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: China Key Figures

Steven Lord

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CONTACT

Food System Economics Commission
contact@fsec.org

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: China Key Figures

Steven Lord

Environmental Change Institute, University of Oxford

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Key figures

Current hidden costs. Annual China 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 2 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, China GDP would be 8% lower (2 trillion USD 2020 PPP is 8% of China's 2020 GDP in purchasing power terms). The correction nearly negates the contribution to gross product from value-add of agriculture, forestry, and fishing (7.7% 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 China food system hidden costs over 2020 to 2050 by 44% (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 677 billion USD PPP per year (Figure 2S bottom panel and Figure 3S middle panel). The cost reduction is maintained over the period (Figure 1S bottom panel Figure 3S right panel). By 2050 the annual hidden costs are reduced by 48% under FST compared to the baseline scenario.

Confidence in benefits increases over the period. China 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, change in demand, and changing labour input prices based on minimal wages, produces large flux in land-use over the period. 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 produces large uncertainty ranges for the avoided hidden costs over the period 2020-2050 (Figure 1S bottom panel). By 2035, benefits from change to healthy and sustainable diets increase, providing increasing confidence that avoided costs will exceed 200 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 likely continue for some decades after 2050.

Composition of avoided costs under food system transformation. Under FST, China reduces potential productivity losses from obesity and noncommunicable disease attributed to diets by ~30% over 2020 to 2050 compared to CT (Figure 3S). In average annual terms, the avoided productivity loss is worth an estimated ~306 billion 2020 USD PPP to GDP PPP per year (Figure 3S middle panel). China has the world's largest economy in GDP PPP terms, but the productivity boost is worth 1% of China's 2020 GDP PPP. Avoided costs of climate change, nitrogen pollution, and lost ecosystem services, from

production provide roughly the other half (~361 billion USD 2020 PPP per year) of avoided hidden costs (Figure 3S middle panel).

Composition of avoided hidden costs from production. China, currently the world's largest agricultural nitrogen polluter, reduces the expected external costs and risks of nitrogen pollution by ~30% under FST over 2020 to 2050, worth ~135 billion 2020 USD PPP to GDP PPP per year (Figure 3S). Nitrate run-off from cropland is the major cost of nitrogen surplus. Its mitigation provides the main benefits from action on nitrogen surplus under FST (83 billion USD 2020 PPP) (Figure 3S middle panel). Avoided damages from GHG emissions average 52 billion USD 2020 PPP, mainly from avoided CH4 emissions from livestock reduction and improved practices in rice production and benefits of CO2 sequestration from increased forest area (Figure 3S middle panel). Cropland and pasture reduces rapidly under FST early in the 2020-2050 period compared to CT, provided large benefits from avoided habitat loss (~184 billion 2020 USD PPP) (Figure 3S).

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.

Poverty. Poverty decreases steadily over the period in line with economic growth and continued transition of the China 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 980 billion USD PPP in 2050 under the baseline scenario to 675 billion USD 2020 PPP in FST (Figure 6S left and middle panel). The major residual uncertainties in avoided costs from production come from costs of nitrate run-off and other land habitat loss weighing up against the benefits from ecosystem services on returning forest habitat (Figure 6S right panel).

Comparison with other regions. China and India 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 China and India are also major global benefits under FST. The largest global environmental benefits under FST to 2050 come from land-use changes in South and Latin America, and changing agricultural practices and avoiding deforestation in Sub-Saharan Africa as production expands and intensifies.

