



Indian Food Systems towards 2050: Challenges and Opportunities

1.1 MOTIVATION

The Green Revolution in the 1970s followed by the liberalization of the Indian economy in the 1990s has been credited with shepherding India onto a path of high growth. Over the last decade, increases in per capita incomes, greater urbanization rates, increase in literacy rates, population growth and poverty reduction have characterized this high growth process. While agricultural development has brought about income generating opportunities to some in the farming sector, in a small farm dominant country like India, poor infrastructure and a lack of institutional support have excluded many small-holders from benefiting from the growth process. At the macro level, the growth process has been highly inequitable, benefiting some states more than others. At the consumer end, increases in income and income generating opportunities continue to coexist with poverty and poor health outcomes. The latter is reflected in the simultaneous prevalence of undernourishment, over-nutrition and micronutrient deficiencies in the country. These conundrums reflect the major paradoxes of the Indian growth story, where we see the simultaneous existence of regional inequality, rural and urban food insecurity and the growing incidence of a triple burden of malnutrition.

Aside from tackling these challenges, looking ahead to 2050 and beyond, we see important trends of unequal growth and climate change challenges threatening India's ability to sustainably and equitably manage an economic and nutrition transformation. Current regional inequality in

economic development is a major challenge due to differences in initial resource endowments and nationalized policies that has placed states on different structural transformation pathways. Some states today resemble poor countries in sub-Saharan Africa, while rapidly developing states resemble counterparts in Latin America. Continuing down this policy pathway will have negative implications, for both national political stability and economic development as we look ahead. Boosting agricultural productivity is critical for economic growth and development in India. Agricultural production, however, affects and is affected by climate change. Productivity growth influenced by increasing demand for higher value agricultural produce will lead to increased greenhouse gas emissions and water and soil degradation, accentuating production risks in agriculture. Through its negative impact on food availability, access, nutrition and affordability, climate change will reduce the effectiveness of policies aimed at increasing food and nutrition security for the future. Feeding a growing population that is both richer and more urban has significant implications for future food systems. Linking urban food demand with rural prosperity, while ensuring environmental sustainability will be essential to ensure both urban and rural food security.

1.2 APPROACH

Much of the prior literature has reflected on the importance of either the development of the agricultural sector, the role of economic growth or the importance of food security for ensuring greater and more equitable economic development. Even works that look at the intersection of these groups focus only on increasing production as a means to increase economic growth or focus on managing consumption as a means for improving health and productivity. They do not evaluate the intersectionality of these domains and their spillovers on the economic, ecological or health systems within the country. Thus, we see the existence of policies that increase productivity in agriculture at the expense of the environment, policies that increase economic growth while also increasing regional inequality and hurting small farmers, and top-down policies that aim to reduce undernutrition without any discussion on how to tackle growing obesity. These policy recommendations remain palliative at best, often treating the symptoms but not the core problems in the economy. Most of these approaches have also not considered the implications of the changing economic, demographic and climatic landscape of the future.

With a view to address the current challenges in the Indian development paradox and in light of the future challenges faced by the country, this book looks at the nexus of economic development, agricultural production and nutrition through the lens of a “food systems approach (FSA)”. A traditional FSA looks for opportunities to strengthen the linkages between agricultural production and consumption with the aim to strengthen nutrition access for individuals and households. The motivation of our FSA model is to expand both opportunities to strengthen nutrition access and to enhance capabilities of individuals so that they can access new opportunities in ways to increase their welfare. Creation of new opportunities and capabilities for increasing farm production and productivity, reducing malnutrition and improving labor productivity and facilitating greater structural transformation that is also inequality reducing are the main goals of the approach.

