Food System Economics Commission

WORKING PAPER

Regional Analysis of Hidden Costs of the Food System Economic Commission Current Trends and Food System Transformation Pathways to 2050: India Key Figures

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Background Brief for the
Food System Economic Commission

Regional analysis of hidden costs of the Food System Economic Commission current trends and food system transformation pathways to 2050: India Key Figures

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Key figures

Current hidden costs. Annual Indian greenhouse gas (GHG) emissions, nitrogen (N) pollution, and habitat losses and returns from land-use change from food production, poverty, and productivity losses from consumption of unhealthy diets, have current hidden costs of 1.5 trillion USD 2020 PPP (Figure 1S)

What are hidden costs? Food production and food consumption in the current year create costs that will be borne in the near- and long-term future. Indicators such as gross product count the value-add of current activities in purchasing power terms but do not account for the future deficits, this is why the costs are hidden from national accounts and not factored into current markets.

Perspective on economic burden of hidden costs. Roughly, corrected for the purchasing power denied to future economies from hidden costs, Indian GDP would be 16.1% lower (1.5 trillion USD 2020 PPP is 16.1% of India's 2020 GDP in purchasing power terms). The correction nearly negates the contribution to gross product from value-add of agriculture, forestry, and fishing (18.2% in 2020).

Accumulating deficit. Unlike a shock such as the global financial crises or the COVID-19 global pandemic, the food system produces costs year on year. The hidden deficit accumulates in real terms and poses risk to future growth and development.

Reduction of deficit by transforming food systems. The Food System Economic Commission (FSEC) Food System Transformation (FST) pathway assumes fundamental changes in food production and food consumption between 2020 and 2050. Over this period the FST would reduce accumulated Indian food system hidden costs over 2020 to 2050 by 26% (Figure 1S top panel). The magnitude and composition of the avoided hidden costs changes over the period 2020 to 2050 as the measures in FST are implemented and responded to, but averaged the avoided hidden costs amount to 296 billion USD PPP per year (Figure 2S bottom panel and Figure 3S middle panel). The cost reduction increases over the period (Figure 1S bottom panel Figure 3S right panel). By 2050 the annual hidden costs are reduced by 57% under FST compared to the baseline scenario.

Confidence in benefits increases over the period. India has a high share of land surface and labourers utilised for agriculture, and incentives such as input subsidies. FST measures for agriculture such as habitat sparing for biodiversity intactness, payment of nitrogen mitigation measures, payment for carbon sequestration, and changing labour input prices based on minimal wages, produces large flux in land-use over the next decade. The FSEC hidden cost analysis includes large uncertainty in environmental prices for GHG pollution, N pollution, and lost or returning ecosystem services. Combining the flux in land-use with uncertainty in the marginal costs such as carbon sequestration versus livestock methane production, produces large uncertainty ranges for the avoided hidden costs over the period 2020-2030 where most restructuring of land-use occurs (Figure 1S bottom panel). By 2040, benefits from change to healthy and sustainable diets increase, providing increasing confidence that avoided costs will exceed 320 billion USD PPP per year by 2050 (Figure 1S bottom panel and Figure 2S third from bottom panel). The avoided hidden costs from implementing FST are still increasing in 2050 and likely continue to grow for some decades after 2050.

Composition of avoided costs under food system transformation. Averaged over the period 2020 to 2050, productivity improvements from healthier diets and avoiding a western-style trajectory of obesity and overconsumption of sugars, salt, and processed foods, provides roughly 2/3rds of the avoided costs (195 billion USD 2020 PPP per year) (Figure 3S middle panel). Avoided costs of climate

change, nitrogen pollution, and lost ecosystem services, provide the other 1/3rd (98 billion USD 2020 PPP per year) (Figure 3S middle panel).

Economic costs of degrading blue water resources. Impacts of water scarcity are endogenous to the land-use partial equilibrium model utilised by FSEC, so impacts on agricultural production and undernutrition of water scarcity factor into land-use and body mass index calculations. Lost ecosystem services from loss of environmental flows due to degraded blue water resources are not counted in the hidden cost figures.