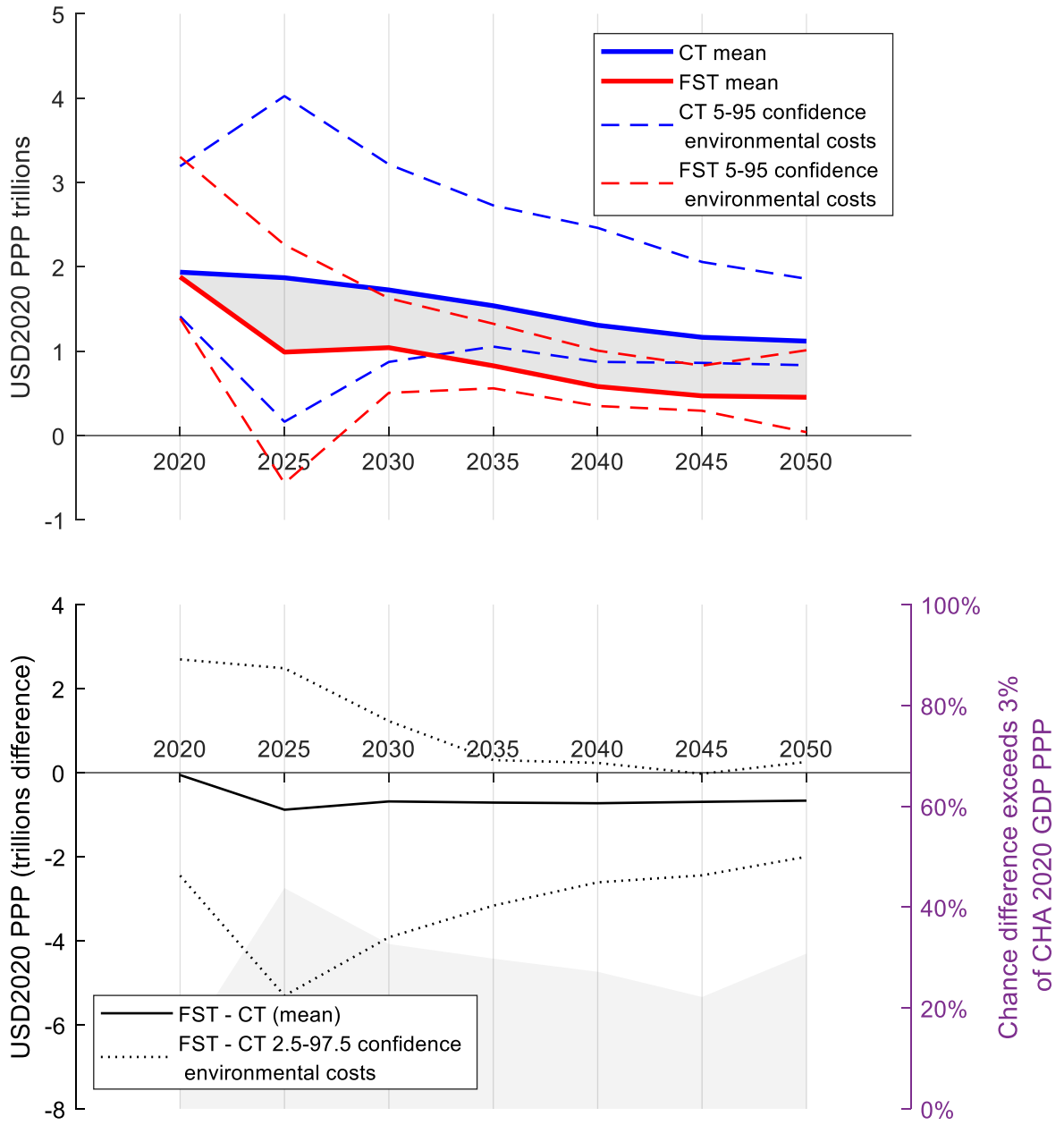

Figure 1S: Trajectory of China total annual hidden costs and cost reduction for CT and FST in 2020 USD PPP. Top panel shows the total expected hidden costs under CT (blue) and FST (red). The shaded area between the trajectories indicates the mean value of the total reduction under FST over the period 2020-2050 in 2020 USD PPP. Trajectories of the 5-th and 95-th percentiles of the respective distributions of China 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 (>95%) by 2035.