In order to implement a holistic approach towards welfare development and nutrition security, we link the goals for agricultural development, health and nutrition and economic development with each other (Fig. 1.1). We bring together the latest data and scientific evidence from the country to map out the current state of food systems. In this book we (1) highlight the nature of food system challenges in India, (2) provide goals and set a food systems

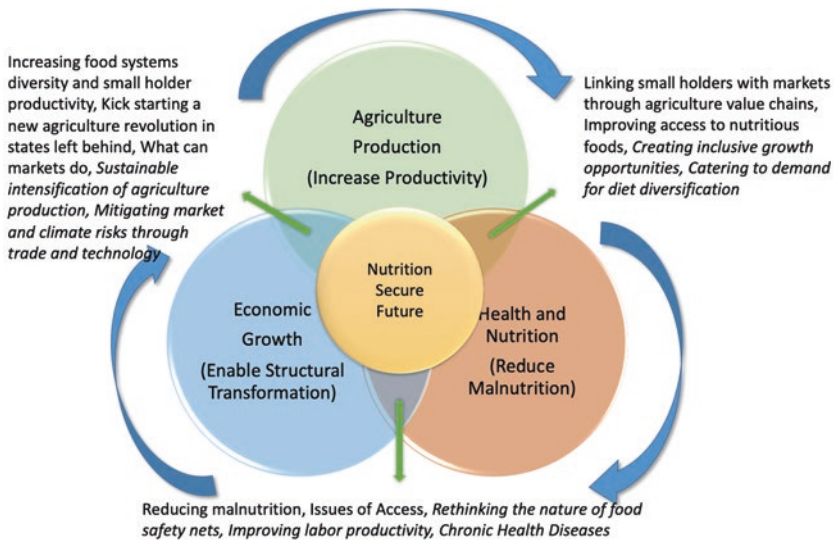


Fig. 1.1 The multi-sectoral approach for food system transformation

agenda for the future for different subnational units in India based on their current structural transformation experience and (3) emphasize policy and institutional interventions that are needed to address these challenges.

The book will be organized along the lines of the food systems framework provided in Fig. 1.1. We first dive into the question about who the new rural and urban consumer of the future would be. We identify their dietary needs and preferences, health challenges and how consumer markets would evolve to meet these changing requirements. We then take a deep dive into challenges for farming in India. We study the farmer, their input usage patterns, institutional challenges in adopting new farming practices and challenges in accessing markets to sell non-staple agricultural products. We highlight issues of access that fall out of intra-household inequalities or social institutions that affect nutrition access. We then travel along the agricultural supply chain and identify the transaction costs and bottlenecks that have prevented a free flow of foods from the farm to the plate. We also identify institutional failures that have prevented market signals from transforming the agricultural landscape away from staple grain production in the country. We identify the challenges for implementing acceptable food quality and food safety standards. Side by side with these insights, we also provide data and evidence on the current food systems challenges from external forces such as the overuse of the environment and the projections from climate change. We study the role of research and development, new technologies, subnational unit-focused policy and the growth of the knowledge and digital economy in mitigating these production and price risks. The book not only aims to inform policy makers on proper actions and respective consequences for future food systems, it also provides researchers new and exciting avenues to conduct research on nutrition security. Additionally, by providing a fresh and holistic perspective on the challenges for the future, and an overview of the policies that are available towards ensuring greater food security, this work aims to increase citizen awareness and engagement in developing food systems of the future.

1.3 KEY TAKEAWAYS FROM THE BOOK

1. *The differential growth experience of Indian states can be explained by their initial investments in agricultural productivity growth and their subsequent focus on robust non-agricultural employment growth.* (Chap. 2)

While India's overall GDP growth rate has been consistently high for the past few decades, there are significant inter-state disparities in growth performance. In Chap. 2, we compare Indian states with countries, in terms of the per capita GDP, and we find that some of the poorest states in India have per capita GDP levels that are comparable to some of the poorest countries in sub-Saharan Africa. On the other hand, the most progressive states in India have per capita GDP levels that are comparable to the emerging economies of Southeast Asia and Latin America. These stark differences in the regional growth experience are also reflected in other indicators such as nutrition or poverty. For example, undernutrition in Madhya Pradesh continues to remain a key nutrition challenge, but in Kerala, rising obesity has brought the problem of over-nutrition into focus. Similarly, while rural poverty in Punjab has reduced due to agricultural development, in Orissa, low agricultural productivity and the lack of alternate employment opportunities has resulted in high rural poverty levels. Indian states have also experienced different levels of structural transformation; less than 20% of the population remains in agriculture in the high-income states, while that figure is over 40% in the *lagging states*.

