PATHWAY TO ACHIEVE A SUSTAINABLE FOOD IN INDIA

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Abstract

The intensity of GDP is to reduce emissions in India by 45% in 2023 and subsequently reach net zero by 2070. To achieve this goal, Greenhouse Gases emissions from agriculture and land use will have to be significantly reduced. Three potential pathways are presented in this paper for India's attainment of its discharge targets by 2050, including moderate ambitions of mitigation action, moderate ambitions coupled with healthy diets, and high mitigation ambitions coupled with healthy diets. Our method of projecting these pathways under cross-country balanced trade flows is based on an integrated accounting tool, the FABLE Calculator, which complements various socioeconomic and biophysical data. According to the projections, by 2050, cereal demand will increase, increasing GHG emissions. By reducing cereal demand over the same period, SUSTAINABLE pathways reduce GHG emissions, while important crop productivity and harvest force gains increase crop production. For India to achieve its mid-century emission aims from the farming sector, improving crop, livestock, and forest productivity and net-zero deforestation are essential.

Keywords: Sustainable, Pathway, India, Agriculture, Food, Greenhouse Emission

Introduction:

By combining data on crop and livestock production, on-farm energy use, land use and land use change, domestic food transport, and food waste disposal, new country-level estimates of greenhouse gas (GHG) emissions from the food system were produced between 1990 and 2018. (Xu et al., 2021). One of the chief sources of greenhouse gas (GHG) emissions is the food, agriculture, and land use structure (Tubiello et al., 2021). The total GHG emission in the world, with abundant assessing them in the range of 21-37% (Zhang et al., 2013). Population, income, and food demand increases will likely put additional pressure on the land-use system, decreasing the likelihood that the SDGs will be met within the anticipated time frames. (Narayan et al., 2011). Understanding the trade is crucial for achieving sustainability goals and meeting food demand because agriculture is a major sector in rural livelihood.

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Agriculture-led growth will be crucial for rural development, poverty reduction, and reducing undernutrition despite the low value addition from the agriculture sector to total GDP. (Pingali and Aiyar 2018; Pingali et al. 2019c). Ninety percent of freshwater is used for agricultural purposes, but the land is being degraded as a result of excessive irrigation, deforestation, soil erosion, agrichemicals, and dangers (Priya et al., 2021). While cropland expansion and technological advancement are solutions that are anticipated, they come with serious drawbacks such as increased emissions related to land use change, increased fertiliser use, and faster groundwater depletion *(Climate Change and the Health of Nations: Famines, Fevers, and the Fate of ... - Anthony McMichael - Google Books, n.d.).* Although technological advancements and the strengthening of cropland are solutions that are anticipated, they come with serious drawbacks, including increased emissions related to land use change, increased groundwater withdrawal rates, and increased fertiliser use (Gupta et al., 2021).

Focusing on agricultural diversification toward more fruits and vegetables and dietary changes are two recommendations to improve the nutritional status of the populace (Zerfu et al., 2016). The National Institute of Nutrition (NIN) of India has recommended dietary intake for the Indian population based on age, gender, and activity levels in light of the available research (ICMR-NIN 2020). Although these dietary suggestions can result in a healthy transition, their effects on the environment are unknown.(Vadiveloo et al., 2013). Even if food production is increased to meet demand through healthy dietary changes, efforts to achieve security and reduce emissions can be thwarted by food loss and waste. The post-harvest losses from food in India's supply chain range from 3.9 to 6.0 percent for cereals, 4.3 to 6.1 percent for pulses, 5.8 to 18.1 percent for fruits, and the highest for vegetables (6.9-13.0 percent) (USD 15.19 billion). A decline in food supply chain losses, when coupled with a change in diet and increased crop productivity, has the potential to support sustainable transitions. Only a small number of studies have evaluated these various aspects' sustainable transformation for India. The raised a number of issues with regard to India's changing food system, particularly in regards to managing climate risks and their effects on agricultural productivity and dietary accessibility. However, the existing literature does not take into account other closely related aspects of agricultural production, such as the variation in GHG emissions from changes in agricultural practises and the overall impacts on the country's trade as a result of these changes. In our study, we model crucial and pertinent elements of the food and land use system to address these concerns. Three possible pathways are presented in order to decide on long-term strategies for India's food and land use systems with potential mitigation measures. A novel accounting tool called the FABLE Calculator is used to integrate various sectors, with agriculture acting as the main driver. In order to give India a realistic, sustainable path toward achieving its GHG emission reduction targets by 2050, our analysis focuses on identifying trade-offs between various food and land use demands. These pathways were developed using current trajectories and extended to meet targets for a national healthy diet. They were also extended to meet specific sustainability targets using a variety of mitigation strategies, such as dietary transitions. As a result, we are better able to

