned for one horned rhinoceros and on other hand it has set a peak mark for agricultural diversity being as a prime production area for mustard, rice and wheat as well. Research on the history of this vivacious cultivation of cereal crops can therefore be a milestone step towards raising awareness on conservation and rectification of agriculture in Chitwan.

Among 223,839 hectares, 59,483 hectares of land in Chitwan are being used for cereal crop cultivation. This means that approximately 26.57% of total land of Chitwan attempts to proselytize cereal crops. Augmenting efficiency is more important than increment of cultivated area. Following the archival study method, this research can perorate that the three most important factors associated with adoption of organic vegetable farming, are: farm size, farmer's participation in organic farming related trainings and visits and compatibility of organic farming to their situations. The detailed study of 'Dynamics of Cereal Crops in Chitwan: Trends and Issues' can help recognize both the deteriorating and flourishing aspects of cereal crops production in Chitwan. This study is important in identifying the central issues of cereal crops production in Chitwan and detecting the points to improve the situation.

Review of Literature

Studies on cereal crops have been made focusing on various issues. Pandey et al. (2021) focus on rice production in their research "Climate Change Impacts on Rice Production in Nepal" that inconsistent monsoon patterns have led to delayed sowing and water stress during critical growth stages, impacting rice productivity (47). It is more related to weather condition and environmental situation.

Similarly, Subedi and Sharma (2019) have studied on the soil fertility. They emphasize on the need for integrated nutrient management practices to restore soil fertility and enhance productivity in Chitwan's agricultural fields (28). Pest infestations and plant diseases significantly affect cereal crops in Chitwan. For instance, maize production is particularly vulnerable to fall armyworm (*Spodoptera frugiperda*), which has spread rapidly in recent years (Bhandari et al., 2020, p. 19). Farmers' limited access to pest management resources exacerbates this issue.

Likewise, irrigation remains a challenge for many farmers. Regmi et al. (2018) note that the reliance on traditional irrigation systems and the absence of modern water management technologies hinder optimal crop production, particularly during dry spells (71). Traditional agricultural system is a present-day challenge. Ghimire and Koirala (2020) argue that smallholder farmers in Chitwan often struggle to adopt advanced farming techniques due to financial and knowledge barriers (34). Even if technologies have been developed but technologies have not reached to the small-scale farmers.

These studies have highlighted issues of soil fertility, technological problem and financial problem as the central points of their research works. Based on these studies, this study sets a point of departure from the limited integration of these factors into a holistic framework that considers both ecological and socio-economic dimensions. Furthermore, there is a lack of region-specific, actionable strategies that address these

challenges in a sustainable and farmer-friendly manner. This study aims to bridge this gap by adopting a comprehensive approach to assess the interconnections between environmental, technological, and socio-economic constraints affecting cereal crop production and yielding in Chitwan. It will also explore adaptive strategies and recommendations tailored to the local context.

Research Questions

This paper addresses the following issues as the research queries.

- What is the trend and context of cereal crop cultivation in Chitwan, including traditional practices and changes over time?
- How do climate and soil conditions affect cereal crop growth and how these have evolved?
- What are the major challenges faced by farmers and potential opportunities for improvement and innovation in cereal crops production and yielding?

Methodology

This research article is of archival nature. It follows qualitative research method. Studying the relevant literature and analysis of secondary data will be the process of data collection. The purpose of this research is to examine the present condition of cereal crop production in Chitwan and identify the issues Chitwan is facing in cereal crop production and thriving. Also, it aims to recommend the points of solution.

Cereal Crops Trend in Chitwan

When history of Chitwan is analyzed, the post 1950 developments brought massive impact to the Chitwan's agriculture. Most parts of the Terai of Nepal were uninhabited by humans until the 1950s due to malaria; but after the eradication of malaria and government resettlement programs in the 1950s, there was a rapid human footprint (Pradhan, 2011). Located at the foothills of the Himalayas, the region contained vast areas of unspoiled virgin forests where ecological processes and natural selection unfolded seemingly undisturbed. With the exception of a few indigenous Tharu tribes, who had lived in the valley for many decades, and occasional expeditions of Rana rulers, who protected Chitwan as their private hunting ground, humans had cautiously avoided the place (Jens Lachmund, 2017). The post 1950s period is when the introduction of irrigation systems and improved farming techniques significantly boosted crop production, The fertile alluvial soil of the Chitwan Valley was well-suited for agriculture, leading to an increase in the cultivation of various crops. The law by then was made so, which would promote the people to migrate from hilly to Terai

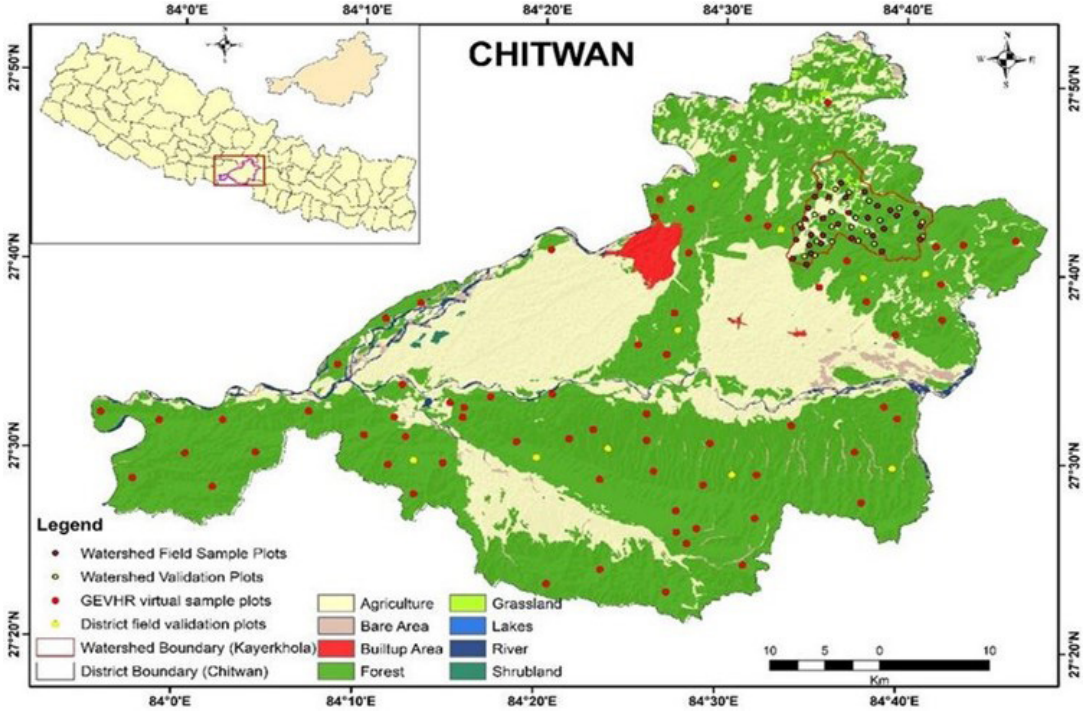
region. And thus, immigrants brought new agricultural practices and crops. Rice, the staple crop, became widely cultivated along with other cereals like wheat, mustard, maize and millet.

