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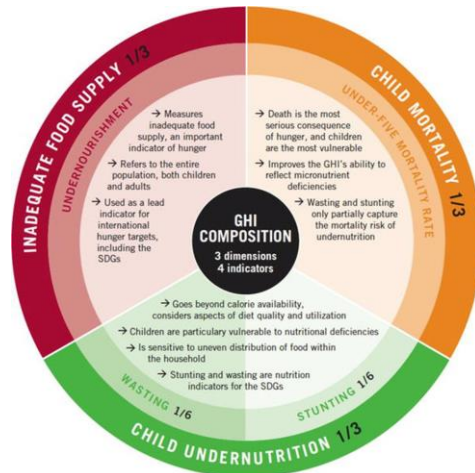
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The Economics of Malnutrition:
Addressing Health Inequality Through Policy Innovation

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Child and maternal undernutrition is still the highest single health risk factor in India, contributing to about 15% of the total disease burden of the country. As per Food and Agriculture Organization 2023, India is paradoxically the second largest food producer in the world, along with annual production of about 310 million tonnes of food grains, and yet hunger and food insecurity are rampant. This contradiction stems from uneven food distribution, food wastage i.e. 14% food is wasted annually due to poor supply chain infrastructure and inadequate accessibility in rural areas. The country is ranked 111th of 125 countries by the Global Hunger Index 2023, which indicates a very strong contradiction: food insecurity in the midst of bountiful production of food. In states such as Uttar Pradesh, over 50% of subsidized food grains do not actually reach the intended beneficiaries according to UNICEF studies of them-the inefficiencies of implementation.

The human tragedy of malnutrition in India is under-nourishment, hidden hunger, and over-nutrition. India stands at a crossroads in its battle against malnutrition. Contributing to the problem is the high incidence of anemia in women of reproductive age, and the low proportion of infants exclusively breastfed for the first six months of life. At present, 50.4% of women aged 15 to 49 suffer from iron deficiency anemia, while only 55% of children are exclusively breastfed. India is also one among the 88 countries projected in the Global Nutrition Report 2024 to miss global nutrition targets for 2025. Malnutrition, according to the World Health Organization (WHO), refers to deficiencies, excesses, or imbalances in a person's intake of energy and/or nutrients. This is a persistent problem that puts India in an extremely critical posture and calls for urgent and comprehensive addressing of systemic inefficiencies and behavioural gaps.



Source: Childhood Malnutrition in India by Abhishek Singh, 2020

According to the National Family Health Survey (NFHS-5), 35.5% of children under five in India suffer from stunting, 19.3% experience wasting, and 32.1% are underweight compared to standard weights. These disturbing statistics expose severe nutritional deficiencies among India's young population, compounded by poor maternal health and inadequate access to healthcare. This cycle of malnutrition perpetuates a vicious circle of poor health and lower economic productivity. Moreover, over 40% of pregnant women in India are underweight at the time of conception, affecting the future generation.

