

# What do we know about THE FUTURE OF FOOD SYSTEMS IN SOUTH ASIA?

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## Key messages

- Micronutrient availability in South Asia is projected to increase by 46 percent by 2050, reflecting a significant transition from traditional cereal-based diets to diverse, nutrient-rich foods, though affordability limits access for low-income groups.
- The shift from traditional diets to processed foods has led to an increase in obesity and diet-related noncommunicable diseases. Rising demand for animal-source foods also puts pressure on local resources and increases reliance on imports.
- Agriculture in South Asia relies heavily on freshwater, primarily groundwater, which is critically overused. Additionally, soil degradation and the burning of crop residues contribute to air pollution and pose risks to the sustainability and productivity of the region's agricultural land.
- Climate change is expected to significantly affect crop yields, particularly for staples such as rice, wheat, and maize, with projected reductions by 2050. This climate impact will exacerbate food insecurity in the region, especially as food demand continues to grow.
- Current foresight studies often overlook the impacts of unexpected external shocks, such as pandemics and the Russia-Ukraine war, on agriculture and food systems. Addressing these research gaps and focusing on context-specific technological solutions, climate-smart practices, and self-sufficiency could enhance resilience and sustainability across South Asia's agrifood sector.

## RECENT TRENDS AND CHALLENGES

South Asia is the most densely populated region in the world, with a current population of 1.8 billion (one-fourth of the global population), which is projected to increase to more than 2 billion by 2050. This rapid population growth will put significant pressure on agriculture and food systems. Despite being an agricultural powerhouse, South Asia has high levels of food insecurity, with many people suffering from malnutrition and hunger. It is also among the regions most vulnerable to climate change and relies heavily on intensive farming practices, leading to several inadequacies in agriculture and food systems that bear directly on food production and security. Further, the highest concentration of agrifood system workers are in South Asia, with 793 million people. South Asia is also home to more than 600 million young people (ages 15–35), who make up around one-half of all agrifood system workers.

### Socioeconomic and demographic context

**High poverty and malnutrition rates.** Despite contributing significantly to global food production, South Asia faces intense food insecurity and poverty challenges. Widespread malnutrition, particularly among youth and marginalized groups, restricts access to affordable, nutritious food and exacerbates the struggle against hunger and poverty (FAO 2019; World Bank 2021).

**Systemic socioeconomic inequalities.** Social, economic, and geographic disparities hinder access to nutritious foods and agricultural resources. These inequalities disproportionately affect marginalized communities, contributing to persistent poverty and malnutrition, and creating lasting barriers from production to consumption in the region (Gillespie, Van Den Bold, and Hodge 2019; Rehman et al. 2024).

**Labor shortages and youth migration.** Rural out-migration, particularly among youth seeking better opportunities in urban areas, has resulted in farm labor shortages (Nandi et al. 2022). This trend increases production costs, complicates efforts to maintain agricultural output levels, and threatens the continuity of agricultural knowledge and practices across generations (Ronto, Wu, and Singh 2018; Singh et al. 2023).

**Policy and market limitations.** Many farmers face weak market access, inadequate extension services, limited irrigation facilities, and nonoptimal enabling policy support. These factors contribute to a significant portion of arable land being left fallow after harvests (Tran et al. 2023; Rehman et al. 2024).

### Environmental pressures and resource depletion

**Water scarcity and overuse.** Agriculture accounts for more than 90 percent of freshwater withdrawal in South Asia, creating severe water stress. The dependence on groundwater for irrigation – especially for water-intensive crops such as rice, wheat, and sugarcane – poses a significant risk to the long-term viability of farming systems in South Asia, which is aggravated by the region’s low groundwater recharge rates (FAO 2021; OECD 2017).