Based on their overall economic performance, in Chap. 2, we group Indian states into three categories—*agriculture-led states*, *urbanizing states* and *lagging states*—and attempt to explain their growth performance over the past 60 years. The categories are based on three outcomes of economic development; these are state GDP per capita, the share of agriculture in GDP and urbanization rate. Both in the *agriculture-led states* and *urbanizing states*, agricultural growth, kickstarted by the Green Revolution, played a crucial role in catalyzing economic growth. However, states such as Punjab and Andhra Pradesh continue to focus on agriculture with a concentration on staple grain production and consequently have seen a slowdown in their prospects for further income growth. On the other hand, *urbanizing states* such as Gujarat and Maharashtra started with investments in agriculture as an engine of growth but then reinvested their agricultural incomes in developing vibrant industrial and commercial sectors. *Lagging states* such as Bihar and Odisha were bypassed by the Green Revolution due to poor agro-climatic and infrastructural constraints and continue to be on a low growth trajectory. Prospects for future growth in the *lagging states* are still linked to agriculture, but perhaps in looking beyond staple grains, and towards meeting the rising demand for food diversity elsewhere in the country by enhancing the productivity of coarse cereals, pulses and high-value crops and livestock.

2. *Meeting the growing urban demand for food and other agricultural products and non-farm employment provides new growth opportunities for rural economies; the challenge is to ensure that it is inclusive of the poor.* (Chap. 3)

As India grows through a rapid process of urbanization, both with the expansion of the mega-cities as well as the smaller cities and district towns, the food policy challenge will increasingly become one of sustainably feeding the cities. Provisioning the cities is the new growth opportunity for rural areas and could lead to accelerated rural transformation. Through organized upstream and downstream network of activities, the urban facing agribusiness, value chains could absorb surplus agricultural labor and provide them with jobs, especially for the youth and women. Employment in logistics, like aggregation, storage, processing and so on, at the agribusiness upstream and food-related services such as restaurants at the downstream could potentially be leveraged as the channel of employment generation.

Such inclusive transformation of rural spaces—by including those who are left out regarding access to non-farm employment—is essential to remove rural poverty. One of the channels for propelling stagnant agricultural growth is to strengthen the rural-urban continuum which provides ample opportunities to the small farmers and other rural population with greater opportunities to share in the fruits of urban economic growth. Indian policies have not focused on the small towns and the middle spaces to create job opportunities. Recognizing these newer urban settlements and then providing them with urban amenities could be a springboard for non-farm diversification. The benefits of local economies can be realized through the creation of urban-rural clusters that supply goods and services both for consumption and for agricultural production in households. While urbanization and changing employment patterns offer opportunities for a more diversified food system, the challenge lies in ensuring these transformations are smooth and contribute to sustainable poverty reduction.

3. *Diet transition and the rising demand for food diversity is not matched with a commensurate rise in the supply of non-staple foods leading to poor access to more nutritious food.* (Chap. 4)

Diet transition is an important outcome of the structural transformation process. Chapter 4 discusses the two stages of dietary transition with structural transformation. In the first stage, economic growth and rise in per capita income induce diet diversification. Consumer preferences move away from *quantity* to *quality*, substituting traditional staples with non-staples, such as fruit, vegetables and livestock products. In the second stage, the effects of globalization of the economy are reflected in an increase in the consumption of processed food which are rich in proteins, sugars and fats. This diet transition in India is increasingly evident. Chapter 4 provides data on the diet transition in India, specifically the declining share of staple grains—rice and wheat—in household diets across all income groups in urban as well as rural populations, though the degree of transition varies considerably. At the same time, we observe the rise in the diversity of food groups consumed, such as fruit, vegetables and livestock products. However, it is clear that access to food diversity is not equitable and that the poor are significantly disadvantaged in this regard.

With a clear shift away from cereals, it is important to ensure other nutritive food items are available at affordable prices. It is clear, however, that the supply of non-staple foods has not matched the rising demand as manifested in the rising and volatile relative prices of these foods. Without access to nutritive substitutes, dietary diversity would suffer. Protein-rich items such as pulses and animal-based protein items have seen an increase in the prices as well as its volatility, primarily driven by greater demand for these products. Similarly, the highly seasonal supply of fruits and vegetables and lack of storage infrastructure to smoothen prices makes access to nutritious food at affordable prices a challenge for consumers, especially the poor. At the same time, access to processed foods has increased significantly, even in rural areas, and often at prices that are substantially below those of more nutritious fresh food and pulses. Chapter 5 provides data that shows that India may be tripping into a rising over-nutrition and obesity problem, even as it tries to solve the undernutrition problem, due to poor access and affordability of nutrition-rich diets.