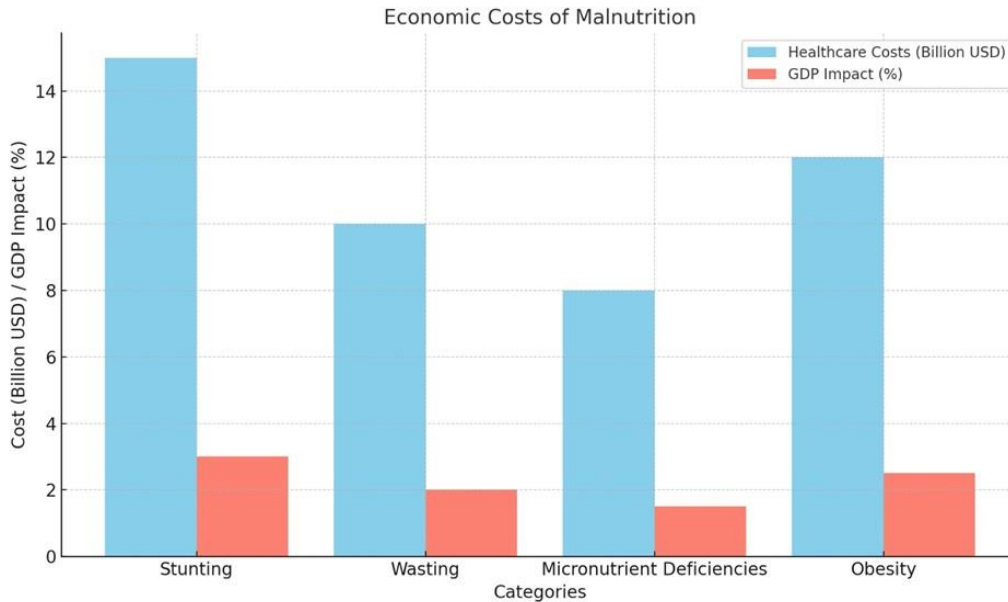
According to the World Bank (2021) micronutrient deficiencies, or "hidden hunger," affect approximately 70% of India's population. Anaemia, propelled by iron deficiency, is a significant concern, with 67.1% of children aged 6 to 59 months being anaemic (NFHS-5). Parallely, India is grappling with a rising obesity crisis due to urbanization and consequent changing dietary patterns. According to the WHO (2023), over 5% of adults in India are obese, and the prevalence of overweight children is increasing annually by 3-4%. This triadic burden of malnutrition- undernutrition, micronutrient deficiency and obesity makes it complex to address health inequality in India.

Malnutrition acts as a barrier to inclusive growth and hence hampers India's human capital potential. According to a study, children who are stunted have 22% fewer chances of achieving secondary education, thus trapping them in cycles of low productivity and poverty. Malnutrition

disproportionately affects women, children, and the lower socio-economic strata. The unequal food distribution experienced by women in slums often tends to work against maternal health, and newborn outcomes. Materially deprived and socially excluded persons, living in the underdeveloped regions of India, are disproportionately affected, magnifying the existing disparities, thereby limiting their participation in growth opportunities. This has deep intergenerational effects with long-term societal costs in health and productivity.

It is not an unknown fact that such a malignant issue comes with a huge cost. Poorly nourished children experience poor brain development, reduced learning capacity, and higher dropout rates, limiting future job prospects. A UNICEF study in 2023 in Tamil Nadu found that stunted children scored 20% lower on math and language assessments and were 19% less likely to complete secondary education. This translates into long-term economic losses, with malnourished adults earning up to 20% less over their lifetimes (Lancet, 2022). Estimates from the World Bank indicate that malnourished workers are 10% less productive.

The Global Nutrition Report (2020) reveals that malnutrition can cost a country up to 11% of GDP annually through lost productivity and healthcare costs. Public Health Foundation of India (2022) states that diseases, fueled by poor nutrition, cost India ₹77,000 crore annually. Stunted physical and cognitive development translates into reduced workforce productivity, and consequently lower earnings and economic contributions. Learning and immune function impairments are effects of hidden hunger, which reduces an individual's ability to add value to the economy. Rising obesity further exerts fiscal burdens in the country through increased burdens of Non-Communicable Diseases (NCDs), such as diabetes and hypertension, that cut productivity and, additionally, health care expenditures. Worsening this, it leads to intergenerational problems. In India, nearly 50% of anaemic pregnant women give birth to underweight babies, contributing to the 40% of all babies born underweight nationwide. Research by Kumar (1998) indicates that babies of uneducated parents are more likely to be underweight (30%) compared to those of educated parents (23%).



This bar graph compares the healthcare costs (in billions USD) and GDP impact (as a percentage) associated with stunting, wasting, micronutrient deficiencies, and obesity. Stunting imposes an estimated \$15 billion in healthcare costs and impacts 3% of India's GDP, while wasting contributes \$10 billion in healthcare costs and a 2% GDP impact. Micronutrient deficiencies account for \$8 billion in healthcare expenses and a 1.5% GDP impact, whereas obesity adds \$12 billion in healthcare costs, affecting 2.5% of GDP.

Building on the foundation laid in this article, we now delve deeper to unearth the underlying causes that have shaped the issue at hand.