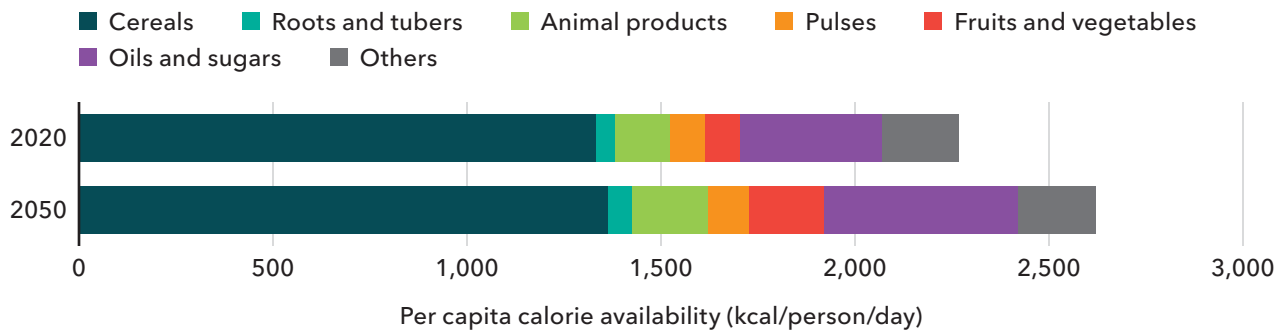
Increasing land degradation and fallowing: A substantial portion of agricultural land in the region faces human-induced degradation driven by dwindling freshwater resources and declining soil health, leading to nearly 22 million hectares lying fallow after the main monsoon season.

**Agriculture-related air pollution.** The prevalence of crop residue burning and excessive use of nitrogenous fertilizers in South Asia contributes to increased air pollution, which negatively impacts agrifood systems by diminishing crop yields and nutritional quality, degrading soil health, and jeopardizing food security and the economic viability of farming (Lin and Begho 2022).

**Policy challenges.** Inadequate water governance in South Asia fails to balance agricultural demands, leading to drying shallow wells and unsustainable water use (Chakraborty and Bhaduri 2023).

### Changing dietary patterns and health implications

**Nutrition transition.** South Asia is experiencing a shift from traditional cereal-based diets to highly processed foods rich in sugars, fats, and salts. This transition has led to a rise in obesity and lifestyle- and diet-related noncommunicable diseases, presenting new and enormous public health challenges (Bishwajit 2015; Baker et al. 2020; Pingali 2007).

**FIGURE 1 South Asia's projected per capita calorie demand (kcal/person/day)**

Source: IMPACT V3.6 model simulations.

**Rising consumption of animal-source foods.** The growth in consumption of animal-source foods is likely to increase demand for animal feed and reliance on food imports for humans despite the region's considerable pastureland resources (FAO 2024; Sarker, Rahman, and Khan 2021).

**Economic barriers to nutritious diets.** Nutrient-dense foods remain unaffordable for many households in the region. Significant seasonal fluctuations and spatial variations in the costs of perishable foods affect rural and low-income populations in particular (Dizon, Mulmi, and Wang 2021).

## LATEST FORESIGHT RESEARCH

Nutrition and dietary shifts are increasingly recognized in foresight studies of the South Asia region as critical factors for shaping sustainable food systems, with direct implications for both human health and environmental resilience. Nutrient availability is expected to increase across South Asia by an average of 46 percent from 2020 to 2050, according to Rosegrant and colleagues (2024), with per capita kilocalorie demand shifting significantly (Figure 1). The International Food Policy Research Institute's (IFPRI) IMPACT (International Model for Policy Analysis of Agricultural Commodities and Trade) model simulations indicate notable changes in production, yields, and harvested area for major commodity

groups in the region over this period. Specifically, production is expected to rise substantially for animal products (81.3 percent), cereals (48.8 percent), and fruits and vegetables (114.8 percent). Crop yields are projected to experience the highest growth in fruits and vegetables (65.4 percent), followed by pulses (46.7 percent) and cereals (38.3 percent). However, harvested area projections show a decline in pulses (-16.9 percent), while cereals are anticipated to increase (+7.6 percent). Additionally, the area for oils and sugars is projected to rise by 13.8 percent, and the harvested area for fruits and vegetables is projected to grow by 29.9 percent. The model projects a diversification away from cereals, reducing their contribution to total kilocalories from 58.7 percent in 2020 to 52.1 percent by 2050.

