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Role of Rice in Food Security of Afghanistan: A Review

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ABSTRACT

Rice is the most important staple after wheat, provides daily calories for most of the country's people, and plays a significant role in food security and nutrition. Rice also contains vitamins and minerals, and its nutrients are more valuable than wheat's. Afghanistan has been considered one of the world's most food-insecure countries due to conflicts, poverty, seasonal factors, drought, and limited access to, availability of, and utilization of staple foods, especially in rural areas. The role of rice in Afghanistan's food security has not been adequately addressed in previous studies and warrants further investigation. This review aims to describe the role of rice in Afghanistan's food security, focusing on production. In the narrative literature review, the relevant keywords for the topic were investigated in popular databases over the last two decades and screened for relevant manuscripts. The resulting information was then organized into different sections of the manuscript. Domestic rice production fulfilled 58.13% of the country's demand in 2023. The average yield of rice in 2023 was 3.11 metric tons per hectare, up 0.7%, and rice-cultivated land increased by 0.7%. Rice cultivated on 129×10^3 hectares in 2023 in 16 provinces not only boosted the domestic market but also employed local people. Thus, Afghanistan's land, farmers, and local rice varieties have the potential to increase rice production and provide a strategic staple food for people. Providing all this information is helpful to researchers, advisors to rice farmers, and policymakers, enabling them to develop a favorable plan for a self-sufficient Afghanistan in rice production to produce enough high-quality rice in the future and improve food security.

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INTRODUCTION

Afghanistan has been identified as one of the world's most food-insecure countries. Conflict, poverty, seasonal variations, and food shortages are factors affecting food security in Afghanistan (Samim & Hu, 2020). In 2024, about 12.4 million people were expected to experience severe food insecurity (WFP,2024). 2.8 million children under the age of five are among the 3.9 million undernourished persons (WFP, 2024). According to Samim and Hu (2020), staple food consumption in Afghanistan is inadequate in both quantity and quality.

Rice is one of the most important crops in Afghanistan and provides calories as a staple food for most of the country's people [Ministry of Agriculture, Irrigation and Livestock (MAIL, 2023). Furthermore, rice, as a second staple food after wheat in Afghanistan, plays a significant role in food security, nutrition, and caloric intake. Additionally, 8% of daily calorie intake comes from rice, with an estimated 17 kg per capita consumed annually between 2004 and 2014 (Hassanzoy et al., 2017). In the meantime, a wide range of essential vitamins and minerals is also present in rice, and it has been reported that rice contains more nutrients than potatoes, maize, and wheat (Mohidem et al., 2022).

Rice production in the country cannot meet the country's demand, and 40% of rice is imported from abroad (Kakar et al., 2019). Also, rice production is insufficient to meet demand and is expected to remain so by 2030 (Samim et al., 2021). Afghanistan's rice production in 2023 was reported at 400,000 metric tons, an increase of 0.7% from 2022. The demand for rice by countries was estimated at 688,000 metric tons, with 288,000 metric tons to be imported from abroad (MAIL, 2023). On the other hand, due to factors such as climate change, including the latest drought, rice production is negatively affected in some provinces of Afghanistan (MAIL, 2023; Salihi & Himatkhwah, 2024; Salihi et al., 2024). However, the total rice-cultivated land in 2023 was 129,000 hectares, an increase of 0.7% compared to 2022 (MAIL, 2023).

In addition to this, for a few decades, a considerable number of people in Afghanistan have been suffering from food insecurity due to war, conflicts, economic problems, poverty, migration, drought, flood, and other factors. Food availability, accessibility, and utilization are the main pillars of food security, but they are not achieved for large segments of the population, especially in rural areas, in Afghanistan. Furthermore, the country's population is increasing rapidly; thus, the demand for food, especially staple foods such as rice, is also increasing significantly. It is urgent to focus on improving rice production nationwide to ensure that Afghanistan's rice demand is met and to improve the country's food security (MAIL, 2023).