Socioeconomic factors play a critical role in shaping nutritional outcomes in India. According to Oxfam (2023) with 10% of India's population holding over 57% of the wealth, income inequality is directly relational with access to nutritious food. The NFHS-5 reveals that malnutrition is disproportionately higher among households in the bottom wealth quintile. A study in PLOS ONE highlighted that urban slum-dwellers experience worse malnutrition rates than some rural populations due to poverty and scarcity of sanitation facilities, clean water sources, and health services that arise from slumming up. Fourth National Family Health Survey (NFHS-4) found that children from poorer households are twice as likely to experience stunting and wasting compared to those from wealthier families. Education and awareness gap is deeply enrooted across the country, hence establishing a strong positive correlation between maternal

education and child nutrition. However, in India only 28% rural mothers have adequate knowledge about their dietary needs (NITI Aayog, 2022). This lack of awareness results in poor dietary choices and inadequate breastfeeding practices.

Structural inequalities also contribute significantly to nutritional challenges. Gender disparities in access to nutrition are evident, with cultural practices generally giving preference to males over females. Such a bias leads women and girls to be more likely to undernutrition in regards to consumption compared to men, while about 3 times more likely to suffer from postpartum anemia, women in India were found to be 1.7 times more prone to anemia compared to men. (WHO, 2023).

Table 2: Women's Malnutrition in India, 2005-06 – Age and Marital Status (in %)

	BMI		Anaemia		CED and Anaemia		
	CED	Overweight or Obese	Moderate or Severe	Any	Both	Either	Neither
Age							
15-19	46.8	2.4	16.6	55.8	26.9	48.6	24.5
20-29	38.1	8.2	17.6	56.1	23.0	47.8	29.2
30-39	31.0	17.4	16.2	54.2	19.2	46.6	34.2
40-49	26.4	23.7	16.1	55.0	17.1	47.2	35.7
Marital Status							
Never-married	44.9	4.5	14.6	51.9	24.3	48.3	27.4
Currently married	33.0	14.9	17.1	56.0	20.7	47.3	32.0
Widowed	33.5	14.4	19.0	59.0	22.1	48.3	29.6
Divorced/separated/ deserted	33.9	14.4	21.4	59.1	23.7	44.9	31.4

Source: Computed from NFHS-3 data.

Source: NFHS-3

Furthermore, regional and caste-based inequalities are always at play. Nutritional outcomes vary widely across states. Bihar and Uttar Pradesh record more than 40% stunting rates, whereas in Kerala and Tamil Nadu, it stands at about 20% (NFHS-5). Marginalized groups across Dalits and Adivasis face structural barriers to health and nutrition, such that stunting is higher by up to 45% among the general population.

Table 1: State-Wise Nutrition Indicators (NFHS-5)

State	Stunting (%)	Wasting (%)	Obesity (%)
Bihar	42.9	20.8	3.2
Kerala	19.4	15.6	17.3
Madhya Pradesh	36.5	19.6	6.8
Punjab	20.3	11.5	18.5
Rajasthan	31.8	16.8	7.6
Uttar Pradesh	39.7	17.9	6.4

Source: NFHS-5

Environmental and market challenges further aggravate the nutritional crisis. Climate change has threatened India's agricultural productivity: a case study of Maharashtra speaks for itself, reporting that drought conditions cut the yields of rice by as much as 35%, worsening food insecurity in those areas. Wheat yields are likely to decrease by 15–20% by 2050 due to rising temperatures and aggravating malnutrition (IPCC, 2023). Therefore, global warming does fuel food insecurity, which is embedded in issues such as corruption undermining efficient resource distribution and the pressures of population explosion that exacerbate the strain on food supply and fair access. Urbanization and dietary shifts also play a critical role, with urban obesity rates have nearly doubled in rural areas with fast food consumption rising by 53% over the past decade, due to processed food having become a staple in urban diets (FAO, 2023). This is brought about by changes in lifestyle and busy schedules for cooking. More consumption of processed and calorie-rich foods contribute to increasing obesity levels and micronutrient deficiencies. The urban poor inhabitants, especially from slums, suffer from "hidden hunger" because of the unaffordable price of nutritious food.