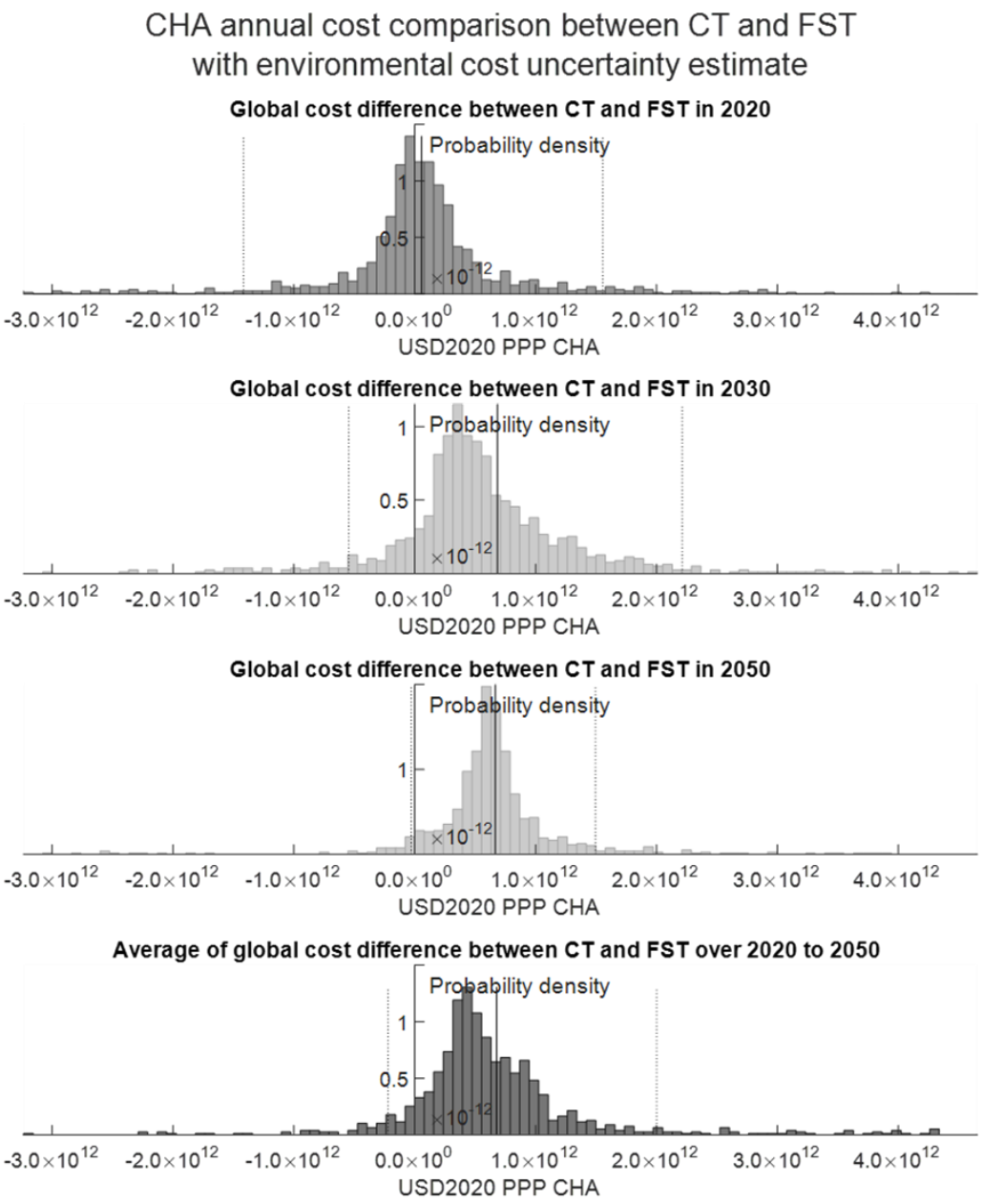

Figure 2S: Distribution of China total annual hidden cost reduction under FST in 2020 USD PPP in 2020, 2030 and 2050. Hidden cost reduction can be examined with uncertainty in environment costs in the FSEC study. Figure 1S bottom panel showed the trajectory of the mean and the 2.5-th and 97.5-th percentile statistics of the distributions of China 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 China's annual hidden costs reduction in the years 2020, 2030 and 2050, with mean (solid line) and 5-th and 95-th percentiles (dashed lines). The bottom panel shows the distribution of the total cost reduction divided by the 30 year period (average annual cost reduction). The uncertainty in environmental costs is large, with wide tails, due to the significant acceleration of land-use transitions under FST and lack of knowledge about the future value of ecosystem services, and the degree of asymmetry between returning ecosystem services from abandoned agricultural land and loss of ecosystem services in established habitat. Nitrate emissions to surface waters are also a considerable uncertainty due to the lack of knowledge of dispersion and retention in inland and coastal ecosystems under the nitrogen cascade and the effect of nitrogen loading on ecosystem services. The conclusions that FST reduces hidden costs by 2050, that average annual hidden cost reduction under FST exceeds 200 billion USD 2020 PPP, are robust to the modelled uncertainty in the marginal costs of GHG, N emissions, and ecosystem services.