In contrast, rice is cultivated in 18 provinces of Afghanistan, and rice production met 58.13% of demand in 2023. Rice cultivation not only provides staple food for the people; however, traditional rice cultivation, which is usual in the country, also provides employment

and supplies the domestic market. Thus, rice plays a significant role in Afghanistan's food security. Even though local rice varieties have adapted to local conditions and are low-cost, their low genetic potential, unimproved cultivation systems, and poor processing management negatively affected yield and quality (Kakar et al., 2019). The average yield of rice in 2023 was 3.11 metric tons per hectare, with an increase of 0.7% (MAIL, 2023). The yield of rice was targeted to increase to 6.5 metric tons per hectare by the adaptation of improved technologies and practices (Kakar et al., 2019). Thus, Afghanistan has the potential to increase rice production in the short term. The objectives of this review article are:

1. To address the role of rice in the food security of Afghanistan, and to provide some insight and suggestions regarding previous research on the topic.
2. To anticipate and facilitate future research to improve rice production, fulfill the country's rice demand, and enhance food security in Afghanistan.

MATERIALS AND METHODS

The narrative literature review provided an overview, summary, and description of the most recent research on the subject. The most well-known databases, including Scopus, Web of Science, ScienceDirect, and Google Scholar, were searched for high-quality, recently published, and relevant papers using keywords associated with the subject, such as Afghanistan, food security, nutritional value, rice, and staple food. English-language, peer-reviewed journal research and review articles published during the past 20 years were included. Non-peer-reviewed publications, conference abstracts, and research conducted more than 20 years ago were all excluded. Approximately sixteen of the forty papers that were chosen were reviewed for the manuscript, along with two recent reports. Relevant keywords were used to target the papers, which were then arranged, and the pertinent information was highlighted and extracted. After that, the data is summarized, paraphrased, and distributed throughout the manuscript.

Status of Food Security In Afghanistan

Over time, food security has become a serious and ongoing issue in Afghanistan. In addition, Afghanistan is among the world's most food-insecure countries. The primary causes of food insecurity that the people of Afghanistan experience are poverty and conflict, which have been stated to be negatively correlated (D'Souza & Jolliffe, 2013). Food security in Afghanistan is affected by several factors, including low incomes, conflict, seasonal variations, and insufficient food (Samim & Hu, 2020). Chronic food insecurity happens for a long time, and it might be considered to be almost a continuous situation. Temporary food insecurity refers to brief periods of limited food availability and access and typically occurs during these periods.

Reports indicate that between May and October 2024, 12.4 million people are expected to experience severe food insecurity, with 2.4 million falling into the Integrated Food Security Phase Classification (IPC) Phase 4 (emergency) (WFP, 2024). A total of 2.8 million children

under the age of five are among the 3.9 million individuals who suffer from acute malnutrition. In Afghanistan, 12.4 million people still live with high levels of acute food insecurity, despite ongoing incremental improvements in food security (WFP, 2024).

Afghanistan's grain consumption is still not met by domestic production. Between 1979 and 2030, the production-to-consumption ratio fell from 0.9 to 0.55. Theoretical food imbalance will worsen, and by 2030, grain production will likely be enough to feed only 49.8% of the population, creating a severe shortfall equal to the amount needed by 24.4 million people. Between 2018 and 2030, per capita cereal production may drop from 120.8 kg to 95.4 kg (Samim et al., 2021). Afghanistan's residential consumption is inadequate in both quantity and quality. Moreover, more than half of the population in the country consumes food at a borderline level, with a significant proportion of rural dwellers (Samim & Hu, 2020). More than half of Afghans are below the poverty line, 53.2% of Afghanistan's population experiences food insecurity, and 35% of the country's population suffers from acute food insecurity. Afghanistan continues to have a severe shortage of food grains due to low productivity and a variety of socioeconomic issues, such as limited market access, low income, war, violence, high food prices, and poverty, which directly affect access to food. Food access is more limited in rural areas than in cities (Samim & Hu, 2020).

