
# NATIONAL RICE DEVELOPMENT STRATEGY

# 2024-2034

**Department of Agriculture**
**Ministry of Agriculture and Livestock**

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# EXECUTIVE SUMMARY

The entire Bhutanese population depends on rice as consumers and producers. Rice security is equated parallel to national food security on its merit as the most preferred cereal, although other crops like maize, buckwheat, wheat, millet, and potato offer self-sufficiency of 113%. Rice is the primary staple of all the Bhutanese, and it has historically been an indispensable commodity to the Bhutanese food system, livelihood, and is intertwined into the Bhutanese food, tradition, culture, and religion. The current estimated per capita consumption is 144 Kg per year. Besides being the primary food security commodity, rice farming and rice ecosystem has several far-reaching benefits to the national economy. At the ecosystem and landscape level, traditionally designed rice terraces on the hill slopes provide an invaluable artistic beauty and value to the natural environment, which are unique and should be treasured. Rice ecosystem, as part of the overall wetland ecosystem is critical for safeguarding and conservation of other biodiversity and several wetland faunal species such as the harvested rice fields in Bumdeling, Trashiyangtse which provide feeding ground for migratory Black Necked Cranes.

Notwithstanding its significance to the national food basket and ecosystem services, rice farming is faced with formidable challenges. Owing to many challenges faced by the sector, there is an average annual decline of 5.6% in cultivated area and average annual decline of 2.9% in production between the periods from 2006 to 2022. Consequently, rice Self-sufficiency Ratio (SRR) which is the best indicator of rice available from domestic production has significantly declined from 47% in 2017 to 25% in 2022 which is an issue of national significance. On the positive side rice productivity has increased by 4.2% from 2006 to 2022 with the actual national average productivity increase from 1.1 MT/acre to 1.8 MT/acre which is attributable to the adoption of improved rice production technologies. The per capita consumption has declined from 157 Kg/year in 2020 to 144 Kg/per year in 2022. This trend is quite likely to continue as more Bhutanese tend to diversify their diet and that a sizeable Bhutanese live outside Bhutan. At present Bhutan meets 75% of its rice requirement through import from India, which is entirely informal and on the good will. Rice import remains highly vulnerable to any changes in the India's rice export policy and can be influenced by unprecedented regional and global events such as COVID 19 and Russia-Ukraine war.

The rice sector and the entire value chain is constrained by six formidable challenges which have remained inadequately unattended. The challenges in the order of priority include increasing shortage of irrigation water due to untimely rainfall and drying of water sources, acute farm labour shortage, intense human-wildlife conflicts, rapidly decreasing land holding sizes and land fragmentation, increasing fallow lands, extreme weather events and natural disasters, lack of coherent policy on commercialization of agriculture, lack of adequate investments in agriculture, and lack of clear policy on subsidy or incentives for rice farming.

To holistically address the challenges, this strategy aims to achieve the following objectives:

i. Recognize the significance of rice commodity program towards attaining 35% SSR by 2034 at the current per capita consumption.

ii. Ensure policy and financial support for implementation of proposed enabling actions to achieve 35% rice self-sufficiency by 2034.
iii. Revamp and strengthen national rice commodity program into a more sustainable, vibrant, and resilient program.
iv. Ensure a dynamic and effective policy for conservation of rice landscapes for sustainable rice farming as a means of livelihood, food security and sovereignty, promotion of our unique tradition, culture, and ecotourism.

Among all the factors, water stands out as the most critical for rice production. Of the total, 84% of the existing irrigation infrastructures are built by farmers which have high conveyance losses, maintenance cost and vulnerable to natural disasters. To improve the access to irrigation water the development and out scaling of irrigation infrastructure of 171.61 Km which can cover a command area of 5968.69 acres of wetland benefiting 3577 farming households is prioritized in the 13$^{th}$ FYP. The estimated investment required is Nu. 905.99 million for 13$^{th}$ FYP and 1073.8 million for 14$^{th}$ FYP.

Rice cultivation continues to be highly labour-intensive requiring 78 person-days per season with labour required for nursery, transplanting, weeding, harvesting, threshing and crop guarding. To address the labour shortage, farm mechanization and seasonal hiring of farm labour are two potential options. From the total wetland area of 47,395 acres, 80% (37,841 acres) is not mechanized while 20% (9,554 acres) has some level of mechanization. To capitalize the proven benefits of farm mechanization, it is crucial that the government continue to provide 40-60% subsidy support for farm mechanization which should be focused on 70% (26,489 acres) of the remaining wetland areas feasible for mechanization. Bringing these areas under farm mechanization would entail a budget of about Nu. 145 million annually at the FMCL hiring charge of Nu. 5510 per acre of wetland without subsidy. If 50% subsidy is given, the cost will reduce to Nu. 73 million. Further supporting licensed national agricultural labour agencies could be explored to mobilize the seasonal farm labour.

The persistent issue of human-wildlife conflict and natural calamities causing significant volume of crop losses exposes farmers to the ever increasing threat of household food security with over 34% of households having no respite from crop guarding, with some risking life, others losing their house and livelihood. In monetary value about Nu. 99.9 million worth of crops are lost annually to this wildlife and natural calamities. The rippling effect of this issue are farmers getting disappointed and leaving their land fallow, migrating to urban areas, opting for off-farm employment, and being driven into poverty. To safeguard 43,000 acres of wetland that is required to meet 35% SSR, 3300 Km of Electric Fencing (EF) will be required. The total cost for 1791 Km of EF that is required to cover the remaining unfenced area will be Nu. 286.5 million. Another complex but a dynamic coping strategy to this daunting issue is the institution of agricultural insurance that is already tested in many countries.

Bhutan ranks second lowest in terms of the total fertilizer use in Asia with the national average of 5.79 Kg/ac which is significantly low. Sub-optimal use of recommended rate of fertilizers leads to low productivity. There is a high disparity in the adoption of recommended rate of

fertilizers among the Dzongkhags. Fertilizer supply and rice yield analysis reveals that in five Dzongkhags of Lhuentse, Sarpang, Trongsa, Tsirang, and Samtse, the adoption of fertilizers is below optimum resulting in low yield. The adoption of recommended fertilizer rate in these Dzongkhags could contribute to yield increase up to 30% annually. To encourage farmers to use adequate fertilizers, subsidy is proposed in the range of 25-100% of the total fertilizer cost per acre which will entail an investment of Nu. 43 to 94 million per year.

The loss of wetland to urban infrastructure development, fallowing, and the lack of irrigation water are the main causes for the rapid decrease of rice area. The cultivated rice area has reduced by 5.6% from 67,566 acres in 2006 to 22,683 acres in 2022. Besides the Land Act, 2007 which prohibits the conversion of wetland to other land uses, there is no policy to support the rice sector and the rice-based ecosystems. Rice farming as an enterprise is much less profitable compared to other agricultural enterprises such horticulture crops and livestock by its nature of high labour demanding operations. High investment and high labour costs in rice thus contributes to low gross return and a negative Benefit-Cost Ratio (BCR) of 0.94.

Despite a challenging scenario and low return to investment, Bhutanese rice farmers strongly contend that they will use all their means to continue rice cultivation. Farmers strongly believe that locally grown rice is better in quality, and it is their assurance of household food security and livelihood. The role of rice and rice ecosystem goes beyond food security contributing to social, religion, tradition, livelihood and providing multiple ecosystem services. It is therefore very important to present the case of rice as a special commodity to the Bhutanese society that needs attention outweighing its low return to investment. The three most compelling reasons why rice and rice-based ecosystem must be supported and protected considering both food security and sovereignty are that rice is the most preferred, socially classed, and historically central to Bhutanese food, livelihood, culture, tradition, and religion; rice engages and will continue to engage significant percentage of Bhutanese as consumers and producers as the most preferred staple; and rice farming system will continue provisioning multiple ecosystem benefits for the conservation of biodiversity and promote ecotourism.

While challenges and the magnitude of investment required for the coping strategies apparently amplify the negative aspects of the rice sector, it also offers several opportunities. There are still 42% of the area not adopting improved varieties which can further enhance the production. Better access to quality seed, weedicides, efficient plant protection services, and timely agro-meteorology advisory services can further ensure higher productivity. The export opportunities for specialty and unique Bhutanese rice varieties remains to be explored through nutrient profiling and branding as Special Agricultural Products by acquiring innovative Geographical Indications and Geographical Indications Environment and Sustainability certification. To capitalize on clean environments, interested private individuals, entrepreneurs, established business should be persuaded to invest on commercial rice cultivation.

To project the future rice requirement, we suggest three SSR scenarios based on the per capita consumption of 144 Kg/year, 120 Kg/year and 100 Kg/year. These three scenarios represent the current per capita consumption, estimated based on the minimum Kcals recommended by

the World Health Organization (WHO), and the reduced per capita consumption at 100 Kg/year assuming a notable dietary shift from rice. To achieve at least 35% SRR by 2034, about 4300 acres of wetland should always be protected through a binding policy decision implemented by the Department of Agriculture through the national rice commodity program. A total investment of about Nu. 11.92 billion will be required to achieve the target of 35% SRR by 2034. If the target of 120 or 100 Kg per capita is pursued with full commitment there is an opportunity to accomplish the SRR to the extent of 40-50%.

This national rice development strategy presents the challenges and enabling actions that envisage to prompt a national debate and discussion towards establishing a long-term policy instrument and guidance for the comprehensive development of the rice sector. A long-term policy mandate should ensure a sustainable, vibrant, and resilient rice sector that will respond to ensure food security and sovereignty.

# 1 Background

Rice is the primary staple of all the Bhutanese, and it has historically been an indispensable commodity to the Bhutanese food system and livelihood. Rice is the key commodity that is intertwined to the Bhutanese food, tradition, culture, and religion. The entire Bhutanese population depends on rice both as consumers and producers. Rice is the most preferred staple food of all the Bhutanese with an estimated per capita consumption of 144 Kg per year. From the standard dietary requirement of 2100 Kcal, 70% (1470 Kcal) accounts for carbohydrates. In the common Bhutanese diet, 80% of 1470 Kcal is estimated to be met from rice while the rest is accounted to other sources of carbohydrates. This exemplifies the role of rice in the Bhutanese food system. Therefore, despite formidable challenges to rice farming, it will continue to remain crucial to the Bhutanese food system, tradition, culture, and livelihood.

Besides rice being the primary food security commodity, rice farming and rice ecosystem has several far-reaching benefits to the national economy. At the ecosystem and landscape level, traditionally designed rice terraces on the hill slopes provide an invaluable artistic beauty and value to the natural environment, which are unique and should be treasured. Rice ecosystem, as part of the overall wetland ecosystem is critical for safeguarding and conservation of other biodiversity and several wetland faunal species such as the harvested rice fields in Bumdeling, Trashiyangtse which provide feeding ground for migratory Black-necked cranes.

Rice farmers are indeed disadvantaged by the provision of the Land Act, 2007 which restricts the conversion of wetland for other purposes. As a result of this rice farmers are losing the opportunity to venture into comparatively remunerative enterprises in the land dedicated to rice. If the policies allow, farmers may opt to use the wetland for other alternative uses including the cultivation of commercial crops that are less labour intensive and more profitable than rice. Notwithstanding the economic benefits, there are also vulnerable rice farming dependent farmers in the far-flung areas who will need continuous support for rice cultivation as they will continue to grow rice for livelihood and socio-cultural values.

The last 17 years (2006-2022) of trend on rice production and the percent Self Sufficiency Rate (SSR) is seeing an unprecedented decline. In 2022, only 25% of the total annual rice requirement could be met from domestic production (Figure 1). The remaining 75% of the rice deficit is met through import, mostly from India which remains at the mercy of its larger trade policy. By 2034, the projected total estimated rice requirement at 144 Kg per capita per year is 120,569.5 MT. Annual agriculture survey and related studies have shown that the decline in area and production is attributable to scarcity of farm labour, inadequate irrigation water, increasing crop depredation by wild animals, drudgery, and low adoption of improved farming technologies and high cost of production. Considering these challenges, the current approach to meet the rice requirement through import may sound pragmatic, however, it may not remain smooth forever owing to frequent global and regional policy shifts, inevitable price rise, impacts of major geopolitical events such as Russia-Ukraine war, COVID 19 and their impact on global trade.