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assess the likelihood of attaining targets for a healthy diet across land-use systems, ceteris paribus, and ascertain the advantages of other transformations in attaining SDG targets concurrently. This essay is divided into five sections. In the section titled "Materials and methods," we go over the procedures and tools used to create three potential long-term routes for India. This is followed in Section 3 by a discussion of scenarios and related assumptions.

Materials and methods:

Researchers and policymakers alike can use the FABLE Calculator since it is based on Microsoft Excel (Mosnier et al., 2020). Due to the fact that it doesn't require knowledge of specific tools and software, the tool is accessible to researchers with diverse skill sets. It works transparently for calculations, assumptions, data inputs, and outputs. At the moment, the Calculator computes historical data and future results every 5 years between 2000 and 2050. The built-in formulas link different sheets and presumptions and are fully visible and iteratively tested to determine if they result in numerous dynamic changes. Various variables at the national level are taken into account in the calculator, such as food consumption, agricultural output, water use for crop production, GHG emissions, and land use across competing categories. Socioeconomic and biophysical data are gathered and harmonised in the corresponding sheets in order to formulate and create Sustainability Science (2023) projections. In order to create projections for the model, assumptions are made about demand, trade, post-harvest food waste, post-harvest losses, and agricultural productivity growth rates. Forecasts of future food supply and demand include import and export relationships with trading partners, which are taken into account when forecasting food production and trade scenarios. FABLE nations combined their national pathways to produce evidence on trade based on initial hypotheses and shifting global demand. Using historical data and national trade policies for outlook, expectations are made about a nation's trade outlines.

The average national influence of climate change on crop productivity is calculated using the ISIMIP database. We specifically estimate the projections until 2050 based on three scenarios for a Sustainable food land-use system: (a) Business as usual (BAU), which serves as the reference scenario; (b) BAU plus a change in diet toward National Institute of Nutrition (NIN) recommendations; and (c) SUSTAINABLE, where food demand is also in line with NIN diets. These figures show how the food groups should be divided up for a target daily caloric intake of 2000 for the general population. NIN promotes cutting back on cereal crop consumption and abstaining from sugar consumption. These recommendations do not currently distinguish between sources of protein from plants and those from meat. For comparison's sake, we combined the protein sources from plants and animals in the BAU scenario as well. The scenario's underlying assumptions for the key elements, such as population, GDP, and food, follow typical socioeconomic trends (SSPs). The parameters used to parameterize the levels of other indicators typically include things like low versus high growth (crop and livestock productivity), decreased versus increased food loss, different afforestation targets, high versus low trade volume,

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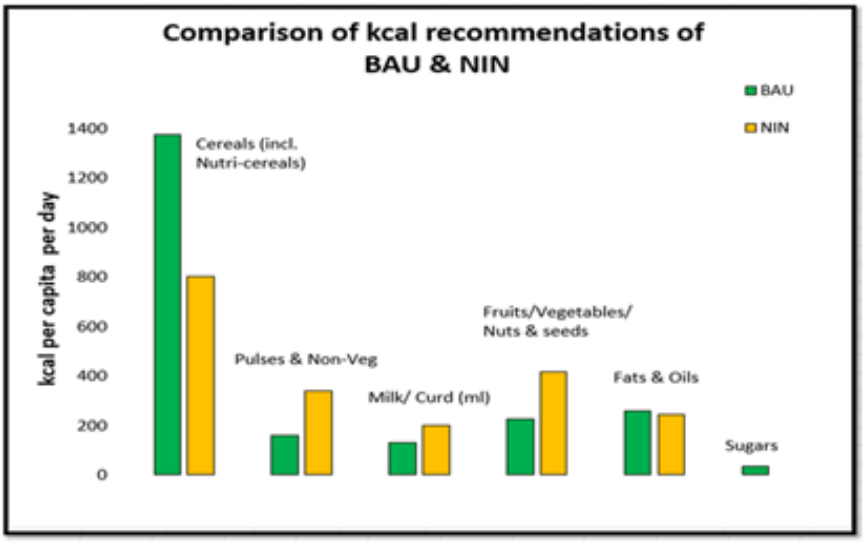
and low versus high resource efficiency (water). According to the BAU and BAU + NIN scenarios, the GDP is predicted to reach 6.5 trillion USD (2005) and 11.9 trillion USD by 2030, respectively (2005).



