Journal of Nepal Agricultural Research Council
Vol.11:9-18, December 2025
ISSN: 2392-4535 (Print), 2392-4543 (Online)
DOI: https://doi.org/10.3126/jnarc.v11i01.86784

Maize Self-Sufficiency Projections for 2050: Challenges and Opportunities in Nepal

S Khaniya[1@], Karki R[1], Kafle S[1]

[1]Himalayan College of Agricultural Sciences and Technology, @: sachinkhaniya.agri7@gmail.com, https://orcid.org/0009-0008-5135-2870; RK: karkirojan.ag@gmail.com; SK: sagar1kafle@gmail.com

Received: Sept. 16, 2024, Revised: Dec. 19, 2024, Accepted: March. 25, 2025, Published: December, 2025.

The authors declare that there is no conflict of interest.

ABSTRACT

Maize is a vital staple crop in Nepal, crucial for food security, rural livelihoods, and animal feed. However, challenges such as low yield, limited use of high-yield varieties, climate impacts, and pest infestations hinder production, contributing to rising import dependency. This study examines current maize production, identifies challenges, and explores the potential for achieving self-sufficiency by 2050. Using data from secondary sources, government reports, expert consultations, projection models were developed based on population and GDP growth scenarios. Regression analysis using the Prais-Winsten model estimated the relationship between maize production, demand, self-sufficiency ratio (SSR), and import dependency ratio (IDR). Results indicate production may increase from 3.49 million metric tons in 2030 to 4.67 million metric tons in 2050, while demand is projected to rise from 4.69 million to 6.07 million metric tons. This growing gap could lead to a reduction in SSR from 52% in 2030 to 2% by 2050. The study highlights the urgent need for improved pest management, technological advancements, and increased productivity to reduce imports and achieve sustainable self-sufficiency by 2050.

Keywords: Agricultural Productivity, Demand and Supply, Maize Import Dependency, Population and GDP Growth Projections, Self-Sufficiency

सारांश

नेपालमा मकै एक महत्वपूर्ण खाद्य बाली हो, जसले खाद्य सुरक्षा, ग्रामीण जीविकोपार्जन र पशु आहारमा महत्त्वपूर्ण भूमिका खेल्छ। तर, कम उत्पादन, उच्च उत्पादन हुने जातहरूको सीमित प्रयोग, जलवायु परिवर्तनको प्रभाव र कीट प्रकोपजस्ता चुनौतीहरूले उत्पादनमा अवरोध पुऱ्याउँछन्, जसले गर्दा आयातमा निर्भरता बढ्दै गएको छ। यो अध्ययनले वर्तमान मकै उत्पादनको स्थिति विश्लेषण गर्छ, चुनौतीहरूको पहिचान गर्छ र २०५० सम्म आत्मनिर्भरता हासिल गर्ने सम्भावना अन्वेषण गर्छ। द्वितीयक स्रोतहरू, सरकारी प्रतिवेदनहरू र विज्ञहरूको परामर्शबाट संकलित तथ्यांकहरूको प्रयोग गर्दै जनसंख्या र GDP वृद्धि परिदृश्यमा आधारित प्रक्षेपण मोडेलहरू विकास गरिएको थियो। मकै उत्पादन, माग, आत्मनिर्भरता अनुपात (SSR) र आयात निर्भरता अनुपात (IDR) बीचको सम्बन्ध अनुमान गर्न Prais-Winsten मोडेलको प्रयोग गरी रिग्रेसन विश्लेषण गरिएको थियो। परिणामहरूले देखाउँछ कि उत्पादन २०३० मा ३.४९ मिलियन मेट्रिक टनबाट २०५० मा ४.६७ मिलियन मेट्रिक टनमा बढ्न सक्छ, जबकि माग ४.६९ मिलियन मेट्रिक टनबाट ६.०७ मिलियन मेट्रिक टनमा पुग्न अनुमान गरिएको छ। यो बढ्दो खाडलले SSR लाई २०३० मा ५२% बाट घटेर २०५० सम्म २% मा पुऱ्याउन सक्छ। अध्ययनले कीट व्यवस्थापनमा सुधार, प्रविधिगत प्रगति र उत्पादनशीलता वृद्धि गर्नको लागि आयात घटाउन र २०५० सम्म दिगो आत्मनिर्भरता हासिल गर्नको लागि तत्काल आवश्यकताको महत्त्व बलाई उजागर गर्छ।

INTRODUCTION

Maize (*Zea Mays* L.) is significant for food, animal feed, and also as an industrial raw material and is a very important staple crop throughout the world, able to be farmed throughout various continents, with the United States, China, Brazil, and Argentina established as its center. (Timsina et al 2016). FAO summarizes staple crops as food that is an important part of the diet and fulfills major energy and nutrient necessities by being consumed regularly in significant amounts (Nayar 2014). Maize is the second most important cereal crop of Nepal after rice which is cultivated in the mid-hill and Terai region. It has huge importance for food security, animal feed, and various other factors in the context of Nepalese agriculture (Thapa 2021; Gairhe et al 2021).