Meanwhile, projections from MAGNET<sup>1</sup> and GLOBIOM<sup>2</sup> show a gradual decrease between 2010 and 2050 in the share of energy from cereals as rising incomes facilitate dietary diversification, with a slight increase in calories from fruits and vegetables as other nutritious food products are consumed (van Meijl et al. 2020).

Climate-induced food insecurity will have far-reaching consequences for South Asian countries' social, economic, and political stability. The region is expected to experience the highest increase in food demand by 2050. The negative impact of climate change by 2050 could be as high as US\$1.01 trillion for the next 40 years, with consumers bearing most of the costs due to increased food prices. However, farmers stand to gain US\$52 billion due to higher prices for their produce, which would more than

1 Modular Applied General Equilibrium Tool (MAGNET) (Woltjer et al. 2014).

2 The Global Biosphere Management Model (GLOBIOM) (Havlík et al. 2014).

compensate for the general decline in production. Food will become less accessible with increasing prices, especially for people experiencing acute poverty, reducing the average per capita consumption of all food crops by 1.7 percent in 2030 and by 3.2 percent in 2050 (Deb Pal and Tyagi 2022).

South Asia's food production faces climate-driven shifts in crop suitability, with particular impacts on key staples such as rice, wheat, and maize. Climate modeling anticipates increased wheat production in high-latitude regions, while warmer areas in South Asia may experience reduced suitability for certain crops. Rice and maize are projected to experience reductions in unsuitable areas by 2050, allowing for improved yields if adaptive strategies are implemented (Ali et al. 2024). However, IFPRI projects substantial yield reductions for key crops in South Asia due to climate stress – wheat (–50 percent), rice (–17 percent), and maize (–6 percent) – by 2050 relative to 2000 levels, because of which South Asia will have the most significant number of food-insecure people by 2050 (World Bank 2021).

Integrated assessments estimate significant cereal production declines by 2050 across South Asia: Bangladesh (–31.5 percent), Pakistan (–24.2 percent), Sri Lanka (–25.7 percent), and India (–6.4 percent) (Alvi et al. 2021). Spatially aggregated yields of all crops show a lower growth rate from 2010 to 2030 for the climate change scenario (+41 percent) compared to the no climate change scenario (+48 percent) based on the IMPACT model analysis. Cereal yields are expected to grow more slowly due to climate impacts, with cash crops including vegetables, cotton, and wheat projected to perform better (Hinz et al. 2020).

Food demand dynamics reshaped by urbanization trends are likely to drive demand for livestock products and diversify dietary intake away from cereals, shifting toward protein-rich foods, dairy, and fish (Zhang et al. 2022). Demand for livestock products will increase by nearly 100 percent between 2010 and 2050, offering nutritional gains and posing environmental challenges (Enahoro et al. 2019; Prager and Wiebe 2021). The global per capita food consumption average is projected at 3,000 kcal/day by 2050, with South Asia's average significantly increasing from 2005 (Le Mouël and Forslund 2017).

By 2050, an estimated 72 percent of maize in South Asia will be explicitly allocated for livestock feed, a considerable increase from 34 percent in 2010, reflecting the growing importance of livestock in regional diets (Kruseman et al. 2020), as well as the fact that efficient feed is the optimal solution to the reduction of greenhouse gas emissions in livestock production systems, especially for cattle.

Rapid urbanization alters food consumption habits, with a growing urban population demanding higher-quality and safer food options. By 2050, a significant portion of South Asia's population is projected to reside in urban areas, leading to increased reliance on modern retail and processed foods (Vorley and Lançon 2016).