Importance of Rice as a Staple Food

One distinct, strategically important grain crop primarily consumed by humans is rice (Khush, 1997). Rice has been used by many nations as a staple diet for energy (Long and Ort, 2010). In addition, rice is a staple crop that is essential to the food security of more than half of the world's population (Mohidem et al., 2022). Meanwhile, rice is second in importance among Afghanistan's staple crops after wheat (MAIL, 2023). It also ranks second among food crops in terms of total production and cultivated area. Most people consider aromatic rice a luxury (Sarhadi et al., 2015). Only 50% of the nation's needs can be met by rice, which is important for food security, nutrition, and calorie consumption (Kakar et al., 2019), 8% of daily calories (2,100 Kcal) come from rice, with an average annual consumption per person of roughly 17 kg from 2003-2004 and 2013-2014 (Hassanzoy et al., 2017). Rice has been cultivated in Afghanistan; thus, it counts not only as the most significant staple food for farmers and rice-producing provinces but also plays a crucial role in providing cash for poor laborers who work in rice fields.

Nutritional Value of Rice

Rice is high in nutritional value and a source of high energy. In addition, rice has a substantial calorie content and a broad range of vital vitamins, minerals, and other nutritional benefits. Protein, fat, crude fiber, carbohydrates, ash, minerals such as Ca, P, Na, and K, and vitamins including thiamine, riboflavin, niacin, and tocopherol, as stated in Table 1. In addition, rice has more nutrients than potatoes, wheat, and maize (Mohidem et al., 2022). Rice is also a fantastic source of iron, calcium, thiamine, magnesium, and vitamins B5 and E. Among the phenolic chemicals included in rice are phenols, sterols, flavonoids, terpenoids, anthocyanins,

tocopherols, tocotrienols, and oryzanol. These substances have been demonstrated to help prevent diabetes and cardiovascular disease and have been positively associated with antioxidant qualities (Mohidem et al., 2022). In milled rice, starch accounts for about 90% of the dry weight, along with fat, protein, non-starch polysaccharides, and a variety of volatile compounds. Moreover, rice contains phenolic compounds with anti-diabetic, anti-inflammatory, and anticancer properties. Rice also has a significant positive impact on human health and helps prevent diseases (Mohidem et al., 2022).

Table1. *Rice nutrients per 100 g*

Nutrient	Content
Energy	345(Kcal)
Moisture	14(g)
Carbohydrates	78 (g)
Protein	6.8 (g)
Fat	0.5 (g)
Fiber	0.2 (g)
Phosphorus	160 (mg)
Minerals	0.6 (g)
Essential amino acids	1.1(g)
Calcium	10 (mg)
Iron	0.7 (mg)
Magnesium	90 (mg)
Riboflavin	0.06 (mg)
Thiamine	0.06 (mg)
Niacin	1.9 (mg)
Folic acid	8 (mg)
Copper	0.14 (mg)
Essential amino acids	1.09 (mg)

Source: (Verma et al., 2011)

Status of Rice Production, Demand, And Consumption In Afghanistan

Rice production in Afghanistan cannot meet the country's demand, so a significant amount of rice is imported from other countries (MAIL, 2023). Afghanistan has been importing a significant amount of milled rice each year from Pakistan, India, and Iran (Kakar et al., 2019). Furthermore, rice production in 2023 was 400,000 metric tons, which, compared to 2022, showed an increase of 0.7% (MAIL, 2023). However, it decreased compared to 2019, when it was 444,452.19 metric tons (Mohidem et al., 2022). According to Kakar et al. (2019), Afghanistan's milled rice shortfall for 2018 was anticipated to reach 270,250 metric tons. However, in 2023, it rose to 288,000 tons (MAIL, 2023). In addition, the effects of climate change have affected rice production, with declines in some areas and increases in others (MAIL, 2023).

Rice has been grown on 129,000 hectares in the country in 2023, demonstrating a 0.7% increase compared to the previous year. Rice is cultivated in 16 provinces of Afghanistan in 2023 (MAIL,2023) as presented in Figure 1.) According to Kakar et al. (2019), the average rice

yield in Afghanistan is 2.8 tons per hectare; however, MAIL (2023) reported a yield of 3.11 tons per hectare in 2023. By implementing new technology and better production techniques, paddy rice yields were expected to reach 6.5 tons per hectare (Kakar et al., 2019). However, Afghanistan has been severely impacted by the recent drought, which has resulted in a significant decrease in rice production areas and yields (MAIL, 2023).