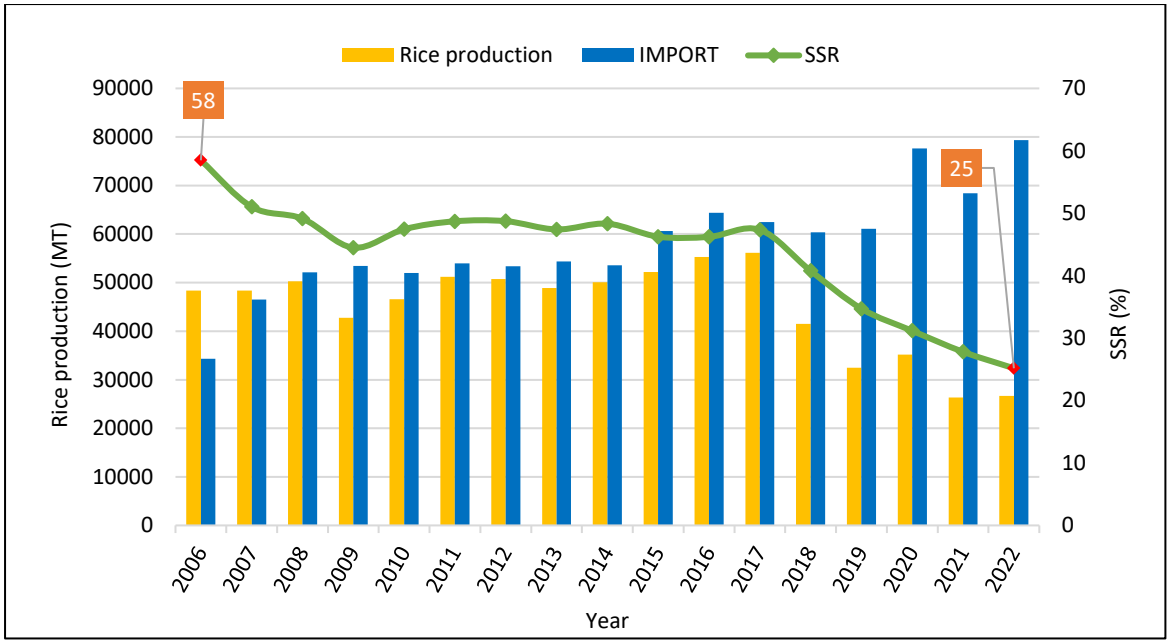


*Figure 1. Trend of rice production, import and SSR*

Even at the outset of 13th Five Year Plan (FYP), which embarks upon the economic transformation there is no effective national policy on rice, especially for protection of critical rice landscapes and rice ecosystem except the Land Act, 2007 which provides a general protection of the wetlands disallowing conversion to other land uses. To halt the rapidly declining trend on rice area and production, it is time for the government to take concrete steps to support the development of rice farming in Bhutan despite a negative return to investment. This is because of the immeasurable value of rice; rice ecosystem and rice-based farming system renders to the Bhutanese society. Left alone to the farmers, the rate of decline of rice area, production, and SSR can be anticipated to be even more rapid. To halt and address the alarming decline of rice area, production and SSR a comprehensive "National Rice Development Strategy 2024 - 2034" is developed.

The proposed ten years National Rice Development Strategy aims to provide evidence-based enabling strategies to guide the national policy decision to the national rice sector to achieve the target of at least 35% national rice SSR from domestic rice production by 2034. The rice sector and the entire value chain must be considered holistically in view of the emerging national, regional, and global trends on rice production and consumption. In view of the challenges that rice sector is faced with, particularly the negative return to investment, it must be viewed with potential trade-offs and other possible consequence that Bhutanese consumers might have to endure if the rice sector is unattended. Thus, being a strategic commodity of national significance, the rice sector will need careful attention in view of the challenges it faces. A broad and holistic rice sector development action plan is necessary to address emerging challenges and to support rice farming that will continue to supplement the increasing rice demand which is largely met through import. This could be possible through a strong national rice commodity program that will steer the national rice sector development.

## 1.1 National Perspective on Food Security

Rice in the Bhutanese context is debated and discoursed largely from the perspective of food security. Considering it as the most preferred cereal and socially allotted high status compared to other staple cereals, it often captures the attention of the decision makers. Food security is defined as "Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (World Food Summit, 1996). This definition compels us to present what are the other alternative crops that can significantly contribute to the national food security (Table 1). If all Bhutanese equally prefer and consume other cereals produced in the country such as maize, buckwheat, wheat, barley, millet, and potato the estimated SRR then will be 113%. However, food security cannot be considered in isolation as a mere commodity ignoring the right to food or food sovereignty where everyone has the right to the food of their preference for their health and wellbeing. The International Forum on Food Sovereignty defines "Food Sovereignty as the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems".

In the event of abject food insecurity scenario and accepting the international definition of food security, Bhutanese can fall back to maize, buckwheat, wheat, barley, millet, and potato which are socially classed as lower to rice but have economic advantage over rice and superior in nutritional profile.

*Table 1. Alternative commodities for food security*

| Commodity | Total Production (MT) in 2022 | Estimated SSR (%) |
|---|---|---|
| Maize | 25981 | 50.35 |
| Buckwheat | 1133 | 92.33 |
| Wheat and Barley | 1385 | 59.5 |
| Millet | 602 | 100 |
| Potato | 31146 | 262 |

**Source: NSB 2022 and DoA estimates*

However, the case of rice cannot be argued solely in the context of its role as an indispensable food security commodity but more from the perspective of food sovereignty that emphasizes the right to choose the preferred food. Rice is the preferred choice and will continue to remain so despite the switch in food habits, access, and affordability to better alternative foods. The role of rice as presented earlier goes beyond food alone to its social status, religion, tradition, livelihood and multiple ecosystem services. It is therefore very important to present the case of rice as a special commodity to the Bhutanese society that needs attention outweighing its low return to investment. We establish three most compelling reasons why rice and rice-based ecosystem must be supported and protected considering both food security and sovereignty.

i. Rice is the most preferred, socially classed, and historically central to Bhutanese food, livelihood, culture, tradition, and religion.

ii. From the perspective of food sovereignty, rice engages and will continue to engage significant percentage of Bhutanese as consumers and producers.
iii. Rice farming system will continue provisioning multiple ecosystem benefits for the conservation of biodiversity and promote ecotourism.

## 1.2 Bhutanese Farmers' perspective on rice farming

Farmers' perception on rice farming is summarized from review of past studies and through rapid telephonic interview with at least five farmers each from Paro, Punakha, Samtse, Trashigang and Trongsa. Review of past participatory studies and surveys on rice farming indicates that in general farmers still consider rice farming as an important means of livelihood. Growing their own rice has been a cultural practice and it also gives them the sense of food security. The farmers prefer to consume their own grown rice over the imported ones despite several challenges that continue to fraught the rice production.

Most studies have established the lack of assured irrigation, crop depredation by wild animals, inaccessibility to fertilizer and weedicides on time, scarcity of farm labour, and inaccessibility to farm machineries as the key challenges to rice farming. The consultation with the farmers also revealed the same challenges with lack of access to assured irrigation as the most pressing constraint. Nonetheless, it was found that farmers would continue to cultivate rice at all means for the foreseeable future. This shows that rice is an integral part of crop production for the rice farmers who had been cultivating since their forefathers' time. There have been past incidences of farmers switching crops to cultivate those that fetch better income. The classic example is that of cardamom. The boom in the industry enticed many farmers into its cultivation in all the land they owned including, wetland. However, the market didn't sustain, and farmers faced huge losses. Consequently, they reverted to rice farming after they realized that relying solely on cash crops did not give a sense of assurance for household food security in the events of market failures.

## 1.3 Global and regional scenario on rice production

Rice is a staple food for more than half of the world's population, serving as a vital source of carbohydrates besides encompassing cultural importance, economic relevance, and ecological impact. Globally, rice production has been increasing steadily. For instance, between 2012 and 2021, there was a production increase of 8% equivalent to 9,761,062 MT (Figure 2). This increase in production is primarily attributed to improved productivity, which has risen to 1.93 MT per acre (Figure 3).

The Asian region boasts the highest productivity, with an average of 2 MT per acre, surpassing the global average. In Bhutan as well, paddy productivity has increased to 1.8 MT per acre in 2022 (NSB, 2022), bringing it nearly at par with the world average.

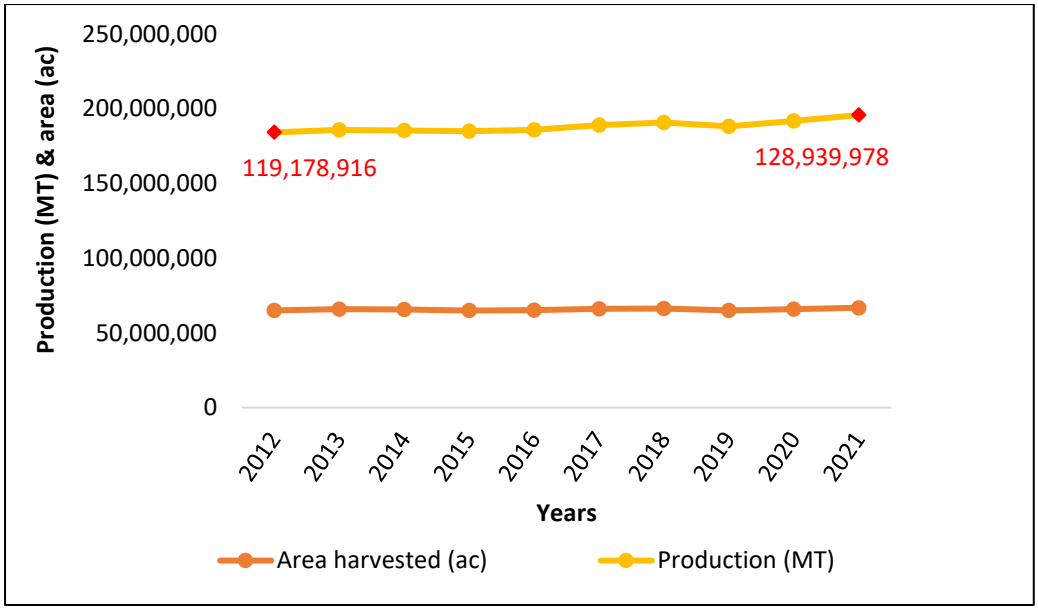


*Figure 2. Global trend of harvested area and production of rice (2012-2021)*

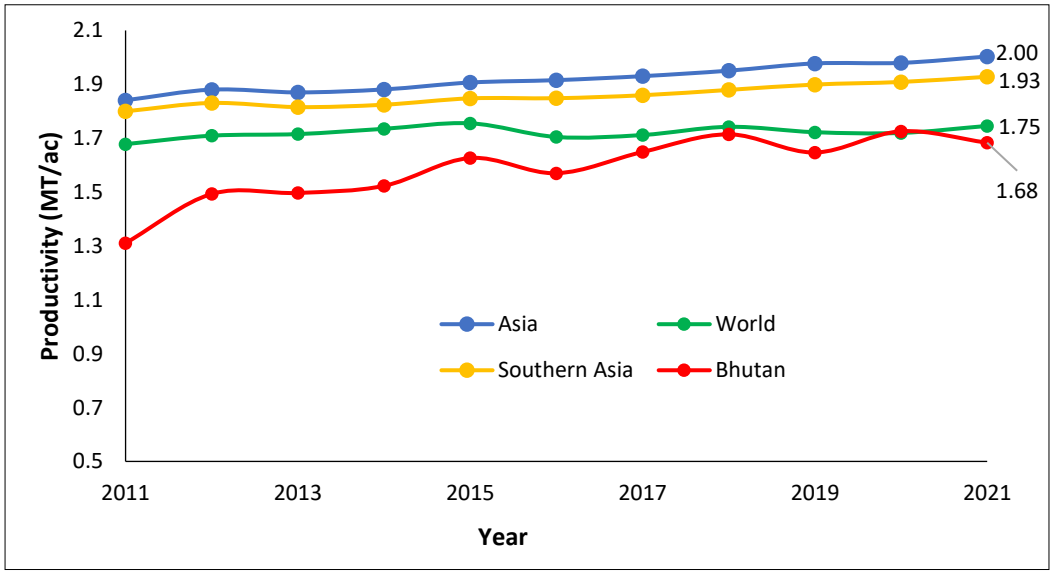


*Figure 3. Global trend of rice productivity (2011-2021)*

The geographical distribution of global rice production remains highly concentrated in Asia. Asian countries, particularly China and India, are the leading producers, accounting for over half of the world's rice production (Figure 4). In the 2021-2022 crop year, China produced over 148 million MT of milled rice, followed by India producing over 129 million MT. Similarly other Southeast Asian countries like Indonesia, Vietnam, Thailand, and Bangladesh also contribute significantly to global rice production.