An alternative pathway developed to sustainably meet the food grain demand of 310 metric tons (MT) in India through specific interventions using a regional model (SAFARI<sup>3</sup>) projects that by 2050, strategies such as shifting to precision irrigation, reducing groundwater dependence, limiting sugarcane acreage, and replacing one-half of rice cultivation with high-yield coarse cereals would help achieve food production sufficiency within the limitations imposed by the availability of natural resources (Ashok et al. 2021).

Despite South Asia being a global hotspot for nitrogen pollution, a concerning projection by Chang and colleagues (2021) suggests that limiting regional nitrogen surplus below a critical boundary without any management strategies could result in a 13 percent reduction in crop and livestock production by 2050. This scenario raises serious concerns regarding dietary energy and protein availability, with up to 495 million people in South Asia potentially at risk of hunger by 2050 due to insufficient nutrient availability.

## KEY GAPS AND OPPORTUNITIES FOR FORESIGHT RESEARCH

Foresight studies in South Asia's agrifood systems frequently focus on broad global challenges such as climate change, food security, and economic trends.

However, they often neglect the implications of external shocks such as the Russia-Ukraine war and health-related shocks, including those experienced during the COVID-19 pandemic. These health crises expose significant vulnerabilities within agriculture, labor dynamics, and supply chains, emphasizing the necessity for foresight research that anticipates these impacts more effectively.

Additionally, while sustainable transitions in agriculture are vital, comprehensive multidimensional synergies and trade-off analyses regarding proposed changes are notably lacking. Such analyses are essential for understanding the broader implications of these transitions for farmers' economic viability and the social fabric of farming communities. Furthermore, documented evidence on effective climate-smart options that can be scaled across the region is scarce, limiting the potential for leveraging best practices in the agriculture sector.

Given South Asia's diverse agricultural and economic contexts, a country-specific focus within foresight research on emerging technologies and innovations is imperative. Conducting detailed assessments of technology feasibility and implementation timelines, along with context-specific solutions, would allow individual countries to adopt the advancements most suitable for their unique conditions. The region's significant dependence on imports further exposes it to risks associated with global supply chain disruptions, as demonstrated during the recent COVID-19 pandemic. To mitigate this vulnerability, foresight research should prioritize evaluating strategies aimed at reducing import reliance and enhancing self-sufficiency, especially in pulses and oilseeds, thereby increasing resilience against external shocks.

Limited high-quality data on consumption, productivity, and climate impacts hinder evidence-based policy decisions. The informal economy is vital for food security and employment but is often neglected in foresight studies. Insights into consumer behavior, especially preferences around health and sustainability, remain insufficient, impacting production and supply chains. Finally, investing in alternative agricultural value chains should be a key focus of foresight research to maximize developmental outcomes across South Asia. By addressing these critical gaps, future research can contribute to a more resilient and sustainable agrifood system in the region.

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Related chapters on the future of food system drivers and impacts, regional and national perspectives, food commodities, and foresight tools are available in our [Table of Contents](#).

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## References

- Ali, S., M. Umair, T.A. Makanda, S. Shi, S.A. Hussain, and J. Ni. 2024. "Modeling Current and Future Potential Land Distribution Dynamics of Wheat, Rice, and Maize under Climate Change Scenarios Using MaxEnt." *Land* 13 (8): 1156. <https://doi.org/10.3390/land13081156>
- Alvi, S., R. Roson, M. Sartori, and F. Jamil. 2021. "An Integrated Assessment Model for Food Security under Climate Change for South Asia." *Heliyon* 7 (4): e06707. <https://doi.org/10.1016/j.heliyon.2021.e06707>
- Ashok, K., R. Natarajan, P. Kumar, K. Sharma, and M. Mathur. 2021. "Sustainable Alternative Futures for Agriculture in India: The Energy, Emissions, and Resource Implications." *Environmental Research Letters* 16 (6): 064001. <https://doi.org/10.1088/1748-9326/abf0cd>
- Baker, P., P. Machado, T. Santos, et al. 2020. "Ultra-Processed Foods and the Nutrition Transition: Global, Regional and National Trends, Food Systems Transformations and Political Economy Drivers." *Obesity Reviews* 21 (12): e13126. <https://doi.org/10.1111/obr.13126>
- Bishwajit, G. 2015. "Nutrition Transition in South Asia: The Emergence of Non-communicable Chronic Diseases." *F1000Research* 4: 8. <https://doi.org/10.12688/f1000research.5732.2>
- Chakraborty, S., and T. Bhaduri. 2023. "Opinion: Nepal Needs a Comprehensive Groundwater Policy." *Dialogue Earth*, July 18. <https://dialogue.earth/en/water/opinion-nepal-needs-a-comprehensive-groundwater-policy/>