Composition of avoided hidden costs from production. Avoided damages from GHG emissions (34 billion USD 2020 PPP), reactive nitrogen surplus (34 billion USD 2020 PPP), and habitat losses (31 billion USD 2020 PPP), make equal contributions to average annual avoided hidden costs (Figure 3S middle panel). Under reactive nitrogen surplus, the main pathways to damages include lost productivity from air pollution due to volatilized ammonia from synthetic fertiliser application and manure and damage to ecosystems from nitrate run-off from cropland and pasture. Nitrate run-off is the major cost of nitrogen surplus its mitigation provides the main benefits from action on nitrogen surplus under FST (26 billion USD 2020 PPP) (Figure 3S middle panel).

Trends of costs over the period 2020 to 2050. Contributions to avoided costs are not constant over the period 2020 to 2050. Avoided cropland expansion under FST occurs in earlier decades, while savings from mitigating nitrogen surplus increase and are the main category of savings as well as the main residual cost on the production side by 2050 (Figure 3S right panel). This is due to diverging input efficiency and agricultural land-use under FST and the baseline scenario. Mitigated CH4 due to reduced livestock production and improved practices in rice production makes up most of the avoided GHG damages (26 billion USD 2020 PPP annually on average). On the consumption side, transition to healthy diets is introduced linearly over the period, consequently labour productivity improvements increase over the period from a proportion of 58% of avoided costs in 2030 (142 billion USD 2020 PPP) to 77% in 2050 (372 billion USD 2020 PPP) (Figure 3S right panel).

Poverty. Poverty decreases steadily over the period in line with economic growth and continued transition of the Indian economy away from an agricultural base. The economic and demographic growth forecast used for the FSEC analysis needs to be long-term to apply appropriate discounting to the hidden costs which are diffused into cost-bearing in future economies. Economic and population growth under IPCC shared socio-economic pathway 2 (SSP2) was used.

Trends in economic risk. Economic risk from uncertain costs of GHG emissions, nitrogen surplus and lost ecosystem services decrease under FST. The 95-th percentile of production hidden costs reduces from 440 billion USD PPP in 2050 under the baseline scenario to 133 billion USD 2020 PPP in FST (Figure 6S left and middle panel). The major residual uncertainties in avoided costs from production come from the cost of residual CH4 emissions and the costs of nitrate run-off from cropland weighing up against the benefits of CO2 sequestration from avoided cropland conversion and returning ecosystem services of recovering forest habitat (Figure 6S right panel).

Comparison with other regions. India and China avoiding a western-style trajectory of obesity and overconsumption of sugars, salt, and processed foods is one of the main global economic benefits of FST (Figure 5S). Nitrogen surplus mitigation and avoided cropland expansion in India and China are also major global benefits under FST. The largest global environmental benefits under FST to 2050 come from South and Latin America, and changing agricultural practices and avoiding deforestation in Sub-Saharan Africa as production expands and intensifies.