The Green Revolution, a concept given by Norman Borlaug, refers to a period of agricultural transformation that began in the 1940s and intensified in the 1960s and 1970s. The first green revolution took place in many developing countries between 1966 and 1985 (Rizal, Youth Engagement and Volunteerism, 2020, pp. 136-138). It involved the introduction of new technologies and farming techniques to increase food production, especially in developing**.** In Nepal, where agriculture transformations were yet to take place, the diffusion effect of the revolution round the world had positive ripples in agricultural production and economics (Rizal, Youth Engagement and Volunteerism, 2020, pp. 136-138). It aimed to combat hunger and involved the introduction of high-yielding crop varieties (especially wheat and rice), modern irrigation methods, chemical fertilizers, and pesticides. These innovations significantly boosted crop output, particularly in countries like India and Mexico. While the Green Revolution helped to prevent widespread famine and made many nations more self-sufficient in food, it also led to environmental challenges such as soil degradation and water pollution, and it widened the gap between wealthy and poor farmers. The concept outran worldwide and its impact could be experienced in different parts of Nepal as well.

The modernization in agriculture in Chitwan was discerned simultaneously with the evolution of the concept of Green revolution (1960s–1980s) worldwide. The introduction of modern agricultural techniques during the global Green Revolution had a substantial impact on Chitwan's agriculture. In the past five decades from 1950 to 2000, the population doubled, the extension of agricultural land was by 30 % yet the production of cereals tripled (Rizal & Pingal, Young Generation towards Green Revolution in Nepal, 2020). High-yield varieties of rice and wheat were introduced, along with chemical fertilizers and pesticides. This led to an increase in agricultural productivity and the expansion of commercial farming in the region. The establishment of agricultural research centers, including the Rampur Agricultural Campus (now part of the Agriculture and Forestry University), further accelerated advancements in farming methods.

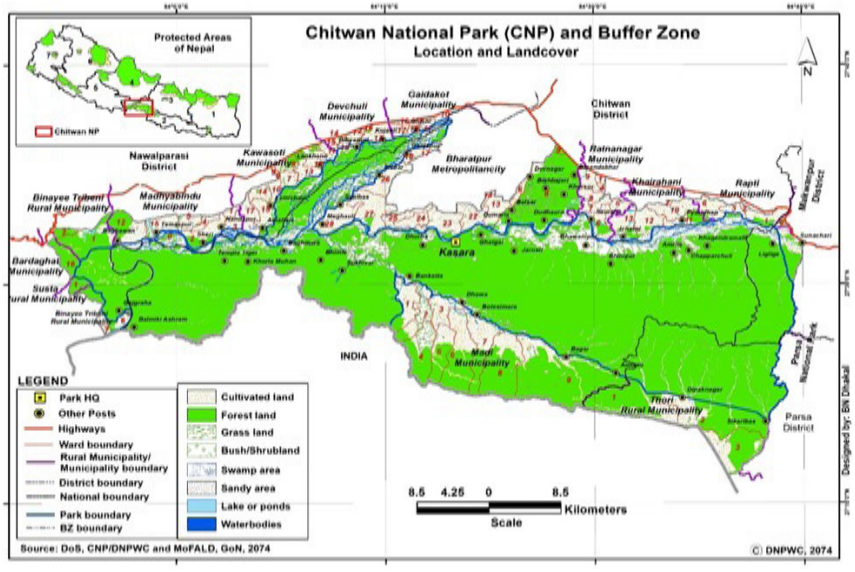
Since the 1990s, it was the time when crop cultivation in Chitwan had diversified significantly. The increase in food production proved the popular Malthusian theory of population and food production wrong (Rizal & Dunn, Young Generation towards Green Revolution in Nepal, 2020). The period when food production surpassed the population growth was celebrated as the first green revolution (Rizal & Pingal, Young

Generation towards Green Revolution in Nepal, 2020). Farmers began growing cereal crops for livelihood and even social diplomacy and cash crops such as mustard, oilseeds, lentils, vegetables, and fruits like bananas and pineapples for commercial purpose. Commercial poultry and livestock farming also expanded during this time. The impact of the Green Revolution was direct on poverty reduction and in lowering the food prices. (Rizal, Youth Engagement and Volunteerism, 2020) With better access to markets, roads, and infrastructure, Chitwan has become an important agricultural center in Nepal. Modern farming techniques, the use of hybrid seeds, and the shift towards mechanization have further boosted productivity.



The delineation below clearly describes the agriculture of Chitwan at present. (Koju, 2019)
Fig. 1. Vegetation at Chitwan

The figure no. 1 offers a detailed geographical representation of Chitwan district highlighting various land cover types, including agriculture, forest, grassland**,** bare areas**,** buildup areas, and rivers**.**
The Ministry of Forests and Environment of Nepal if is followed then we get to see the following figure:



(Ministry of Forests and Environment, 2024)

Fig. 2: Vegetation at Chitwan National Park

The figure no. 2 is a detailed geographic map of the Chitwan district in Nepal. The above picture illustrates the climatic and agronomical elements of Chitwan such as cultivated land, forest area, grass lands, swamp area, sandy area etc. These situations have created many challenges in the cereal crops production.