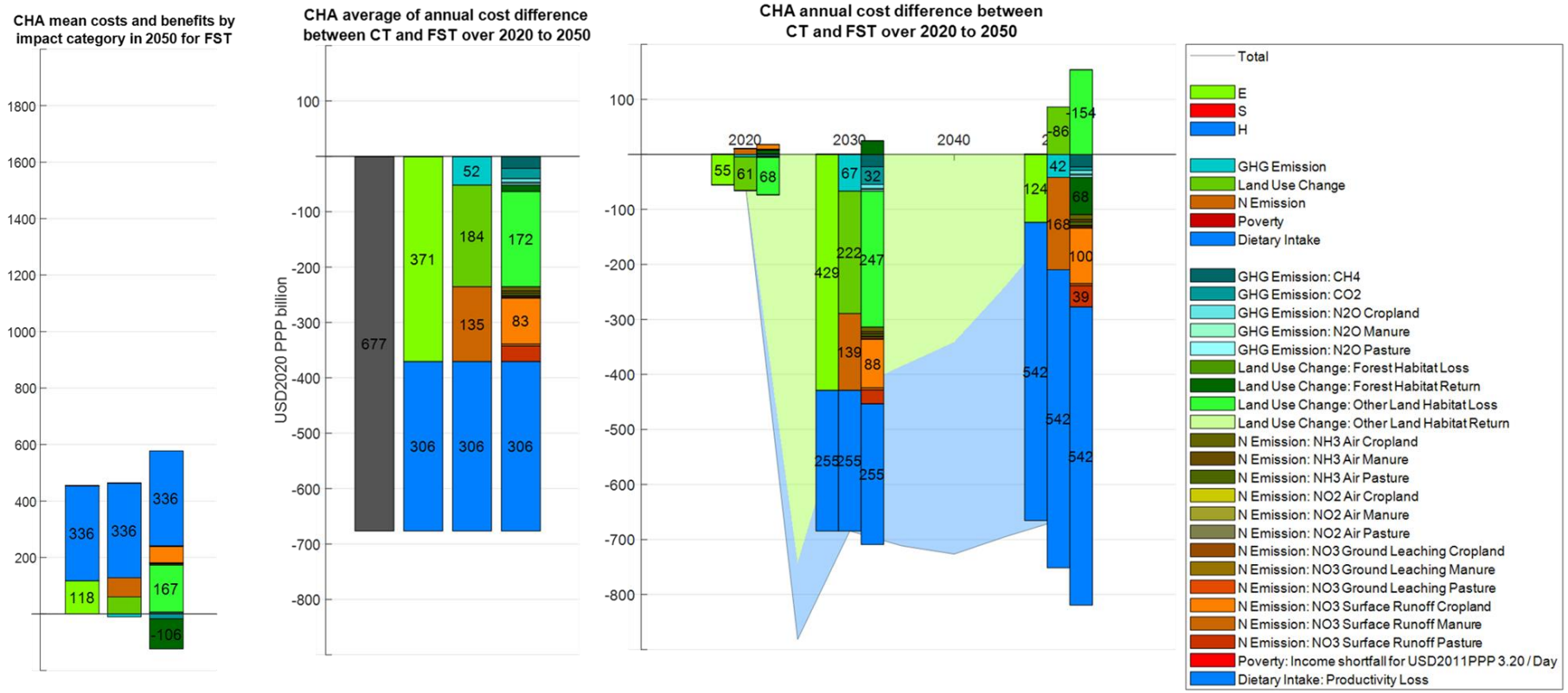

Figure 3S: Breakdown of China annual hidden cost reduction under FST in 2020 USD PPP in 2020, 2030 and 2050. Large average hidden cost reductions under FST over 2020-2050 come from burden of disease from food consumption, avoided habitat loss, and mitigating NO3- run-off from cropland (middle panel). Up to uncertainty in production hidden costs, reduction in N pollution contributes benefits over the period 2020-2050, whereas avoided habitat loss under FST is more prominent early in the period (middle panel). The land-use changes instigated by the implementation of environmental and social FSM measures in 2025 accelerates the reduction in cropland and pasture area in FST. Reforestation and afforestation occur in CT and FST but accelerates more quickly under FST becoming a benefit by 2050. Afforestation outstrips the reduction in cropland and pasture, utilising other land habitats and resulting in reduction in benefits from avoided habitat loss over the period (right panel). Avoided environmental hidden cost production 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). 