IFPRI Modeling Systems

Informing future pathways and priorities

Updating yield growth rates in the IMPACT model to enhance global analysis of the future of agriculture

IFPRI Modeling Systems Technical Paper No. 2

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Recommended Citation: Hareau, G., Rosegrant, M. W., Andrade, R., Petsakos, A., Sulser, T. B., Wiebe, K., Chamberlin, J., Sonder, K., Kihiu, E., Suarez, V., Cenacchi, N., Dunston, S., Hartley, F., Mishra, A., Thomas, T. S., Alene, A., Gbegbelegbe, S., Mjuma, A., Enahoro, D., Petnkeu, J. M., Antonio, R. J. S., Cabrera, E., Basnet, S., Gimutao, M., Pede, V., Chan, C. Y., Chung, K. Y. K., & Sarı, E. C. (2025). *Updating yield growth rates in the IMPACT model to enhance global analysis of the future of agriculture*. Modeling Systems Technical Paper No. 2. International Food Policy Research Institute. https://hdl.handle.net/10568/178821

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Introduction

Changes in yields of food commodities are key drivers—and consequences—of changes in agriculture and food systems. Simulation models used to explore the future of agriculture require initial assumptions about baseline levels and changes in yields as a starting point and then can be used to analyze how those yields are affected by the dynamic interaction between changes in demand, markets, technology, climate and other factors. This paper reports on how critical initial yield assumptions have recently been reviewed and updated in the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT). This paper is aimed at a technical audience interested in core details of the IMPACT modeling framework and is a follow-up to the latest full model documentation (Robinson et al 2024).

IMPACT was developed at the International Food Policy Research Institute (IFPRI) at the beginning of the 1990s to address a lack of long-term vision and consensus among policymakers and researchers about the actions necessary to feed the world in the future, reduce poverty, and protect the natural resource base. Over time, this economic model has been expanded and improved, and IMPACT is now a system of linked models around a core multimarket economic model of global production, trade, demand, and prices for agricultural commodities. IMPACT supports integrated analysis of the implications of physical, biophysical, and socioeconomic trends and phenomena, allowing for varied and in-depth analysis on a variety of key issues of interest to policymakers. As a flexible policy analysis tool, IMPACT has been used to research linkages between agricultural production and food security at the national and regional levels. IMPACT also has been used in commodity-level scenario analyses and has contributed to thematic and interdisciplinary scenario-based projects. IMPACT is one of major global models of the agriculture sector, but because of its high level of commodity and geographic disaggregation, it plays a particularly important role in analyzing patterns of agricultural productivity growth around the world.

Potential commodity yields are key drivers in the IMPACT baseline scenario and an important lever influenced by investment and policy scenarios. The baseline assumptions about exogenous growth in crop and livestock yields are referred to in IMPACT as "intrinsic productivity growth rates" (IPRs). This paper describes the approach developed to review and update the IPRs to reflect recent trends and incorporate expert[1] opinion, making the yield projections more transparent, inclusive, and efficient, and more consistent across CGIAR centers, improving projections and enhancing policy relevance. The remaining sections include a description of the IMPACT Model, the methods for updating the IPRs using projections based on FAOSTAT data and expert consultations, the findings related to the IPRs from each of the expert consultations, and a description of the process used to incorporate the findings from the consultations into IMPACT and concludes with discussion. A description of the Power BI tool used to support the expert consultations is presented in Appendix A.

Description of IMPACT

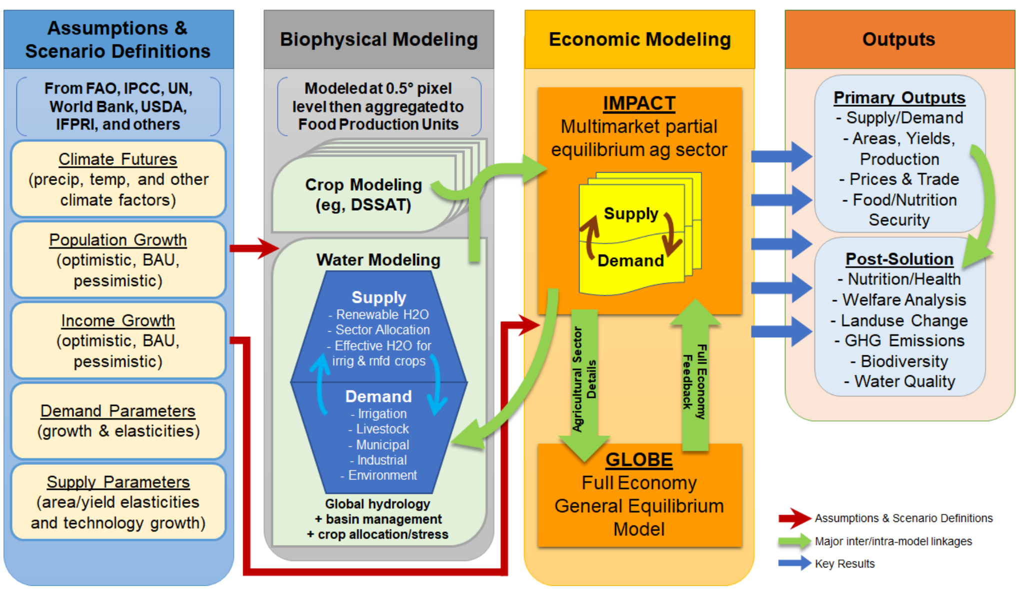
IFPRI's IMPACT framework (Figure 1) is an integrated system of models that links information from climate models, crop simulation models (for example, the Decision Support System for Agrotechnology Transfer, DSSAT), and water models with a core global, partial equilibrium, multimarket model focused

[1] Experts consulted in this exercise are recognized in the Acknowledgments section at the end of the document.

on the agriculture sector. The economic model simulates national and global markets of agricultural production, demand, and trade associated with 62 agricultural commodities across 158 countries (Robinson et al. 2024). The model system supports longer-term scenario analysis through the integration of these multidisciplinary modules to provide researchers and policymakers with a flexible tool to assess and compare the potential effects of changes in biophysical systems, socioeconomic trends, agricultural technologies, and food policies. IPRs enter the IMPACT modeling framework as supply parameters, shown in the lower right of Figure 1.

The main drivers of the baseline IMPACT scenarios are income (represented by gross domestic product, GDP), population, and *assumptions about potential growth in agricultural sector productivity* (represented by the IPRs). GDP growth rates and population growth are obtained from the Shared Socioeconomic Pathways (SSP) database of the IPCC from the International Institute for Applied Systems Analysis (K.C. et al 2024).[2] This report describes the current methodology and data sources that are used to quantify IPRs used in IMPACT. For further details on the equations at the core of the model, refer to the IMPACT model documentation (Robinson et al. 2015) and the open access parameter database at https://github.com/IFPRI/IMPACT.

Figure 1. Extended IMPACT modeling framework.



Source: https://www.ifpri.org/project/ifpri-impact-model

Updates of IPRs using FAOSTAT

The *assumptions about potential growth in agricultural sector productivity* are represented in IMPACT by intrinsic productivity growth rates (IPRs, as noted above). Because of the importance of productivity

[2] SSPs are evolution pathways for human societies and natural systems which are used as scenario components in climate change assessments. There are five SSPs, representing different challenges for climate mitigation and adaptation: SSP1 (sustainability); SSP2 (middle of the road); SSP3 (regional rivalry); SSP4 (inequality); and SSP5 (fossil-fueled development) (O'Neill et al. 2014, 2017).

growth in the model (and in agricultural development), it is essential that these IPRs be kept updated to reflect changing realities. But updating them is difficult because it requires a wide range of commodity- and geography-specific expertise on changes in technology and resource conditions as well as expertise on market dynamics at multiple scales. Updating IPRs through the process described herein presents a unique opportunity to bring these sources of expertise together and strengthen collaboration on foresight among CGIAR scientists and beyond.