Due to the multiple challenges to be faced by maize production, the average yield in Nepal is considerably low compared to international standards. It is approximately 2.67 tons per hectare which is lower than the average maize-producing countries (Kandel 2020). The problems observed include not enough seed production and distribution, pest and disease infestation, climate change, and also high input costs and credit accessibility. Hybrid seed varieties are introduced in Nepal but only 10% of the total maize-producing area is covered by hybrid varieties (Gairhe et al 2021). Specifying to disease pest infestation, pests like maize stem borer and fall armyworm and diseases like grey leaf spot reduce the yield alongside increases the cost of production (Subedi 2015). Maize growth cycle and total output experience ups and downs due to erratic weather patterns along with unpredictable rainfall and temperature changes (Nayava and Gurung 2010).

Maize has not been able to establish its economic impact despite the importance in livestock, poultry industry, and the country's GDP. The rising input costs, which have reached $1,392 per hectare for infrastructure, fertilizers, and pesticides, further reduce the profitability of the maize sector (Gairhe et al 2021). Mainly for feed purposes the huge dependency on maize imports clarifies the trade imbalance resulting in a wide gap between production and demand (Timsina et al 2016). A comprehensive approach including enhanced seed production and distribution, improved disease pest management, and easy access to input, credit, and market are prime to overcome these challenges.

To maintain the country's food security, economic stability, and sustainable agricultural development achieving self-sufficiency in maize is a very important parameter for Nepal. This study tries to find out the current situation of maize production, challenges and opportunities behind maize production, and scenario-based projection analysis to find out the possibility of achieving self-sufficiency by the year 2050. This study tries to spread light to policymakers, stakeholders, and farmers to make proper planning for better results. The conclusive objective is to maintain food security, reduce poverty, and maintain sustainable agriculture in Nepal by increasing productivity and reducing the import dependency of maize. This also aims to give insights during the preparation of future policies and interventions.

METHODOLOGY

This study employed a comprehensive strategy to examine maize output, import dependency, and Nepal's projected self-sufficiency by 2050. Major components used under methodology include:

Data Collection

Data was mainly extracted from secondary literature, government reports, and expert consultation, being specific to the projection for population and GDP growth rate scenario, study "Rice Demand and Production Projection for 2050: Opportunities for Achieving Self-Sufficiency in Nepal" by Timsina (2023). The study used historical data of demand and production of rice which was similarly used under consideration for maize based on its dynamics in Nepal. The past 14 years' data have been used to establish a correlation between economic growth and maize production for analyzing GDP growth-based scenarios.

Projection Models

The number of sets of projections used were two where one was population growth and the second was GDP growth. The objective behind these projections was to determine future maize production, demand, self-sufficiency ratio (SSR), and import dependency ratio (IDR).

Population Growth-Based Projections

- **Projection Data and Methodology**: Population growth rate was used for the last three decades (1991-2019), a 5% rise in the growth rate, the last decade (2009-2019), and a 5% rise in growth rate adapted from Timsina (2023). Historical growth rates and potential changes in maize consumption patterns were considered as variables in the scenario.

- **Scenarios**: Based on the population growth rate, production growth rate, and maize consumption pattern 12 different scenarios were used. All these scenarios are adopted from Timsina (2023 (data not shown here).

GDP Growth-Based Projections

- **Data Source and Analysis**: The economic trend of the last 14 years was analyzed correlating historical data of GDP growth with maize production to derive GDP growth projections. This helped undergo analysis of economic factors affecting production capabilities and consumer demand.
- **Scenarios**: Based on different economic growth criteria scenarios were structured which is shown in **Table** 1. The effects of multiple levels of agricultural investments along with overall economic growth were taken into consideration.

Table 1. Details of production projection scenario

	Agriculture GDP Growth Rate	Non-Agriculture GDP Growth Rate	Total GDP Growth Rate (Current Price)	Total GDP Growth Rate (Constant Price)	Per Capita GDP Growth Rate	Description
G1A1	-8.27% per annum	2.00% per annum	1.00% per annum	1.00% per annum	0.50% per annum	This scenario assumes a continued negative growth rate in agriculture GDP with a low non-agriculture GDP growth rate. The total GDP growth rate is low, reflecting overall economic pessimism.
G1A2	-8.27% per annum	3.00% per annum	2.00% per annum	2.00% per annum	1.00% per annum	This scenario also assumes a negative agriculture GDP growth rate but with a slightly higher non-agriculture GDP growth rate. This results in a moderate total GDP growth rate.
G2A1	-5.00% per annum	4.00% per annum	3.00% per annum	3.00% per annum	2.00% per annum	This scenario assumes a slight negative growth rate in agriculture GDP with a moderate non-agriculture GDP growth rate, leading to a moderate total GDP growth rate.
G2A2	-5.00% per annum	5.00% per annum	4.00% per annum	4.00% per annum	2.50% per annum	Similar to G2A1, but with a higher non-agriculture GDP growth rate, resulting in a higher total GDP growth rate.
G3A1	0.00% per annum	5.00% per annum	4.50% per annum	4.50% per annum	3.00% per annum	This scenario assumes zero growth in agriculture GDP with a high non-agriculture GDP growth rate, leading to an optimistic total GDP growth rate.
G3A2	2.00% per annum	6.00% per annum	5.50% per annum	5.50% per annum	4.00% per annum	This scenario assumes a positive agriculture GDP growth rate with a very high non-agriculture GDP growth rate, resulting in a highly optimistic total GDP growth rate.