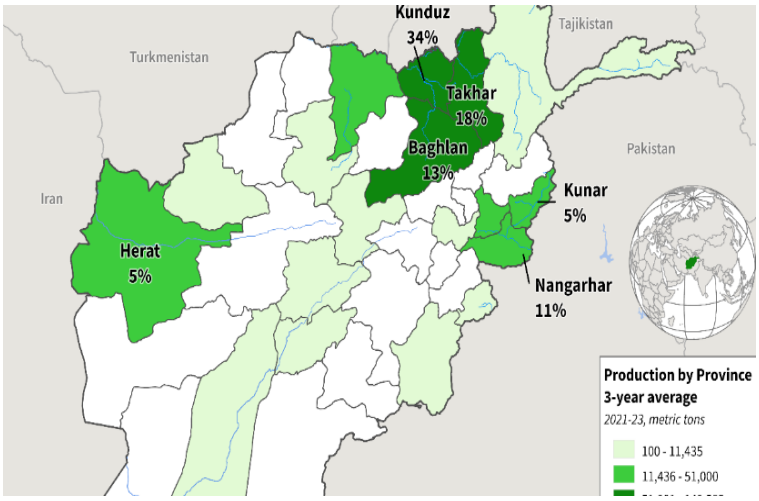

Figure1. *Rice production by provinces in Afghanistan*
Source: Afghanistan Central Statistics Office, 2023

The country's total rice demand in 2023 was estimated at 688,000 tons, of which 298,000 tons were imported from abroad (MAIL, 2023). By 2030, it is likely that rice production will remain insufficient, as it falls short of demand (Samim et al., 2021). Table 2 summarizes the area, yield, and rice production in Afghanistan for the past ten years.

Due to semi-subsistence and livelihood rice cultivation, the persistence of low-quality local rice varieties, and the growing demand for rice from Afghanistan's expanding population, the country's rice consumption is primarily dependent on imports (Alamyar & Boz, 2018). The self-sufficiency of Afghanistan as a whole has decreased from 0.9 to 0.54 over the past four decades, and it has been volatile during this period, becoming more unstable recently. Afghanistan's low agricultural performance keeps it far from becoming self-sufficient in its main food crops (Samim et al., 2021).

Table 2. *Afghanistan Rice Area, Yield and Production*

Market year	Area (1,000 ha)	Milled Production (1,000 Tons)	Rough Production (1,000 Tons)	Yield (T/ha)
2014/2015	220	349	537	2.4
2015/2016	164	266	409	2.5
2016/2017	119	232	357	3
2017/2018	109	220	338	3.1
2018/2019	118	229	352	3
2019/2020	128	249	383	3
2020/2021	148	285	438	3
2021/2022	141	271	417	3

2022/2023	128	258	397	3
2023/2024	140	270	415	3.1
2024/2025	140	270	415	3
5-year average 2019-2023/24	**137**	**267**	**410**	**3**
Change from 5 years	**2%**	**1%**	**56%**	**-1%**

Source: *adapted from https://www.usda.gov*

Local Cultivated Rice Varieties and Their Characteristics In Afghanistan

Although indigenous rice varieties are inexpensive and have adapted to the local environment, their yield and quality performances are poor due to low genetic potential, outdated farming methods, and poor processing management. The majority of rice seeds used in Afghanistan are native varieties with low yields and high susceptibility to pests and diseases (Kakar et al., 2019). In the northern region of Baghlan, local cultivars such as Sarda Bala, Luke Qasan, Sherkati, Permel, and Sela Doshi are grown; additionally, in the northeastern Takhar province, Sela Takhar, Lawangi, and Germa Bala are grown. The provinces of Konar and Laghman cultivate Pashadi Konar and Monda Mashruqi, respectively (Sarhadi et al., 2015).

Local rice cultivars from Afghanistan, Sarda Barah, Garma Barah, Surkha Zurahti, and Shah Lawangi, have long, thin grains and are linked to noticeably increased protein and amylose concentrations in the grain (22.9 and 8.1%, respectively) (Noori et al., 2018). Conversely, the Koshihikari variety, which has short- and medium-grain varieties, showed the lowest protein and amylose concentrations in its grains (17.7% and 5.5%, respectively). In addition, according to Sarhadi et al. (2015), Pashadi Konar exhibited an intermediate plant height, desirable yield components, thin and slender grain, and a pleasant aroma.