India is committed to addressing its nutritional challenges. In past decades, various programmes and schemes have been launched and expanded to improve the nutritional situation of the country. The oldest scheme, the Integrated Child Development Services (ICDS), launched in 1975, adopted a multi-pronged approach to children's well-being by integrating health, educational and nutritional interventions through a community network of AnganWadi Centres (AWCs). The measures initiated included a supplementary nutrition programme, growth

monitoring and promotion, nutrition and health education, immunisation, health checkups and health referrals, as well as preschool education. Today, the AnganWadi services scheme operates through a network of 7,075 projects, implemented across 1.37 million AnganWadi centres, providing supplementary nutrition to 83.6 million beneficiaries. Between 2006 and 2016, owing to the programme, supplementary nutrition intake increased from 9.6 percent to 37.9 percent; health and nutrition education from 3.2 percent to 21 percent and child specific services of immunisation and growth monitoring from 10.4 to 24.2 percent. ICDS has proven to be incredibly helpful by showing its benefits over time, especially in the cases of rural areas where a whopping 60.5% of mothers have been able to access the services during their pregnancy as compared to just 38.8% whose mothers had access in urban areas (NITI Aayog, 2021). The Seventh Five Year Plan emphasized on this issue further, stressing that it must address community nutrition and extend supplementary nutrition to vulnerable groups.

The Midday Meal scheme, providing hot meals to children attending government schools, dates back to 1925, having been started locally by the Madras Municipal Corporation. To enhance enrollment, retention and attendance in schools, and simultaneously improve nutritional levels among, it was launched nationally from 1995. At present, the scheme benefits almost 91.2 million children in 1.14 million schools. Its beneficiaries fulfill nutritional targets by meeting 450 kcal and 12g of protein for primary students, and 700 kcal and 20g of protein for upper primary students, thereby reducing malnutrition incidence. The increase in enrollment was estimated at 4-6% among children, especially Dalits and Adivasi children. It was also a major factor in reducing educational gender disparity, retaining about 11% more girls in schools. It helped in employment generation- created jobs for over 2.5 million cooks and helpers, predominantly women, enhancing empowerment and livelihoods. The financial year 2023-24 in which ₹12,800 crore was allocated for the scheme reaffirms the importance of the scheme in tackling both educational and nutritional issues.

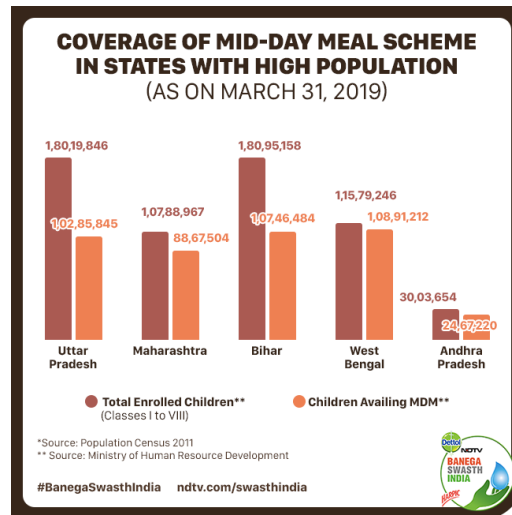
The next is the POSHAN Abhiyaan, or the National Nutrition Mission, launched in 2018, is India's flagship initiative to combat malnutrition, focusing on improving nutritional outcomes for children, adolescent girls, pregnant women, and lactating mothers. Despite decades of economic growth, malnutrition remains a pressing issue, with one in three children stunted and nearly half of all women anaemic. The program aims to reduce stunting by 2%, undernutrition by 2%, and

anaemia by 3% annually, emphasizing the critical "first 1,000 days" of a child's life. The mission prioritizes cross-sectoral convergence, behavioral change, and technology-driven solutions like the ICDS-Common Application Software (ICDS-CAS) to enhance service delivery and monitoring. Community initiatives such as Village Health and Nutrition Days foster grassroots engagement and promote awareness of nutrition practices.