Cereal Crops Production Issues: Land Use, Productivity, Environment and Wild-Life

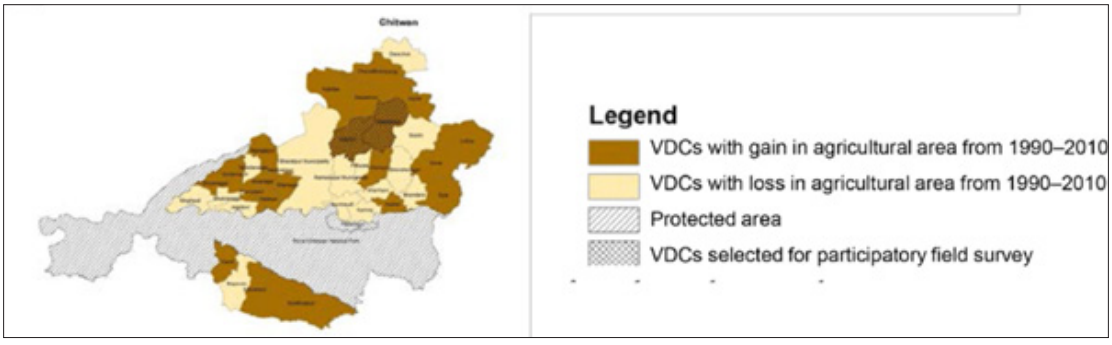
The evolution of cereal crop cultivation in Chitwan, Nepal, offers valuable insights into broader agricultural trends. Historically, cereal production in Chitwan has been a cornerstone of subsistence farming, with the region's fertile plains primarily dedicated to rice, wheat, and maize. According to Müller-Böker (1991) the agricultural economy of the Tharus in the Chitwan valley was dominated by northern Morang pointed to a strong cultural ethos of exchange and reciprocity (Sugden, Dhakal, & Rai, 2022). Over time, however, there have been notable shifts due to technological, socio-economic, and environmental factors.

Cereal cultivation in Chitwan has modernized due to government programs promoting high-yielding seed varieties, improved irrigation systems, and increased use of chemical fertilizers. More mechanized farming has emerged, and there's been a gradual diversification toward cash crops (like fruits and vegetables), which are

more profitable than cereals.The data from Ministry of Agriculture and Livestock Development allows us to perorate into the fact that cereal yields were relatively low in Chitwan prior to the introduction of modern agricultural technologies. The reliance on monsoon rains and traditional seed varieties meant that per hectare yields of rice, maize, and wheat were modest. Furthermore, the prevalence of smallholder farmers, who practiced mixed farming systems, meant that cereal cultivation was interspersed with other crops, leading to less specialization and optimization for cereals alone.
With the adoption of new techniques and seed varieties, cereal yields have improved markedly. For instance, rice productivity in Chitwan has increased significantly due to hybrid seeds and improved irrigation infrastructure. It dominated the country's crop sector accounting for over 42.5 percent (168,047 ha) of the total area under food grains and shared 51.6 percent in total food grain production as of (MOAD, 2017), (Gadal, Shrestha, Poudel, & Pokharel, 2019). Maize and wheat yields have also risen due to better input availability and market access. Government subsidies on fertilizers and programs supporting climate-resilient farming methods have helped increase output despite environmental challenges like erratic rainfall.

The integration of Chitwan into national and regional markets has transformed cereal farming from a subsistence activity to a more commercialized one. This shift has been driven by better access to transportation networks, government programs encouraging market-oriented farming, and increased demand for food in urban centers. This impact was the influence of world's agricultural progress because in between 1960 and 1980, there was a linear increase in its growing area, with nearly 1.5 million ha of new land planted to rice each year in the world paddy scenario too (Lang, Rakszegi, & Bedo, 2014). However, despite this shift, cereal crops are still less profitable than vegetables or fruits, leading some farmers to pivot toward high-value crops.

Environmental challenges in the past, such as dependency on monsoon rainfall, limited the scale and consistency of cereal crop production. Inadequate irrigation systems and traditional farming methods left crops vulnerable to droughts, floods, and pests. Climate change has introduced new risks for cereal cultivation in Chitwan, with increasingly unpredictable rainfall patterns affecting rice and wheat production in particular. It was the time when entire nation including Chitwan was struggling to adjust with the changes in cultivar and cultivations. The growing area was continuing to increase, but the rate of growth has now slowed to 0.7 million ha a year globally (Lang, Rakszegi, & Bedo, 2014). However, modern irrigation systems and the introduction of drought-resistant crop varieties have helped mitigate some of these effects. The three decades starting in 1960 were a period of rapid development, involving intensive mechanization and the improvement of management practices.



(Maharjan, Kochhar, Chitale, Hussain, & Gioli, 2020)

Fig no. 3: Agricultural Status of local level committee of Chitwan from 1990-2010

The figure no 3 illustrates the developmental committees having gain in the agricultural area (shaded dark brown) and also the loss in the agricultural area (shaded light brown) during the time 1990-2010. It shows that land of Chitwan still struggles for promotion of cereal crops. The protected area somehow still has been a praiseworthy mode for thriving vegetations in Chitwan.

Area in Hectare (Ha), Production in Metric Tonnes (Mt), Yield in Mt/Ha

	2078/79 (2021/22)			2079/80 (2022/23)		
District	Area	Production	Yield	Area	Production	Yield
Makawanpur	43,617	141,471	3.24	43,095	137,801	3.20
Chitwan	63,402	236,145	3.72	59,483	224,425	3.77
Bagmati Subtotal	476,432	1,451,755	3.05	458,530	1,410,282	3.08

(Ministry of Agriculture and Livestock Development, 2023)

Table No. 1: Aggregate Major Cereal Crops (Paddy, Maize, Wheat, Millet, Barley, and Buckwheat), by District. Fiscal Year 2078/79 (2021/22**)** and 2079/80 (2022/23)

Table no 1 illustrates the area of production of popular cereal crops in Chitwan i.e. maize, wheat, millet, barley, etc. It also demonstrates the present average production condition of those cereal crops. The yield of production has raised to 3.77 Mt/Ha from 3.72 Mt/Ha which is just a satisfactory result though it stands 3rd highest in Bagmati Province alone.