The most well-known fragrant rice cultivars in Afghanistan are Pashadi Konar, Lawangi, Germa Bala, Sela Doshi, Sarda Bala, and Sela Takhar (Sarhadi et al., 2015). Consumers choose aromatic rice because of its pleasant flavor, aroma, and soft texture after cooking (Sarhadi et al., 2017). According to Sarhadi et al. (2015), four of the ten native rice varieties in Afghanistan were non-aromatic, and six were aromatic. Moreover, for further breeding of aromatic rice, Germa Bala, Sarda Bala, Sela Takhar, Takhar, Sela Doshi, Pashadi Konar, and Lawangi can be utilized, as they possess positive aromas and desired agronomic traits, including thin and slender grains (Sarhadi et al., 2015).

The highest values of grain yield, antioxidant activity, tiller and panicle numbers per hill, and 1,000-grain weight were observed in Jalalabad-14. Attai-1 improved flavor points (quality score) by having a higher proportion of perfect grains and lower levels of amylose, protein, and fat. Attai-1 had superior physicochemical characteristics and morphological traits, whereas Jalalabad-14 generally showed the highest performance in growth and yield attributes, as well as antioxidant activities (Kakar et al., 2019). Attai-1, Shishambagh-14, and Zodrass accumulated amyloplasts and starch granules without abnormalities, as observed by scanning electron microscopy (Kakar et al., 2019). Afghanistan's Pashadi Konar is

distinguished by its middle plant height, longer grain (11 mm), heavier 1,000-grain weight (32 g), and pleasant aroma. In terms of grain length and width, 1,000-grain weight, and the number of grains per panicle, almost all native rice cultivars in Afghanistan were identical to Basmati 370. Accordingly, native rice cultivars from Afghanistan resembled Basmati 370 in having small, slender grains, but they also had more panicles per plant (Sarhadi et al., 2015).

Rice Market in Afghanistan

Local rice varieties have adapted to local conditions and are low-cost, but their low genetic potential, unimproved cultivation systems, and poor processing management have led to low yields and quality. Most of the rice seeds used in Afghanistan are local varieties with low yields and are susceptible to diseases and pests (Kakar et al., 2019). Local varieties such as Permel, Sherkati, Luke Qasan, Sela Doshi, and Sarda Bala are cultivated in the Baghlan province in the north; furthermore, Sela Takhar, Lawangi, and Germa Bala in Takhar province in the northeast. Moreover, Pashadi Konar and Monda Mashruqi are cultivated in Konar and Laghman provinces, respectively (Sarhadi et al., 2015).

Since the supply and trade of local rice are primarily concentrated in markets near central rice-producing provinces, the surplus and deficit markets for local rice appear to be separated (Hassanzoy et al., 2017), a protracted period of market uncertainty following a shock may be detrimental to producers and consumers alike (Hassanzoy, 2018). Furthermore, the paddy-rice domestic value chain is now quite short (Hassanzoy et al., 2017). Domestic markets may be relatively less vulnerable to importing rice from Pakistan (Hassanzoy, 2018). Compared with imported rice, local rice may be price-competitive but not quality-competitive (Hassanzoy et al., 2017).

DISCUSSION

Even though the people of Afghanistan have been suffering from food insecurity for a few decades, it is currently a critical problem in the country, Samim & Hu. (2020) also stated similarly. Afghan people, especially children, have been suffering from different kinds of food insecurity and poor nutrition due to poverty, floods, drought, and other socioeconomic factors, especially in rural areas. Samim & Hu. (2020), and WFP (2024) reported similar findings. The increase in food insecurity in Afghanistan may be due to low productivity and the low quality of cereal crops, including rice. Factors of climate change in the country, such as drought and flooding, caused people to migrate, and it not only affected staple food production, including rice, but also negatively affected food production, access, availability, and utilization for a large number of populations.