Statistical Methods

Prais-Winsten regression model was used to find the relations between different variables like GDP, yield, IDR, and SSR. To have a correction in autocorrelation in time series data, the Prais-Winsten model was used over the Cochrane-Orcutt method giving a more clear and accurate result (**Table** 2).

Table 2. Details of Dependent and Explanatory Variables Used in Prais-Winsten Regression Projections

Model	Dependent Variable	Explanatory Variables	Period Covered	Notes
MODEL 1	Production Growth Rate	Population Growth Rate, Per Capita Consumption	1990-2019	Assesses the impact of population dynamics on maize production
MODEL 2	Self-Sufficiency Ratio (SSR)	Production Growth, Import Dependency	1990-2019	Analyzes the feasibility of achieving maize self-sufficiency
MODEL 3	Import Dependency Ratio (IDR)	GDP Growth Rates, Production Changes	1990-2019	Evaluates economic factors affecting maize import needs

Data Source: Historical Production data from government reports MoALD (2022), reviewing different literatures and other data like [(population, demand, per capita income) from FAOSTAT (2023) and import, export from Trade Map(2023)]

Analysis and Interpretation

- **Trend Analysis**: Historical trend analysis of maize production, area harvested, and import-export data was done to understand the past. An evaluation of historical SSR and IDR was done to find areas for improvement.
- **Scenario Analysis**: For forecasting maize production, SSR, and IDR under various conditions of population growth and GDP expansion, a detailed scenario analysis was performed. The future situation of maize self-sufficiency was tried to be explained by graphs and tables.

Data Presentation and Analysis

Different visual aids such as graphs and tables were used to present trends, projections, and scenario analysis. For a clear interpretation of historical trends, current dynamics, and future projections, a data visualization technique was used.

Data Visualization: Various historical trends and projections were presented systematically in graphs and tables. This helped analyze the relationship between production, SSR, and IDR of maize in Nepal. For the objective of interpreting data and drawing conclusions for achieving self-sufficiency by the year 2050, these figures and tables were used.

RESULTS

Trend Analysis

Maize Production and Area Harvested Over Time

Both the maize production and area harvested showed an increasing trend from 2009/10 to 2021/22 from 1,855,184 metric tons to 3,106,397 metric tons of production and 875,660 hectares to 985,565 hectares of area harvested which was shown in **Figure** 1. This clarifies that efforts have been made to uplift the productivity of maize over the years.

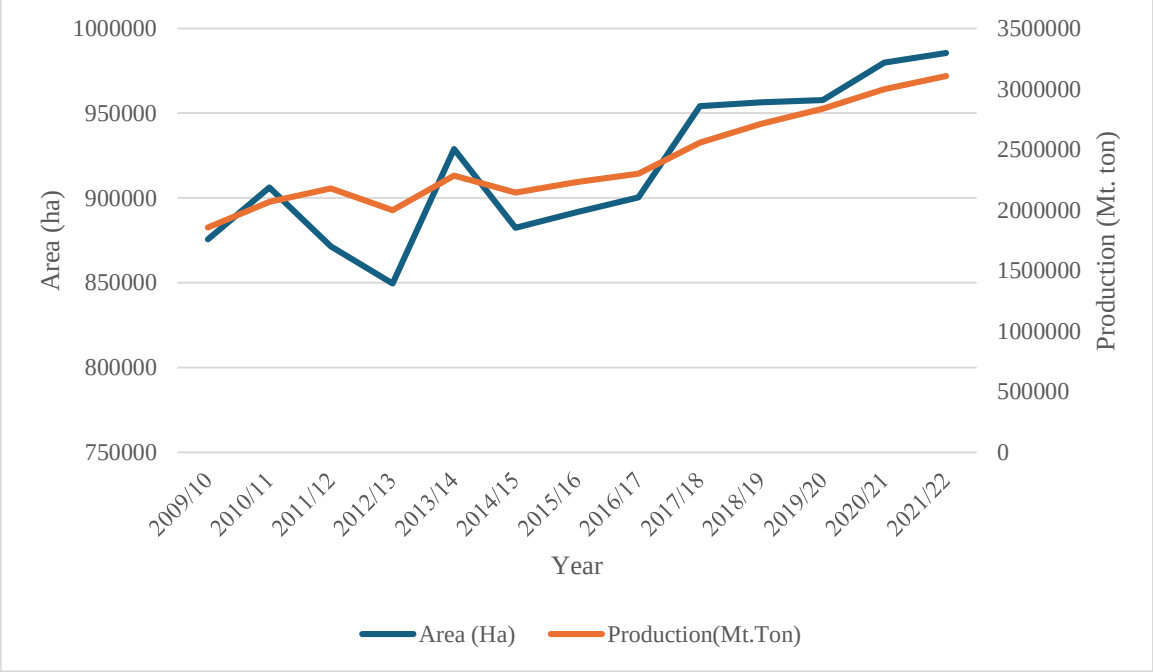

Figure 1: Line graph showing trends in maize production and area harvested over time.