This paper describes three steps in updating the IPRs for IMPACT. First, the base year for all data in the model has been updated from 2005 to a three-year average of the most recent FAOSTAT data centered on 2021. Second, the projected reference (or baseline) commodity yield growth rates have been updated using a participatory approach, which updates existing (previous) estimates (the priors) based on additional information that becomes available. In this case, the existing commodity yield projections are the priors, and the commodity yield growth rates estimated from recent FAOSTAT data are additional information. Commodity yield growth rate assumptions in IMPACT were based initially on methodology in Evenson and Rosegrant (1995) and Evenson et al. (1999), which assessed ex ante trends in yield growth rates due to agricultural research, extension, and market infrastructure, calibrated with yield trends from FAOSTAT data, and used these to project longer term yield growth. These estimates have been adjusted periodically over time through consultation with experts, economic model comparison projects, trends in agricultural research expenditures, and updates on trends in long term yield growth rates based on FAOSTAT data.

Recent past yield growth is an important predictor of long-term future yield growth, but not the only one. We developed an approach we called “feathering” to blend FAOSTAT recent historical yield growth rates computed by regression[3] for 2009–2018 for each country and commodity together with the yield growth rates from the latest IPR update in 2017 based on expert opinion. We used weighted averages of the historical computed growth rates and the previous long-term projected growth rates in IMPACT to generate updated future yield growth assumptions. For the 2019–2024 period, the weights are 0.4 for the historical computed yield growth rates and 0.6 for the previous long-term projected yield growth rates in IMPACT. The weight for the historical computed yield growth rates declines by 0.1 in each 5-year period after that, reaching 0.0 in 2040–2050. Because of the weighting procedure, the recent historical trends have the highest influence in the immediate post-2020 period and declining influence thereafter. The weights provide a smooth transition from the data-based historical yield growth trends and the views of experts about growth rates in the future. Other weighting systems were also considered, with different rates of transition between historical and future growth rates, but they did not significantly change the overall patterns of growth or the final projected yields in 2050. The project steering group considered the alternatives, and the consensus was to choose a reasonably gradual transition between the historical numbers and the new projections through the projection period.

The IPRs estimated using this approach are the starting point for the third step in the IPR update.

[3] Annual growth rates were computed by regressing log of yield on a constant and the year for each country-commodity combination in IMPACT for 2009 to 2018 FAO data. If there was less than 7 years of data for any country-commodity combination, no regression was performed for that combination and the prior value assigned by experts was retained as the new value without modification from FAO data.

IPR updates using expert consultation

The third and crucial step is the implementation of broad expert consultations to review the IPRs estimated in the first two steps above, and to modify those IPRs in the long-term as indicated by the consultation.

To ensure that expert consultations carried out by all Centers followed the same principles and generated comparable results across commodities, the team prepared a set of guidelines that covered all phases of the expert consultation process: (1) Choice of commodity by region/country; (2) Criteria for choosing experts; (3) Implementation of the consultation with experts; and (4) Synthesis and documentation of information and data collected.

Given that IMPACT simulates the supply and demand equilibrium for 158 countries or country groups, eliciting yield information for each country was considered unrealistic given the time frame of the exercise and the low overall impact of the updates for commodity-country combinations with low global shares of total production.

For this reason, the emphasis was on countries with an aggregate global production share of around 80 percent based on FAO data statistics. The choice of the benchmarked percentage was subjective, yet it ensured that it covered "price maker" countries, i.e., countries with the highest volumes of production and/or exports and thus the highest impact on the simulated global trade and market equilibrium. Moreover, Centers conducted expert consultations for their own target countries, or other countries in which they have developed substantial work experience or connections with experts, even if these countries were outside the 80 percent production threshold (see Table 1 and Center summaries below). In addition, subsequent efforts and updates will include focus on other regions beyond the 80 percent threshold such that full coverage can be achieved over the next few years.

Each CGIAR Center participating in the exercise was responsible for its mandate commodities in their target countries/regions, and sometimes for other countries of relevance even if the center does not work in them. In practice, the relevance of countries went beyond simple production shares. Some countries were prioritized because they host established pools of experts with long-standing knowledge of specific crops, others were included due to their strategic importance in regional or global markets despite lower production shares. For example, potato require updating yields from Russia and Ukraine as major potato producers, even though CIP does not have direct research work in any of the countries. Also, while Centers' commodity mandate is sometimes clear (e.g., CIP on potato and sweet potato), this mandate can also overlap, requiring specific arrangements among Centers. Hence, in the case of rice, IRRI was responsible for the Asia and Pacific region, and the Alliance of Bioversity International and CIAT (hereafter, "the Alliance") for Latin America and the Caribbean (LAC). For cassava, IITA was responsible for Africa, while the Alliance led the consultations for LAC and Asia. These cases illustrate how the consultation process combined global production benchmarks with practical considerations of expertise availability and regional relevance.

Centers were given substantial flexibility to conduct consultations in various formats (single expert or group of experts, in person or online) and to take advantage of meetings, conferences, and other events. The experts consulted could be of any background and affiliation (including non-CGIAR), ensuring that they had knowledge and professional experience of the commodity and the country/region under investigation.

An IPR is a technical modeling concept that reflects a combination of R&D, farmer adoption, and market dynamics. As such, it is a concept that most commodity experts would not feel comfortable with, so it was agreed that the consultation would not focus on IPRs per se, but instead it should revolve around expert opinion about future yields in 2030, 2040, and 2050. Thus, Centers conducting the consultation would have to clarify that the objective is to obtain feedback on national average yields, as reported in FAOSTAT. It was agreed that a relevant question which could help experts better understand what the exercise was about is the following: "*If you were in the future and looked at FAOSTAT, what would be the national yield average reported for your commodity and country and/or region of expertise in 2030, 2040, and 2050?*". A key requirement of all consultations was to document the feedback provided by the experts, particularly the reasons behind each opinion.

The original plan for the expert consultations involved illustrating projections from the IMPACT model and discussing the validity of these projections. For this purpose, IFPRI had provided Centers with updated results from IMPACT for a business-as-usual foresight scenario under an assumption of no climate change (since the impacts of climate change are captured elsewhere in the IMPACT modeling framework). The method to illustrate these projections was developed in a first pilot consultation at the 2023 International Rice Congress in Manila, the Philippines. The pilot revealed that Centers needed a tool which could be used to display not only projections from IMPACT, but also past yield trends, as reported in FAOSTAT. It also revealed that projections incorporating a range of alternative future yields under climate change assumptions would be helpful to provide a sense of the uncertainty about future yields. This uncertainty also allowed the experts to provide more confident opinions in terms of yield range rather than point values.

Drawing on this experience, a set of yield projections under a scenario positing SSP2 and Representative Concentration Pathway 7.0 (RCP7.0) assumptions was provided by IFPRI and added to the data.[4] A Power BI tool was also developed to answer the above requirements of the expert consultations and to illustrate historic and future yields for all IMPACT commodities and all countries. The tool presents three different yield projections which provide an indicative range of future yield uncertainty to experts. The "current climate change trends persist (no specific climate change assumptions)" is a business-as-usual (BAU) projection but with no additional climate change impacts. The "minimum yield under climate change" projection includes similar BAU SSP2 assumptions but incorporating the most pessimistic yield projection under RCP7.0 across all available Global Circulation Models (GCMs). Accordingly, the "maximum yield under climate change" projection includes SSP2 assumptions along with the most optimistic RCP7.0 climate change impacts across all available GCMs considered by IMPACT simulations. The guidelines were then adjusted to also incorporate use of the Power BI tool during the expert consultations. Center facilitators were given the option to first go through current FAOSTAT yield trends since 1960 in selected countries and discuss how these may possibly look like in the future (also highlight FAOSTAT data issues which may affect IMPACT projections). As a second step, Center facilitators could show the IMPACT projections to the experts and discuss these projections with respect to the opinions that the experts had given. A key requirement of all consultations was to document the feedback provided by the experts, particularly the reasons behind each opinion. It was also made clear that formal

[4] RCPs are future climate change scenarios, where the number following their name represents the approximate level of radiative forcing by 2,100 (in W/m^2) above pre-industrial levels. The selected RCP7.0 assumes 7 W/m^2 of radiative forcing and is considered the most realistic among the "extreme" climate pathways (Rosegrant et al. 2024).

consensus on feedback was not required. This process captured a plurality of expert opinion rather than forcing agreement, thereby increasing transparency and robustness. This consultation process thus provided not only quantitative adjustments to yield projections but also qualitative insights into drivers of future productivity, bridging modeling assumptions with real-world expertise.