In the same scenario, there will be 1.63 billion people on the planet by 2050. Based on these figures, all parameters—including GDP, population, and food demand—are presumptive. We concentrated on the ICMR NIN recommendations while taking into account food demand as in the BAU+NIN pathway (2010). 2020 (ICMR-NIN). Projections for the economy and population are made under the assumption that they will follow the SSP1 trajectory. The projected GDP under the sustainable pathways is 7.09 trillion USD by 2030 and 13.26 trillion USD by 2050, despite the fact that the population is anticipated to reach 1.48 billion by that time. The BAU-NIN scenario and the SUSTAINABLE pathway both assume the same levels of food demand. SSP1 has a higher GDP per capita and a slower rate of population growth when compared to SSP2. Because prices are not incorporated into our model and are only used ex-post to determine production and trade values, they have no impact on consumer preferences or food demand. Furthermore, price elasticity has not yet been considered by the FABLE Calculator. Under the SUSTAINABLE pathway as opposed to BAU, we anticipate a gradual increase in the yields of several important crops, including rice, wheat, corn, pulses, groundnuts, and soybean. Based on the aforementioned hypotheses, our results show that rice productivity increases under SUSTAINABLE compared to BAU and BAU+NIN by 16 percent in 2030 and 59 percent in 2050. The productivity increase for corn under SUSTAINABLE is comparable, increasing by 27 percent in 2030 and 62 percent in 2050. Groundnut, soybean, and pulse productivity will increase by 41%, 126%, and 248% by 2050 under the SUSTAINABLE scenario. This is primarily due to the SUSTAINABLE pathway's assumed higher productivity levels and lower impact of climate change (RCP 2.6).

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Conclusion:

The current analysis using a simple but integrated food and land use assessment tool shows that India would not be able to meet both its nationally determined minimum daily energy requirements (MDER) and GHG emissions targets if current trends were to continue. The alternative, sustainable pathway involves intensifying crop and livestock production, reforestation in line with the objectives of the Bonn Challenge, and increased food demand that doesn't put additional stress on cropland The adoption of ICMR-NIN dietary recommendations reduces crop emissions because there is a decrease in the demand for cereal crops. With the exception of corn, where imports would increase as food and bioenergy demand rises, the majority of the targets can be achieved through domestic production. India has handled the COVID-19 shock reasonably well in terms of the food supply sector. Its reliance on mom-and-pop stores rather than supermarkets, its extensive network of pushcart FFVs, and its naturally short supply chains are some of the major contributing factors (fresh fruit and vegetable vendors). With the exception of corn, where imports would increase as food and bioenergy demand rises, the majority of the targets can be achieved through domestic production. As far as the food supply segment is concerned, India has reacted to the COVID-19 shock fairly well. One of the main factors is its dependence on mom-and-pop shops rather than supermarkets, its extensive network of pushcart FFVs, and its inherently short supply chains (fresh fruit and vegetable vendors). Our findings demonstrate the need for a strategic policy framework that prioritises raising productivity and lowering reliance on trade of the major food crops, primarily pulses, oil crops, fruits, and vegetables. Additionally, the diversion of subsidies from cereal crops to pulses, oil crops, fruits, and vegetables will go a long way in achieving India's emissions targets from the food and land use sectors while simultaneously meeting the population's nutritional requirements. Moving forward, even though the contributions from various stakeholders have greatly benefited our analysis and assumptions, we aim to keep improving our assumptions within the model to produce specific and useful results through ongoing stakeholder engagement.

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