Imports and Exports of Maize over Time

In **Figure 2**, the import chart shows a regular rise in maize imported from the year 2009/10 to 2021/22 from 33,319 tons to 583,256 tons respectively in numbers. While exports except for the year 2009/10 of 1002 tons were negligible for the year 2021/22. The import chart clarifies that production at the domestic level has not been able to fulfill the increasing demand. The export chart clarified that production at the domestic level was needed predominantly for domestic use leaving near to no surplus.

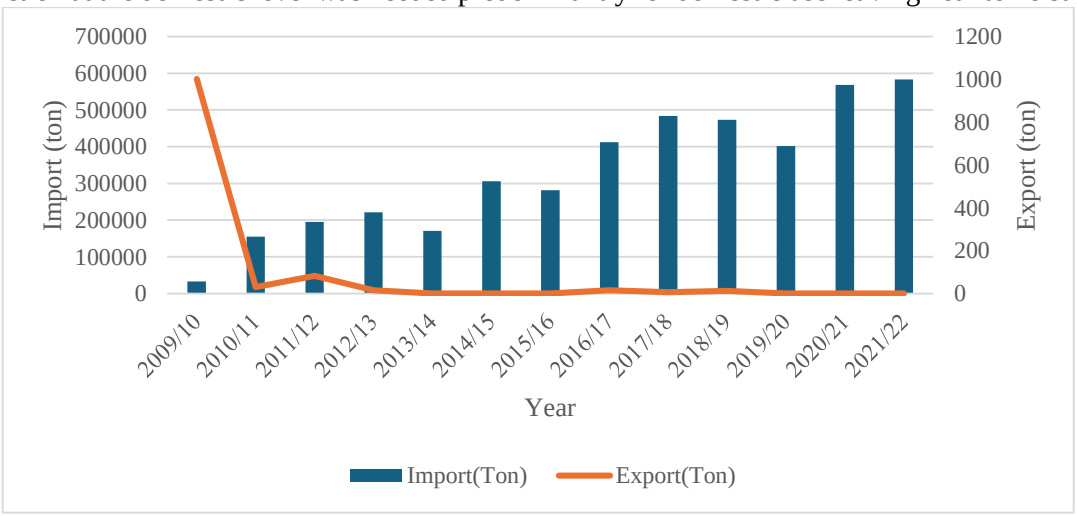

Figure 2. Line graph depicting trends in maize imports and exports over the period.

Import Dependency Ratio (IDR) and Self-Sufficiency Ratio (SSR) Over Time

To achieve self-sufficiency, Import Dependency Ratio (IDR) should have a downward trend while Self –Sufficiency Ratio (SSR) should have an upward trend. But inversely, IDR raised from 1.76% to 15.81% from year 2009/10 to 2021/22 while SSR declined from 98.23% to 84.19% (**Figure** 3). This declining SSR and inclining IDR try to summarize the challenges present in maize production in Nepal to demand to achieve self-sufficiency in maize. So, increasing production has missed the pace of increasing demand in the sector of maize in Nepal leading to import dependency. Also explaining the need for a better strategic plan for a rise in productivity.

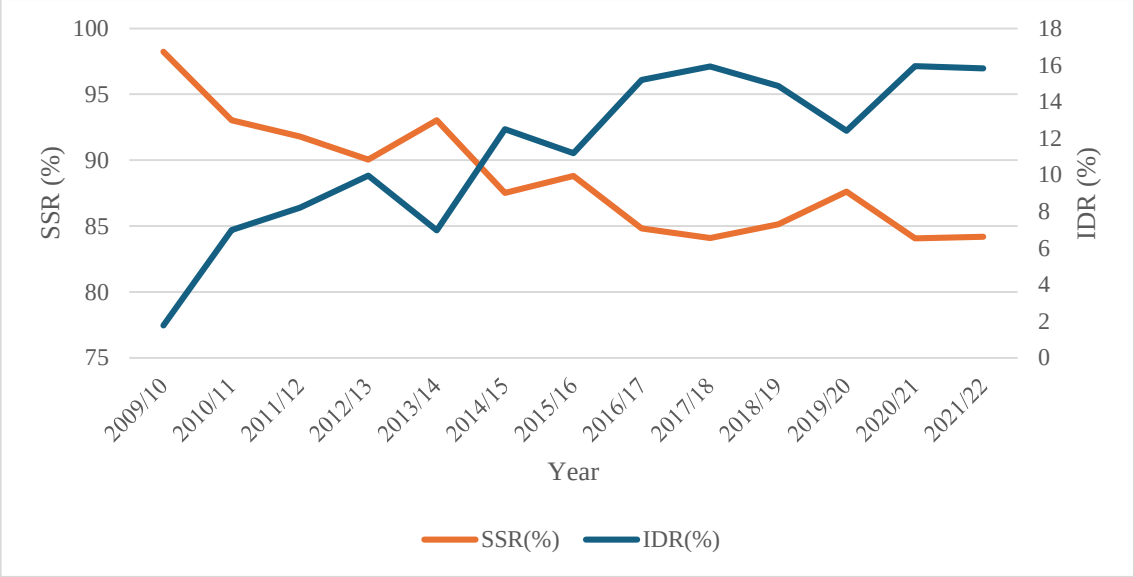

Figure 3. Dual-axis line graph showing trends in IDR and SSR from 2009/10 to 2021/22.