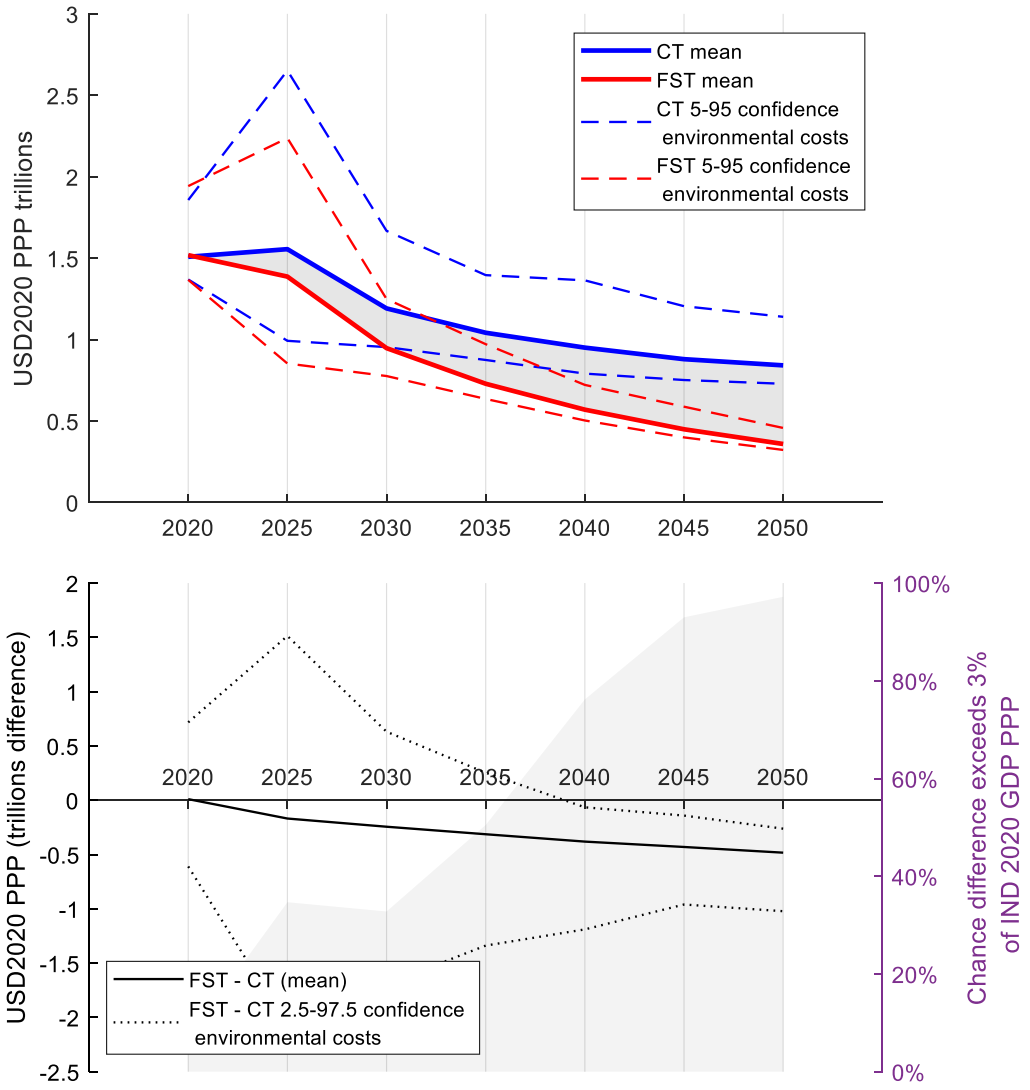

Figure 1S: Trajectory of India total annual hidden costs and cost reduction for CT and FST in 2020 USD PPP. Top panel shows the total expected hidden costs under CT (blue) and FST (red). The shaded area between the trajectories indicates the mean value of the total reduction under FST over the period 2020-2050 in 2020 USD PPP. Trajectories of the 5-th and 95-th percentiles of the respective distributions of India hidden cost are shown, accounting for uncertainty in the production costs (greenhouse gas (GHG) and reactive nitrogen (N) emissions, lost habitat from land use changes and returned habitat from abandoned agricultural land). Even with high uncertainty in environmental costs the bottom panel shows that hidden cost reduction under FST is very likely (>97.5%) by 2040 with an increasing probability that the reduction exceeds 3% of India's 2020 GDP PPP.