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, nitrogen pollution, and an uncertain trade-off in benefits from returning forest habitat with costs of losing other land habitat to afforestation (left panel and Figure 6S).

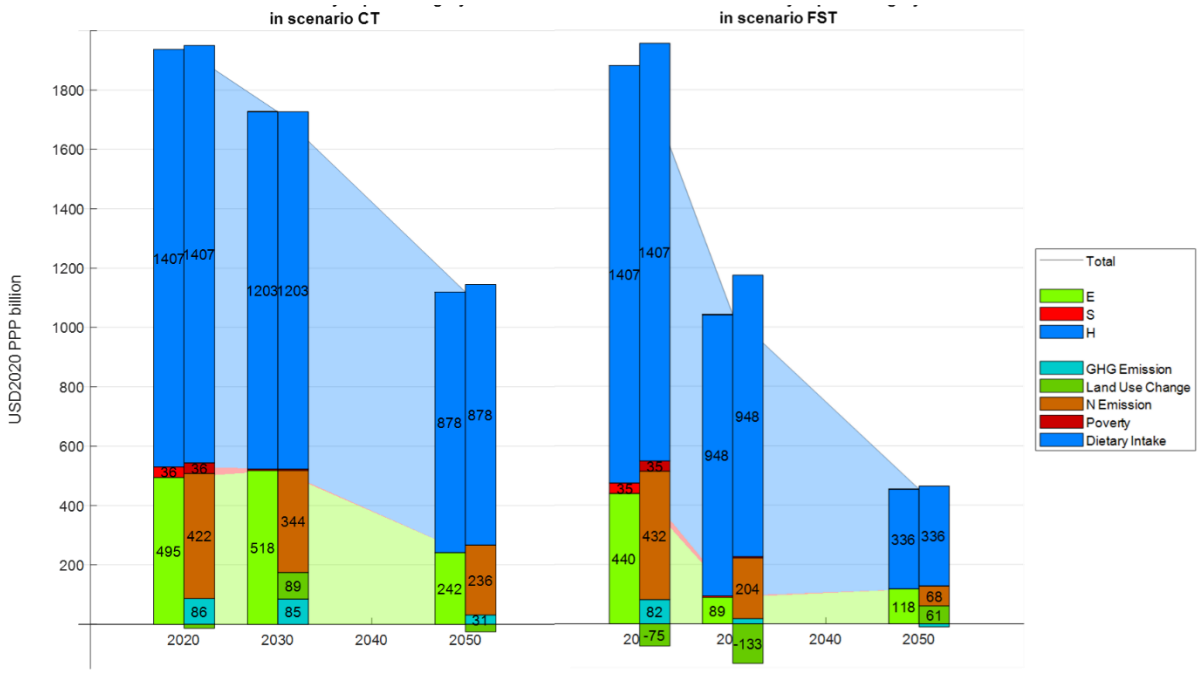

Figure 4S: Transition of production away from hidden costs and avoided western-style disease burdens and costs from unhealthy diets in annual hidden cost reduction under FST in 2020, 2030 and 2050 for China (CHA). As a complement to Figure 3S, this Figure shows cost reduction in its context of changes in total hidden costs. Current hidden costs are predominately productivity losses (blue) from consumption and reactive nitrogen surplus (brown). Economic burden from the environmental consequences of food production (green E) under the baseline CT scenario are averted and reversed under FST due to rapid and earlier reductions in cropland and pasture. Return of forest habitat is strongly incentivised under FST for China, leading to afforestation of additional land above returns of abandoned pasture and cropland in 2050. Poverty reduction 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.