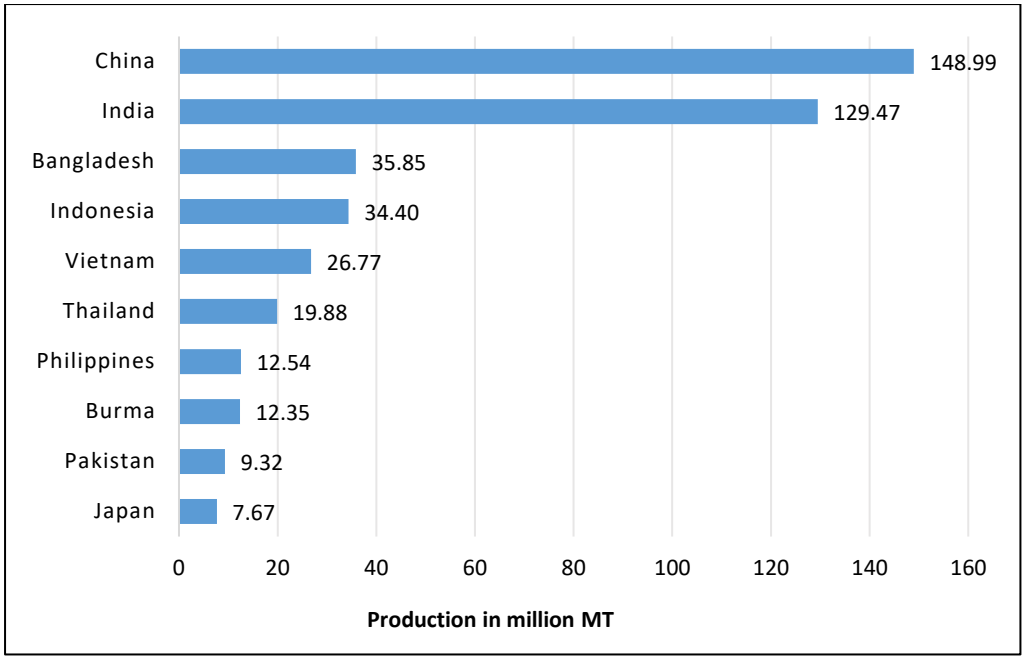


*Figure 4. Top 10 rice producing countries*

According to FAO statistics (FAOSTAT, 2022), global rice consumption per capita has remained relatively constant over the decades, with a slight decrease in 2020 compared to 2011 (Figure 5). Among the regions, Asia has the highest per capita rice consumption in the world, with an average of 115 Kg per year. In terms of individual countries, Bangladesh has the highest per capita rice consumption at 257 Kg per year (FAOSTAT, 2022). Similarly, Bhutan is also among the top 10 countries, consuming 157 Kg per year per capita as of the 2020 which has decreased to 144 Kg per year in 2022.

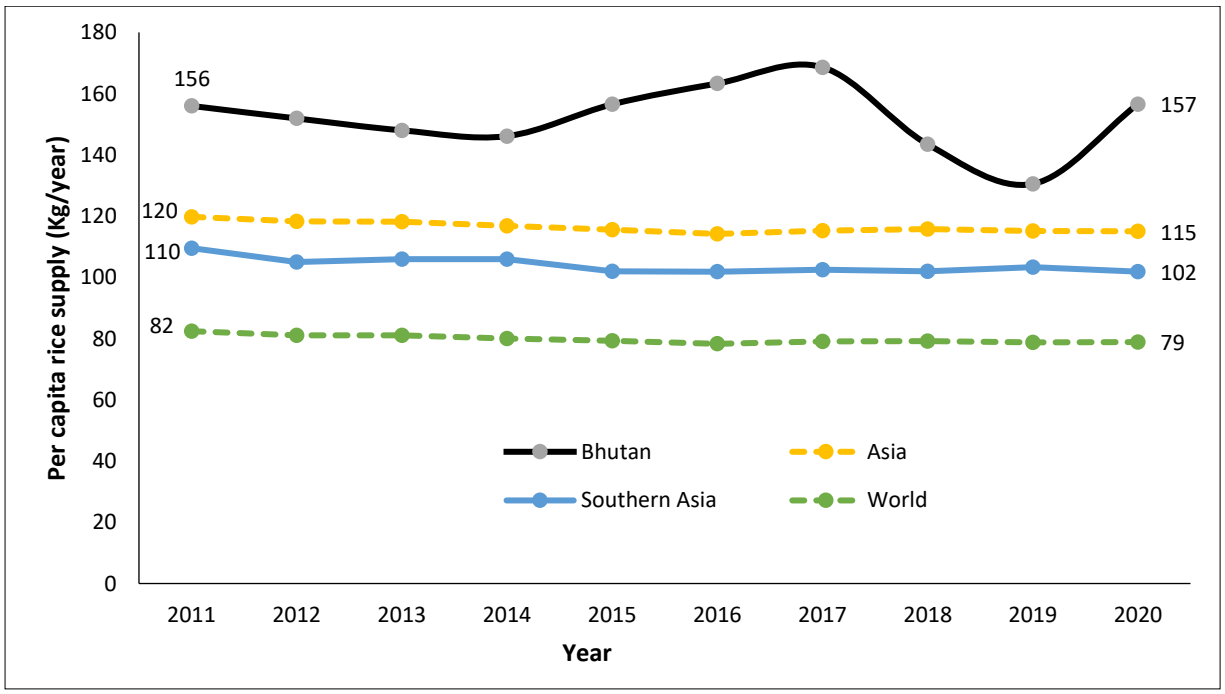


*Figure 5. Per capita Rice consumption in different regions and Bhutan (2011-2020)*

# 2 Situational Analysis

To comprehensively project the rice requirement and enabling strategies, a detailed analysis of the rice area, production and SSR are computed.

## 2.1 Trend of rice production, area, import and SSR

In 2022, the cultivated paddy area was 22,683 acres producing 41,049 MT of Paddy equivalent to 26,682 MT of rice at 65% milling recovery, with a national average yield of 1.8 MT/acre. From 2006 till 2022, there is an average annual cultivated area decline of 2600 ac (5.6%) and average annual production decline of 1900 MT (2.9%). Although cultivated area decreased, the rice yield in the same period increased from 1.1 MT/acre to 1.8 MT/acre, which is an average annual increase of 4.2% (Figure 6).

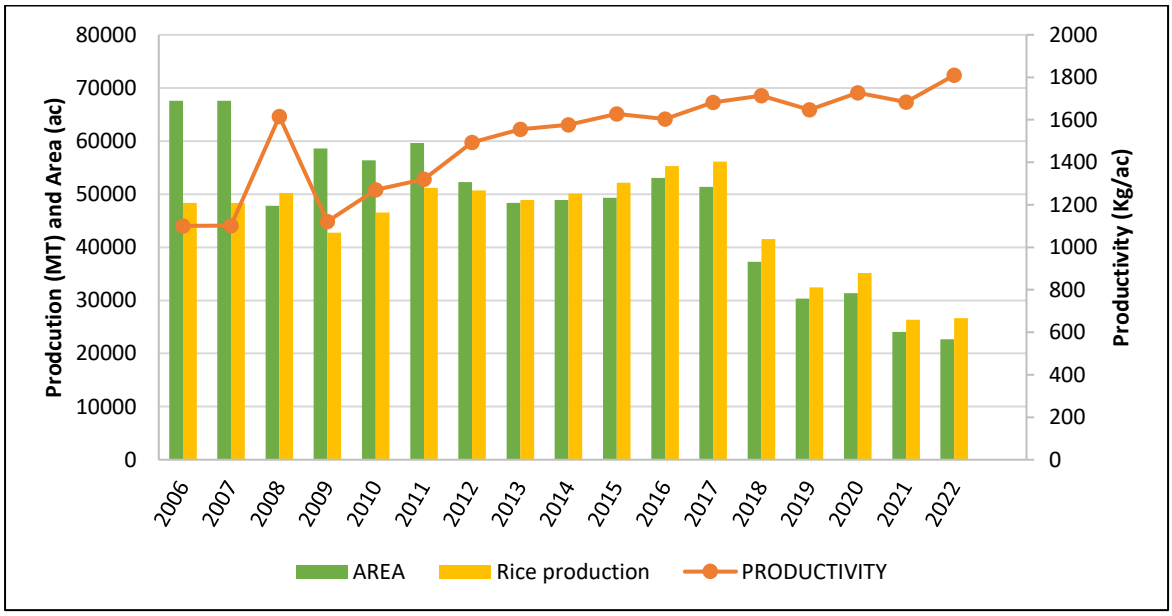


*Figure 6. Rice cultivated area, production and productivity (2006-2022)*

## 2.2 Rice import and export

Rice imports have seen a consistent increase over the years which can be attributed to increase in demand, decline in domestic production, affordability, and access. In 2016, the import volume was 64,368 MT which increased to 79,324 MT in 2022, showing an annual average increase of 4.3%. In the import volume, the broken rice imports are excluded as they are assumed to be used in breweries. The total value of rice imports has surged from Nu. 1 billion in 7 years to Nu. 2.6 billion in 2022 (Figure 7). In contrast, the maximum volume of rice exported has been recorded at 27 MT in 2019 amounting to Nu. 1.46 million (Table 2).