Projections for 2030, 2040, 2050

Population Growth-Based Projections

Impact of Population Growth and Demand and Supply on Maize Production

Table 3. Projected demand and supply of maize by 2050 in different scenarios (1000 mt)

Scenarios	Demand			Supply		
	2030	2040	2050	2030	2040	2050
P1D1	4690.5	5337.2	6073.0	6720.6	31471.1	237673.9
P1D2	4426.8	4685.7	4959.7	6720.6	31471.1	237673.9
P1D3	4923.3	5602.1	6374.5	6720.6	31471.1	237673.9
P1D4	4646.5	4918.3	5205.9	6720.6	31471.1	237673.9
P2D1	4690.5	5337.2	6073.0	6739.9	31521.5	237765.1
P2D2	4426.8	4685.7	4959.7	6739.9	31521.5	237765.1
P2D3	4923.3	5602.1	6374.5	6739.9	31521.5	237765.1
P2D4	4646.5	4918.3	5205.9	6739.9	31521.5	237765.1
P3D1	4690.5	5337.2	6073.0	6682.3	31371.9	237496.7
P3D2	4426.8	4685.7	4959.7	6682.3	31371.9	237496.7
P3D3	4923.3	5602.1	6374.5	6682.3	31371.9	237496.7
P3D4	4646.5	4918.3	5205.9	6682.3	31371.9	237496.7

The projection of demand had a gradual rise accepting all the scenarios for the years 2030, 2040, and 2050 where the highest demand reached 6.37 million metric tons at higher population growth and maize consumption in D3 scenarios. Supply was also at an increasing trend but not accordingly with the demand with a maximum reach of 237,765 metric tons in 2050 in P2 scenarios summarized in **Table 3**. This indicated the creation of a huge gap between demand and supply in the coming years in the maize sector. The gap getting broader and broader explained the need for immediate changes in strategy. Without impactful actions, Nepal might face the problem of challenges in food security maintenance or should completely rely on imports. Also, the need for a strategic plan for control of population as well as production rise has been the area of highlight.

Scenario-based analysis for SRR

The data gives a clear vision of production rise compared to demand going through various scenarios for the years 2030, 2040, and 2050. The prediction of production in the P1D1 scenario in the year 2030

projected 3491 thousand metric tons with a demand of 4690.5 giving a 1199.4 thousand metric ton deficit. This deficit continued to climb way reaching 1877.5 thousand metric tons with a demand of 6374.5 and production of 4497 thousand metric tons in the P3D3 scenario in the year 2050 (**Table 4**).

Projection tried to conclude, without any proper planning for improvement in production techniques, technologies or change of pattern of consumption, the country should regularly rely on import to fulfill even its domestic demand. A proper plan looks to be the most as the deficit widens and widens, and the gap is created between demand and supply.

Table 4. Estimated production and demand of maize by 2050 in different scenarios (1000 mt)

Scenarios	2030			2040			2050		
	Production	Demand	Surplus/ Deficit	Production	Demand	Surplus/ Deficit	Production	Demand	Surplus/ Deficit
P1D1	3491.1	4690.5	-1199.4	4039.6	5337.2	-1297.6	4674.2	6073.0	-1398.8
P1D2	3491.1	4426.8	-935.7	4039.6	4685.7	-646.1	4674.2	4959.7	-285.5
P1D3	3491.1	4923.3	-1432.2	4039.6	5602.1	-1562.5	4674.2	6374.5	-1700.3
P1D4	3491.1	4646.5	-1155.4	4039.6	4918.3	-878.7	4674.2	5205.9	-531.7
P2D1	3510.4	4690.5	-1180.1	4090.0	5337.2	-1247.2	4765.4	6073.0	-1307.6
P2D2	3510.4	4426.8	-916.4	4090.0	4685.7	-595.7	4765.4	4959.7	-194.3
P2D3	3510.4	4923.3	-1412.9	4090.0	5602.1	-1512.1	4765.4	6374.5	-1609.1
P2D4	3510.4	4646.5	-1136.1	4090.0	4918.3	-828.3	4765.4	5205.9	-440.5
P3D1	3452.7	4690.5	-1237.8	3940.4	5337.2	-1396.8	4497.0	6073.0	-1576
P3D2	3452.7	4426.8	-974.1	3940.4	4685.7	-745.3	4497.0	4959.7	-462.7
P3D3	3452.7	4923.3	-1470.6	3940.4	5602.1	-1661.7	4497.0	6374.5	-1877.5
P3D4	3452.7	4646.5	-1193.8	3940.4	4918.3	-977.9	4497.0	5205.9	-708.9

Concerning all the scenarios, the Self-Sufficiency Ratio (SSR) has shown a declining trend from the year 2025 to 2050. The SSR of 74-75% drops to 51-52% by 2030 and by continuous downfall reaches 1.9% by the year 2050 presented in **Table 5**. Shortly the country completely relies on imports to fulfill domestic demand and probably price rise may lead to a challenge for food security. This decline concludes the immediate need for policy-making to enhance domestic maize production, increase the yield per hectare, and diversify the sources of import of maize.