- Chang, J., P. Havlík, D. Leclère, et al. 2021. "Reconciling Regional Nitrogen Boundaries with Global Food Security." *Nature Food* 2 (9): 700-711. <https://doi.org/10.1038/s43016-021-00366-x>
- Deb Pal, B., and N.K. Tyagi. 2022. *Synthesis Report: Scaling-Up Climate Smart Agriculture in South Asia*. New Delhi: IFPRI. <https://doi.org/10.2499/p15738coll2.135902>
- Dizon, F., P. Mulmi, and Z. Wang. 2021. "The Cost of a Nutritious Diet in Bangladesh, Bhutan, India, and Nepal." Policy Research Working Paper WPS 9578. World Bank, Washington, DC. <https://hdl.handle.net/10986/35285>
- Enahoro, D., D. Mason-D'Croz, M. Mul, et al. 2019. "Supporting Sustainable Expansion of Livestock Production in South Asia and Sub-Saharan Africa: Scenario Analysis of Investment Options." *Global Food Security* 20: 114-121. <https://doi.org/10.1016/j.gfs.2019.01.001>
- FAO (Food and Agriculture Organization of the United Nations). 2019. *Crop Prospects and Food Situation*, Quarterly Global Report 4. Rome. <https://openknowledge.fao.org/handle/20.500.14283/ca7236en>
- FAO. 2021. *The State of the World's Land and Water Resources for Food and Agriculture: Systems at Breaking Point*. Synthesis Report 2021. Rome. <https://doi.org/10.4060/cb7654en>
- FAO. 2024. *Food Outlook: Biannual Report on Global Food Markets*. Rome. <https://doi.org/10.4060/cd1158en>
- Gillespie, S., M. Van Den Bold, and J. Hodge. 2019. "Nutrition and the Governance of Agri-food Systems in South Asia: A Systematic Review." *Food Policy* 82: 13-27. <https://doi.org/10.1016/j.foodpol.2018.10.013>
- Havlík, P., H. Valin, M. Herrero, et al., 2014. "Climate Change Mitigation Through Livestock System Transitions." *PNAS* 111 (10): 3709-3714. <https://doi.org/10.1073/pnas.1308044111>
- Hinz, R., T.B. Sulser, R. Hüfner, et al. 2020. "Agricultural Development and Land Use Change in India: A Scenario Analysis of Trade-Offs between UN Sustainable Development Goals (SDGs)." *Earth's Future* 8 (2): e2019EF001287. <https://doi.org/10.1029/2019EF001287>
- Kruseman, G., K.A. Mottaleb, K. Tesfaye, et al. 2020. "Rural Transformation and the Future of Cereal-Based Agri-food Systems." *Global Food Security* 26: 100441. <https://doi.org/10.1016/j.gfs.2020.100441>
- Le Mouél, C., and A. Forslund. 2017. "How Can We Feed the World in 2050? A Review of the Responses from Global Scenario Studies." *European Review of Agricultural Economics* 44 (4): 541-591. <https://doi.org/10.1093/erae/jbx006>
- Lin, M.Y., and T. Begho. 2022. "Crop Residue Burning in South Asia: A Review of the Scale, Effect, and Solutions with a Focus on Reducing Reactive Nitrogen Losses." *Journal of Environmental Management* 314: 115104. <https://doi.org/10.1016/j.jenvman.2022.115104>
- Nandi, R., C.M. Pratheepa, S. Nedumaran, N. Rao, and R. Rengalakshmi. 2022. "Farm Parent and Youth Aspirations on the Generational Succession of Farming: Evidence from South India." *Frontiers in Sustainable Food Systems* 5: 804581. <https://doi.org/10.3389/fsufs.2021.804581>