The following sections present brief summaries of the expert consultations undertaken by participating centers (see overview in Table 1) followed by a description of the changes made in IMPACT based on the consultations and discussion of the process and results. A description of the Power BI tool is presented in Appendix A.

Table 1. Summary of expert consultations by center, commodity, coverage, and key lessons

Center	Commodities	Countries / Coverage	# Experts	% Global Production Covered	Key Lessons / Insights
The Alliance of Bioversity International and CIAT	Cassava (Asia), Rice (LAC), Banana/Plantain, Beans	Asia, Africa, LAC; strong coverage for banana (Asia), rice (LAC >90%)	22	Banana 67%, Plantain 48%, Rice LAC >90%	FAO data accuracy questioned; IMPACT generally aligned but some projections implausible; climate change not a major uncertainty; disease risks manageable with R&D and policy support.
CIMMYT	Wheat, Maize	14 countries (LAC, South Asia, SSA)	~7	Major wheat producers in South Asia; maize in LAC/SSA	IMPACT projections close in some cases, but often over/under expert expectations; diminishing yield gains likely in India/Nepal; Bangladesh projections inflated due to rice expansion; government policy and demand shifts crucial.
CIP	Potato	China, India, Peru, Colombia, Bolivia, Ecuador	~34 (30 in LAC workshop + 4 Asia)	~42.5% of global potato production	In China/India, national institutions' data critical for validation; experts provide nuance beyond FAO trends; potato production plateauing in China, still expanding in India; strong role of policies and private sector.
IITA	Cassava, Cowpea, Yam	9 African countries (e.g., Nigeria, Benin, Angola, DRC, Tanzania, Zambia, etc.)	38 (cassava), 25 (cowpea), 23 (yam)	>70% of African cassava; >45% global cassava; >85% cowpea; >95% yam	Experts more optimistic than IMPACT; Nigeria cassava yields rising despite FAO trends showing decline; drivers: climate-resilient varieties, mechanization, extension, market demand; some drivers underrepresented in foresight models.

Center	Commodities	Countries / Coverage	# Experts	% Global Production Covered	Key Lessons / Insights
ILRI	Livestock (milk, beef, poultry, eggs, sheep/goat, pigmeat)	9 countries (SSA: Ethiopia, Ghana, Kenya, Nigeria, Senegal, Tanzania, Uganda; Asia: India, Viet Nam)	~13 per country (plenary avg.)	Milk India + key SSA commodities (20–70% regional/global coverage)	National averages not meaningful for livestock; system-level framing preferred; experts agreed poultry productivity growth strong, milk higher than IMPACT, small ruminants overestimated; need culturally sensitive facilitation; livestock consultations extend method's boundaries.
IRRI	Rice	10 Asian countries (China, India, Bangladesh, Thailand, Viet Nam, Cambodia, the Philippines, Indonesia, Myanmar, Pakistan)	12	~85% of global rice production	Government policies (NRP, RCEF, RTL in the Philippines) strongly affect projections; experts saw higher yield potential than IMPACT in some cases; local infrastructure and farmer adoption behaviors matter; national targets often referenced by experts.
WorldFish	Aquatic foods (fish, shellfish)	7 African countries (Egypt, Nigeria, Tanzania, Zambia, Ghana, Kenya, South Africa); 8 Asian countries (Malaysia, Viet Nam, Indonesia, Bangladesh, Cambodia, Myanmar, the Philippines, Thailand)	15-20 per workshop	~30% of global aquatic food production	Context-specific modelling needed; climate change is a significant risk to capture fisheries and aquaculture; high potential for youth employment in the African fish sector; quality feed and seed are key constraints to aquaculture expansion

The Alliance of Bioversity International and CIAT expert consultations on cassava, rice, banana/plantain, and beans

Background on consultations

Over the course of 2024, the Alliance organized 10 separate meetings to gather expert opinion on plausible future yield trajectories of banana/plantain (4), cassava (2), beans (2), and rice (2 – only in LAC) across multiple countries. Half of them were in-person meetings. In total, 22 experts were consulted (Rice-5, Cassava-4, beans-3, banana/plantain-10) whose collective geographical focus covered parts of Asia, Africa, and Latin America. While we prioritized the main producing countries, experts were also given the opportunity to choose and discuss additional countries for which they had knowledge and working experience. Out of all the Alliance crops, the greatest coverage in terms of global production share was achieved for banana (67 percent) and plantains (48 percent). Crops for which the Alliance research is region-specific, the regional production share achieved through the consultations was often higher, and in the case of rice in LAC exceeded 90 percent.

Commodity case study: Plantain in Uganda

Uganda is the largest plantain producer in the world and the biggest consumer in terms of per capita consumption. The experts consulted about plantain yields in Uganda expressed doubts about the validity of the historic FAO data. Although in the beginning of the 2000s there was a big problem with bacterial wilt, the yield drop reported in FAOSTAT seems extreme, and yields appear to have been underestimated. All experts agreed that the IMPACT projections look plausible, and that by 2050 they can reach the levels at which they were in 2000 (around 6–7 t/ha). This increase in yields will be driven by population growth leading to higher food demand, but also due to new sources of demand (like starch). New agricultural technologies are expected to further support this increase. Climate change and higher temperatures can also contribute, making environmental conditions more favorable for the crop, assuming that water will not be a limiting factor. One expert clarified that policy yield targets also exist for individual districts in Uganda, and these targets are known to drive yield growth at that spatial sale. The area cultivated with plantain is also expected to increase, following a trend that is even observed in the present day with plantain expanding in the north regions of the country (currently it is mostly concentrated in the south). Another expert suggested that it would be interesting to see how the (predominantly) backyard production can be shifted towards commercial production. If this shift happens, and the post-harvest transport infrastructure keeps pace to also support exports, along with an appropriate seed system, then yields by 2050 could be higher than the IMPACT projection.

Lessons from the consultation process

Most experts were confident providing yield projections, particularly for highly commercialized commodities (e.g., cassava in Southeast Asia, or rice in South America), highlighting agroclimatic conditions, technology, and government support as the key driving/limiting factors. Disease emerged as a critical concern, though experts considered pest/disease threats manageable with proper research funding. Notably, climate change was not a source of uncertainty; experts assumed higher future temperatures and the need to adapt heat-sensitive crops accordingly. The consultations revealed that IMPACT projections often align with expert opinion. No case was identified as agronomically infeasible, although some projections were considered implausible given expected technology and market developments. However, concerns emerged about FAO data accuracy used to parameterize IMPACT, potentially affecting overall projections. Experts valued the exercise for encouraging reflection on their crops' broader roles in food systems and yield growth constraints.