	2078/79 (2021/22)			2079/80 (2022/23)		
	Bagmati	Chitwan	Share of Chitwan	Bagmati	Chitwan	Share of Chitwan
Cultivation Area	476,432 hectares	63,402 hectares	13.30%	458,530 hectares	59,483 hectares	12.97%

Production	1,451,755 metric tons	236,145 metric tons	16.26%	1,410,282 metric tons	224,425 metric tons	15.91%
Yielding	3.05 Mt/Ha	3.72 Mt/Ha		3.08	3.77	

Table no 2: Collation between Bagmati Province and Chitwan's status

Table no 2 shows that the average area of cultivation in Chitwan is found to be 59,483 hectares (decreased from 63,402 hectares) and the average area of cultivation in Bagmati Province is measured to be 458,530 hectares (decreasing from 476,432 hectares)**.** Similarly, from given data the role of Chitwan in Bagmati Province can be calculated to be 13.30% in fiscal year 2078/79 and 12.97% in fiscal year 2079/80. The average Production in Chitwan was found to be 224,425 metric tons and the average production in Bagmati Province was collected as 1,410,282 metric tons. This helps to calculate the role of Chitwan to be 15.91%. Meanwhile, the average yield of Chitwan was calculated to be 3.77 Mt/Ha and the average yield of Bagmati Province is expected to be 3.08 Mt/Ha. Each and every datum in table no. 2 describes many facets of agricultural activities prevailing in Nepal and the level of concentration paid to the field. Chitwan is relatively in low status of cereal crops cultivation and yield. Yield being increased, cultivated area being decreased and production being declined reflects the efficiency of advancements in the field. However, getting high productivity with decreased cultivation area cannot be fully contenting to some extent. Despite its advancements and modernization, Chitwan is not in the race of high production of crops as it has to be. Though its cultivability and fertility can never be doubted because it has been a shelter to wide variety of perennial or seasonal vegetations and forests since many decades. Overally, if agricultural factor is taken, the supremacy of Chitwan can hardly be matched but with aspect to cereal crops, it has a lot to improve.

	2078/79 (2021/22)			2079/80 (2022/23)		
	Nepal	Chitwan	Role of Chitwan %	Nepal	Chitwan	Role of Chitwan %
Cultivation	3,486,249 hectares	63,402 hectares	1.81%	3,343,135 hectares	59,483 hectares	1.77%
Production	10,772,498 metric tons	236,145 metric tons	2.19%	10,913,266 metric tons	224,425 metric tons	2.05%
Yielding	3.09 Mt/Ha	3.72 Mt/Ha		3.26	3.77	

Table no 3**:** Collation Between Chitwan and whole Nepal's status

As of (Ministry of Agriculture and Livestock Development, 2023), The average area of cultivation in Nepal decreased from 3,486,249 hectares to 3,343,135 hectares and the average area of cultivation in Chitwan changed to 59,483 hectares. The average production in Chitwan was found to be 224,425 metric tons and that the average production in Nepal is around 10,913,266 metric tons. The average yield of Chitwan was approximately 3.72 Mt/Ha till 2079 and reached 3.77 Mt/Ha during 2080 whereas the average yield of Nepal was expected to be 3.09 Mt/Ha but it increased to be 3.26 Mt/Ha at fiscal year 2079/80. There is a wide variety of topographical qualities that affects the production of cereal crops in Nepal. Chitwan has humid subtropical monsoon influenced climate which is suitable for the cereal crops like wheat, maize, soybean, etc. From 1.81% of total cultivated land of Nepal, 1.77% of total cultivated land is used by Chitwan for cultivation of cereal crops whereas about 2.05% of total productions of Nepal is contributed by Chitwan alone. The proportion is quite less as compared to the standard of developments the Chitwan has maintained, and in this case too, there are some faces that requires improvement.

Area in Hectare (Ha), Production in Metric Tonnes (Mt), Yield in Mt/Ha

Districts		Spring Season Area	Spring Season Production	Spring Season Yield	Main Season Area	Main Season Production	Main Season Yield	Total Area	Total Production	Total Yield
DOLAKHA	-	-	-	2,814	6,894	2.45	2,814	6,894	2.45	
SINDHUPALCHOK	464	1,956	4.22	8,871	25,815	2.91	9,335	27,771	2.97	
RASUWA	85	304	3.58	1,102	2,325	2.11	1,187	2,629	2.22	
RAMECHAP	14	52	3.72	8,615	18,695	2.17	8,629	18,747	2.17	
SINDHULI	1,120	5,220	4.66	12,950	48,951	3.78	14,070	54,171	3.85	
KAVRE	100	550	5.5	9,880	37,850	3.83	9,980	38,400	3.85	
BHAKTAPUR	-	-	-	3,891	19,922	5.12	3,891	19,922	5.12	
LALITPUR	-	-	-	4,012	17,894	4.46	4,012	17,894	4.46	
KATHMANDU	-	-	-	5,556	25,058	4.51	5,556	25,058	4.51	
NUWAKOT	6,477	28,379	4.38	11,370	46,844	4.12	17,847	75,223	4.21	
DHADING	2,305	11,090	4.81	11,240	44,510	3.96	13,545	55,600	4.1	
MAKWANPUR	2,530	10,626	4.2	9,540	37,690	3.95	12,070	48,316	4	
CHITWAN	5,028	24,134	4.8	22,350	85,688	3.83	27,378	109,822	4.01	
BAGMATI	18,123	82,311	4.54	112,191	418,135	3.73	130,314	500,446	3.84	

(Ministry of Agriculture and Livestock Development, 2024)

Table No 4: Paddy by Seasons and Districts, Fiscal Year 2079/80 (2022/23)

The Ministry of Agriculture and Livestock Department of Nepal recognizes the differences in the agricultural activities, its impacts and its consequences in two different seasons so it has distributed the data as such so that there could be detailed and flawless study about area of cultivation, production and yield of cereal crops. The (Ministry of Agriculture and Livestock Development, 2023) indicated that, Chitwan cultivates 4,975 hectares of its land during spring season whereas 22,940 hectares is cultivated at its main season. Thus, during its whole cycle of cultivation of crops, about 27,915 hectares of total area of Chitwan is utilized for cultivation of cereal crops in its season.