- OECD (Organisation for Economic Co-operation and Development). 2017. *Water Risk Hotspots for Agriculture*. OECD Studies on Water. Paris: OECD Publishing. <https://doi.org/10.1787/9789264279551-en>
- Pingali, P. 2007. "Westernization of Asian Diets and the Transformation of Food Systems: Implications for Research and Policy." *Food Policy* 32 (3): 281-298. <https://doi.org/10.1016/j.foodpol.2006.08.001>
- Prager, S.D., and K. Wiebe. 2021. "Strategic Foresight for Agriculture: Past Ghosts, Present Challenges, and Future Opportunities." *Global Food Security* 28: 100489. <https://doi.org/10.1016/j.gfs.2020.100489>
- Rehman, A., Z. Batool, H. Ma, R. Alvarado, and J. Oláh. 2024. "Climate Change and Food Security in South Asia: The Importance of Renewable Energy and Agricultural Credit." *Humanities and Social Sciences Communications* 11 (1): 1-11. <https://doi.org/10.1057/s41599-024-02847-3>
- Ronto, R., J.H. Wu, and G.M. Singh. 2018. "The Global Nutrition Transition: Trends, Disease Burdens and Policy Interventions." *Public Health Nutrition* 21 (12): 2267-2270. <https://doi.org/10.1017/s1368980018000423>
- Rosegrant, M.W., T.B. Sulser, S. Dunston, et al. 2024. "Food and Nutrition Security under Changing Climate and Socioeconomic Conditions." *Global Food Security* 41: 100755. <https://doi.org/10.1016/j.gfs.2024.100755>
- Sarker, N.R., S.M.R. Rahman, and M.Y.A. Khan. 2021. "Feeds & Fodder Production in Bangladesh: Present Trend, Availability, Future Requirements and Challenges for Dairying in 2030." *Growth* 15 (16): 201.
- Singh, V., M. Stevanović, C.K. Jha, et al. 2023. "Assessing Policy Options for Sustainable Water Use in India's Cereal Production System." *Environmental Research Letters* 18 (9): 094073. <https://doi.org/10.1088/1748-9326/acf9b6>
- Tran, N., U.P. Rodriguez, C.Y. Chan, et al. 2023. "Future Scenarios of Fish Supply and Demand for Food and Nutrition Security in Bangladesh: An Analysis with the Asia Fish Model." *Aquaculture* 568: 739288.
- van Meijl, H., L. Shutes, H. Valin, et al. 2020. "Modelling Alternative Futures of Global Food Security: Insights from FOODSECURE." *Global Food Security* 25: 100358. <https://doi.org/10.1016/j.gfs.2020.100358>
- Vorley, B., and F. Lançon. 2016. "Food Consumption, Urbanisation and Rural Transformation." IIED Working Paper, IIED, London. [www.iied.org/10767iied](http://www.iied.org/10767iied)
- World Bank. 2021. *Climate Change Action Plan 2021-2025: South Asia Roadmap*. Washington, DC. <http://documents.worldbank.org/curated/en/262891632949399367>
- Woltjer, G.B., M. Kuiper, A. Kavallari, et al., 2014. *The MAGNET Model: Module Description*. Report 14-57. LEI Wageningen UR: The Hague. <https://edepot.wur.nl/310764>
- Zhang, Y., S. Li, L. Jin, and F. Wu. 2022. "How Will the Global Food Landscape Accommodate Developing Countries' Dietary Change under Urbanization?" *Food* 11 (22): 3598. <https://doi.org/10.3390/foods11223598>

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