CIMMYT consultations on wheat and maize

Background on consultations

Expert consultations for wheat and maize were held for 15 countries across Latin America, South Asia, and sub-Saharan Africa (SSA). Expert consultations were conducted in person, with wheat and maize breeders, a wheat pathologist, agronomists, a socio-economist, and an agronomist/spatial modeler. For South Asia, the selected countries (Bangladesh, India, Nepal, Pakistan) are highly representative of both wheat and maize production systems, capturing diversity in scale, uses, and production environments. Together they account for 52 MMT (million metric tons) of maize, and 137 MMT of wheat (98 percent and 89 percent of South Asia's total production). For Latin America, the selected countries (Colombia, Guatemala, Honduras, Mexico, Venezuela) are highly representative of maize's central role in diets and smallholder farming systems in Central America and northern South America. Together, these countries account for 32 MMT of maize and nearly 4 MMT of wheat (15 percent and 9 percent of total production in Latin America). For SSA, the countries (Kenya, Nigeria, Tanzania, Uganda, Zambia, Zimbabwe) account for more than 31 MMT of maize production, about 35 percent of the regional total. These six countries are highly representative of maize production in SSA, in both volume and in system diversity (different agro-ecologies and market structures). Additional review comments have also been received for maize and wheat in China, Brazil, and Ethiopia, and for maize in Malawi, which were some of the important geographical gaps in the earlier consultations.

Commodity case study: Wheat in South Asia

Outcomes for wheat productivity growth in South Asia have important global implications. FAO's historical trends show that wheat yields have been increasing over time in Nepal (from 1.4 t/ha in the 1960s to 3.5 t/ha in 2022). Considering the current socioeconomic, biophysical, technological, and policy factors, this trend is likely to continue and may align with the IMPACT model projections. However, given wheat's sensitivity to climate change and terminal heat stress, the IMPACT model's projection for 2050 under the BAU scenario could be overly optimistic. Achieving around 4 t/ha (the current IMPACT model projection) may be difficult under the existing technological constraints in Nepal. For India, FAO data show an increase in wheat yield from less than 1 t/ha in the 1960s to 3.5 t/ha in 2022, suggesting that the yield trend in India is likely to continue rising in the future. This may somewhat align with the IMPACT model projections. However, given the substantial yield gains achieved over the past five decades, the IMPACT model's average projection of 4.5 t/ha under a BAU scenario may be difficult to achieve. Gaining an additional 1 t/ha in the next couple of decades will be challenging, as many biophysical and technological interventions have already been deployed. Further yield increases will likely be limited, except in areas where significant yield gaps still exist. In Bangladesh, given the historical yield increase from approximately 0.5 t/ha in the 1960s to 3.5 t/ha in 2022, the trend appears to align with the IMPACT model projections. However, due to the expansion of Boro rice (winter-season rice with higher yield potential driven) and a strong consumer preference for rice over wheat, the IMPACT model projections for wheat may be overestimated. With current policies prioritizing the expansion of Boro rice, efforts to boost wheat yields are likely to be limited, resulting in slower gains in wheat productivity in Bangladesh. In this context, achieving an additional 1 t/ha increase by 2050 appears highly unlikely, and the IMPACT model projections may thus be overly optimistic. The increase in yield from less than 1 t/ha in the 1960s to almost 3 t/ha in 2022 suggests that wheat yield in Pakistan is likely to continue increasing, albeit at a decreasing rate. Given Pakistan's high vulnerability to climate change and declining groundwater resources for irrigation, the projected marginal yield increase to 3.5 t/ha by 2050, as estimated by the IMPACT model, appears highly relevant. However, a reduction in cotton area—due to declining productivity on intensively farmed land—may lead to an expansion of wheat cultivation. This could increase overall wheat production, but the gains in productivity may remain marginal, aligning with the current IMPACT projection. Assuming that current socioeconomic, biophysical, technological, and policy interventions continue under a business-as-usual (BAU) scenario, the IMPACT model's projections for wheat production in Pakistan are a reasonable estimate.

Lessons from the consultation process

IMPACT projections are close to the expectations of the experts in many countries but in some cases are high or low relative to expert assessments (see Table 1). In all regions, in addition to technological and agronomic developments, experts reiterated that government policy will be a highly important conditioner of future wheat and maize productivity and production trends. Trends in consumer demand—for example, the preference for rice in Bangladesh— can shift cropping areas in ways that reduce expected wheat productivity growth.

CIP expert consultations on potato

Background on consultations

Consultations for potato initially focused on China and India as the two major potato producers of the world, and four Latin America (LAC) CIP target countries in the Andean zone (Peru, Colombia, Bolivia, and Ecuador). This is the region center of origin of the potato crop and where a large area of native potatoes is also grown. Collectively, all 6 countries account for 42.5 percent of total production. The LAC consultation gathered a group of 30 experts in a workshop in Lima in October 2024, while the 4 Asia experts (all CIP scientists) were interviewed online. India backed up the claims and projections with a comprehensive report on 2050 projections for the potato sector in the country (published by the Indian Council of Agricultural Research in 2015). For China, complementary information was exchanged through email, after the CIP experts consulted with a broader group of Chinese scientists from other institutions.

Commodity case study: Potato in India and China

India is expected to become a major producer of potatoes in 2050, growing near 3.5M (from current 2.2M) hectares and 120 million tons of total production. Together with China, both countries alone may account for more than 45 percent of global potato production. The increase in India is driven by the expected increase in population and domestic consumption (currently at 25 kg per capita and potatoes being a major vegetable in current Indian diets), changes in diets driving more consumption of processed potatoes, and increase in exports. Supporting policies that started the growth of the potato sector in the 60's continue today, promoting adoption of new technologies: development of a strong seed sector and seed technologies, strengthening the potato research institutional environment, development of a large network of cold storage facilities, and the strengthened role of the private sector in both the seed and processing sector. The most optimistic scenarios expect average yields of nearly 35 tons per ha in 2050.

China has seen a large increase of potato production in the last 20 years that seems to be plateauing. Increases in average yields are expected but some of the drivers of the past growth (e.g., population growth) maybe be fading. Potato production is shifting to the southwest of the country due to groundwater irrigation in the north becoming increasingly strict and the emergence of soil borne diseases, among other constraints.

Lessons from the consultation process

Expert consultations are a valuable tool for adjusting IPRs in the IMPACT model. In countries with strong government institutions (such as China and India), projections need to be checked with data produced by national institutions. Still the experts can challenge projections and can provide more nuanced feedback. In countries where such national data does not exist, experts are the sole source of information, even for papers or grey literature that may address the topic.

IMPACT projections that combine statistical trends from the past are useful to engage in conversation with experts. The experts can provide more detailed explanations for some of the data. At the same time, they identify "*what if*" scenarios and key policy interventions for improving or worsening the food policy outcomes these projections imply.

IITA expert consultations for cowpea, cassava, and yam in Africa

Background on consultations

The validation process targeted cowpea, cassava, and yam as major IITA mandate crops. Countries were selected based on the global/continental production share of at least 80 percent based on FAO data, which also happen to be IITA's focus countries for crop improvement and scaling efforts. The target countries for cowpea and yam account for over 85 percent and 95 percent of the global production, respectively, whereas the target countries for cassava account for over 70% of the production in Africa and over 45 percent of the global production. Experts were selected from both IITA and national programs based on their knowledge on the potential drivers of crop production and yield trends for the target crops. The experts included breeders, agronomists, seed system specialists, product managers, social scientists, and postharvest specialists. A total of 38 experts were involved in the validation of the IPRs for cassava. In addition to the IITA team (9), there were national experts for Angola (1), Benin (8), Côte d'Ivoire (3), Democratic Republic of Congo (DRC) (3), Malawi (1), Mozambique (1), Nigeria (7), Tanzania (1), and Zambia (2). Similarly, 25 experts were involved in the validation of IPRs for cowpea in Nigeria (3), Niger (2), Ghana (3), Burkina Faso (3), Cameroon (2), and Mali (2); 10 other experts were from IITA. 23 experts were involved in the validation of IPRs for yam in Benin (1), Côte d'Ivoire (2), Ghana (2), Nigeria (1), and Togo; 17 were from regional (West Africa Centre for Crop Improvement) or international (IITA) research organizations. The expert consultation process involved group consultations through both physical workshops (i.e., for cowpea and cassava) as well as virtual meetings (i.e., for yam).