Meanwhile, it_implies that, with respect to area used for cultivation, Chitwan cultivates 5,028 hectares of its land during spring season whereas 22,350 hectares is cultivated at its main season. Thus, during its whole cycle of cultivation of crops, about 27,378 hectares of total area of Chitwan is utilized for cultivation of cereal crops in its season. Among districts of Bagmati Province, Chitwan ranks 1st in case of total area of cultivation, production as well as yield of cereal crops too. Though it remains behind during some specific seasons (as of Spring season) but Chitwan tremendously hits a comeback resulting in massive data of given aspects. So, Chitwan has one of the largest areas dedicated to paddy cultivation, ranking among the top districts in Bagmati Province. This suggests that rice remains a staple crop in Chitwan, especially during the main monsoon season.

With respect to production of crops**,** Chitwan produces 20,980 metric tons of paddy during its spring season in 2078/79 and 24,134 metric tons of paddy during its spring season in 2079/80. Meanwhile during main season, it produces 83,564 metric tons of paddy in 2078/79 and 85,688 metric tons in 2079/80. Thus, during the whole cycle of paddy production, approximately 109,822 metric tons are produced. It says that Chitwan is a significant producer of rice in Bagmati, with its production levels among the highest compared to other districts. Its total production is notable, contributing heavily to the province's overall rice supply.

With respect to yield productivity, Chitwan yields 4.8 metric tons per hectare of crops during spring season and 3.83 metric tons per hectare of crops during main season. As a whole 4.01 metric tons per hectare is the total annual yield of Chitwan. This demonstrates the fact that Chitwan's yield per hectare is has attained huge progress in this one-year interval. However, its spring season yield (4.8 Mt/Ha) is above average, indicating better productivity during the off-season. This could be due to irrigation, better seed varieties, or targeted agricultural practices during the spring season. In case of Production Scale, Chitwan's 109,822 metric tons of total paddy production make it one of the top producers in Bagmati Province. For example, Nuwakot**,** which also has a

large area (75,223 Mt), lags behind in production. This highlights Chitwan's efficiency in utilizing its agricultural land.

Similarly, in area under cultivation**,** Chitwan's 27,378 hectares dedicated to paddy is only surpassed by Nuwakot. This vast cultivation area reflects Chitwan's status as an agricultural hub, leveraging the fertile plains of the Terai region. The yield comparison meanwhile brings discontentment. While Chitwan performs well in terms of total area and production, its yield during the main season (3.83 Mt/Ha) is lower than other districts like Bhaktapur (5.12 Mt/Ha), which is more urbanized and uses intensive farming techniques on smaller plots. This suggests that while Chitwan produces large volumes, there may be room to improve productivity, especially in the main season.
Chitwan is one of the largest producers of paddy in Bagmati Province, with extensive land devoted to both spring and main season crops. While its overall production is strong, there is potential to enhance yields, particularly during the main season, through modern farming techniques, improved seed varieties, and efficient use of water resources. This would further bolster Chitwan's position as a key player in Nepal's food security.

Area in Hectare (Ha), Production in Metric Tonnes (Mt), Yield in Mt/Ha

	2078/79 (2021/22)						2079/80 (2022/23)					
	Maize			Wheat			Maize			Wheat		
District	Area	Production	Yield	Area	Production	Yield	Area	Prod.	Yield	Area	Prod.	Yield
Lalitpur	8,573	33,656	3.93	3,485	11,858		9,160	36,823	4.02	2,502	9,357	3.74
Kathmandu	6,897	29,748	4.31	3,200	11,174	3.49	6,317	25,331	4.01	2,043	9,480	4.64
Nuwakot	16,206	49,408	3.05	4,495	16,044	3.57	16,218	49,457	3.05	4,493	16,021	3.57
Dhading	19,776	45,785	2.32	4,748	15,396	3.26	19,530	48,750	2.50	4,650	13,113	2.82
Makwanpur	24,113	78,209	3.24	4,128	13,622	3.3	24,120	72,360	3.00	3,840	13,440	3.50
Chitwan	28,055	105,239	3.75	5,151	23,248	4.51	26,116	96,629	3.70	3,460	15,224	4.40
Bagmati Subtotal	216,338	696,409	3.22	59,156	173,472	2.93	210,686	678,365	3.22	52,087	153,441	2.95

(Ministry of Agriculture and Livestock Development, 2024)

Table No. 5: Maize and Wheat by Districts, Fiscal Year 2078/79 (2021/22) and 2079/80 (2022/23)

Maize Cultivation in Chitwan is one of the prominent agricultural practices. The Area of cultivation is 26,116 hectares and production is 96,629 metric tons. It means the yield of maize crops from Chitwan is 3.70 metric tons per hectare. The table no 5 demonstrates the decreasing area and production whereas increasing yield that indicates the increment in productivity through the use of fertilizers despite the impact

of urbanization. In terms of area, Chitwan has the largest area under maize cultivation in Bagmati Province, with 26,116 hectares (Ministry of Agriculture and Livestock Development, 2024). This demonstrates the district's heavy reliance on maize as a staple and cash crop. On the other hand, in case of production, Chitwan's maize production of 96,629 metric tons is the highest among all its neighboring districts and the districts listed, making it the leading maize producer in Bagmati Province. Thus, the yield in Chitwan is 3.70 metric tons per hectare, which is slightly above the provincial average of 3.22 metric tons per hectare.

The area of cultivation is 3,460 hectares and the production is about 15,224 metric tons. This signifies that the Yield is 4.40 metric tons per hectare. In matter of maize cultivation, Chitwan dominates maize production in Bagmati Province, both in terms of area and total output. However, the yield, though above average, lags behind districts like Kathmandu and Lalitpur, indicating room for productivity improvement (Ministry of Agriculture and Livestock Development, 2024). Furthermore, farmers seem to lose interest in wheat cultivation as reflected by recent data.

Meanwhile, if the point is shifted for wheat, Chitwan stands out for its high productivity in wheat cultivation, with the highest yield among all districts after Kathmandu. The capital city boosts up its productivity in these recent days as analyzed from table no 5. This indicates that wheat farming in Chitwan is particularly efficient and might be benefiting from more modern farming techniques or better resource management.