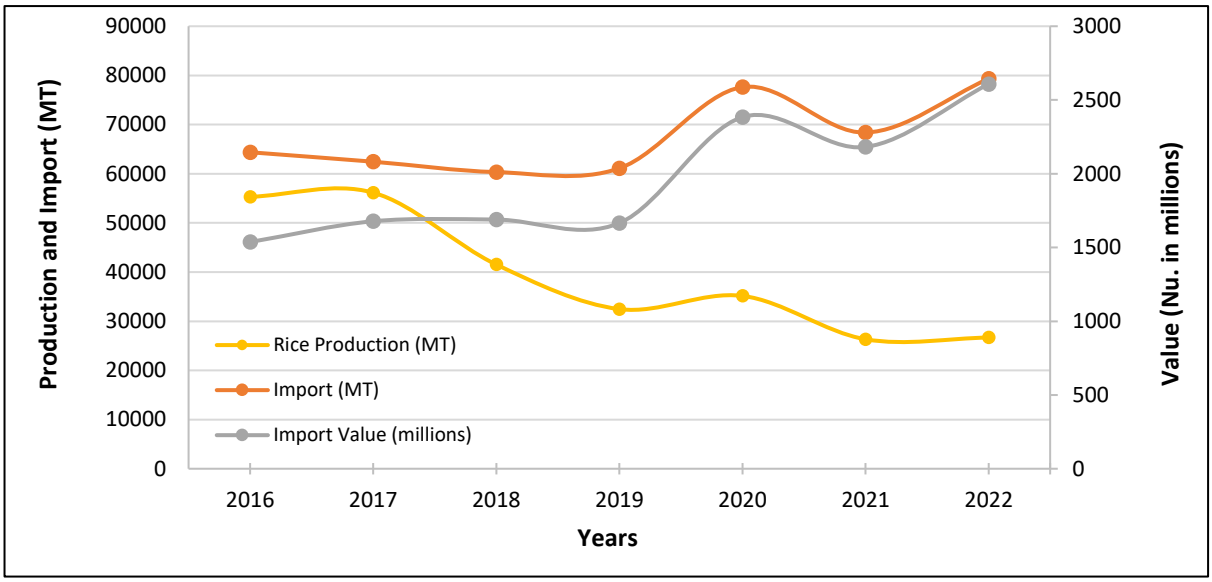


*Figure 7. Rice production, import (MT) and values (Nu.in millions) from 2016-2022*

*Table 2. Rice import and export (MT) and values (Nu. in millions) from 2016-2022*

| Year | Rice Production (MT) | Import (MT) | Import Value (Nu. in millions) | Export (MT) | Export Value (Nu. in millions) |
|---|---|---|---|---|---|
| 2016 | 55309 | 64368 | 1537 | 5.00 | 0.12 |
| 2017 | 56150 | 62445 | 1678 | 6.00 | 0.43 |
| 2018 | 41529 | 60335 | 1689 | 10.00 | 0.04 |
| 2019 | 32466 | 61106 | 1666 | 27.00 | 1.46 |
| 2020 | 35157 | 77627 | 2384 | 0.00 | 0.00 |
| 2021 | 26330 | 68377 | 2182 | 1.41 | 0.01 |
| 2022 | 26682 | 79324 | 2608 | 0.30 | 0.02 |

## 2.3 Projection of rice production, area and SSR from 2023-2034

Rice per capita consumption has declined from 157 Kg/year in 2020 to 144 Kg/per year in 2022. This trend is quite likely to continue as more Bhutanese tend to diversify their diet and that a sizeable population live outside Bhutan. To project the future rice requirement, we suggest three SSR scenarios based on the per capita consumption of 144 Kg/year, 120 Kg/year and 100 Kg/year. These three scenarios represent the current per capita consumption, estimated based on the minimum Kcals recommended by the World Health Organization (WHO), and the reduced per capita consumption at 100 Kg/year, assuming a notable dietary shift from rice.

### 2.3.1 Scenario 1: 144 Kg/year per capita consumption

The current estimated SSR stands at 25.2% which is calculated based on the domestic production, import and export. This indicates that the national per capita consumption is 144 Kg/year at the current population. Assuming per capita consumption remains constant at 144 Kg/year and targeting 35% SSR by 2034, the rice requirement for the country is forecasted to be 119,839.40 MT based on the projected population. To meet 35% SSR by 2034 at the current productivity of 1.8 MT/ac, at least 35,849 acres of wetland has to be cultivated (Table 3).

*Table 3. Rice requirement, area and production forecast at per capita consumption of 144 Kg/year*

| Year | Rice Production (MT) | Projected Population | Per capita consumption (Kg/year) | Rice requirement (MT) | Import (MT) | SSR (%) | Paddy (MT) | Area (ac) |
|---|---|---|---|---|---|---|---|---|
| 2022 | 26681.9 | 763,249 | 144.0 | 109907.9 | 79317.7 | 25 | 41049 | 22683 |
| 2023 | 27729.9 | 770,276 | 144.0 | 110919.7 | 83189.8 | 25 | 42661 | 23701 |
| 2024 | 29099.3 | 777,224 | 144.0 | 111920.3 | 82821.0 | 26 | 44768 | 24871 |
| 2025 | 30483.6 | 784,043 | 144.0 | 112902.2 | 82418.6 | 27 | 46898 | 26054 |
| 2026 | 31881.7 | 790,718 | 144.0 | 113863.4 | 81981.6 | 28 | 49049 | 27249 |
| 2027 | 33293.7 | 797,264 | 144.0 | 114806.0 | 81512.3 | 29 | 51221 | 28456 |
| 2028 | 34716.6 | 803,626 | 144.0 | 115722.1 | 81005.5 | 30 | 53410 | 29672 |
| 2029 | 36148.8 | 809,785 | 144.0 | 116609.0 | 80460.2 | 31 | 55614 | 30896 |
| 2030 | 37590.0 | 815,755 | 144.0 | 117468.7 | 79878.7 | 32 | 57831 | 32128 |
| 2031 | 39037.0 | 821,485 | 144.0 | 118293.8 | 79256.9 | 33 | 60057 | 33365 |
| 2032 | 40487.8 | 826,957 | 144.0 | 119081.8 | 78594.0 | 34 | 62289 | 34605 |
| 2033 | 41344.6 | 832,218 | 144.0 | 119839.4 | 78494.8 | 34.5 | 63607 | 35337 |
| 2034 | 42199.3 | 837,288 | 144.0 | 120569.5 | 78370.2 | 35 | 64922 | 36068 |

### 2.3.2 Scenario 2: 120 Kg/year per capita consumption

Considering the daily dietary energy requirement of 2100 Kcal as recommended by WHO, and with 1176 Kcal (80% of 1470 Kcal) assumed to be met from rice consumption, the recommended per capita consumption will decrease to 120 Kg/year. Keeping the per capita consumption at 120 Kg/year, the rice SSR can be increased to 42% by 2034 based on the projected population provided the cultivated area and productivity is maintained as in scenario 1 (Table 4).

*Table 4. Rice requirement, area and production forecast at per capita consumption of 120 Kg/year*

| Year | Rice Production (MT) | Population | Recommended Per capita consumption (Kg/year) | Rice requirement (MT) | Import (MT) | SSR (%) | Paddy (MT) | Area (ac) |
|---|---|---|---|---|---|---|---|---|
| 2022 | 26681.9 | 763,249 | 144.0 | 109907.9 | 79317.7 | 25.2 | 41049 | 22683 |
| 2023 | 27729.9 | 770,276 | 120.0 | 92433.1 | 64703.2 | 30.0 | 42661 | 23701 |
| 2024 | 29099.3 | 777,224 | 120.0 | 93266.9 | 64167.6 | 31.2 | 44768 | 24871 |
| 2025 | 30483.6 | 784,043 | 120.0 | 94085.2 | 63601.6 | 32.4 | 46898 | 26054 |
| 2026 | 31881.7 | 790,718 | 120.0 | 94886.2 | 63004.4 | 33.6 | 49049 | 27249 |
| 2027 | 33293.7 | 797,264 | 120.0 | 95671.7 | 62377.9 | 34.8 | 51221 | 28456 |
| 2028 | 34716.6 | 803,626 | 120.0 | 96435.1 | 61718.5 | 36.0 | 53410 | 29672 |
| 2029 | 36148.8 | 809,785 | 120.0 | 97174.2 | 61025.4 | 37.2 | 55614 | 30896 |
| 2030 | 37590.0 | 815,755 | 120.0 | 97890.6 | 60300.6 | 38.4 | 57831 | 32128 |
| 2031 | 39037.0 | 821,485 | 120.0 | 98578.2 | 59541.2 | 39.6 | 60057 | 33365 |
| 2032 | 40487.8 | 826,957 | 120.0 | 99234.8 | 58747.0 | 40.8 | 62289 | 34605 |
| 2033 | 41344.6 | 832,218 | 120.0 | 99866.2 | 58521.6 | 41.4 | 63607 | 35337 |
| 2034 | 42199.3 | 837,288 | 120.0 | 100474.6 | 58275.2 | 42.0 | 64922 | 36068 |

### 2.3.3 Scenario 3: 100 Kg/year per capita consumption

With economic growth, affordability and increased awareness, it is expected that Bhutanese populace will likely shift towards protein-based diet which will reduce rice consumption. In such a scenario, we are assuming per capita consumption to 100 Kg/year which will further enhance SSR to 50.4% provided the cultivated area and productivity is maintained as in scenario 1 (Table 5).

*Table 5. Rice requirement, area and production forecast at per capita consumption of 100 Kg/year*

| Year | Rice Production (MT) | Population | Recom. Per capita consumption (Kg/year) | Rice requirement (MT) | Import (MT) | SSR (%) | Paddy (MT) | Area (ac) |
|---|---|---|---|---|---|---|---|---|
| 2022 | 26681.9 | 763,249 | 100.0 | 76324.9 | 49643.0 | 35.0 | 41049 | 22683 |
| 2023 | 27729.9 | 770,276 | 100.0 | 77027.6 | 49297.7 | 36.0 | 42661 | 23701 |
| 2024 | 29099.3 | 777,224 | 100.0 | 77722.4 | 48623.1 | 37.4 | 44768 | 24871 |
| 2025 | 30483.6 | 784,043 | 100.0 | 78404.3 | 47920.7 | 38.9 | 46898 | 26054 |
| 2026 | 31881.7 | 790,718 | 100.0 | 79071.8 | 47190.1 | 40.3 | 49049 | 27249 |
| 2027 | 33293.7 | 797,264 | 100.0 | 79726.4 | 46432.7 | 41.8 | 51221 | 28456 |
| 2028 | 34716.6 | 803,626 | 100.0 | 80362.6 | 45646.0 | 43.2 | 53410 | 29672 |
| 2029 | 36148.8 | 809,785 | 100.0 | 80978.5 | 44829.7 | 44.6 | 55614 | 30896 |
| 2030 | 37590.0 | 815,755 | 100.0 | 81575.5 | 43985.5 | 46.1 | 57831 | 32128 |
| 2031 | 39037.0 | 821,485 | 100.0 | 82148.5 | 43111.5 | 47.5 | 60057 | 33365 |
| 2032 | 40487.8 | 826,957 | 100.0 | 82695.7 | 42207.9 | 49.0 | 62289 | 34605 |
| 2033 | 41344.6 | 832,218 | 100.0 | 83221.8 | 41877.2 | 49.7 | 63607 | 35337 |
| 2034 | 42199.3 | 837,288 | 100.0 | 83728.8 | 41529.5 | 50.4 | 64922 | 36068 |

# 3 Challenges and issues

## 3.1 Inadequate irrigation infrastructure

Water and irrigation are integral to rice production, playing a vital role in crop development, yield, and overall food security. Sustainable and efficient water management practices are essential for the continued success of rice farming. On an average, 2500 liters of water is required to produce one Kg of rough rice (Bouman, 2009).

Considering the importance of water for rice production, the government has prioritized the development of irrigation facilities since the inception of planned development. As of 2022, 67,955 acres, which accounts to 28% of the total agricultural land is under assured irrigation. However, there is no disaggregated data to determine the area of wetland under assured irrigation. Despite the government's continuous intervention, Bhutanese farmers still rank the lack of irrigation as the most important factor constraining rice production.

There are two types of irrigation management system focused on rice production which are Community managed irrigation system (CMIS) and Agency built community managed irrigation systems. From the two systems, there are over 1200 CMIS existing in the country of which about 1000 systems are currently functional. It is reported that the government has supported the construction and renovation of over 200 irrigation schemes totaling to a length of 901.04 km (RSD, 2019). It must be noted that of the total irrigation schemes, only a little over 16% was supported by the government while the remaining 84% was constructed by the farmers. This indicates a huge gap towards meeting the irrigation requirement for rice production. The lack of irrigation water is further exacerbated by the impact of climate change resulting in drying of irrigation water sources, shift in rainfall pattern, damages to irrigation infrastructure and reduced discharge. This calls upon urgent actions to climate proof and make the irrigation system resilient, ensuring assured water availability.