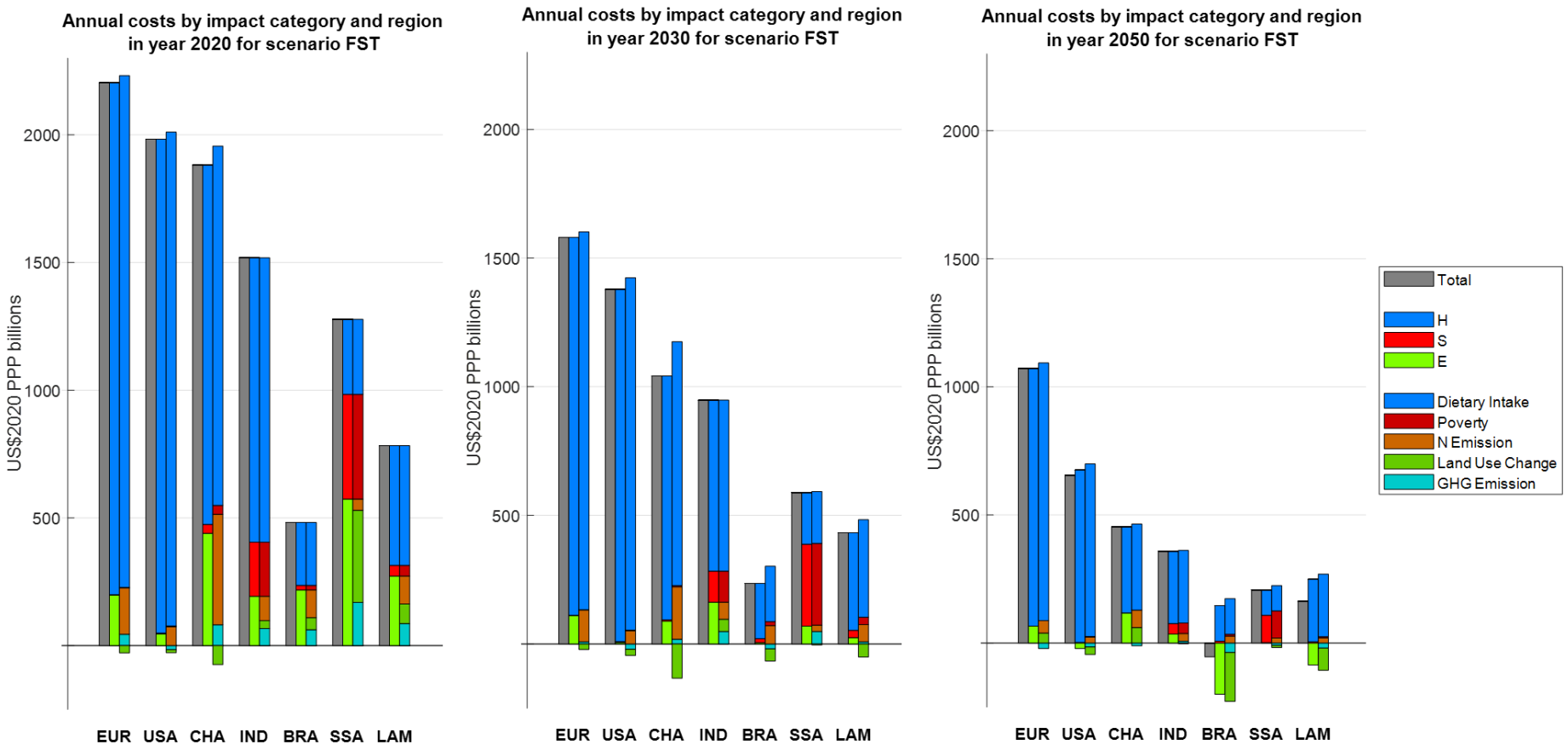

Figure 5S: Comparison of annual hidden costs under FST in 2020 USD PPP in 2020, 2030 and 2050 for 7 FSEC regions. Regional trajectories show transitions in productivity loss from diets and N pollution in China (CHA) and India (IND), global GHG cost neutrality from balancing CH4 emissions and CO2 sequestration,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