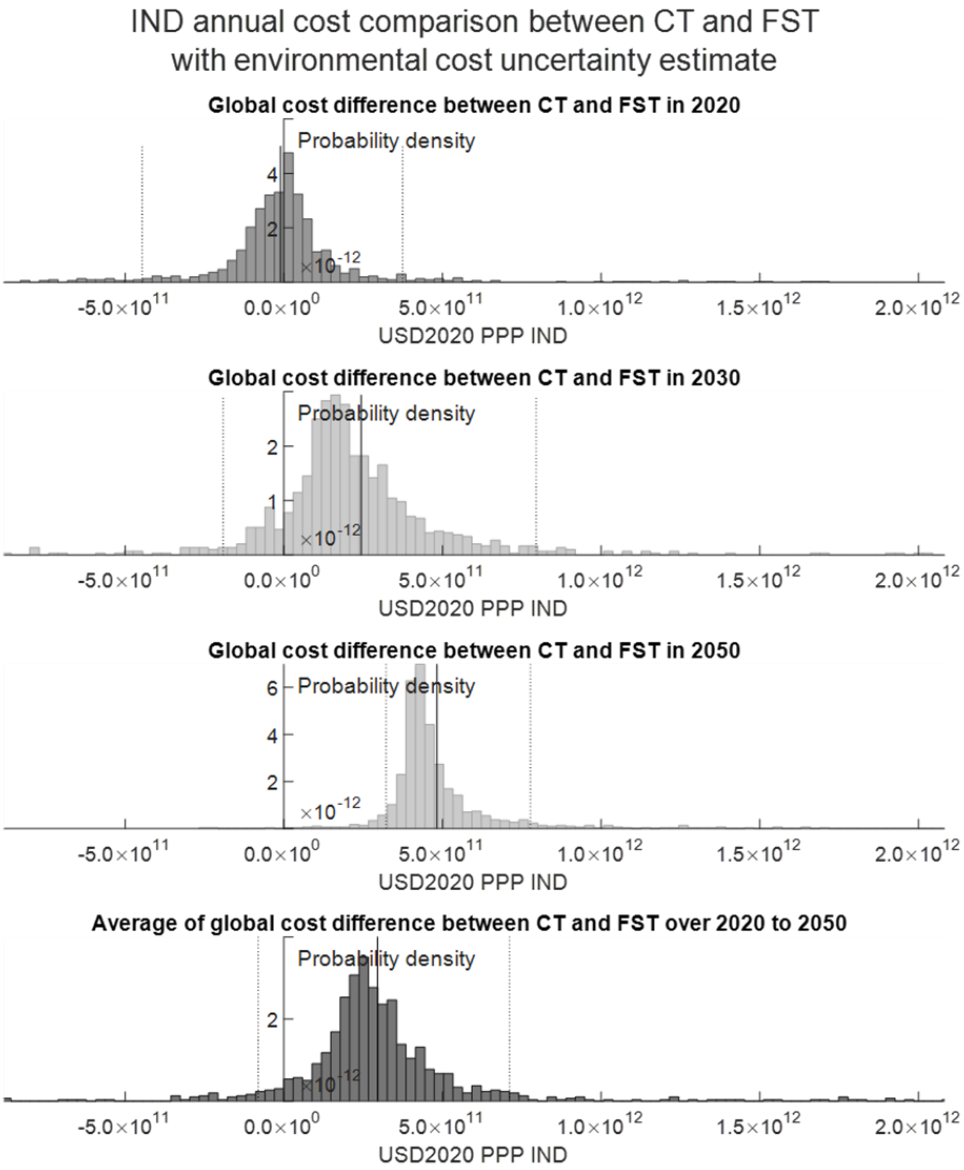

Figure 2S: Distribution of India total annual hidden cost reduction under FST in 2020 USD PPP in 2020, 2030 and 2050. Hidden cost reduction can be examined with uncertainty in environment costs in the FSEC study. Figure 1S bottom panel showed the trajectory of the mean and the 5-th and 95-th percentile statistics of the distributions of India annual hidden cost reduction under FST. The top, second to top, and second to bottom panels in this Figure show cross-sections of the full distribution of India's annual hidden costs reduction in the years 2020, 2030 and 2050. The bottom panel shows the distribution of the total cost reduction divided by the 30 year period (average annual cost reduction). The conclusions that FST reduces hidden costs by 2050, and that annual hidden cost reduction by 2050 exceeds 320 billion USD 2020 PPP, are robust to the modelled uncertainty in the marginal costs of GHG, N emissions, and ecosystem services.