## 3.2 Farm labour scarcity

Rural areas are now dominated by old people and largely women (53% feminization) as youth and abled age group population have left rural areas seeking employment in urban areas and even exiting from the country. Farm labour shortage coupled with high labour charges has been identified as one of the major constraints to farming population resulting in high cost of production. Rapid urbanization aided by national developmental plans have initiated huge rural-urban migration leading to aging farming population and feminization in the farming communities. About 19% of the rural household left the wetland fallow due to labour shortage (RSD, 2019). Moreover, based on the Labour Force Survey (LFS) data (2019 and 2022), there is a decrease of 30% employment from age group 15-45 as compared to 17% reduction from 46-65+ age group, which shows that the working age group employed in agriculture falls above 46 age.

Over the years, the agricultural sector has witnessed a steady decline in employment, with an average annual decrease of 3% and in 2022, only 43% (123,417 individuals) were employed in agriculture (Figure 8). The decline of 3% annually employed in agriculture have led to the decrease in cultivated land as well as production of paddy.

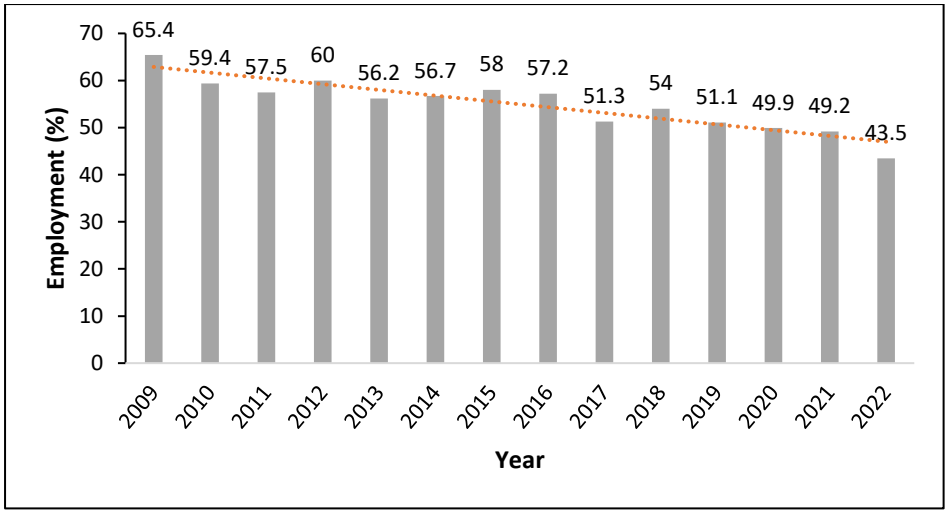


*Figure 8. Employment by agriculture sector from 2009-2022*

For paddy production, 78 person-days (DoA, 2023) is required for one acre of land which totals to 2,796,222 person-days to manage 35,849 acres of wetland. This is a clear indication that our rice production is highly labour intensive with significant person days required for crop guarding. A regional analysis of the labour requirement for rice production is presented in Table 6. From the table, we can see that the labour required for paddy is highest in Bhutan in the region due to low mechanization.

*Table 6. Total Labour required for rice production per acre and cost of production per Kg*

| **Country** | **Labour requirement (Person/days/acre)** | **COP/ Kg (Nu.) 1 USD=Nu. 80** | **Remarks** |
|---|---|---|---|
| Bhutan | 78 | 49 | High labour required for crop guarding, high cost of meals and wage |
| China | 14 | 25 | Highly mechanized |
| Indonesia | 38 | 28 | High cost of water and pest and disease management |
| India | 32 | 16 | Semi mechanized, low wage rate |
| Nepal | 57 | 21 | Low wage rate |
| Thailand | 4 | 16 | Highly mechanized |
| Philippines | 28 | 22 | Mechanized |
| Vietnam | 8 | 12 | Highly mechanized, Irrigation cost not included |

## 3.3 Crop Damage by wildlife and Natural disasters

This has been and remains one of the biggest un-resolved national issues faced by the country. According to RNR Census (2019) about 34% of household faced difficulties preventing crop damage by wildlife, which lead to land being left fallow. Farmers also suffer crop and livestock damage due natural calamities such as earthquakes, hailstorms, cyclones, untimely rain, landslides, windstorms, drought, floods, and disease outbreaks. Losses due to such calamities differ in intensity and extent. According to Agriculture Statistics (2013 to 2015), an average

crop worth Nu. 99.92 million are lost annually to wildlife and natural calamities (MoAF & RICBL, 2018). The incessant rainfall event during rice harvest in 2021 affected 16 Dzongkhags, 100 gewogs and 3829 households. This disaster caused damage to 2502 acres of paddy fields resulting in 2264 MT of production loss amounting to Nu. 90 million. The above data indicates vulnerability of rice sector to wildlife and climate related disasters.

As per the impact assessment of electric fencing (EF) conducted by National Plant Protection Centre (NPPC) in 17 Dzongkhags, 2021, the paddy production lost to wildlife without electric fencing was 33%, which is equivalent to about 20,220 MT paddy. In monetary term, it amounts to Nu. 970 million at the farm gate price of Nu. 48 per Kg. The yield loss in paddy to wild animals with electric fencing can be reduced by 26%, which can save around Nu.765 million per season. Currently, there are 23,754 acres of wetland covered by 1828 Km of EF of which 17% (310 Km) is apparently nonfunctional due to breakdown of energizers, and poor management by farmers.

## 3.4 Limited area and Low economic returns

As per the record with National Land Commission Secretariat (NLCS), total agricultural land in the country is only 2.7% of the total area and approximately 18% (70,927 acres) is registered as wetland. Given an average land holding of 3.7 acres, most Bhutanese farmers are categorized as smallholders (RSD, 2019). Furthermore, wetland cultivation is progressively declining each year resulting in fallowing, stemming from irrigation water shortage, human wildlife conflict, and labour shortage. The main issue is the gross underutilization of the available wetland area at present. The challenge is to optimally use the available wetland by reducing fallow wetland through appropriate interventions discussed in this report. The contraction of the already limited rice-growing area by smallholders is evident in the fact that the total cultivated rice area has experienced an average annual reduction of 5.6%, decreasing from 67,566 acres in 2006 to 22,683 acres in 2022. Moreover, according to data till 2022 from the Land Management Unit under the Department of Agriculture, there were a total of 1160 land transactions, resulting in 805 acres being converted from wetland to dryland for rural construction purposes.

From an economic perspective, rice farming faces challenges due to its low return on investment, primarily stemming from the high costs associated with labour. According to the Department of Agriculture in 2023, the estimated expenditure for one acre amounts to approximately Nu. 82,516. Consequently, the cost of production is around Nu. 49 per Kg of paddy. Notably, about 61% of the total cost is attributed to labour expenses, encompassing activities from fencing and field operations to the transportation of grain into storage facilities. As per the cost-return analysis, the Benefit-Cost Ratio (BCR) is 0.94, indicating negative return as an enterprise. The availability of cheaper imported rice in the market also discourages rice farmers. Furthermore, there are more lucrative alternatives, such as cultivating horticulture that offer better profit margins than rice farming.

## 3.5 Sub-optimal use of inorganic fertilizers

The use of inputs, mainly fertilizers both inorganic and farm yard manure, is vital for optimum crop production, and fertilizer use alone can enhance crop productivity by 30 to 50% (Stewart et al., 2005). It is estimated that one-third of the surge in cereal production worldwide and half of India's grain production during the green revolution period resulted from the increased use of fertilizer by the farmers. On the global scale, in 2018 cereals accounted for nearly 53% of the major nutrients (NPK) use of which 19% was used in maize followed by 15% each in wheat and rice (Figure 9) (IFA, 2022). According to the World Bank estimate, the fertilizer consumption in Kg/hectare (ha) in arable land in 2021 in the selected Asian countries ranged from 5.2 to 384.2 Kg/ha (Figure 10). The total fertilizer use in Bhutan is significantly low, and higher than that of Afghanistan only. (Thang & Phuc, 2016)

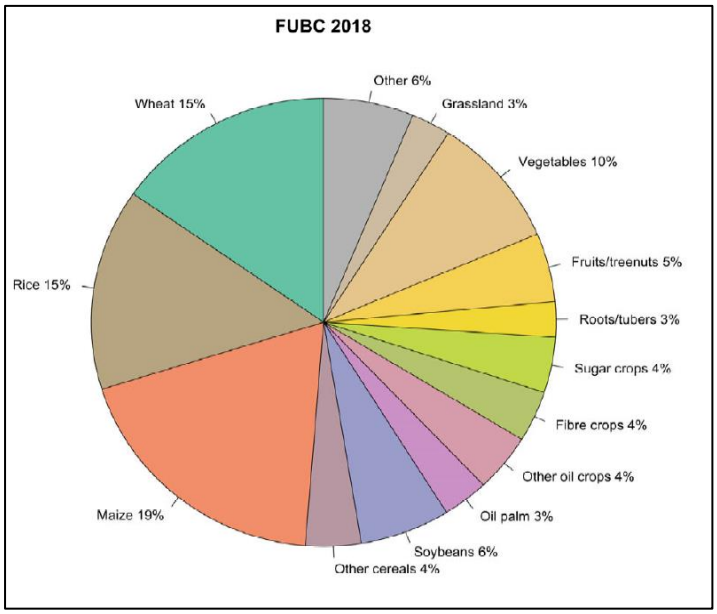


*Figure 9. Global mineral fertilizer use (NPK) by crop, FUBC 2018*

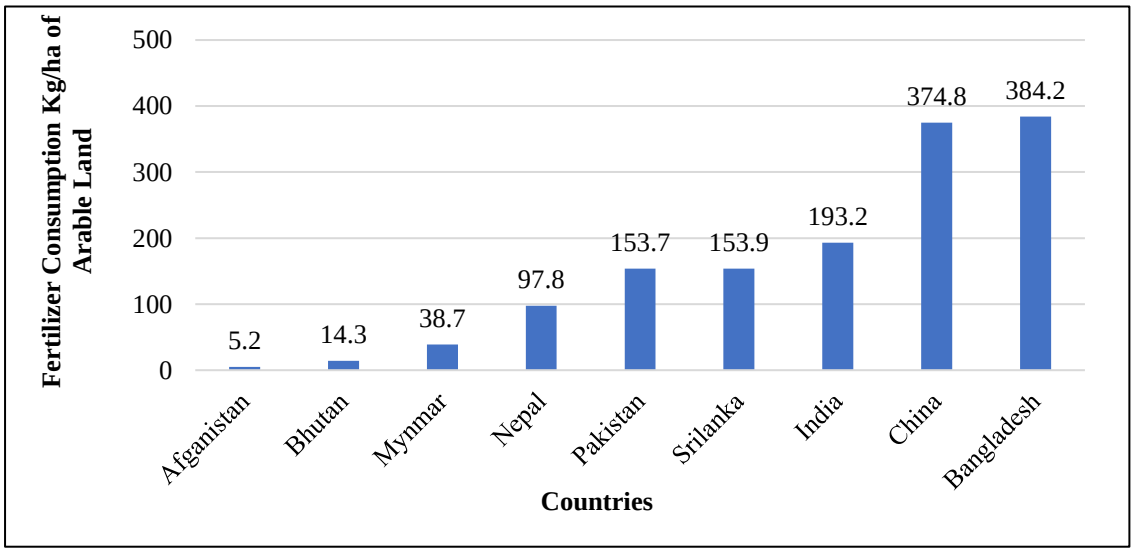

*Figure 10. Fertilizer consumption in Kg/ha of arable land in selected Asian countries in 2021 (WB, 2021)*

Long-term fertilizer uses studies conducted by the National Soil Service Center (NSSC) in rice and potato in Bhutan have shown that 25 to 40% increase in yield can be achieved. The soil fertility status of some rice producing Dzongkhags namely Samtse, Sarpang, Tsirang, and Dagana are significantly low, which is further aggravated by low use of chemical fertilizers. The average rice yield in these Dzongkhags is 1.34 MT/acre as compared to 2.50 MT/acre recorded in Paro and Punakha, which is 46% less. The fertilizers distribution trend from 2018 to 2023 shows that these four Dzongkhags use less than 1% of the country's total fertilizer share. As compared to these Dzongkhags, fertilizer use is comparatively higher in Paro, Punakha, Wangduephodrang, Chhukha, and Trashigang Dzongkhags (Table 7). The lower productivity of rice in Samtse, Sarpang, Tsirang, Dagana, Samdrupjongkhar, and Trongsa is attributable to significantly lower use of fertilizer. This gives a clear indication that there is scope and opportunity to enhance rice productivity by 25 to 40% in those Dzongkhags where current use of fertilizer is relatively lower. To maximize the gains in productivity from higher fertilizer use, it must be packaged with the promotion of high yielding varieties that are more responsive to fertilizer application, optimum water availability, adequate weed, and pest management practices.