Further schemes were devised to pour funds into the health of women and children with present mention of the POSHAN Abhiyaan, under the aegis of ICDS. Such schemes include Anganwadi Services, Pradhan Mantri Matru Vandana Yojana (PMMVY), and Scheme for Adolescent Girls. The National Food Security Act, 2013, under the targeted public distribution system, grants provisions for subsidized food grains; this covers almost one-third of the population. The PMMVY is a maternity benefit program, launched nationally in 2016, with a conditional cash transfer to pregnant women for safe delivery and good nutrition and feeding practices. This, along with PMVVY, are benefits of Janani Suraksha Yojana, where beneficiaries will also get cash incentive if they deliver through institutional delivery. PMMVY recorded a 52% reduction in the number of beneficiaries in 2020-21 while MAMATA of Odisha, which has included every phase in their allotments, registered a 57% increase in women- all indications of inclusive and efficient implementation.

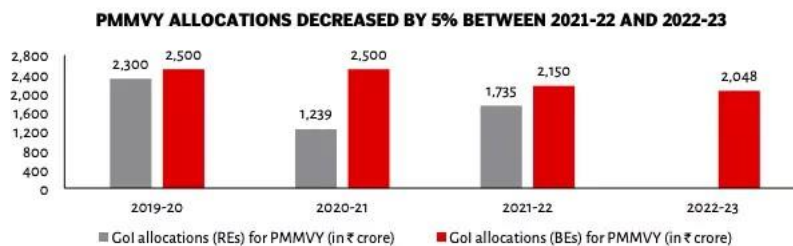
In spite of having so many programs for food security and maternal and child health and nutrition, there has been very little change in its uptake as only 51% visit a single facility for at least the minimum visits of saying-four antenatal clinics, and only 30% consume iron folic acid (IFA) tablets. Regarding the use of supplementary nutrition, uptake varies from 14 to 75% among children and is 51% and 47.5% among pregnant and lactating women respectively. Only 50 percent of pregnant and lactating women are enrolled in the maternity benefit scheme across states. Correct infant and young child feeding practices are also less adopted. In terms of deliveries, 79% are established, while within that figure, a mere 42% manage to start breastfeeding on time. Exclusive breastfeeding for the first six months stands at 55% while showing a drop in the timely introduction of complementary feeding from the previous 52.6% of children in 2015 to 42.7% in 2016.

Despite laudable goals, the nutrition and health programs of India face very many challenges in implementation, thus significantly undermining their impact. The MDMS also face critical infrastructure deficits: 43% of the schools lack clean kitchens and appropriate storage facilities. Food spoilage and cases of poisoning make meals erode trust in the scheme. Leakage in funds and diversion of stocks are still major challenges to implementation, especially in urban slums and tribal areas, where coverage remains grossly low.



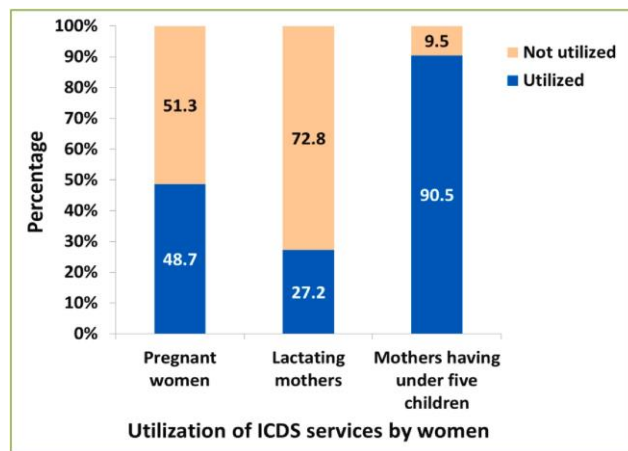
Source: Ministry of Human Resource Development

PMMVY offers inadequate monetary benefit, with ₹5,000 over one year, with which one cannot compensate the wages during an entire 12-week period of maternity benefit under the Maternity Benefit Act, 1961. More than 50% of eligible women are not aware of the scheme due to inadequate outreach along with a three-step registration process involving multiple documents, which delays or denies access to benefits.



Source: India Spend

The ICDS program reported better rural outreach compared to urban areas, with 60.5% utilization in rural areas compared to just 38.8% in the urban areas, but it suffers with underdeveloped Anganwadi Centers where low provision, poor infrastructure, and limited training for workers affect the quality of services. Inequality is continued in service access, mainly affecting marginalized groups residing in rural and tribal areas. Furthermore, the program has a narrow focus on supplementing food, neglecting better determinants of sanitation and poverty.