Table 5. Estimated Self-sufficiency Ratio (SRR) of maize based on population growth in static and dynamic scenarios

	P1D1	P1D2	P1D3	P1D4	P2D1	P2D2	P2D3	P2D4	P3D1	P3D2	P3D3	P3D4
2025	74.5	74.5	74.5	74.5	74.6	74.6	74.6	74.6	74.5	74.5	74.5	74.5
2030	51.9	51.9	51.9	51.9	52.1	52.1	52.1	52.1	51.7	51.7	51.7	51.7
2035	28.5	28.5	28.5	28.5	28.7	28.7	28.7	28.7	28.2	28.2	28.2	28.2
2040	12.8	12.8	12.8	12.8	13.0	13.0	13.0	13.0	12.6	12.6	12.6	12.6
2045	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.0	5.0	5.0	5.0
2050	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.9	1.9	1.9	1.9

GDP Growth-Based Projections

Concerning all the scenarios, the Self-Sufficiency Ratio (SSR), **Table 6** has shown a declining trend from the year 2025 to 2050. The SSR of 77-81% drops to 67-79% by 2030 and by continuous downfall reaches 15% by the year 2050 in the G1A2 scenario. Soon countries completely rely on imports to fulfill domestic demand and probably price rise may lead to challenges for food security. This decline concludes the immediate need for policymaking to enhance domestic maize production, uplift the yield per hectare, and also may be diversifying the sources of import of maize.

Table 6. Estimated Self-Sufficiency Ratio (SSR) based on GDP Growth on static and dynamic scenario

	G1A1	G1A2	G2A1	G2A2	G3A1	G3A2
2025	77.69706	77.01351	78.76029	78.11291	81.41843	82.0351
2030	67.20524	65.24162	70.22356	68.3919	77.44272	79.02438
2035	54.65809	51.25671	59.99835	56.74424	72.89951	75.65882
2040	41.48986	37.07225	48.82087	44.30005	67.82147	71.94496
2045	29.43463	24.81477	37.76009	32.53241	62.28419	67.90483
2050	19.70264	15.60504	27.84197	22.62115	56.40653	63.57744

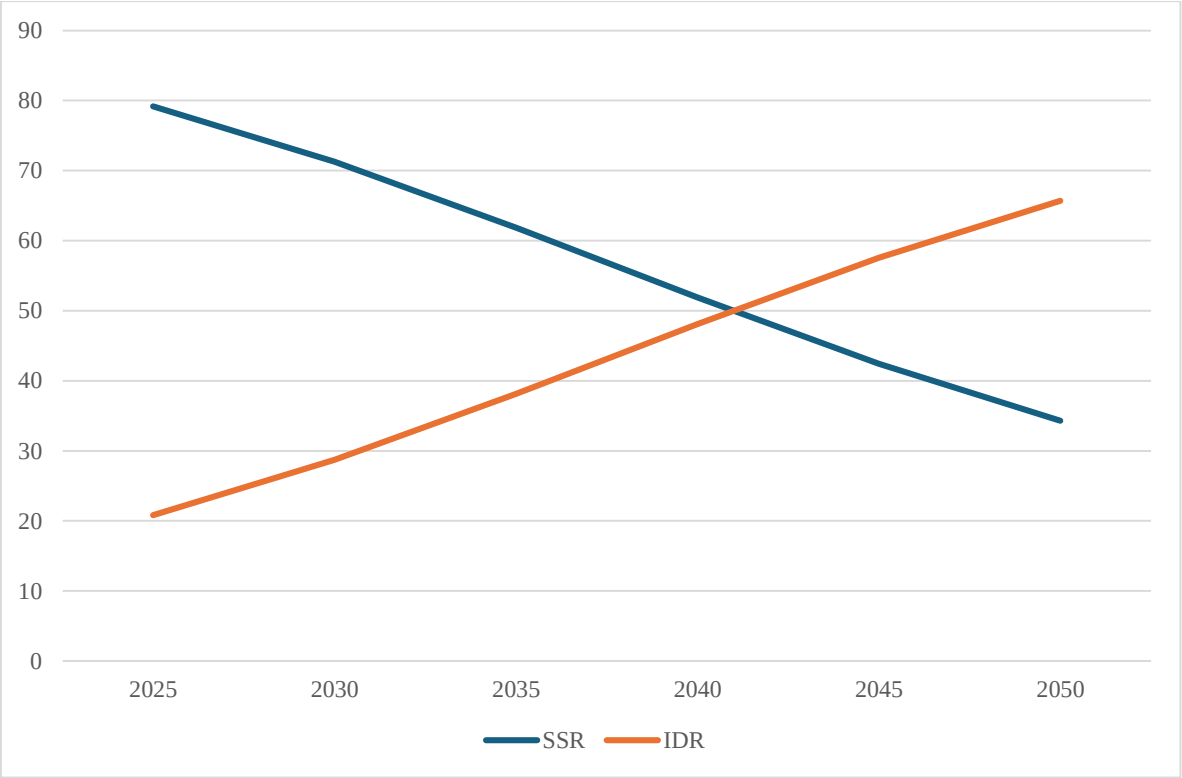

Figure 4. Line graph showing projections of SSR and IDR under various GDP growth scenarios.