Commodity case study: Cassava in Africa

For cassava, the expert opinions on future yields are consistent with the IMPACT model projections of future cassava yields only in two out of the nine countries, namely Malawi and Côte d'Ivoire. In contrast, the expert opinions for seven countries—Nigeria, Benin, Angola, the DRC, Tanzania, Mozambique, and Zambia—differ from the IMPACT model projections. In the case of Zambia, the experts contended that the yield projections from IMPACT were excessively high and revised the projected yields downwards.

For Nigeria, on the other hand, the experts disagreed with FAO's past trends showing declining yields as well as the IMPACT model's projections showing declining future yields of cassava. They argued that annual cassava yields in Nigeria have been rising and will continue rising due to increased mechanization and efficient farming techniques; increased access to fertilizers and agricultural inputs; adoption of improved varieties; improved farmer training schemes and extension services; and increased adoption of climate-smart agricultural practices by farmers. Overall, the experts expect increased future yields of cassava driven by improved varieties, government support, mechanization, and market demand.

Lessons from the consultation process

Overall, the IPR validation process indicated that the experts are generally more optimistic about future national average yields of cowpea, cassava, and yam than those implied by the IMPACT model projections. The process also allowed the experts to list what they considered as key drivers of future crop productivity: climate-resilient varieties, good agronomic practices, mechanization, government support, value addition, and market demand. Some of these drivers (e.g., mechanization and value addition) have not been extensively studied in foresight studies. Hence, future studies would benefit from participatory approaches where key stakeholders develop future scenarios using tailored and realistic drivers which can be tested in foresight-related models.

ILRI expert consultations for livestock

Background on consultations

The review of livestock IPRs facilitated by ILRI covered nine countries and six commodities. Countries were selected for relevance to CGIAR research on livestock and the transformation of animal source food systems. Selected countries in SSA (Ethiopia, Ghana, Kenya, Nigeria, Senegal, Tanzania, and Uganda) together accounted in year 2022 for 20 to 50 percent of the region's production of beef, milk, sheep and goat meat, pigmeat, chicken meat, and eggs, while India and Viet Nam produced 30 to 70 percent of these commodities in South and Southeast Asia. In all countries except Viet Nam, an in-person workshop format was used, where experts reviewed the IPRs in commodity-specific sub-groups of 2 to 5 experts, then in plenary sessions of 13 experts on average per country. The consultation in Viet Nam included 18 experts and used an online focus group discussion format. For all countries, livestock experts were drawn from practitioners in livestock value chains, academia, research institutes, and government agencies.

Commodity case study: Milk in India

The expert consultation in India brought together 20 experts to review the IPRs for milk (from cattle and buffalo), sheep and goat meat, and poultry (meat and eggs). The experts agreed with the direction of change projected by IMPACT for milk yields but expected higher increases (than the projection of around 1.3 percent annually from 2030 to 2050). The primary explanation given was that milk yields of indigenous cattle in smallholder systems contribute 75 percent of India's dairy-producing animals and are increasing at a high rate (in response to technological and other changes). The experts however concluded that IMPACT's baseline projection on milk animal numbers was not viable given constraints of (un)availability of grazing land and commercial feeds. While the experts agreed with the model's projections of sheep and goat numbers, there was less confidence in the yield estimates. Experts opined that these were too high, inconsistent with historical trends, and could not be supported by science or evidence. The experts however suggested that current high rates of growth of poultry meat and egg production will be maintained into the future, citing production intensification, genetic improvements, and advances in poultry reproductive technologies.

Lessons from the consultation process

Livestock experts in all study countries were uncomfortable with the concept of assigning national averages to animal yields, opting instead for regional and production-system level discussions. However, as the same basic tools were used, there was a high degree of uniformity in how the process was implemented across countries. The resulting output were synthesized, with the support of facilitators with good subject matter and local knowledge, into consistent country and commodity narratives. The exercise highlighted the importance of using standardized tools, testing and adopting culturally sensitive expert elicitation processes, and engaging experienced facilitators to bridge the gap between quantitative models and livestock scientific knowledge and practice. The countries included in the review of livestock IPRs do not contribute large shares of global production (except, for example, milk in India), but the outcomes of the exercise improve our representation of countries that are regionally relevant and likely hugely impacted by changes in the global livestock system. A necessary follow-up on this study will be to deploy a more global consultative process, using an online format in non-CGIAR countries.

IRRI expert consultations for rice

Background on consultations

The selection of countries covered by IRRI's IPR review process was based on the countries covering at least 85 percent of global rice production, which amounted to ten Asian countries. From 2020 to 2022, the following countries accounted for the said production threshold based on data from FAO: China, India, Bangladesh, Thailand, Viet Nam, Cambodia, the Philippines, Indonesia, Myanmar, and Pakistan. Country experts from IRRI were consulted about whether they would want to be interviewed or prefer to recommend another country expert after being given a brief description of the IPR process and its objectives. Overall, 12 country experts were interviewed with two experts for Bangladesh and India and one expert for all other countries. The country experts interviewed were either IRRI Country Representatives or Scientists with knowledge or existing projects in the country, or partners from either the government ministries related to agriculture or prominent universities recommended by IRRI staff. Country experts located at the IRRI Headquarters were interviewed in-person (3 interviews) while the remaining were conducted online.

Commodity case study: Rice in the Philippines

Rice area harvested in the Philippines is expected to decrease over time—by 10 percent by 2050—due to pressures from the increasing population requiring more area for housing and services. Yield is expected to increase due to the landmark government policies such as the National Rice Program (NRP) and the Rice Competitiveness Enhancement Fund (RCEF). Related to these, due to the Rice Tariffication Law (RTL) making it cheaper to import rice, some rice producing areas will diversify in the future due to unsustainability and low profits from rice farming. The IMPACT projections (2030: 4.33 t/ha; 2050: 4.97 t/ha), are quite low and may not have considered the recent policy interventions. Yield could reach 5.00 t/ha in 2030 and around 5.5 t/ha by 2050 with some high yielding provinces reaching approximately 9.00 t/ha. Aside from these policies and interventions mentioned, the expert said that a driver of yield growth would be increasing investment in irrigation facilities and a drive from farmers to be more competitive (by adopting newer technologies and correct management practices) due to increasing reliance on imports. Other potential drivers of yield identified are the development of high-yielding varieties and high-value rice, use of climate-smart practices, increasing access to flood-resilient varieties, and the potential of agricultural mechanization. In terms of yield potential, there is evidence that a 9.0 to 10.0 t/ha yield is possible since it is already happening in some provinces; however, optimal irrigation and farm management would be required, which is difficult to implement across the country.

Lessons from the consultation process

The IPR process highlighted the need to validate projections with experts who have a deep understanding of domestic conditions that may not have been covered by the assumptions and variables considered in a forecasting model. The various interviews conducted highlighted that knowledge of domestic government policies and priorities, technology development, existing infrastructure conditions, farmer perception and behavior towards technology adoption, and specific country situations all impact yields, production, and area in ways that are not easily captured in economic models. Furthermore, the views of the experts on the projections inform how close or far the projections are not only from the personal perceptions of the experts but also from government targets, industry expectations, and results of other economic studies.

WorldFish expert consultations on aquatic foods

Background on consultations

WorldFish led a series of expert consultations to update its IPRs for fish and aquatic foods across Asia and Africa. These consultations engaged stakeholders from government, academia, and industry to validate foresight modeling and provide insights on yield trajectories, climate risks, and investment requirements. Building on its long-standing role in capture fisheries and aquaculture foresight, WorldFish used the IMPACT fish model in collaboration with IFPRI and other partners, integrating biophysical, socioeconomic, and market factors into projections of future supply and demand. The consultations covered mollusk-producing countries in Southeast Asia, aquaculture and fisheries in Egypt, employment and investment pathways in Africa, and regional fish supply and demand projections in ASEAN.