Source: Clinical Epidemiology and Global Health

Systemic flaws, including weak inter-agency coordination, inadequate mechanisms for monitoring, and corruption, enhance these weaknesses. In addition, awareness campaigns lack information gaps, which is a hindrance to including beneficiaries, with 50% of those in urban areas still unserved.

These issues call for focused, comprehensive interventions that can improve infrastructure and aligned processes to ensure equal access across demographics and regions.

Below is the generalized framework to optimize implementation and ensure these programs achieve their intended impact.

Digital tracking systems should be integrated to counter various inefficiencies such as leakages, misutilization of funds, and adulteration, and therefore, provide transparency and accountability.

The real-time monitoring of food supply chains, fund flow, and quality of service counters operational gaps and enhances efficiency of programs. Digital oversight will show resource utilization and the amount allocated, allowing for prompt corrective action whenever necessary. Collaborations with private entities can effectively address infrastructure deficits and improve service delivery in a number of social schemes. PPPs can be used for facility construction, for example kitchens or daycare centers, adhering to stringent standards of sanitation and safety. Private supply chains can be drawn in to reduce the operational cost and food wastage making services delivery cost-effective. For example, using a food-tech company to facilitate smooth meal distribution enhances reliability. Private firms can also develop training modules for field workers, such as cooks or Anganwadi Workers, to improve their skills and provide better service and adherence to safety standards.

The inclusion of private players in social schemes can lead to significant improvements across various metrics. Currently, 43% of AWCs lack proper infrastructure. Addressing infrastructure deficits in Anganwadi Centers (AWCs) could make 90% fully operational by 2030. PPPs could bring 10%-15% reductions in stunting in five years through targeted nutrition programs. NGO partnerships can ensure 100% training for AWWs, improving service quality by 40%-50%. Addressing nutrition gaps, where 36% of children under five are stunted, through PPPs like the Tata Trusts' initiative in Rajasthan, could reduce stunting rates by 10%-15% in five years. Furthermore, each dollar spent on improving meal programs through PPPs could yield \$16 in economic returns, as highlighted by World Bank Nutrition Report (2021). Regular third-party audits check for fund utilization, service quality, and program outreach. Establishing quality benchmarks and conducting periodic reviews helps maintain high standards while identifying scope for improvement. Collaborations with food safety experts or independent evaluators can further strengthen this mechanism, ensuring objective assessments and driving continuous improvement. Raising public awareness is indispensable for improving program participation, particularly in underserved regions. NGOs, private entities, and targeted media campaigns can educate communities about the benefits of social schemes, driving higher enrollment and engagement. This is especially effective in bridging utilization gaps in urban slums and remote areas where access to information may be limited.

Technology-driven solutions, such as those implemented under Poshan Abhiyaan, have demonstrated significant positive impact. Efficient tracking and monitoring systems can reduce fund leakages, improve data accuracy, and streamline service delivery. Technology empowers program administrators with the tools needed to make data-driven decisions and optimize resource allocation.

The integration of PPPs in schemes such as the ICDS or PM Poshan can do much towards the achievement of SDG 2 (Zero Hunger) by eliminating malnutrition and boosting educational outcomes. Schemes like these also fit into India's idea of making a healthy and educated population, thus yielding sustained and long-term benefits in the long run.

With the right measures, the vision of a Healthy India can transition from a dream to a tangible reality. The future of a malnutrition-free India hinges on effective policy implementation and strategic interventions.

Additionally, malnutrition can be fought internationally by India's partnerships as well. From time to time, international organizations like UNICEF and WHO come forward to help the country with technical expertise and funds needed so that the alliance-formed nutrition policies can blend with the global level. Such developments allow the knowledge and best practices from other countries to flow in. There surely have been many imperfections in India's attempts to integrate global expertise into domestic policy. Further, though, internal problems, such as a lack of inter-agency coordination and adaptation of the international model to local contexts, fall short of availing themselves of the maximum potential of such partnerships for the organization committed to assist India in every aspect of grassroots development work. Nonetheless, past collaborations have delivered significant outcomes. For instance, UNICEF has supported India in combating child malnutrition by developing modules for Anganwadi workers and implementing community-based management of acute malnutrition. The World Bank has contributed funding and expertise for projects like the Integrated Child Development Scheme, enhancing its operational scope. Additionally, WHO has worked on maternal and child health by promoting breastfeeding and fortification programs. These partnerships underscore the value of external support in reinforcing India's fight against malnutrition.