For the GDP growth scenario, Self-Sufficiency Ratio (SSR) will be declining while Import Dependency Ratio (IDR) will be increasing comparing the years 2025 to 2050 with percentages of 79.17% to 34.29% of SSR and 20.83% to 65.71% of IDR. **Figure 4** tries to clarify that the country soon will be in a serious problem due to the expansion of the gap between production and demand in a negative direction. As with all previous conclusions, there was not much difference in the GDP scenario as this also explained the critical situation of risk in the country's ability to fulfill the demand. Just the thing is talking respect to the number GDP scenario was found to be better than other scenarios.

DISCUSSION

For the importance of maize crops for food security, rural livelihoods, and the animal feed industry achievement of self-sufficiency by the year 2050 is among the major goals of Nepal. However, the projection from this study has shown a huge barrier to achieving this goal. Self-Sufficiency Ratio (SSR) will show a sharp decline despite the rise in maize production, as it will not meet the rising demand. The gap between production and demand cannot be bridged by lone efforts at the domestic level and the projected fall of SSR from 52% to 2% from 2030 by the year 2050.

To understand this gap the relationship between maize production, demand, SSR, and Import Dependency Ratio (IDR) was analyzed using the Prais-Winsten regression model. Due to its effectiveness in addressing autocorrelation for a clear understanding of trends, the Prais-Winsten

regression model was used in time series data. The result indicated that without any significant intervention, maize production continuously creates a gap with demand increasing reliance on imports. However, the use of this model might not be as effective as other models like ARIMA and State Space as the Prais-Winsten regression model has a simple structure that might not capture the complexities of agriculture trends (Mishra et al 2022). Integrating these advanced models in future research could enhance strategic planning and policymaking by providing deeper knowledge.

Challenges like low yield and less use of high-yield varieties were also identified. Despite the introduction of high-yield varieties like a single cross hybrid, due to insufficient seed distribution, less extension services, and high input cost it has covered only around 10% of the total cultivated area of Nepal (Joshi and Gautam 2021). These issues are compounded by frequent pest infestations like maize stem borer and fall armyworm also suppress the yield. Along with that, climate-resilient agricultural practices were needed to overcome the suppression of productivity due to climate variability, erratic rainfall, and temperature rise (Katel et al 2023).

Some studies clarify economic growth, and agricultural investment can push toward self-sufficiency whereas this paper presents more complex scenarios. Even in the best scenario, i.e. optimistic GDP scenario, the reach of production to demand looks tough. The expectations differ concerning Prasad et al (2011), who anticipated potential surpluses under favorable economic conditions. This explained not only economic growth but also advancement in technology, input accessibility, and other various improvements that were needed to reach the goal (Giri et al 2017).

The scenario that integrated population growth rate and increased per capita maize consumption has shown a very critical situation by the year 2050. It explains that the dependency on imports will rise significantly without targeted interventions (Timsina et al 2023). This has indicated the need for immediate action in production strategies. Based on Prasad et al., (2011), though maize production maintains a surplus based on demand, demand for feed and seed resulted in a deficit. Thapa (2021) explained that 87% of maize used in feed was imported from India. A comprehensive approach including increased investment, better seed, and use of technologies can overcome the gap (Prasad et al 2011). High-yielding varieties, disease-resistant varieties, improved pest disease management, and quality seeds stand out as key strategies for boosting maize production (Joshi and Gautam 2021). Supportive policy, reducing input costs, financial support to farmers, and investment in agricultural infrastructure can also be effective. Timsina et al (2023) highlighted that effective policy and advancement in technology can reduce the dependency on imports.

Declining SSR and inclining IDR created challenges to food security and economic stability in Nepal. The growing reliance on imports not only contributes to the country's trade deficit but also makes Nepal vulnerable to global market fluctuations (Katel et al 2023). Strategic policy support, investment in agricultural research, and the development of resilient infrastructure played a vital role in mitigating these risks (Giri et al 2017).

In conclusion, the future projection in the sector of maize summarized the wide gap between the production and demand of maize resulting in different challenges to achieve self-sufficiency by the year 2050. Though the production growth has shown a good trend, the supply will not be able to meet the demand resulting in a rise in import dependency to fulfill the country's needs. This clarified the need for urgent strategic interventions, high-yield varieties use, disease-resistant hybrid, and better disease pest management. The situation not only threatened food security but also the economic stability of the country. Finally, if all the previously discussed interventions were not applied the supply-demand gap keeps rising and the goal to achieve self-sufficiency by the year 2050 will be even further and longer.

CONCLUSION

Despite of increasing trend of production and area harvested, the rise in demand, and consumption have a huge gap with production resulting in challenges to achieve self-sufficiency by the year 2050. Along with that, a regular rise in imports, and almost negligible exports also clarifies the critical situation of

the maize sector of Nepal. Because of all these aspects, IDR showing a positive trend and SSR showing a negative trend indicates the necessity of urgent actions that could be an improvement in agricultural practices, technological adaption, and supportive policies using the multi-approach method for better and clear results. This can result in to rise in production reaching future demand and maintaining food security and economic stability.