Commodity case study: Mollusk in Southeast Asia

Mollusks are a vital component of Southeast Asian's food system, providing an affordable and nutrient-rich source of protein with relatively low environmental impact. Although Southeast Asia currently accounts for around 3 percent of global mollusk aquaculture production, the sector faces growing threats from climate change. Rising temperatures, increased rainfall, flooding, and ocean acidification are expected to disrupt production, particularly for shell-forming species that are the backbone of the industry. Despite their importance, future trends in mollusk supply and demand in Malaysia, Viet Nam, and Indonesia remain poorly understood. To address this gap, a consultation on future mollusk production was held in Penang, Malaysia, on 23 September 2025, with 15 participants from Malaysia, Viet Nam, Indonesia, and the United Kingdom. WorldFish presented its preliminary BAU projections for mollusk production in the three countries. During group discussions, participants provided feedback that informed the refinement of model assumptions for each country.

Bivalves dominate aquaculture production in Malaysia, while cephalopods account for most capture output. Our projections suggest a continued decline in aquaculture and stagnation in capture fisheries, leading to potential trade deficits as imports rise. In Viet Nam, aquaculture, which is largely bivalve-based, has expanded rapidly and is projected to surpass capture fisheries by 2050. Indonesia is projected to experience steady growth in capture fisheries but relatively slow aquaculture expansion. Across all three countries, climate change risks, including ocean warming, salinity fluctuations, algal blooms, and stronger storms, pose significant threats to mollusk systems, particularly capture fisheries.

Lessons learned from the consultation process

WorldFish's consultations highlight three key lessons for the IPR updating process. First, the diversity of production systems—from mollusk aquaculture in Southeast Asia to large-scale tilapia farming in Egypt—necessitates tailored approaches to integrating expert knowledge. Second, stakeholder workshops contributed not only to updating yield growth parameters but also to generating qualitative insights on climate risks, input constraints, and market dynamics, all of which are essential for robust scenario development. Third, regional foresight exercises, such as those conducted for Africa and ASEAN, underscore the importance of linking IPRs to broader development objectives, including employment, trade, and food and nutrition security. Looking ahead, continued engagement with national and regional stakeholders, alongside the refinement of fish productivity parameters, will help ensure that aquatic food systems are more accurately represented in global foresight modeling.

IFPRI updates of long-term crop yield growth assumptions in IMPACT based on the expert consultations

This section summarizes how outputs received from the expert solicitation was used in the IMPACT model to update the IPR assumptions for crops. Changes were not made for livestock commodities in this round and will be made in a subsequent update of IMPACT. Aquatic foods are now reintegrated into the core of IMPACT from version 4 onwards. The IPR consultations that informed updates in the IMPACT-Fish framework have been embedded in IMPACT v4.

Summary of comments received

The expert solicitation process resulted in 116 comments. Of the 116 comments received, 41 validated current yield trajectories included in the model while 25 indicated that current yield country/commodity combinations were too high and 45 indicated they were too low.[5] Between the start period of soliciting the opinion of experts and the updating of the model IPR assumptions, the IMPACT model base year was updated to 2021 and recalibrated. This update resulted in some changes to the IMPACT model crop yield trajectories which resulted in improved alignment with many of the expert comments received. As a result, of the yields indicated to be too high or too low relative to the 2020 update used in the expert consultation, a subset was chosen to be changed in the IMPACT model. This subset also accounted for differences in impacts that are largely driven by comments highlighting disagreement with the base FAO data. Experts were asked to evaluate the base year FAO yield data which is used as the starting point for

[5] Five of the comments could not be classified due to insufficient information. These were excluded from the updating exercise.

IMPACT projections. A total of 32 comments were addressed by changing the long-term yield assumptions in the IMPACT model. This subset is presented in Table 2.

Table 2 List of commodity/country combinations for which IPR changes were made in IMPACT

Crop	Country
Banana	Dominican Republic, Peru, Viet Nam
Bean	Argentina, El Salvador, Mexico
Cassava	Angola, Benin, Brazil, Colombia, Dem. Rep. of Congo, Indonesia, Mozambique, Nigeria, Tanzania
Cowpeas	Burkina Faso
Maize	Kenya, Mexico
Potato	Ecuador
Rice	Bangladesh, China, Guatemala, Guyana, India, Indonesia, the Philippines, Thailand, Uruguay, Viet Nam
Wheat	Bangladesh
Yams	Côte d'Ivoire, Ghana

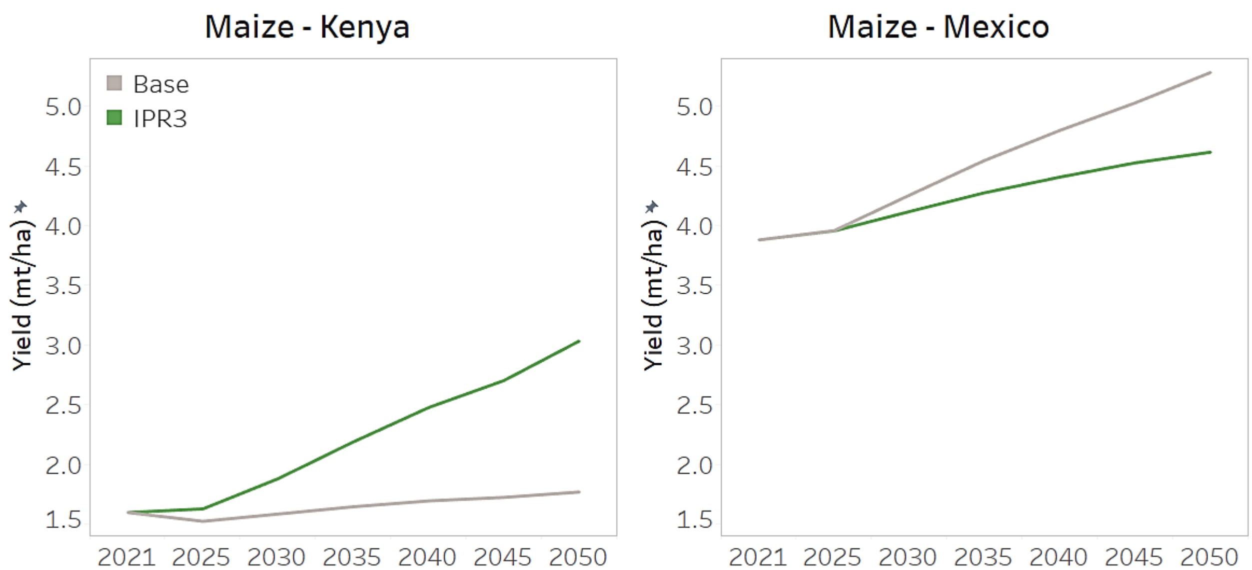
Note: Application of expert opinion in the IMPACT model

For all but four commodities (i.e., cassava, cowpeas, rice and yams), long-term yield growth assumptions were changed such that the 1) expert yield estimates were reached in the model for 2030 and 2050; and 2) trends in yield growth matched implied trends from expert estimates.[6] The IPRs were adjusted using mostly multiplicative factors, although in some case additive factors were needed. As far as possible the short-term yields (to 2025) were kept unchanged from the current IMPACT assumptions as these were informed by the feathering process.

Examples of this type of commodity are shown in Figure 2.

[6] In the case of bananas in Peru, yields were not changed to meet expert opinion but rather targeted at slightly higher levels. Experts' assumptions were based on the presence of disease in the future. In the case of IMPACT, this should be treated as a scenario instead of built into the long-term growth projections.