To provide overall insight, it can be understood that Chitwan is a good leader in both maize and wheat production in Bagmati Province, with particularly strong performance in wheat yield. The focus for future growth could be on enhancing maize yields to match the productivity levels seen in districts like Kathmandu. This could involve improved seed varieties, better irrigation, and advanced farming techniques.

Area in Hectare (Ha), Production in Metric Tonnes (Mt), Yield in Mt /Ha

Districts	Millet			Buckwheat			Barley		
	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield
DOLAKHA	3,675	5,219	1.42	935	870	0.93	136	165	1.21
SINDHUPALCHOK	17,550	23,693	1.35	205	185	0.9	165	155	0.94
RASUWA	895	1,012	1.13	21	19	0.9	243	331	1.36
RAMECHAP	4,884	5,470	1.12	18	15	0.83	63	85	1.35
SINDHULI	12,065	12,371	1.03	456	376	0.82	36	58	1.61

KAVRE	3,510	4,563	1.3	600	648	1.08	347	340	0.98
BHAKTAPUR	86	224	2.6	-	-	-	16	50	3.1
LALITPUR	520	546	1.05	-	-	-	40	48	1.21
KATHMANDU	602	632	1.05	4	4	1.03	-	-	-
NUWAKOT	5,114	7,258	1.42	219	231	1.05	154	194	1.26
DHADING	6,920	6,445	0.93	92	78	0.85	278	312	1.12
MAKWANPUR	2,655	3,186	1.2	170	187	1.1	240	312	1.3
CHITWAN	1,464	1,610	1.1	1,050	1,113	1.06	15	26	1.2
BAGMATI	59,940	72,228	1.21	3,770	3,725	0.99	1,733	2,076	1.2

(Ministry of Agriculture and Livestock Development, 2024)

Table No. 6: Millet-Barley-Buckwheat by Districts, Fiscal Year 2079/80 (2022/23)

The (Ministry of Agriculture and Livestock Development, 2023) presents data on the cultivation of millet**,** buckwheat**,** and barley in districts of Bagmati Province for the fiscal year 2078/79 (2021/22) and table no. 6 represents for fiscal year 2079/80 (2022/23). The data try to explain trend of millet**,** buckwheat, and barley flourishing in different district of Bagmati province. The division of data in such way helps to make deep analysis about why the crops are thriving in different manner though their administrative, political and climatic difference doesn't differ much unless its topographic landscapes are considered.

When Millet Cultivation in Chitwan is taken into consideration, its area of cultivation is found to be decreased from1,478 hectares to 1,464 hectares and its production fell from 1,693 metric tons to 1,610 metric tons. The yield went to 1.1 metric tons per hectare which portrays the declining in millet agricultural status. If area is concentrated**,** Chitwan's millet cultivation area is relatively small compared to districts like Dhading (6,920 hectares), Sindhuli (12,065 hectares) and Sindhupalchowk (17,550 hecatres). This suggests that millet is not a dominant crop in Chitwan, possibly because of the district's focus on higher-yield cereals like maize and rice.

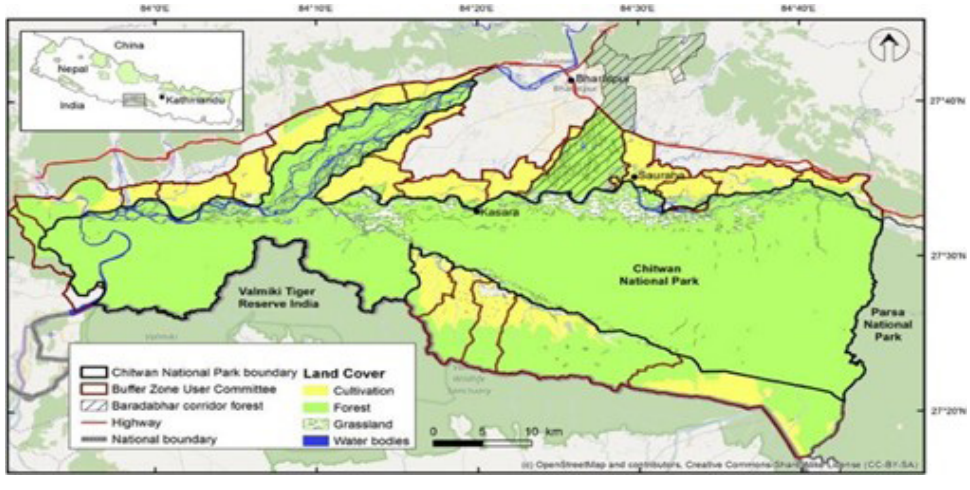
Meanwhile**,** with 1,610 metric tons of millet produced, Chitwan's contribution is modest. The production levels are considerably lower than those of major millet-producing districts like Sindhupalchowk (23,693 metric tons). Chitwan's millet yield of 1.1 metric tons per hectare is slightly below the provincial average of 1.21 Mt/Ha. It also lags behind many other districts, indicating potential for productivity improvement through better farming techniques or seed varieties. When Buckwheat Cultivation in Chitwan is taken into consideration, its area of cultivation is found to be 1,050 hectares declining from 1,300 hectares meanwhile its production is 1,113 metric tons. The yield has slightly depressed to1.06 metric tons per hectare from 1.07 Mt/Ha which warns the

condition of buckwheat in Chitwan.

Chitwan has one of the larger areas devoted to buckwheat cultivation compared to districts like Kathmandu (4 hectares) and Ramechhap (18 hectares). Chitwan stands second highest in area of buckwheat cultivation among entire nation after Jhapa (1,850 hectares), indicating that dwellers of Chitwan is highly focused on the buckwheat growth these days. Chitwan's production of 1,113 metric tons is the highest compared to other districts in Bagmati. The individual yielding of Chitwan being 1.06 metric tons per hectare exceeds the provincial yield (0.99 Mt/Ha) indicating the outstanding result of Buckwheat cultivation in Chitwan.