ACKNOWLEDGEMENT

Authors like to acknowledge Dr. Krishna Timsina the author of "Rice Demand and Production Projections for 2050: Opportunities for Achieving Self-Sufficiency in Nepal" (Timsina 2023) for providing guidance and discussion for contributing to developing the methodology for the study. Authors also want to thank the Ministry of Agriculture and Livestock Development (MoALD) for providing necessary data needed for the completion of the study. Finally, thanks to all the individuals who helped with the successful completion of the research.

REFERENCES

FAOSTAT (2023). *Crops and livestock products*. [online] Food and Agriculture Organization of the United Nations. Available at: https://www.fao.org/faostat/en/#data/QCL

Gairhe S, K Timsina, Y Ghimire, J Lamichhane, S Subedi and J Shrestha. 2021. Production and distribution system of maize seed in Nepal. Heliyon 7. **DOI**: http://doi.org/10.1016/j.heliyon.2021.e06775

Giri A, R Giri, V Nelson, K Lovercamp, S Sharma and I Protopop. 2017. Can Nepal attain self-sufficiency in major crops production? *Journal of Forest and Livelihood* **15**(2).

International Trade Centre (ITC) (2023). *Trade Map - Trade Statistics for International Business Development*. [online] Trademap.org. Available at: https://www.trademap.org/Index.aspx

Joshi P and D Gautam. 2021. Genetic insights on single cross maize hybrid and its importance on maize self-sufficiency in Nepal. *Archives of Agriculture and Environmental Science* **6**(2):218-226. **DOI**: http://doi.org/10.26832/24566632.2021.0602014

Kandel B. 2020. Status, prospect and problems of hybrid maize (Zea mays L.) in Nepal: a brief review. *Genetic Resources and Crop Evolution* **68**:1-10. DOI: http://doi.org/10.1007/s10722-020-01032-0

Kattel S, PSY Shubh, K Abishek, K Nikita and N Shobita. 2023. Cereal import and consumption patterns in Nepal – Analysis of rice, wheat, maize, and millet: A review. *Russian Journal of Agricultural and Socio-Economic Sciences* **139**(7):16-32. **DOI**: http://doi.org/10.18551/rjoas.2023-07.03

Ministry of Agriculture and Livestock Development (MoALD) (2022). *Ministry of Agriculture and Livestock Development | Ministry of Agriculture and Livestock Development*. [online] https://moald.gov.np/wp-content/uploads/2023/08/Statistical-Information-on-Nepalese-Agriculture-2078-79-2021-22.pdf. Available at: Statistical-Information-on-Nepalese-Agriculture-2078-79-2021-22.pdf (www: moald.gov.np)

Mishra P, S Yadav, B Kumari, IA Shah, K Karakaya, S Shrivastri, C Fatih, S Ray and AM Ghazi Al Khatib. 2022. Modelling and forecasting of maize production in South Asian countries. *Economic Affairs* **67**(4). **DOI**: http://doi.org/10.46852/0424-2513.4.2022.18z

Nayar NM. 2014. Origin and Phylogeny of Rices. *Academic Press;* **pp**.1-14. **DOI**: http://doi.org/10.1016/B978-0-12-417177-0.00001-2

Nayava J and D Gurung. 2010. Impact of Climate Change on Production and Productivity: A Case Study of Maize Research and Development in Nepal. *Journal of Agriculture and Environment* **11**:59-69. **DOI**: http://doi.org/10.3126/AEJ.V11I0.3653

Prasad SK, H Pullabhotla and A Ganesh-Kumar. 2011. Supply and demand for cereals in Nepal, 2010–2030. IFPRI Discussion Paper 01120. *International Food Policy Research Institute*, New Delhi, India

Sapkota M and N Joshi. 2021. Factors Associated with the Technical Efficiency of Maize Seed Production in the Mid-Hills of Nepal: Empirical Analysis. *International Journal of Agronomy*. **DOI**: http://doi.org/10.1155/2021/5542024

Subedi S. 2015. A review on important maize diseases and their management in Nepal. **1**:28-52. **DOI**: http://doi.org/10.5281/ZENODO.34292

Thapa R. 2021. A detail review on status and prospect of maize production in Nepal. *Food and Agri Economics Review* 1(1):52-56. **DOI**: http://doi.org/10.26480/faer.01.2021.52.56

Timsina K, Y Ghimire and J Lamichhane. 2016. Maize production in mid hills of Nepal: from food to feed security. **2**:20-29. **DOI**: http://doi.org/10.3126/JMRD.V2I1.16212

Timsina KP, D Gauchan, S Gairhe, SR Subedi, BB Pokhrel, S Upadhyay, KD Joshi, S Pandey and J Shrestha. 2023. Rice demand and production projections for 2050: Opportunities for achieving self-sufficiency in Nepal. *Nepal Agriculture Research Journal* **15**(1):163-180. **DOI**: http://doi.org/10.3126/narj.v15i1.51926

||-------|||-------||