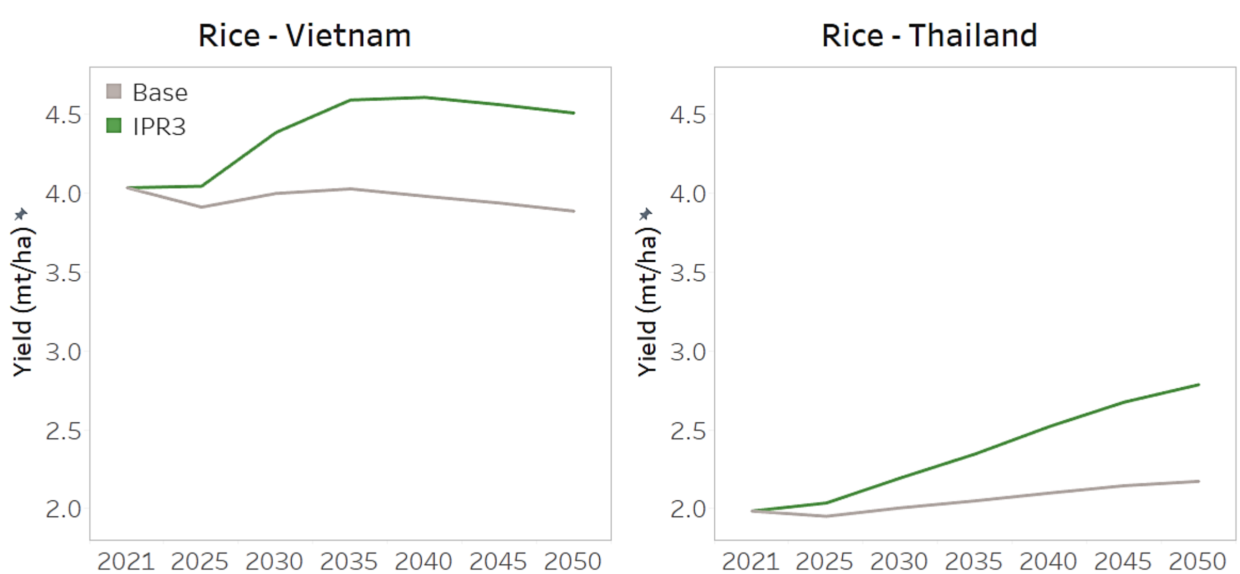
Figure 2. Yield growth projections for maize in Kenya and Mexico. Reference scenario (Base) and new trends based on expert estimates (IPR3)



In the case of cassava, cowpeas, rice, and yams, a more balanced approach was taken to adjusting the long-term yields. Expert opinion indicated the need for significant changes in assumptions that had large impacts on global commodity prices (e.g., decrease in prices in the range of 30 to 40 percent). Experts deemed such shocks not realistic, and it was thought best to limit price changes in the IMPACT model to around 10 percent.

Examples of yield projections for this type of commodity are shown in Figure 3

Figure 3. Yield growth projections for rice in Viet Nam and Thailand. Reference scenario (Base) and new trends based on expert estimates (IPR3)



Appendix B provides a comparison of the new crop yield projections incorporating expert opinion relative to the previous projections for all of the crops and countries that were adjusted.

Together, these adjustments demonstrate how expert consultations can meaningfully refine model assumptions while balancing data constraints and model stability.

Discussion and Conclusions

Productivity growth plays a critical role in agricultural development (and thus in agricultural modeling), so it is essential to keep these assumptions updated, but difficult to do so, because it requires multiple types of expertise from different disciplines and geographies. This paper shows how that can be done, and the value of doing so, both for improved analysis and for improved understanding and credibility of the analysis.

The paper describes the methodology to review and update the projections of potential growth in crop and livestock yields, which are represented in IMPACT by intrinsic productivity growth rates (IPRs). The review and update of the IPRs captures recent yield trends and expert opinion to make the process and resulting IPRs more transparent and efficient, improving projections, and enhancing policy relevance. The base year yields are first updated to a three-year average of FAOSTAT yield data centered on 2021. We blend FAOSTAT yield growth rates computed by regression for 2009–2018 for each country and commodity together with the IMPACT baseline yield growth rates from the latest update in 2017. This blending or feathering of yield projections used weighted averages of the recent computed growth rates with the previous IMPACT assumptions for future yield growth, with the weights on the recent growth rates declining over time.

The updated yield projections were then subjected to expert opinion using newly developed methodologies to elicit expert opinion on future yield growth for key crops and animals across important producing countries. This required testing of different approaches to elicitation of expert opinion and resulted in a practical methodology that used initial projections of future yield growth from IMPACT to anchor the discussions with the experts. The development of the Power BI tool provided the visualization of the updated yield projections in a clear and convenient way.

For most commodities and countries, the experts found that either the IMPACT baseline yield projections with or without climate change are reasonable. Others needed moderate adjustment, and a few, like cassava and bananas in several countries, should have larger yield projections revisions. In addition to the specific comments on the yield projections, many of the expert consultations provided important insights into the factors that will determine future productivity growth. In some cases, policies were cited as important as science and breeding in determining yield growth rates.

Based on the expert consultations discussed in this paper, the Centers provided IFPRI specific quantitative recommendations for adjustment in the IPRs in IMPACT by commodity and country. IFPRI has made the necessary adjustments as described above. For commodities that are not covered in the expert consultations, IFPRI used the Power BI tool and the updated IMPACT projections to determine additional IPRs that need adjustment and to make these adjustments.

The updated IPRs will underpin the new IMPACT baseline scenario to be featured in the 2025 Global Outlook Report. Beyond this immediate application, the process sets a precedent for future CGIAR foresight work, ensuring that updates are regular, documented, and scientifically grounded. More importantly, the experience demonstrates that combining global modeling tools with participatory, expert-informed approaches increases both the technical rigor and the policy relevance of foresight outputs. This model can be extended to other parameters in IMPACT, and to other foresight models across CGIAR, strengthening the evidence base for strategic investment, innovation prioritization, and policy engagement.

This process also revealed several limitations. The scope of consultations, while broad, did not cover all producing countries, particularly "price taker" countries outside the 80 percent global production threshold. For livestock, the challenge of defining national average yields highlighted the need for system-level data and consultation methods better suited to diverse production systems. Moreover, while expert consultations improved transparency, the diversity of views and reliance on professional networks underscore the importance of broadening participation through online platforms (e.g., Delphi surveys) to capture a wider range of perspectives. Future updates would also benefit from stronger integration of national datasets and foresight exercises led by governments and regional organizations.

The Power BI tool proved instrumental in standardizing presentations, facilitating dialogue, and documenting expert reasoning. However, challenges remain. For crops like cassava or livestock commodities, expert optimism often exceeded model projections, which if fully adopted would have produced unrealistic global price shocks. Reconciling local expert perspectives with global market plausibility required careful judgment and compromises. Similarly, the reliance on FAOSTAT as the anchor dataset remains a constraint, as several experts indicated problems with the FAO data for several commodity/country combinations. Given the importance of this data in the IMPACT model and for consistency in data used across countries and commodities, changes cannot be made to the base FAO country data used in the model.

A key contribution of this exercise is that it institutionalizes a transparent and replicable process for updating productivity assumptions in IMPACT. By combining statistical evidence with expert judgment, the revised IPRs are more robust and credible, which enhances the legitimacy of foresight exercises and policy dialogues that rely on IMPACT outputs. This is particularly important given that small changes in yield growth assumptions can significantly alter global food prices, trade, and nutrition outcomes. The integration of wide expert consultations also ensures that country-specific policy priorities, institutional contexts, and emerging drivers are reflected in the global model, bridging the gap between global foresight and national realities. By incorporating the input of commodity scientists, we make IMPACT more transparent and increase non-economists' understanding of (and perhaps confidence in) economic modeling; they are no longer a black box since they get to discuss and validate some of the underlying assumptions that fall within their area of expertise. This "democratization" of some aspects of the modeling process can increase the acceptability of our results and the acknowledgement of foresight's role within the broader CGIAR and the broader agricultural modeling community.