4. *While progress is being made on undernutrition, the emerging nutrition transition towards over-nutrition and the rising incidence of non-communicable diseases requires a move away from policies that promote calorie sufficiency to ones that promote food system diversity. (Chap. 5)*

Similar to the experience of other countries that have undergone greater structural transformation, India has made progress towards reducing hunger and reducing undernutrition while witnessing significant economic growth. Over the last three decades, the country has managed to reduce undernutrition by at least ten percentage points across all individual groups. On the other hand, obesity and NCD rates are rising among urban and rural populations, albeit at a slower rate in the latter. Chapter 5 argues that increased dietary diversity is associated with lower prevalence of hidden hunger and higher nutrient adequacy ratios for individuals. It also presents the case that the lack of diet diversity and excessive carbohydrates and sugar consumption is associated with higher risk of obesity and NCDs.

Given this close relationship between dietary diversity of households and nutrition outcomes, ensuring that households can access diverse foods requires interventions at two levels. First is to ensure that there is greater availability of food diversity within the local system. The second set of interventions would need to improve the affordability of these diets. Effective food policy, hence, becomes tantamount to a nutrition sensitive food system which enables transition towards a healthier diet. Policy debates around food security in India have mainly focused upon ensuring adequate access to calories through a continued focus on staple grain production. However, trends around dietary changes and nutrition transition provide a compelling case for questioning the existing paradigm and open up conversations around access to a good quality and balanced diet. Focus on staples has affected incentives to develop markets for non-staples, thus affecting their supply and increasing price uncertainty. Creating new opportunities for the food system diversification, to cater to changing consumer demand, should thus become a focus for policy makers. Chapter 5 also presents the multi-sectoral pathways towards improved nutrition outcomes, such as access to clean drinking water and sanitation, gender empowerment and behavior change and so on.

5. *The objectives and design of India's safety net programs, whether food or cash based, need to evolve with economic growth and the changing nutritional needs of the marginalized populations.* (Chap. 6)

Safety nets have been an essential part of the poverty reduction policies in India by contributing to risk management and reducing vulnerability for a large section of the population. Chapter 6 argues for the future role

of safety nets to be more *transformational* rather than vulnerability reducing. Overall effectiveness of safety nets would depend to a large extent on how they are combined with structural reforms and long-term interventions to increase human capabilities and address structural poverty through that. Synergies between agriculture and safety nets, therefore, become essential. Public work, life-cycle based food assistance programs need to be dovetailed into the local agrarian economy.

Regarding the future of safety nets, it is essential to take into account the changing nature of the economic structure, demographic changing, and future livelihood patterns. Urbanization, especially, poses a challenge as well as opportunity in restructuring the safety net architecture. Current policies have not taken into account the fact that India would be more urban than rural by 2050. Most of the existing food-based policies have a greater rural presence. Public works program Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) has only been designed for the rural areas, assuming rural employment is the only concern. With rising urbanization, urban informality and unemployment in urban areas, especially among the educated, raise important challenges for the food systems going ahead.

In the case of food-based safety nets, innovations are limited by the modalities of grain procurement. To supply rice and wheat through Public Distribution System (PDS), a massive food grain procurement structure has come about which incentivizes only staples and other more nutritive food products are crowded out. Not only consumers are at a disadvantage due to restricted choice, but the idea of a nutrition-sensitive food system is undermined. It is therefore essential to break the staple grain procurement-storage-distribution interlocked channel. But these interlocked incentives are deeply mired into India's rural political economy. It is one of the major hurdles to India's food system.

6. *Promoting small farm commercialization and diversification serves the dual objectives of enhancing farm incomes while improving the supply and access to food system diversity.* (Chap. 7)

The rising demand for diversified agricultural products has brought about opportunities and challenges for the Indian agricultural sector. The opportunities come from increasing demand for diversified and higher value crops that can improve agricultural incomes and improved access to a varied food basket at the household level. Commercialization of small-holders' farms is an essential pathway to improved rural incomes and better

access to diversified and nutritious food. The major challenges, however, are problems associated with the supply side conditions such as poor access to markets, credit, purchased inputs, technology and extension services that have hindered commercialization and made income opportunities inaccessible to many small farm producers. Rising rural wages due to growth in non-farm employment opportunities add to the challenges of commercializing small farms.