More than half of the country's rice demand was met by domestic production in 2023, up 0.7%. An average of 3 years of rice production showed that marginal amounts were produced in Kunduz, Tahkar, Baghlan, and Nangarhar provinces, accounting for 34%, 18%, 13%, and 11% of total production, respectively. A review of the last 5 years of rice data showed that the

total area of rice cultivation, milled rice production, and rough rice production increased by 8.57%, 7.7%, and 7.71%, respectively; however, yield remained unchanged. On the other hand, the demand and consumption of rice in the country are increasing rapidly due to a growing population and changing dietary habits. With a reasonable strategic plan and the implementation of improved technologies for rice farmers, such as the adoption of improved varieties and new agronomic practices, Afghanistan can meet the country's demand in the short term (Kakar et al., 2019).

Most of the local rice varieties cultivated in Afghanistan have low yields and are susceptible to diseases and pests, as reported by Kakar et al. (2019). On the other hand, Noori et al. (2018) reported that some local varieties have desirable characteristics, such as slender grains and high amylose and protein contents. Some local rice varieties have favorable growth, performance, and yield characteristics, as reported by Kakar et al. (2019). Even though some local rice varieties have low genetic potential, are unimproved, and are susceptible to disease and pests, they are adapted to the local climate and are low-cost. Other local varieties not only have favorable characteristics to the domestic market but also have the potential to improve performance, yield, and quality.

In addition, due to poverty, low productivity of staple foods, including rice, unemployment, low income, migration, drought, flooding, and other climate change factors, food security was negatively affected in Afghanistan, especially in rural areas. The role of rice in Afghanistan's food security is a promising alternative for addressing future food security challenges. Recently, rice cultivation land, rough and milled rice production increased, fulfilling more than half of the country's rice demand, while yield per unit of land remained unchanged. In addition to the potential of rice local varieties' favorable characteristics, adaptation, low cost, cultivated lands, and rice farmers' potential to improve rice yield and productivity, the future is promising. If government agencies, private companies, research centers, government, and NGOs could provide some assistance in terms of improved varieties, equipment, fertilizers, and adaptation of agronomic practices and technologies for a lower price, thus it would be affordable to the regular farmers to adopt the technologies and improve rice production in order fulfill the demand of country rice and improve food security in the country.

CONCLUSION

Afghanistan has been considered a food-insecure country worldwide. Food security has become a permanent and critical problem in Afghanistan recently. Different kinds of food insecurity affect people in Afghanistan, such as chronic, transitory, and seasonal, due to conflicts, insufficient food, and low income. Currently, 54.5% of people live below the poverty line, 53.2% of people are food insecure, and 35% of people are acutely food insecure in the country. On the other hand, food grain production in Afghanistan remains insufficient due to low productivity, limited market access, low incomes, and poverty.

Additionally, Afghanistan's residential consumption is not only insufficient in quantity but also qualitatively inadequate. At the same time, rice is the second most important staple food after wheat in Afghanistan, in terms of cultivated area and production, and provides nutrition for many populations. Rice also contains a significant number of calories and a wide variety of essential vitamins and minerals.

Even though rice production has been affected by climate change, rice was cultivated on 129,000 hectares in 16 provinces of Afghanistan, and production reached 400,000 metric tons, demonstrating an increase of 0.7% in both cultivated land and production in 2023. Rice production in 2023 met 58.13% of the country's demand. On the other hand, local rice varieties have been cultivated in different provinces of Afghanistan, adapted to local weather and climate change conditions, while the maximum yield of rice was reported at 3.11 metric tons per hectare. Thus, local rice varieties, farmers' land, and other facilities cannot only increase rice yield and production but also produce high-quality aromatic rice that is favorable to consumers in the short term, providing nutrition and improving food security in Afghanistan.

AUTHORS CONTRIBUTIONS

Mohammad Sadiq Salihi, Khalid Ahmad Yaqoobi, and Wakil Ahmad Seerat conceptualized the review, conducted the literature review, and wrote and edited the original manuscript. Hassanullah Irfan cooperated in literature collection, formatting, and reference management.

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The authors declare that they have no conflict of interest.

DATA AVAILABILITY STATEMENT

As this manuscript is a narrative review and does not involve analysis of primary data. All data in this review are extracted from previously published literature, which is cited in the manuscript.

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