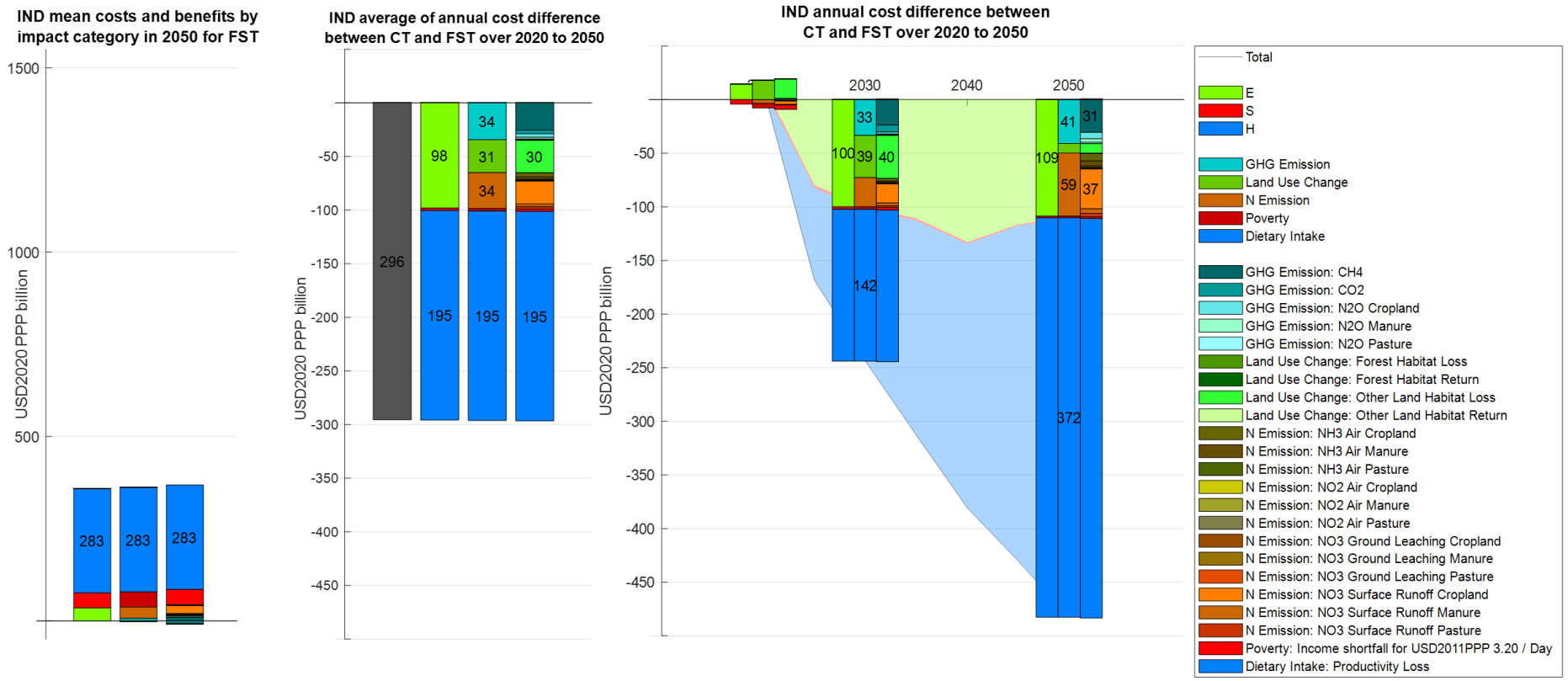

Figure 3S: Breakdown of India annual hidden cost reduction under FST in 2020 USD PPP in 2020, 2030 and 2050. Large average hidden cost reductions under FST over 2020-2050 come from burden of disease from food consumption, CH4 emission reductions from livestock and rice, avoided cropland expansion, and mitigating NO3- run-off from cropland (middle panel). Up to uncertainty in production costs, GHG emission reduction, avoided loss and return of habitat, and reduction in N pollution, provide equal contribution to hidden cost reduction over the period 2020-2050 (middle panel). Reduction in N pollution contributes more later in the period (right panel). Environmental hidden cost reduction and productivity losses from burden of disease from food consumption have an approximately equal contribution to hidden cost reduction over the period 2020-2050 (middle panel). Environmental hidden cost reduction stabilises while the avoided productivity losses from burden of disease increase over the period (right panel). Residual hidden costs by 2050 under the FST trajectory are predominately productivity losses from food consumption, income shortfall from the $3.20/day (2011 PPP) poverty line, and nitrogen pollution (left panel). There is little difference between CT and FST in income shortfall from the $3.20/day (2011 PPP) poverty line. Poverty reduction is driven by economic growth of all sectors in SSP2, not in the implementation of FST measures.

Figure 4S: Transition of production away from hidden costs and avoided western-style disease burdens and costs from unhealthy diets in annual hidden cost reduction under FST in 2020, 2030 and 2050 for India (IND). As a complement to Figure 3S, this Figure shows cost reduction in its context of changes in total hidden costs. Current hidden costs are predominately productivity losses (blue) from consumption and income shortfall from the $3.20/day (2011 PPP) poverty line (red). An increasing economic burden from the environmental consequences of food production (green) under the baseline CT scenario are averted and reversed under FST. Poverty reduction largely follows general economic development of other sectors and is not largely changed by the FST measures. GHG emissions (predominately CH4) and an increasing burden from nitrogen surplus in the baseline (predominately nitrate run-off) are averted by nitrogen mitigation and lower livestock production under FST.