More particularly, concerning their role played by the private sector, these involve food fortification and nutrition education campaigns; much-publicized and mostly viewed malnutrition campaigns. Yet again, profit motives in most private companies lead to the promotion of 'unhealthy' foods and thus worsen the double burden of malnutrition, as they target undernutrition and increasing rates of obesity, diet-related diseases, and so on. Many grassroots NGOs have contributed greatly in this regard by improving nutrition practices and providing food aid while increasing awareness. Organizations like Akshaya Patra Foundation, which serves mid-day meals to millions of schoolchildren, and Action Against Hunger, focusing on community-based management of acute malnutrition, have made a significant difference at the local level. Additionally, The Hunger Project empowers women in rural areas to lead nutrition and health initiatives, while Goonj repurposes urban surplus into resources for rural communities, addressing food scarcity. CSR initiatives can go a long way towards overcoming the budgetary constraints. Corporates can help social schemes by sponsoring infrastructure upgradation, training programs for the workforce, and other outreach and awareness campaigns. CSR contributions, when aligned with government schemes, enable schemes to reach more beneficiaries and amplify their overall effectiveness.

The study of the contribution of technology to nutrition enhancement promises to be extremely rewarding. Awash with advanced technologies linked to artificial intelligence and big data, it will address very much the manner through which nutrition programming is brought to fruition by enabling precise heterogeneous interventions based on the different peculiar regional food requirements. Digital information systems could also assist in creating public consciousness as well as real-time information on healthy living. The challenges, however, such as digital illiteracy, limited internet, and poor infrastructure in rural areas, deter considerable outreach of the gains from such technological advances.

Another dimension in policy innovation is implicated in behavioural economics. Through providing monetary incentives for consuming healthier food, the government could nudge citizens to practice healthier eating habits, especially involving the low-income population. Other policies would include food marketing restrictions on unhealthy foods, particularly directed towards children, and introduction of taxes for high sugar and high fat products. Thus the

policies will pay more than dealing with under-nutrition, as the benefits can be extended towards reducing the increasing burden of diet-related diseases such as obesity and diabetes.

Another critical area for policy intervention is strengthening local food systems encouraging more nutrient-rich traditional foods such as millets, pulses, and vegetables to boost production and consumption can remedy micronutrient deficiencies and diversify diets. One other main area of policy impact is food wastage. According to estimates, about 40% of produced food is lost in India due to poor infrastructure and ineffective supply chains. Improving the food storage, transport, and distribution system ensures that more food reaches poor populations who need it the most.

Now India stands at a critical juncture in battling malnutrition: it necessitates an integrative approach between technology and behavioral insight and a much more solid innovation in policy. Using developed advances in artificial intelligence and big data would be a game changer in making interventions targeted specifically on nutrition that can empower the most vulnerable people with the most precise solutions. However, overcoming systemic challenges such as inadequate infrastructures and digital divides will be critical to unlocking the full potential of these technological advances.

Innovations in policy should be shaped by behavioral economics e.g. monetary incentives to consume healthier foods while taxing unhealthy products which would probably shift the dietary pattern greatly towards better nutrition for the population. Promoting supply chain efficiency, enhancing efforts to direct social safety schemes toward using healthy, traditional, nutrient-rich foods, and reducing food waste would further help in improving dietary diversity and fighting malnutrition.

India's fight against malnutrition finds inspiration in global success stories that show what's possible with the right approach. Programs like Brazil's Bolsa Família highlight how something as simple as conditional cash transfers can transform lives, improving nutrition while addressing deeper social and economic inequalities. By drawing lessons from such initiatives and adapting them to its unique challenges, India can craft solutions that don't just tackle hunger but also uplift communities. The vision goes beyond filling empty stomachs—it's about creating a future

where every individual, regardless of their background, has the opportunity to thrive with access to the nourishment they need to lead healthy, dignified lives.

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