*Table 7. Fertilizer distribution trend from 2018-2023*

| Dzongkhag | 2018-2019 | 2019-2020 | 2020-2021 | 2021-2022 | 2022-2023 | Total | % Share |
|---|---|---|---|---|---|---|---|
| Wangdue | 743.99 | 826.55 | 867.98 | 317.44 | 730.59 | 3486.54 | 23.66 |
| Bumthang | 495.09 | 505.40 | 604.18 | 186.33 | 352.12 | 2143.11 | 14.54 |
| T/gang | 299.20 | 552.60 | 387.44 | 470.03 | 287.66 | 1996.92 | 13.55 |
| Paro | 230.26 | 248.69 | 455.01 | 301.25 | 223.49 | 1458.69 | 9.90 |
| Thimphu | 235.15 | 269.60 | 258.46 | 155.05 | 177.08 | 1095.33 | 7.43 |
| Punakha | 239.19 | 242.04 | 266.55 | 184.92 | 151.61 | 1084.30 | 7.36 |
| Chhukha | 174.02 | 224.61 | 379.30 | 117.41 | 159.50 | 1054.83 | 7.16 |
| T/yangtse | 179.33 | 206.27 | 94.86 | 152.35 | 120.54 | 753.33 | 5.11 |
| Mongar | 194.17 | 128.89 | 101.59 | 91.33 | 46.43 | 562.41 | 3.82 |
| Lhuentse | 110.69 | 55.58 | 44.11 | 76.18 | 47.33 | 333.88 | 2.27 |
| Haa | 28.37 | 40.06 | 41.05 | 59.06 | 55.64 | 224.17 | 1.52 |
| Sarpang | 22.99 | 10.66 | 32.55 | 35.07 | 63.49 | 164.75 | 1.12 |
| Trongsa | 23.96 | 23.55 | 35.26 | 32.18 | 13.86 | 128.80 | 0.87 |
| Tsirang | 27.74 | 12.38 | 20.42 | 34.00 | 21.97 | 116.51 | 0.79 |
| Dagana | 19.04 | 18.27 | 20.04 | 22.99 | 17.84 | 98.17 | 0.67 |
| Samtse | 6.23 | 6.29 | 7.56 | 6.53 | 2.36 | 28.96 | 0.20 |
| P/Gatsel | 0.12 | 0.00 | 5.13 | 0.00 | 0.00 | 5.25 | 0.04 |

### 3.6 Policy inadequacy

Absence of any firm national policy directives on the commodity of national significance like rice is a major constraint for the continuity and sustained pursuance of the national rice commodity development program. Until now there have been no specific or effective policies on rice, especially for the protection of critical rice landscapes or rice-based ecosystems. The Land Act, 2007 provides for general protection of the wetlands disallowing conversion to other land uses but it is faced with several implementation challenges. Despite the restriction to wetland conversion, about 700 acres of paddy fields have been lost to road, building, and township development, and about 323 acres more to illegal conversion of wetland and natural disasters (Kuensel, July 10th 2017). Rice cultivation is not remunerative as other agricultural enterprises due to high labour requirement and low level of farm mechanization. Nonetheless, rice farming offers multiple benefits beyond food security, which calls for the attention of the government to recognize the contributions of rice farmers and incentivize them as is prevalent in many South Asian countries where rice is a staple food. The current import regulation on rice as a nontaxable commodity without any cap on the quantity is apparently speculated to be misused by business enterprises as an option to undervalue their taxes. The ecosystem services of the rice production landscapes are evident but has not been valued and recognized.

## 4 Objective of the National Rice Development Strategy

**Short Term**

i. Recognize the significance of rice commodity program towards attaining 35% SSR by 2034 at the current per capita consumption.
ii. Ensure policy and financial support for implementation of proposed enabling actions to achieve 35% rice self-sufficiency by 2034.
iii. Revamp and strengthen national rice commodity program into a more sustainable, vibrant, and resilient program.

**Long Term**

iv. Ensure a dynamic and effective policy for conservation of rice landscapes for sustainable rice farming as a means of livelihood, food security and sovereignty, promotion of our unique tradition, culture and ecotourism.

## 5 Enabling Actions

To accomplish the proposed National Rice Development Strategy 2024-2034, the following different enabling actions are proposed to achieve 35% national rice SSR from domestic rice production by 2034. Subsequently, higher levels of SSR could be accomplished if the per capita consumption reduces to 120 or 100 Kg/year (Scenario 2 and 3).

## 5.1 Develop and out-scale irrigation

As irrigation is outlined as the most important factor contributing to rice production, both by farmers and experts, it should be accorded highest priority amongst all the interventions. The focus should be to develop and out-scale irrigation systems to cover more command areas with assured water availability. It is critical for the government to support construction and renovation of irrigation infrastructures to improve accessibility to assured irrigation. The irrigation development should align to the National Irrigation Master Plan (NIMP 2016) and targets laid out in the 13th FYP.

The dominant irrigation system in Bhutan comprises open earthen canals constructed by farmers which are known to have less than 50% conveyance efficiency. Therefore, the new irrigation structures should be climate proof and resilient with use of appropriate modern technologies to reduce the impact of extreme climate events while increasing the conveyance efficiency.

In the 13th FYP, 171.61 km of irrigation channels with a command area of 5968.69 acres of wetland benefiting 3577 farming households is planned to be brought under assured irrigation. The total cost projected is Nu. 905.99 million of which Nu. 182.21 million has already been secured from various sources and the balance fund gap of Nu. 723.78 million is the investment required in the irrigation component. In the 14 FYP, 206.50 km covering 5961.36 command area will be brought under assured irrigation with the investment of about Nu. 1073.8 million. The total investment for irrigation in 13th and 14th FYP will be Nu. 1979.79.

## 5.2 Enhance access to fertilizers and adopt improved nutrient management practices

Fertilizer intervention stands as a pivotal component in the quest for increased paddy productivity, a crucial element in realizing national food security. This strategy targets Dzongkhags that demand critical intervention for the extensive adoption of fertilizer use. An in-depth analysis reveals promising prospects, particularly in five Dzongkhags of Lhuentse, Sarpang, Trongsa, Tsirang, and Samtse, where the adoption of fertilizers is projected to yield a remarkable 30% increase in annual productivity. In concrete terms, the current paddy production from 7778.67 acres in 5 Dzongkhags stands at 10,889 MT (Table 8). With the promotion of advanced fertilizer technology, the anticipated surge in production will be 14,002 MT from the same acreage annually. In 10 years, the net gain will be 31,128 MT paddy equivalent to 20,233 MT of milled rice.

*Table 8. Projected yield increase in the targeted district with fertilizer use*

| Dzongkhag | Current Harvested area (ac) | Current Production (MT) | Current Yield (MT/ac) | % increase in yield from current to 1.8 | Projected Production (MT) | Net gain in production (MT) |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| Lhuentse | 1,062.36 | 1,825.11 | 1.72 | 4.65 | 1,912.25 | 87.14 |
| Sarpang | 1,841.45 | 2,998.88 | 1.63 | 10.43 | 3,314.61 | 315.73 |
| Trongsa | 883.19 | 1,421.49 | 1.61 | 11.80 | 1,589.74 | 168.25 |
| Tsirang | 1,306.41 | 1,551.90 | 1.19 | 51.26 | 2,351.54 | 799.64 |
| Samtse | 2,685.26 | 3,091.43 | 1.15 | 56.52 | 4,833.47 | 1,742.04 |
| **Total** | **7,778.67** | **10,888.81** | | | **14,001.61** | **3,112.80** |

To facilitate the accomplishment of above projected yield, effort should be made to improve the availability of fertilizers in all Dzongkhags through active Agriculture Sales and Services Representatives (ASSRs) and advocate the judicious use of fertilizers along with other recommended package of practices.

Besides the above action, one major intervention proposed is to reform the current fertilizer subsidy. The current subsidy amount of Nu. 15 million for transportation and Nu. 19 million sales commission allocated to National Seed Centre (NSC) is insufficient to make a substantial impact on achieving self-sufficiency. As fertilizer use in rice is low, farmers should be encouraged to use more fertilizers to achieve higher yields. The fertilizer subsidy could be targeted only for 5 Dzongkhags with low use of fertilizers or in all rice growing Dzongkhags. The current fertilizer cost per acre is Nu. 5500. To encourage farmers to use adequate fertilizers, subsidy is proposed at 25%, 50%, 75% and 100% of the total cost per acre (Table 9).

*Table 9. Proposed fertilizer subsidy for rice production at different rates*

| **Area (ac)** | **Price subsidy/ac at the current cost of Nu. 5500/ac** | | | | **Remarks** |
|---|---|---|---|---|---|
| | **25%** | **50%** | **75%** | **100%** | |
| 7779 | Nu 11 M | Nu 21 M | Nu 32 M | Nu. 43 M | Sarpang, Samtse, Trongsa, Tsirang, Lhuentse |
| 22683 | Nu 32 M | Nu 62 M | Nu 94 M | Nu. 94 M | All Dzongkhags |

## 5.3 Enhance access and adoption of improved plant protection services

Globally, rice farmers experience an average loss of 37% in their rice crop due to pests and diseases annually. Efficient crop management practices, coupled with timely and accurate diagnosis, can significantly mitigate these losses. According to a survey conducted in rainfed lowland rice in Bhutan, insect pests led to a notable 22% reduction in rice yield. Additionally, weed can cause yield losses from 10-50%. In warm temperate rice producing areas, the perennial broadleaf semi-aquatic *Potamogeton distinctus* (*Sochum*) can cause up to 37% yield loss (Karma and Ghimiray, 2006).

Weed management in rice demands substantial farm labour. As shortage of farm labour is a serious constraint, farmers have significantly adopted the use of weedicides namely Butachor and Sunrice. Presently, the average herbicide usage stands at 6.1 Kg/ac falling below the recommended rate of 10-12 Kg/ac. The farmers of Samtse, Sarpang, Tsirang, and Dagana Dzongkhags have reported the unavailability of weedicides. Thus, improving the accessibility of weedicides through ASSR can boost rice productivity. The Dzongkhag wise supply of two weedicides is presented in Table 10.