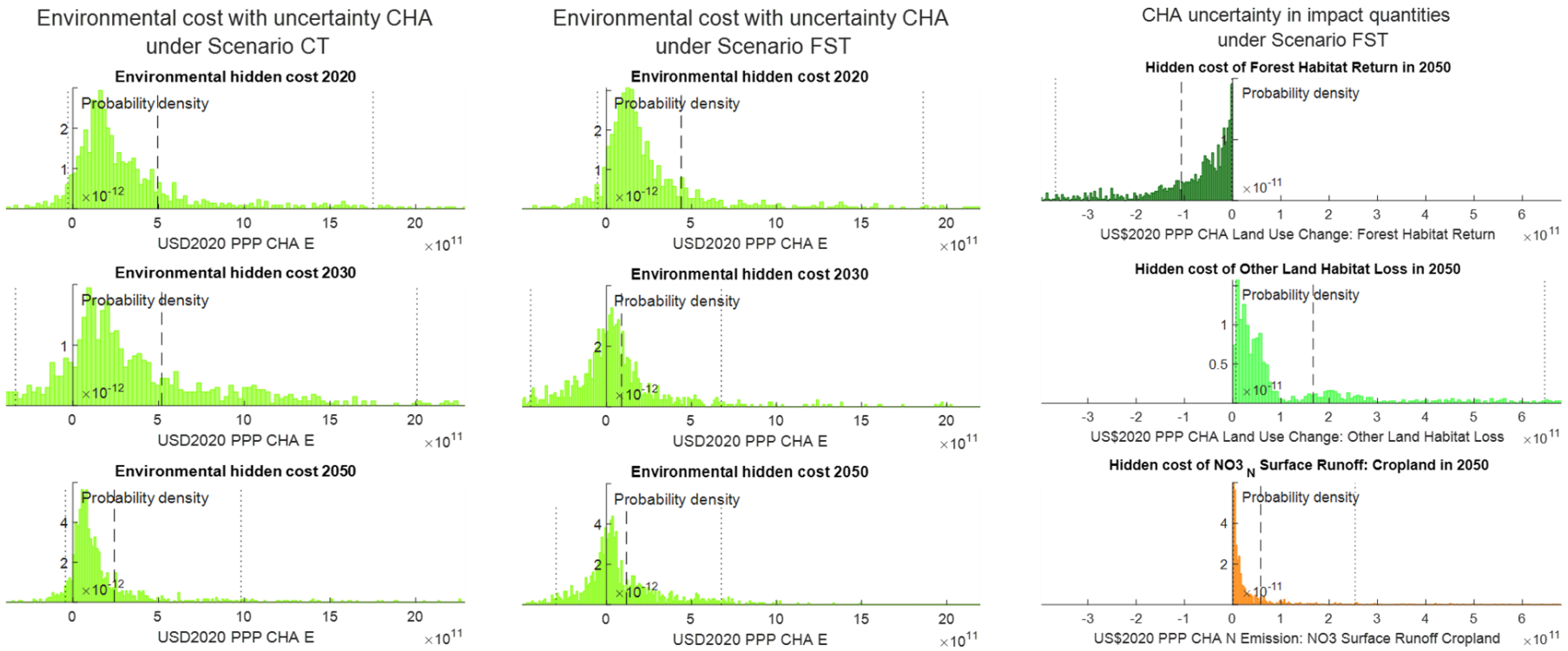

Figure 6S: Distribution of production annual hidden cost reduction under FST in 2020, 2030 and 2050 for China (CHA). Left panel shows the distribution of environmental hidden cost in 2020, 2030 and 2050 under the baseline scenario CT. Under FST the distribution transitions to higher mass on lower costs by 2050, with a three fold reduction in the 95-th percentile by 2030 due to accelerated reductions in cropland and pasture under FST (middle panel). Large uncertainty in the residual hidden costs of production under FST in 2050 resides in one benefit item (ecosystem services from return of forest habitat) and two cost items (ecosystem services loss from other habitat loss and nitrate run-off from croplands), see right panel.