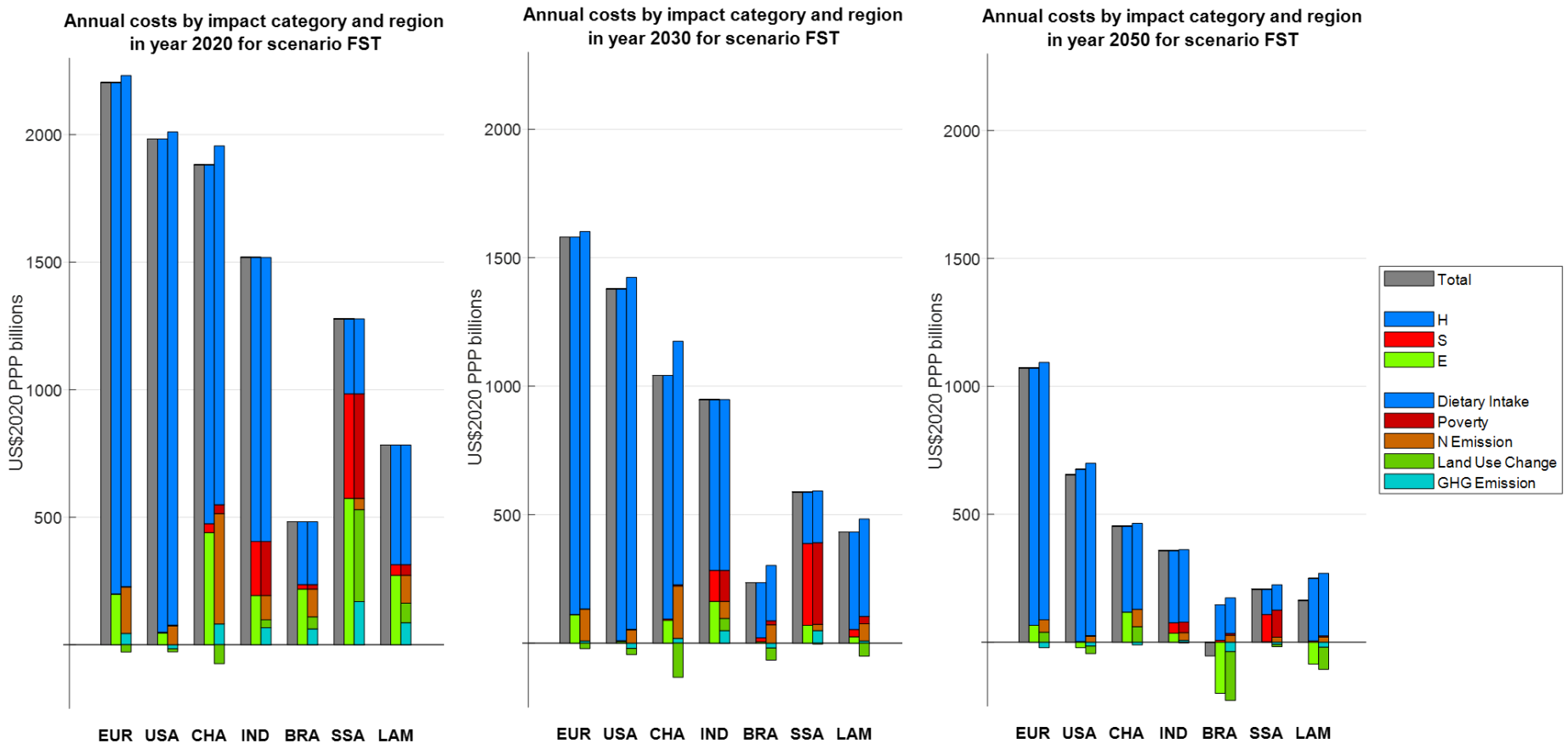

Figure 5S: Comparison of annual hidden costs under FST in 2020 USD PPP in 2020, 2030 and 2050 for 7 FSEC regions. Regional trajectories show transitions in productivity loss from diets and N pollution in China (CHA) and India (IND), global GHG cost neutrality from balancing CH4 emissions and CO2 sequestration, land-use change in Brazil (BRA), Latin America (LAM), and Sub Sahara Africa (SSA), and residual poverty in IND and SSA under SSP2.