*Table 10. Dzongkhag wise weedicides supply*

| Dzongkhag | Butachlor 5 G (litre) | | | | | Sunrice 15 WDG (litre) | |
|---|---|---|---|---|---|---|---|
| | 2017-18 | 2018-19 | 2019-20 | 2020-21 | 2021-22 | 2020-21 | 2021-22 |
| Bumthang | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chukha | 10300 | 16500 | 8500 | 11500 | 19500 | 0 | 0 |
| Dagana | 5000 | 5200 | 5000 | 10000 | 8400 | 0 | 0 |
| Gasa | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Haa | 5000 | 0 | 10000 | 5000 | 6000 | 0 | 0 |
| Lhuntse | 14000 | 23000 | 14500 | 20000 | 24000 | 0 | 7 |
| Mongar | 7000 | 11600 | 10000 | 9000 | 6540 | 0 | 0 |
| Punakha | 90000 | 70000 | 75000 | 80000 | 89830 | 110 | 116 |
| Paro | 161000 | 162000 | 131400 | 110850 | 132000 | 174 | 177 |
| P/gatshel | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Samtse | 7300 | 5000 | 4500 | 0 | 7160 | 0 | 0 |
| S/J | 0 | 1000 | 1000 | 0 | 0 | 0 | 0 |
| Sarpang | 10200 | 9000 | 20000 | 10000 | 12000 | 18 | 0 |
| Tsirang | 10300 | 10000 | 20000 | 5000 | 6000 | 0 | 0 |
| Trongsa | 16000 | 17000 | 20000 | 20000 | 19000 | 4 | 5 |
| T/gang | 27000 | 20000 | 18000 | 24000 | 24000 | 0 | 0 |
| T/yangtse | 46000 | 62000 | 30900 | 35000 | 40600 | 0 | 0 |
| Thimphu | 35000 | 30000 | 35000 | 35000 | 40600 | 14 | 13 |
| Wangdue | 36000 | 50000 | 51000 | 29840 | 55400 | 79 | 82 |
| Zhemgang | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **480100** | **492300** | **454800** | **405190** | **491030** | **399** | **400** |

## 5.4 Addressing farm labour scarcity

### 5.4.1 Farm mechanization

Studies conducted under local situation has revealed that farm mechanization has a potential to reduce cost of production by almost 10-20% (Gyem et al., 2018). Studies conducted by AMTC in 2016 in central, southern and western regions on farm mechanization show that cost of production per acre decreased by 9% (Nu. 3800/acre), 11% (Nu. 3330/acre) and 39% (Nu. 30570/acre) respectively. The average across the region was about 20%, which clearly indicates the benefits of farm mechanization. As per the RNR Census 2019, total wetland

owned is 47,395 acres, out of which 9,554 acres (20%) is under mechanization, and remaining 37,841 acres (80%) is not mechanized. To capitalize the proven benefits of farm mechanization, it is crucial that the government continue to provide 40-60% subsidy support for farm mechanization. Given the steep terrain, farm mechanization should be focused for 70% of the remaining feasible wetland which accounts to 26,489 acres. Bringing these areas under farm mechanization would entail a budget of about Nu. 145 million annually at the FMCL hiring charge of Nu. 5510 per acres of wetland without subsidy. If 50% subsidy is given, the cost will reduce to Nu. 73 million.

### 5.4.2 Address the seasonal farm labour scarcity for rice farming

The potential alternative solution to address labour shortage is to pilot and support licensed agricultural labour agencies, which should first explore and mobilize the national seasonal farm labour work force targeting unemployed youth. This agency could also be authorized to import regulated foreign labour on a seasonal short-term basis. Besides addressing the seasonal labour such a move could also help to reduce the cost of production as contractual wages would be relatively lower and save the high cost of food and drinks that has to be mandatorily offered to community shared labour. Therefore, there is a need for strong policy support to pilot and promote agricultural labour emulating the concept and modalities of construction workers.

## 5.5 Enhance crop protection from wild animal damages and natural disasters

To safeguard 43,000 acres of wetland that is required to meet 35% SSR, 3300 Km of EF will be required. In terms of covering the remaining area (19,246 ac), a total length of 1791 Km of EF inclusive of 310 km non-functional EF will be required. The total cost for 1791 Km of EF will be approximately Nu. 286.5 million at the estimated cost of Nu. 0.16 million per Km of EF.

Globally, many countries saw a surge in policy interventions on agricultural insurance programs for risks management. Developed countries mostly established agricultural insurance in the past. However, the German Agency for International Cooperation (GIZ) survey in 2020 found that there are about 265 million agricultural insurance programs offered in low and middle-income countries. It helps transfer risks to the insurance market and enables farmers to cope with certain events of disasters and protect against income shortage. Furthermore, agricultural insurance helps farmers take more risks in adopting new technologies and increasing production. Today, there are many types of innovative agricultural insurance that are suitable for smallholder farmers besides traditional indemnity insurance schemes.

Bhutan has no policy or legal framework for risk management for agricultural production. Most agricultural insurance is supported globally with government subsidy and re-insurance (Kramer et al., 2022). Unfortunately, agricultural insurance in Bhutan has not made its progress despite the need to protect smallholder farmers. For example, in India, under the Pradhan Mantri Fasal Bima Yojana (PMFY) crop insurance scheme, farmers only pay about 2% of the premium for Kharif (summer) and rabi (winter) crops and 5% for commercial and horticultural crops while government bears five times more than the farmers (Rai, 2019). Similarly, Bhutan government

intervention is critical to ensure the Bhutanese farmers' access and realize the benefits of agricultural insurance and reduce the crop loss to natural disasters and wildlife depredation.

## 5.6 Enhance adoption of improved rice varieties

Rice area is spread over three broad agro-ecological zones of high, mid and low based on the altitude. The high-altitude zone, also referred to as warm temperate zone, covers rice areas from 1,600 m and above. Around 20% of the rice areas falls under this zone. The mid altitude zone which accounts for 45% of the rice areas has an elevation of 700 m to 1500 m. The remaining 35% is the low altitude zone (200 m – 600 m) concentrated in the southern part of Bhutan and is also referred to as the wet sub-tropical zone (Ghimiray et al., 2013). Using the expert estimated adoption rate of improved rice varieties, the total area not adopted to improved rice variety is 10,604.30 acres (Table 11). Considering that improved varieties under similar management conditions produce about 1000 Kg additional grains from a hectare (or 400 Kg per acres), additional 4241.72 MT of paddy equivalent to 2757.12 MT of rice (65% milling recovery) can be obtained simply through the rapid promotion and adoption of improved varieties. It will be therefore imperative for the national rice commodity program and extension service to rapidly promote and upscale the dissemination of improved rice varieties particularly in the mid and low altitude zones.

*Table 11. Estimation of rice area not adopted to improved rice varieties*

| **Rice production zone** | **% Share of Rice Area** | **Estimated Harvested Area (ac)*** | **% Variety adoption (Expert estimate 2013)** | **Area Adopted to Improved Varieties (ac)** | **Area Not Adopted to Improved Varieties (ac)** |
|---|---|---|---|---|---|
| High | 20 | 4537 | 80 | 3629.28 | 907.32 |
| Mid Low | 45 | 10207 | 40 | 4082.94 | 6124.41 |
| Low | 35 | 7939 | 55 | 4366.478 | 3572.57 |
| **Total** | | | | | **10604.30** |

**Based on harvest area of 22683 acres*

## 5.7 Strengthen and revamp the national rice commodity program

Historically, the national rice commodity program is institutionalized and implemented from Agriculture Research and Development Center (ARDC) Bajo which is the designated center of excellence for coordinating the National Field Crops research and development program. ARDC Bajo as the implementing arm of the DoA should be capacitated to confidently lead the national rice commodity program. Over time, the rice program has severely weakened without even a minimum critical mass of experts to coordinate the commodity program. Recognizing the significant role of rice as a commodity of national priority, the DoA should consider the immediate overhauling of the rice commodity program by deputing a team under the leadership of Program Director to lead the rice program. The following are the priority action area:

i. Constitute a national rice committee to guide and oversee the rice sector development.
ii. Revive linkages with IRRI to initiate rice breeding program and access to germplasm.
iii. Fast tracking dissemination of available technologies by identifying the gaps and unreached areas.
iv. Coordinating and facilitating the access to inputs.
v. Strengthen and organize the rice value chain in partnership with SOEs and private sector.

## 5.8 Incentivization of rice cultivation

There is always a high economic trade-off for farmers growing rice compared to other vegetable and fruit crops. Growing rice is not as economically profitable as cultivating other crops within the rice ecosystem. Although the gross revenue from rice is significantly higher than that of other cereals, it falls far short when compared to horticultural crops (Figure 11). The analysis demonstrates that farmers would be better off growing horticultural crops than rice, given that the gross revenue of most other crops significantly exceeds that of rice from an acre of land. For example, farmers in Paro and Thimphu would be more financially viable growing asparagus and apples, as the opportunity cost of growing rice is approximately Nu. 163,400 and Nu. 276,800 per acre, respectively. Similarly, farmers in the south would benefit from investing in areca nuts. Therefore, rice cultivation is a low-return crop with intensive investment costs.

To encourage rice farmers to continue cultivating rice and to protect rice-based wetland production ecosystems, one option the government should explore is providing monetary incentives to reduce the cost of production and make rice cultivation more profitable for farmers. However, incentivizing rice farmers solely based on an economic trade-off analysis between rice and horticulture crops could have significant financial implications for government revenue and may not be sustainable.

Therefore, a more sustainable approach would be providing an incentive covering approximately 20-30% of the cost of production. This measure aims to safeguard 43,000 acres of wetlands and achieve a 35% SSR by 2034. To attain this goal, farmers should be incentivized with approximately Nu. 20,000 per acre which is 25% of the CoP of paddy per acre (Nu. 82,516). In such a setting, the total cost for the government to protect 43,000 acres of wetland would be approximately Nu. 860 million per year. Another option the government could consider incentivizing rice farmers is waiving the land tax for wetlands conserved for critical ecosystems, tourism, and rice cultivation.

Governments commonly employ economic compensation as an effective incentive to encourage farmers to adopt protective practices for cultivated land. The protection of rice farmland and incentivization policy is common in many developing countries like Vietnam, China, and Indonesia (Chu et al., 2021). In Vietnam, direct support for rice land management

and use was 500,000 VND (Nu. 1700) per hectare (ha) per year for rice growers and 50% of land tax reduction. Further, Vietnamese rice farmers are credit-supported with inputs, training, and subsidized insurance premium (Thang & Phuc, 2016). Similarly, In China farmers with basic farmland can receive a subsidy of 6000 yuan/ha (equal to Nu. 69,660) per year (Xiao et al., 2019). A direct payment scheme for agriculture is also practiced in many developed countries. For instance, in EU countries, there are four different cash payment systems. One such is the 'Active farmers or the basic payment scheme,' where farmers receive an average payment of Euro 266 (Nu. 21,280) per ha per year. Such innovative incentives and policy interventions are now crucial to prevent the loss of most wetlands for other purposes and reduce imports.

In the absence of any incentive or support price for rice, it is likely that majority of farmers may produce only minimum for their own consumption and needs, and leave the remaining land follow, convert to more profitable options, or opt for cultivation of other remunerative crops. Such a situation will lead to a 100% rice import. If we value the current domestic production of paddy at Nu. 49 per Kg, the total value for producing 41,049 MT of paddy equivalent to 26682 MT of milled rice is Nu. 2.01 billion. Assuming a scenario of 100% rice import, the total cost at the current import price of Nu. 32.88 will be Nu. 3.48 billion which will give a theoretical saving of Nu. 1.47 billion. This analysis is without taking into account other relevant economic parameters such as value of land, employment of farmers, and overhead cost of reaching rice to the consumers, subsidies and the ecosystem services.

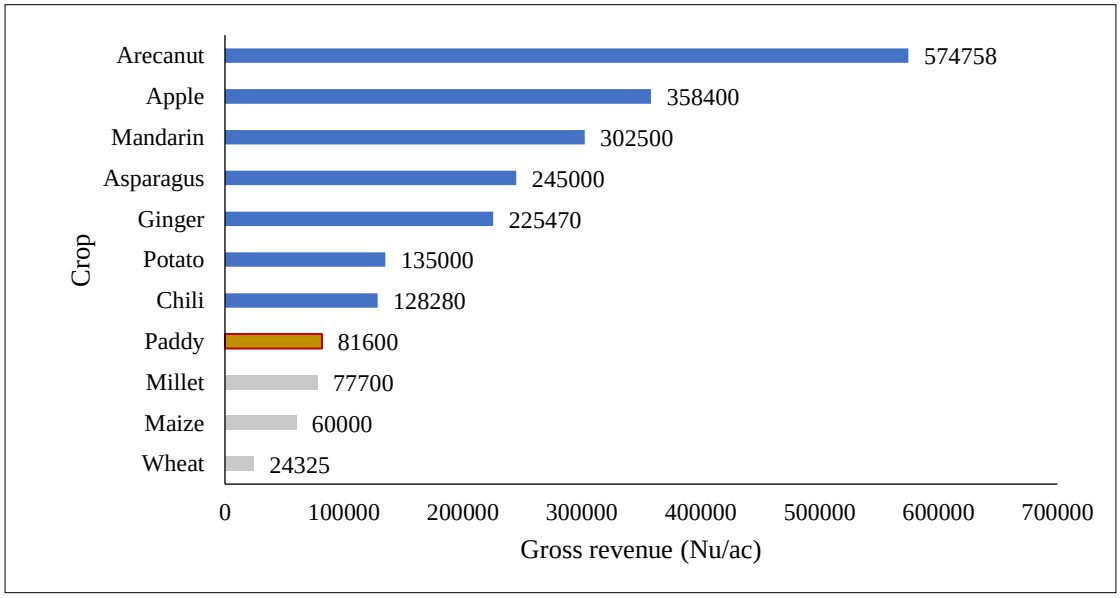


*Figure 11. Comparison of returns from rice against other crops*

## 5.9 Engaging State-Owned Enterprises and private entrepreneurs

Farmers have traditionally grown rice primarily for their own consumption and to generate additional income, especially in the key rice-growing regions in the west. Advances in the agricultural sector have made it easier for farmers to access seeds and seedlings for horticultural

crops, which offer higher returns per unit compared to rice. As a result, there has been greater diversity in the crops cultivated by farmers compared to previous decades.