Chapter 7 assesses the major institutional innovations associated with mitigating some of the transaction costs associated with market entry and resolving problems associated with achieving economies of scale. Aggregation models such as producer organizations and cooperatives, where smallholders organize themselves in groups to jointly access resources and market their produce, have shown to reduce transaction costs and benefit from the resulting economies of scale. Lagging regions of Eastern and Northeastern India are a particular challenge regarding small farm commercialization. With investments in markets and agricultural infrastructure, such as irrigation, warehouses and cold storage facilities, and a supportive policy environment, such as promoting contract farming, it is possible for these regions to leap frog from the current subsistence systems to commercial operations that are focused on supplying urban demand for food diversity.

7. *Effective aggregation models, such as producer groups, can help reduce the high transaction costs of small farms accessing urban food value chains, especially for fresh food.* (Chap. 8)

With increasing demand for quality and high-value agricultural produce, alternative value chains and newer marketing platforms have emerged. Vertical coordination (VC) by which retailers form direct linkages with farms, bypassing traditional markets, has been growing in India's more progressive states. Newer marketing platforms where farmers can participate in online auctions and trading such as eNAM and Rashtriya eMarket Services Pvt. Ltd (ReMS) in Karnataka and warehousing platforms such as the National Commodity & Derivatives Exchange (NCDEX) eMarkets Limited to hedging price risks can be viable alternatives to existing traditional markets. VC can be more relevant for perishable crops and farmers in regions with good linkages to market (*agriculture-led growth states*), while futures and warehousing platforms can be useful for non-perishable commodities and can emerge in low potential areas such as those in *lagging states*.

Institutional interventions, such as Farmer Producer Organizations (FPOs) and cooperatives, can offset scale disadvantages faced by small farms in supplying to the modern value chains as well as access to electronic markets and futures trading platforms. By reducing the risk associated with the adoption of new crop technologies and reducing transaction costs in market access, these interventions could help in farm diversification as well as better price realizations in the output market.

In Chap. 8, we highlight some recommendations that differ by the stage of development a particular state is in. In the *lagging states* with low agricultural productivity, FPOs have the potential to enable greater commercialization, enabling greater yields. Linkages to output markets will help incentivize the production of pulses and coarse grains, given their comparative advantage. In *agriculture-led states* and *urbanizing states*, alternative models such as contract farming are more likely to succeed since farms in these areas are already highly commercialized. Enabling conditions for contract farming through mechanisms to enforce contracts and allowing retailers and processors to transact directly with farmers, especially in the cash crops, could be the way forward. Here, aggregation models can help reduce organization costs of engaging with a more significant number of small farms and reduce contracting costs that often exclude small farm contracts. Policy measures to financially support FPO emergence and extend financial and insurance-based services, linking them to information and extension services and enabling market linkages by improving connectivity, will further incentivize group formation and establish linkages across the value chain.

8. *Technology will continue to play a vital role in enhancing smallholder productivity and competitiveness, but it's time to look beyond staple grains, and take a holistic view of the technological options for promoting a diverse food system.* (Chap. 9)

Technology in the past has played a critical role in enabling food security in the developing world. The Green Revolution helped in increasing yields of wheat and rice, making many countries like India self-sufficient in these grains. One main reason the Green Revolution was successfully implemented was that it was a public sector intervention that was scale-neutral, allowing small and marginal producers to adopt them. The limitation of these technologies was that they were focused on the main staple grains—rice and wheat—and to regions where irrigation resources were available,

leading to interregional and intercrop disparities. The impact these technologies had on the environment because of poor management was also high, leading to depletion of water tables and land degradation.

Chapter 9 makes the case that technology remains critical in the face of the new food security challenges India will face, as it seeks to meet the demand for quantity as well as quality and food system diversity. First- and second-generation GM technologies hold promise in improving returns to farming through reduced cost of production and increasing resilience and the nutritive value of crops. Crop improvement technologies are a priority for the more nutritious crops, especially coarse cereals, such as millets, and pulses. Yield improvements coupled with the effective management of resources (nutrient, water, natural resources) are essential to improve efficiency and achieve sustainable intensification.