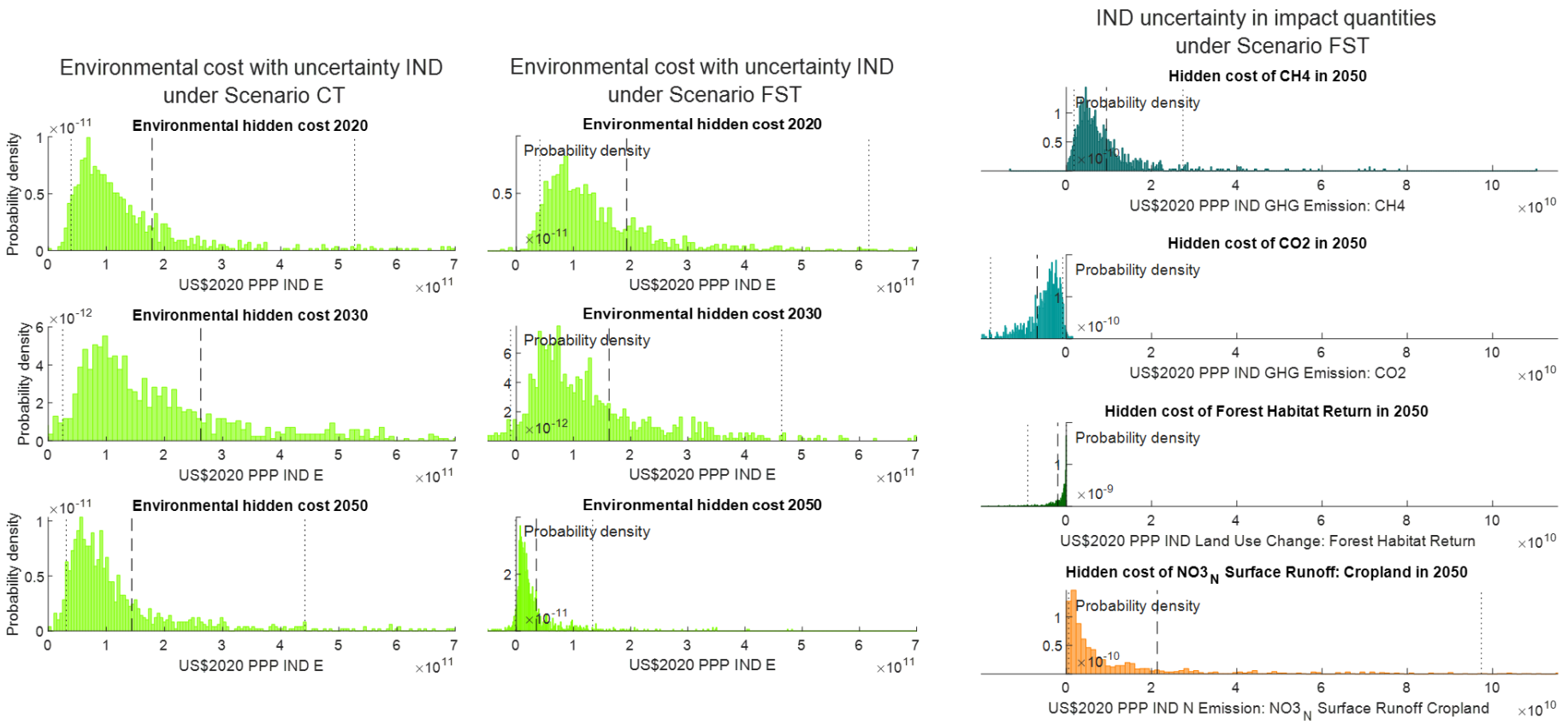

Figure 6S: Distribution of production annual hidden cost reduction under FST in 2020, 2030 and 2050 for India (IND). Left panel shows the distribution of environmental hidden cost in 2020, 2030 and 2050 under the baseline scenario CT. Under FST the distribution transitions to higher mass on lower costs by 2050, with a three fold reduction in the 95-th percentile (middle panel). Uncertainty in the residual hidden costs of production under FST in 2050 resides in two benefits items (CO2 sequestration and ecosystem services from return of forest habitat) and two cost items (CH4 emissions and nitrate run-off from croplands), see right panel.