Rice production has been on the decline, primarily due to a reduction in the cultivated areas. This decrease is a result of farmers leaving their fields fallow and shifting to crops other than rice. Rice cultivation is labour-intensive, leading to high production costs due to minimal mechanization. This issue is exacerbated by a shortage of labour as younger individuals are not interested in farming.

As production by smallholder farmers has proven to be difficult owing to various constraints, engaging SOEs and private entrepreneurs may be a better alternative for commercial rice production that will supplement in achieving 35% SSR. Recognizing the important role that SOEs can play to produce rice on a commercial scale they should be supported to invest on rice related infrastructures. In addition, the department should also create an enabling environment for interested private individuals, entrepreneurs, established business houses, industrialists through financial and technical support to help them venture into commercial rice cultivation. Such entities may also invite foreign direct investment to improve the rice value chain.

## 5.10 Policy intervention to protect and conserve wetland

Enabling policy and institution environments are critical to drive the rice sector development. In the absence of any firm policy guidance and target, the rice SSR target has remained highly flexible. The national rice SSR at the beginning of the 12$^{th}$ FYP was 46.7%, which has declined to 25% in 2022. The flexibility of the SSR target has affected the adequate allocation of resources and focus to the rice commodity program. In the absence of any clear policy directive, this strategy proposes the government for a national policy directive to achieve at least 35% rice SSR by 2034. Such a government directives shall serve as a mandatory guideline to design and pursue a more robust national rice commodity program comprised of the following enabling actions. The different enabling actions are proposed under each relevant sub-heading.

### 5.10.1 Protect and conserve rice-based wetland production ecosystem

Land conversion and land use change from wetland to other categories allowed under the Land Act, 2007 has become convenient provision for farmers to leave the land fallow for a long period of time and apply for conversion. In and around urban areas, many farmers have already transacted their wetland area. Additionally urban centers are planned and developed in prime rice growing areas like Bajo, Thimphu, and Paro to name a few.

Despite the provision in the Land Act 2007, there is continuous pressure on the conversion of wetland which makes it imperative to develop and implement a holistic plan for wetland protection and conservation to achieve at least 35% SSR by 2034. This requires protection of about 43,000 acres of wetland exclusively for rice cultivation. This area includes 36000 acres projected earlier and additional buffer of 7000 acres. The protected area should also have provisions to declare and conserve unique and historical rice farming landscapes where ecotourism can be promoted. Further, revenue plough back as special incentive for rice

ecosystem supporting conservation for example Bumdeling Geog in Trashiyangtse Dzongkhag should also be explored.

### 5.10.2 Organize and support access to high end markets for specialty Bhutanese rice and rice products

There are several unique and rare aromatic Bhutanese rice varieties conserved and cultivated by farmers in untouched pristine ecosystem whose potential as specialty rice in the export market remains unexplored. The genetic composition and quality profiling of these varieties has also not been studied. The Department of Agricultural Marketing and Cooperative (DAMC) in collaboration with DoA, and the National Biodiversity Center (NBC) should plan to leverage the expertise and resource of FAO to obtain the Geographical Indication to facilitate market for exclusive Bhutanese rice products produced under pristine environment. Such products should be certified, branded, and exported under the Brand Bhutan initiative to help generate income for farmers. Postproduction and market facilitation interventions should be developed to support farmers. This will encourage farmers to pursue rice farming as a viable enterprise besides earning foreign exchange for the country.

Further, FAO is currently identifying Special Agricultural Products (SAP) by assessing and monitoring the quality of the local environment where the product grows. It is also deploying an innovative tool Geographical Indications Environment & Sustainability (GIES) that uses open science to trace the geographical origin of a specific special agricultural product. DAMC should immediately grab this opportunity for special rice varieties. In addition to the above actions, it would be very important to recognize and reward rice farmers for their effort in rice production through nationally recognized forums and events by organizing rice fair and festivals coinciding with important national events.

In the absence of a formal domestic rice market, the access of consumers to local rice is limited. To encourage and keep farmers in rice farming it is essential to establish formal rice marketing channels for income generation.

## 5.11 Estimated impact of different production technologies to rice productivity

Under an enabling policy environment where land, labour, capital and market are not the limited factors, the rate of contribution of individual production technologies varies. However, optimal productivity results from the combined effect of all the technologies. To understand which technology is the most critical relatively, data from international and national studies have been used to compute the potential contribution of each technology (Table 12). Among all technologies, irrigation contributes the highest followed by fertilizer application and fencing. Apparently, in the Bhutanese context, fencing is the most important intervention considering the huge losses reported by farmers including drudgery of crop guarding that impacts the farmers' health and social wellbeing. If these interventions are supported, the cost of production will be reduced and encourage farmers to continue rice farming. To be more precise in the local context, factorization of the contributions of technologies to yield needs to be studied for evidence-based resource allocation.

*Table 12. Contribution of production technologies to rice yield*

| Production technology | Estimated contribution to yield (%) | Percentage contribution of each factor (%) | Source |
|---|---|---|---|
| Irrigation | 56 | 38 | IRRI |
| Fertilizer | 30 | 20 | NSSC |
| Fencing | 27 | 18 | NPPC |
| Improved varieties | 25 | 17 | IRRI |
| Weed management | 10 | 7 | IRRI |
| **Total** | **148** | **100** | |

# 6 Cost estimate and return analysis

The cost estimate and return analysis provides insights into the anticipated paddy production and the associated financial implications. The annual estimated paddy production stands at 73,100 MT, covering an area of 43,000 acres with 2 MT/ac productivity and 15% post-harvest loss. Over a decade, the cumulative production is projected to reach 731,000 MT, highlighting the sustained nature of the rice cultivation initiative. The gross revenue, calculated at Nu 48 per Kg of paddy, amounts to Nu. 35,088 million. This figure represents the total income generated from the paddy yield over 10 years. The Net Present Value (NPV) is assessed at Nu. -1026 million, indicating that the current value of future cash flows associated with rice production does not cover the initial investment, revealing potential financial challenges. Similarly, the Benefit-Cost Ratio is calculated at 0.94, suggesting that the project may not be financially viable in its current form.

Given the significant difference between the selling price of rice and paddy, a comprehensive evaluation that includes post-milling considerations and a focus on cost-effective strategies will be essential to navigate potential financial challenges and secure the viability of Bhutan's rice production initiative.

To achieve the target of 35% SRR by 2034, with per capita rice consumption as 144 Kg/year, a total investment cost for 10 years period (2024-2034) is estimated at Nu. 11.92 billion (Table 13). If the target of 120 or 100 Kg per capita is pursued with full commitment, there is an opportunity to accomplish the SRR to the extent of 40-50%. The investment encompasses interventions such as new construction and renovated irrigation system, monetary incentivization for wetland protection and conservation, support for electric fencing, subsidy for farm mechanization, subsidy for farm mechanization and support for technology adoption. A committed approach to these interventions could significantly impact the success of the rice production in Bhutan.

*Table 13. Cost estimate and return analysis (43000 acres)*

| Interventions for the enabling actions | Estimated expenses (Nu. in million) | Target Area (ac) | Useful life | Estimated cost (depreciated 2024-2034) Nu. in million | Estimate cost for 2024-2034 without depreciation (Nu. in million) |
|---|---|---|---|---|---|
| **Constraint cost (Government intervention)** | **3232.29** | | | | |
| Irrigation new construction & renovation | 1979.79 | 14521 | 35 | 565.65 | 1979.79 |
| Wetland protection and conservation | 860 | 43000 | 1 | 8600 | 8600 |
| Support for Electric fencing | 286.5 | 47143 | 10 | 286.5 | 286.5 |
| Subsidy for Fertilizer adoption (25%)- all dzongkhags | 32 | 22683 | 1 | 320 | 320 |
| Subsidy for farm mechanization | 73 | 33177 | 1 | 730 | 730 |
| Support for technology adoption | 1 | 10000 | 1 | 10 | 10 |
| **Unconstraint cost (Farmer's costs- Nu. in million)** | **2847.499** | | | | |
| Labor cost for rice production Nu.650/day/person for 43000 ac | 2180.1 | 43000 | 1 | 21801 | |
| Seed and other costs | 463.69 | 33000 | 1 | 4636.9 | |
| Maintenance cost for irrigation (10%) in 5 years | 197.979 | 14521 | 1 | 395.958 | |
| Maintenance cost for irrigation (2%) in 3 years | 5.73 | 47143 | 1 | 17.19 | |
| **Gross estimate (Nu. in million)** | | | | **37363** | **11926** |
| **Expected paddy production (MT/year)** | 73100 | | | | |
| **Expected paddy production (MT/ 10-year)** | 731000 | | | | |
| **Return analysis** | | | | | |
| Gross revenue @ Nu 48/kg of paddy (Nu. In million) | 35088 | | | | |
| Net return (Nu. in million) 10 year | -2275 | | | | |
| Net Present Value (NPV) | -1054 | | | | |
| Benefit-Cost Ratio (BCR) | 0.94 | | | | |

# 7 Conclusion

Rice plays an important role in the Bhutanese food system, livelihood, culture, and tradition. The rice based terraced landscape renders multiple benefits beyond rice production. Although rice cultivation is less remunerative compared to the cultivation of horticultural crops, its role as a preferred staple food of the Bhutanese cannot be valued in monetary terms alone. Rice area and production is rapidly declining causing the decline of SRR, with current SSR reduced to 25%, which is an issue of national significance. Bhutan meets its 75% rice requirement through import from India, which is entirely on the goodwill and is highly vulnerable to any changes in the India's rice export policy. Rice cultivation is faced with increasing shortage of irrigation water, acute labour shortage, intense human-wild life conflicts, rapidly decreasing land holding sizes and land fragmentation, increasing fallow lands, lack of coherent policy on commercialization of agriculture, lack of adequate investments in agriculture, and lack of clear policy on subsidy or incentives for rice farming. Given the indispensable role of rice to the Bhutanese society, it deserves to be recognized as a special commodity that needs attention outweighing its low return to investment. The three most compelling reasons why rice and rice-based ecosystem must be supported and protected considering both food security and sovereignty are that rice is the most preferred, socially classed, and historically central to Bhutanese food, livelihood, culture, tradition, and religion. Rice engages and will continue to engage significant percentage of Bhutanese as consumers and producers and rice farming system will continue provisioning multiple ecosystem benefits for the conservation of biodiversity and promote ecotourism.

This national rice development strategy prepared by the DoA analyzing the challenges along with appropriate enabling actions is expected to prompt a national debate and discussion towards framing a long-term policy vision and guidance for the comprehensive development of the rice sector. A long-term policy directive is critical to ensure a sustainable, vibrant, and resilient rice sector thus securing food security and sovereignty.

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