Unlike Green Revolution technologies which were public sector generated, technological innovations today are generated in the private sector and hence pose challenges of access for small farms. This is true for crop production and post-harvest technologies. Institutional interventions that enable public sector access to private sector innovations and to adapt them to small farm conditions are crucial. Farm aggregation models could also help small farms access modern technologies for enhancing the productivity of non-staple crops and livestock.

9. *Climate change can have significant adverse impacts on agricultural productivity, rural incomes and welfare; in addition, it can pose serious risks to the nutritive value of the food system since it can have a disproportionately higher effect on non-staple foods.* (Chap. 10)

The impact of rising temperatures on the major staples, such as rice and wheat, is well studied. Declining productivity of these crops can be expected with rising temperatures. However, less well understood is the impact of climate change on crops that are important to the poor, such as millets and sorghum. Also, less studied are the impacts of climate change on a more nutritious food system, such as its impacts on the productivity of fruit, vegetables, pulses and livestock products. Given the lack of technologies currently available to safeguard productivity and the lack of information about climate impacts on these foods, vulnerability of non-staple crop production becomes a major food security concern for the future. Safeguarding the production of these crops and livestock will be important to the goal of achieving nutrition security. Climate change can also have

adverse impacts on production systems in the rain-fed areas, particularly those in the semi-arid and the arid fringe areas. Higher temperatures could drive some of these areas out of crop and livestock production activities, especially where irrigation infrastructure is not well established.

Chapter 10 argues that continuing down the current path of development without integrating adaptation and mitigation strategies will have serious negative repercussions on food security within the country. Side by side with adaptation strategies, integrating mitigation strategies that reduce overall carbon foot print will contribute to the global goals of GHG mitigation and help reduce global food systems risks. Policies to encourage investments in clean energy sources, climate-smart infrastructure, preservation and conservation of biodiversity and groundwater management processes have been important steps taken in this direction by the government of India as well as individual state governments. It is also important that these policies not only operate at the level of strategy but that progress and goals can be measured and tracked.

As we look ahead, climate policies for the future should allow diversification of the food system in ways that enhance the environment while improving the nutrition content of foods produced and ensuring equity in access. In order to truly create a food system that ensures nutrition security of all individuals, climate change risks must not be understated, and appropriate actions towards its mitigation need to be adopted.

10. *Food and agricultural policy need to transition from a focus on quantity to emphasize quality, diversity and safety; it should also leverage multi-sectoral synergies with economic growth, improved access to clean drinking water and sanitation and behavior change for promoting improved diets.* (Chap. 11)

This book brings agricultural sector-led developmental approach to the center of policy formulation to ensure nutrition security and rural prosperity for greater welfare. India's recent history has shown that smallholder agricultural productivity growth kickstarted overall economic growth, rural poverty reduction and structural transformation of the economy. However, the predominant focus of agricultural policy on the productivity growth of the major staples—rice and wheat—resulted in significant interregional growth disparities and poor nutrition outcomes. While these policies played an important role in ensuring calorie sufficiency across the country and thereby led to substantial reduction in the incidence of hunger, they

tended to inhibit diversification of the food systems and hence the overall supply of micronutrient-rich food. In order to make substantial progress in tackling the problem of malnutrition, both micronutrient malnutrition and the emerging problem of obesity, India's food and agricultural policy needs to move towards promoting food system diversity. This would require clear strategies for diversification of production systems in order to improve the access and affordability of nutritious food, such as fresh fruit, vegetables, pulses and livestock products, and it would also require strategies for promoting individual diet diversity.

In addition, the quality of health and hygiene environment also plays a major role in reducing malnutrition. Poor hygiene environments increase disease burden and sickness and affect nutrient absorption. Improving water and sanitation infrastructures is essential to reduce the spread of disease, especially waterborne diseases. Behavior change programs that promote healthy diets and seek to improve household health environment by encouraging water storage practices, encouraging hand washing before water use and after toilet use and encouraging cleanliness in the surrounding environment have been effective in reducing malnutrition around the world. Finally, interventions that increase education of girl children and women, delay child marriages, provide households information on economic opportunities for women and increase safety at workplaces have been known to impact both nutrition outcomes for women and their children. Research has shown that women's empowerment leads to positive nutrition and health outcomes, especially for young children.

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