When Barley Cultivation in Chitwan is taken into consideration, its area of cultivation is found to be 15 hectares meanwhile its production is 26 metric tons**.** The yield is 1.2 metric tons per hectare which portrays deteriorating stats than in the previous fiscal year.

As a key insight, it can be analyzed that, Chitwan is a moderate millet producer but lags behind leading districts. While its yield is slightly below average, improvements could raise productivity. Chitwan shows promise with one of the larger areas dedicated to buckwheat, though its yield being improved to match top-performing districts. Chitwan's barley yield is excellent, but the crop is grown on a very small scale, indicating that the focus



(Lamichhane, 2017)

Figure no. 5: The Land use of Chitwan

In the post-Green Revolution period, increased inputs and, most recently, technical change have sustained productivity growth, particularly in Asia. Recent signs indicate,

however, that productivity growth of the primary cereals- rice and wheat—has slowed, especially in the intensively cultivated lowlands of Asia. Degradation of the land resource base resulting from intensive cultivation and a slackening of infrastructure and research investments have curtailed productivity growth. Future increases in productivity growth will require substantial research investments to shift the yield frontier and make cereal-crop production more profitable through greater input efficiency. (Pingali & Heisey, 2001) Nepalese economy is heavily dependent on the agriculture sector, which contributes about 26% of the total GDP and 60.4% of Nepalese population are involved in agricultural sector**.** (MOF, 2021) (NPC , 2019) The study has confirmed earlier research which showed that farmer' perception and motivation about organic farming and participation in extension activities are the main determinants of organic farming among small farmers in Iran (Kafle, 2011).

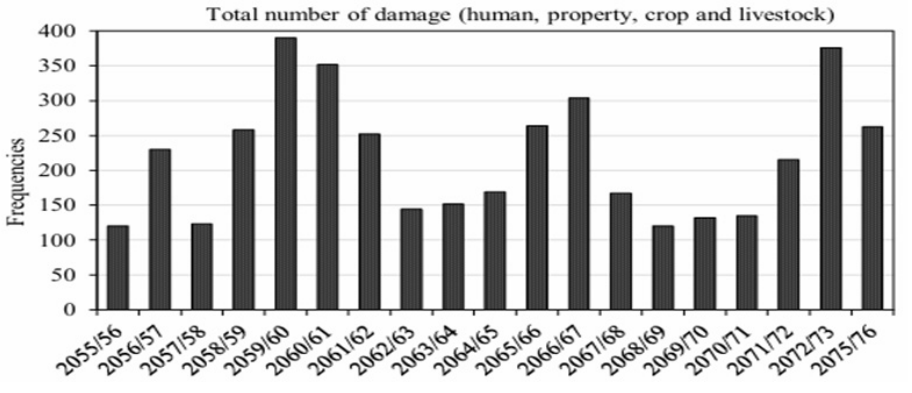
Environmental factors play very crucial role in the growth and also in the development of crops. The simulation of crop development, growth, and yield is accomplished through evaluating the stage of crop development, the growth rate and the partitioning of biomass into growing organs. All of these processes are dynamic and are affected by environmental and cultivar specific factors. (Ritchie, 1998)**.** That's why the crops of same topographic structures can vary. Environmental factors and stresses affecting the cell expansion are different from those that affect mass growth. This is why plants' vegetative stage at different temperatures and at similar radiation levels, with time, have a different size and mass (Ritchie, 1998). Such case can affect the crop cultivation, production and yield in both positive or negative way. One of the ways to stabilize the environment and maintain homeostasis or uniformity in plants or crops can be artificial greenhouse.

The principal environmental factor affecting both phasic and morphological development rates is the temperature of the growing part of the plant. The cultivar characteristics affecting plant response to photoperiod is also an important determinant of the duration of growth in addition to the temperature influence (Ritchie, 1998)**.** *Rameur* first suggested in 1735 that the duration of particular stages of growth was directly related to temperature and that this duration for a particular species could be predicted using the sum of mean daily air temperature (Wang, 1960)**.** The length of the day (or night) can influence the rate at which plants change from vegetative growth to reproductive growth. This phenomenon or process is defined as photoperiodism. Maize, sorghum, pearl millet and rice are termed short day plants because they have minimum vegetative development in long days. In contrast, wheat and barley are long day plants and minimize their development during short days. (Ritchie, 1998)

Vernalization is a chilling treatment given to plant seeds for controlling germination

or flowering. Vernalization is assumed to occur at temperatures between 0 and 18°C (Ahrens, 1963; Trione, 1970). Winter wheat and barley varieties usually require exposure to relatively low temperatures before spikelet formation can begin. (Ritchie, 1998). But the optimum temperature for vernalization is assumed to be in the range of 0 to 7°C, with temperatures between 7 and 18°C having a decreasing influence on the process. Spring wheat varieties have a low sensitivity to vernalization. (Ritchie, 1998)**.** All these environmental factors and their variation in Chitwan, greatly affects the results and trends of cereal crops.

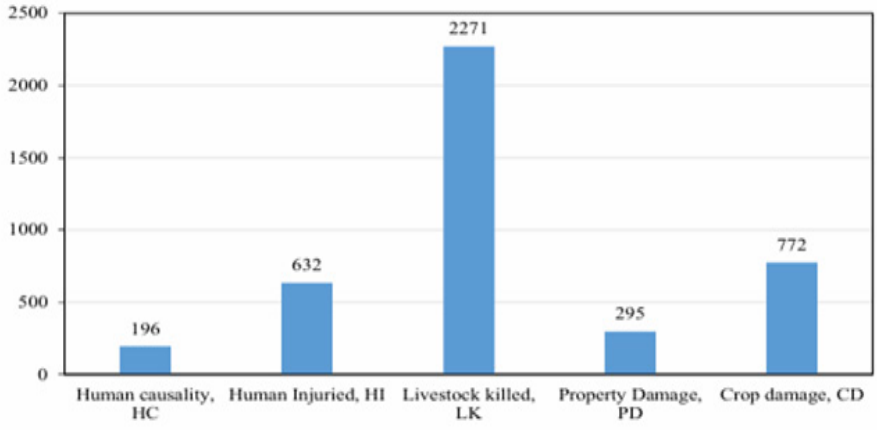
The cultivation and management of cereal crops is not an easy job. Sometimes, its practice is challenged by nature, some days by facilities, some days by climate and some days by individual snags. But among all the major challenge for the farmers in Chitwan is the wildlife-induced damage. Since most of the area of Chitwan is covered by national park, the animals cause a lot of impact in the agriculture of Chitwan nearby. Many studies and reports illustrate the harms of such problem but none of the mitigating measures seem to be followed. Diagrammatically, the data can be represented as:



(Barrientos, 2009) (Ghimire, 2022)

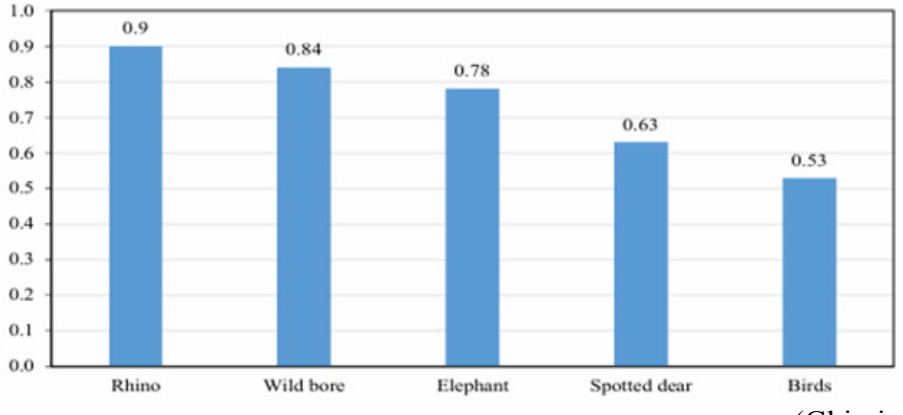
Figure no. 6: Frequency of total damage due to wild-life conflict around Chitwan National Park

The damage by wild boar is probably the most widespread because of its availability in almost all forested habitats including highly degraded and fragmented ones (Subedi, 2020). A total of 87.86% of rice-growing households reported damage to rice, whereas 90.32% and 87.68% of households reported damage to wheat and maize, respectively. The loss of wheat and maize per household was 86 and 96 kg with the worth of NRs. 2523 and 2019, respectively. (Ghimire, 2022). The severity of wildlife-induced damage to crops was more near the borders of national parks and buffer zone.



(Ghimire, 2022)

Figure No. 7: Total frequency of different types of wild-life conflicts in last 20 years around Chitwan National Park



(Ghimire, 2022)

Figure No. 8: Ranking of wildlife for crop damage.

The fig no 7 and 8 present that 90.32% of wheat growers and 87.68% of maize growers reported the damage (Ghimire, 2022). The major problematic animals in the study area are rhinos, wild boars, elephants, spotted deer, and birds. Almost all (87.65-90.32%) people are suffering from crop and livestock as well as poultry loss damage. The average loss from crop damage was 78 kg rice/HH (worth of NRs. 1776), 86 kg wheat/HH (NRs. 2583/HH), and 96 kg maize/HH (NRs. 2019/HH). (Ghimire, 2022). The farmer' perception and motivation about organic farming and participation in extension activities were the main determinants of organic farming among small farmers (Kafle, 2011) too.

In this way, cereal crop production in Chitwan has greater significance in the national production and has higher potential among other districts. However, the production is not smooth and steady. There are different factors for the instability of its production. Land use, productivity, environment, wildlife and socio-economic factors like the market are the issues Chitwan is facing in Cereal crop production and yielding.

Recommendations

Focus on Millet and Barley is essential to uplift the quality and quantity of capabilities of Chitwan for the promotion of cereal crops. Chitwan grows both Millet and Barley but at relatively modest levels compared to its cereal crop (maize, rice, wheat) cultivation. Millet and buckwheat are likely secondary crops in Chitwan's agricultural portfolio, cultivated in smaller pockets of land. Buckwheat cultivation has amazingly increased in fiscal year 2079/80 being the 2nd highest cultivator and producer district in whole Nepal.

Room for yield improvement can be observed and this step can help dominate the cereal crops production because Chitwan's land has huge potential to endorse such crops if essential heed is paid, and if necessary prerequisites are ensured. The environmental challenges, wildlife-induced damage and every other aspects of crop devastations must be taken into considerations.

Improving productivity aligns with national goals of boosting agricultural output and reducing reliance on food imports. However, advancing modern farming techniques, irrigation, and market infrastructure is essential. Sustainable agricultural practices must be prioritized to protect natural habitats and forested areas. By introducing better seed varieties and integrated farming practices, Chitwan could achieve a sustainable balance between rural development and long-term agricultural growth.

Conclusion

Hence, cereal crop production in Chitwan holds significant importance in national production and demonstrates higher potential compared to other districts. However, its production is neither smooth nor consistent. Various factors contribute to this instability, such as, land use, productivity, environmental challenges, wildlife, and socio-economic issues such as market dynamics. Besides, farming technology and farmers security are other issues. These factors collectively impact cereal crop production and yields in the region.

The promotion of cereal crops in Chitwan holds significant potential for enhancing both food security and economic stability in the region. Given Chitwan's agricultural resources, forest cover, and favorable climate, the cultivation of high-yielding varieties

of crops such as rice/paddy, maize, wheat, and rice could lead to increased productivity. This aligns well with broader national goals of improving agricultural output and reducing dependency on food imports. However, to maximize the benefits, efforts must be made to improve access to modern farming techniques, irrigation facilities, and market infrastructure. Enhancing productivity aligns with national goals to increase agricultural output and reduce dependence on food imports. Advancing modern farming techniques, irrigation, and market infrastructure is crucial. Prioritizing sustainable practices will help protect natural habitats and forests. By adopting improved seed varieties and integrated farming methods, Chitwan can achieve a sustainable balance between rural development and long-term agricultural growth.

Moreover, sustainable practices should be encouraged to balance agricultural expansion with the region's environmental conservation needs, ensuring that forested areas and natural habitats remain protected. Promoting cereals in Chitwan through the introduction of better seed varieties and integrated farming practices can offer a sustainable pathway to both rural development and long-term agricultural growth.

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