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Acknowledgements

This work was funded by the CGIAR Initiative on Foresight and the CGIAR Science Program on Policy Innovation. We also thank Daniel Mason-D'Croz for review comments, Gillian Hollerich for editing the draft report, and Pamela Stedman-Edwards, Jamed Falik, and Eleanor Jones for their help with production. The consultation process described here relied on many experts around the world. Together they provided a range of inputs from collected data and documentation to informed opinions and feedback. Contributions are acknowledged below by each participating CGIAR Center. Please contact specific Centers for more information. We sincerely apologize for any omissions. Final results and interpretation are the responsibility of the authors.

The Alliance of Bioversity International and CIAT

The Alliance thanks 22 experts who participated in online and in-person interviews regarding productivity trends for banana, rice, cassava, and beans in different countries. We would also like to thank Esperanza Orozco and Tatiana Rivera for their technical support in developing the Power BI tool used in this project.

CIMMYT

CIMMYT thanks Biswanath Das, Thanda Dlihwayo, Dorcus Gemenet, Deo-Gratius Hougni, Nushrat Hussain, Dan Makumbi, Lennin Musundire, Gokul Paudel, Ajay Pundir, Felix San Vicente, Deepak Kumar Singh, and Pawan Singh for their contributions to this exercise.

CIP

CIP thanks 30 participants in the Workshop "Trends and Perspectives of the Potato sector and the Potato Market for Processing in the Andean region" in Lima, Peru, October 24th, 2024. CIP also thanks Sunil Chaudhar, Jianmin Xie, Philip Kear, and Willy Pradel for their contributions to this exercise.

IITA

IITA thanks 25 participants in the "Cowpea Regional Network Workshop" held on September 28th, 2024, in Abomey Calavi, Benin Republic; 23 participants in the Group Discussion regarding productivity trends for yams in Africa conducted on November 20th, 2024, via virtual internet conference call; 30 participants in the "Modernising Crop Breeding Programs" held on October 18th, 2024, in Ibadan, Nigeria; 10 participants in the small group discussion regarding productivity trends for cassava in Benin conducted on October 23rd, 2024, via virtual internet conference call; and 5 participants in the small group discussion regarding productivity trends for cassava in Angola conducted on October 24th, 2024, via virtual internet conference call.

ILRI

ILRI thanks the more than 120 livestock sector experts who participated in IMPACT data validation workshops in Ghana, Nigeria, Kenya, Uganda, Tanzania, Senegal, Viet Nam, Ethiopia, and India between October and December 2024. We also thank the following experts who supported facilitation of the expert consultations: Isabelle Baltenweck, Braja Swain, Mulugeta Y. Birhanu, Thinh Nguyan, Bombasun Tuoho, Nana Adwoa Agyemang, Oladeji Bamidele, Margaret Lukuyu, Mohamadou Fadiga, and Aichi Kitalyi.

IRRI

IRRI thanks Humnath Bhandari, Rafiqul Islam, Mallikarjuna Swamy, Suresh Kadaru, Alice Laborte, Robert Caudwell, Ronnachai Changsri, Hasil Sembiring, Shakeel Ahmad, and Wen-Min Wang for their contributions to this exercise.

WorldFish

WorldFish thanks 15 experts from Malaysia, Viet Nam, and Indonesia for their feedback on future mollusk production in Southeast Asia. We also would like to acknowledge the contributions of a wide range of African government, academia, and non-profit organizations who provided valuable information and feedback to this research work, in particular: Dr. Richard Abila, IFAD; Dr. Alexander Shula Kefi, Department of Fisheries, Zambia; Dr. Diaa Al-Kenawy, WorldFish, Egypt; Dr. Bernadette Tosan Fregene, University of Ibadan, Nigeria; Dr. Emmanuel Nii Abbey, University of Ghana; Dr. Mafaniso Hara, University of Western Cape, South Africa; Dr. Amon Paul Shoko, Tanzania Fisheries Research Institute; and Dr. Anthony Dadu, Department of Aquaculture, Ministry of Agriculture, Livestock and Fisheries, Tanzania.

WorldFish also thanks 20 specialists from academia, government and NGOs in 10 countries (Australia, Bangladesh, Cambodia, Indonesia, Malaysia, Myanmar, the Philippines, Thailand, and Viet Nam) representing a diverse range of expertise covering fisheries, aquaculture, trade, and economics, for their help in exploring maximum carrying capacity, national government targets, scenario setting, and future visioning in the ASEAN region.

Appendix A.

Exploring Yield Growth to 2050: Power BI Tool for Updating Exogenous Yield Growth Parameters in IMPACT

Tatiana Rivera, Esperanza Orozco, Athanasios Petsakos, and Robert Andrade

A key instrument to support the expert consultations is the Power BI tool that was developed under the auspices of the CGIAR Initiative on Foresight & Metrics. The initial planning for the consultation exercise involved the development of a graphical tool to display historical and projected yield data from FAO and IMPACT. However, the pilot expert consultation in Manila during the 2023 International Rice Congress revealed the need for a tool with more functionality than just a visual aid for the consultations. Given the specificities of the exercise, including the overlap of Center mandates for certain commodities and the country prioritization to cover 80 percent of global production, it became clear that the tool would also need to contribute to the team's preparation and organization, in addition to conducting the expert consultations.

The tool had to be easily accessible and have a standardized interface across all country-commodity combinations to ensure harmonization of the background information used by Centers during the expert consultations. To address the accessibility requirements, it was decided that the tool would be a dynamic decision-support tool, web-based, and managed by a core development team at ABC (Cali). The purpose of being dynamic allows the users to use the latest data available and allows interaction when exploring different country-commodity combinations. This adaptability allows the tool to be responsive to changing discussions while updating IPRs, allowing users to manipulate variables and see instant results. We decided to foster the tool at a specific website to ensure geographical accessibility and allow disperse teams to use it while updating IPRs. Finally, there is a core team managing the tool to maintain accuracy and relevance for future updates, ensuring quick reactions when troubleshooting uses and refining features needs. This guarantees consistency and trustworthiness facilitating long-term utility.

The web interface was developed in Power BI due to its familiarity, robust capabilities, and seamless integration with the Microsoft ecosystem. Leveraging a platform already well-known to our team allowed us to develop and deploy the tool efficiently, minimizing the learning curve and enabling rapid iteration. Power BI's ability to connect with diverse data sources, such as FAO databases and IMPACT outputs, made it an ideal choice for dynamically visualizing and combining agricultural data. Additionally, Power BI offers scalability and cost-effectiveness, providing a comprehensive solution without the need for significant development resources, while its integration with tools like Excel and Teams enhances workflow efficiency and stakeholder engagement. Currently the tool is hosted in the Foresight and Metrics website (https://foresight.cgiar.org/ipr-tool/).

The web interface created by the development team includes five pages of relevant information: (1) a home page which explains the purpose of the tool and provides the appropriate references for IMPACT and FAOSTAT; (2) a page with FAOSTAT data for crops; (3) a page with IMPACT projections for crops appended to FAOSTAT historical data; (4) a page with FAOSTAT historical data for livestock commodities; and (5) a page with IMPACT projections for livestock commodities, appended to FAOSTAT historical data for the same commodities. The pages displaying only FAOSTAT data were included for Centers who preferred to conduct the consultations by displaying first the historical trends, and the IMPACT projection as a second step, to avoid biasing expert opinion.[7] All commodity pages include a commodity drop-down list from which the user can select the desired commodity. The country of interest can be selected from a side panel which displays the list of countries producing the commodity in descending order based on production volumes. The pages with historical FAOSTAT data also include a "Countries prioritization" tab which calculates the relative production share of each country as well as the cumulative production share. This functionality is used to identify the countries that cover the 80 percent global production threshold and need to be included in the consultations. Its objective is to facilitate the distribution of tasks between Centers with overlapping commodity mandates.

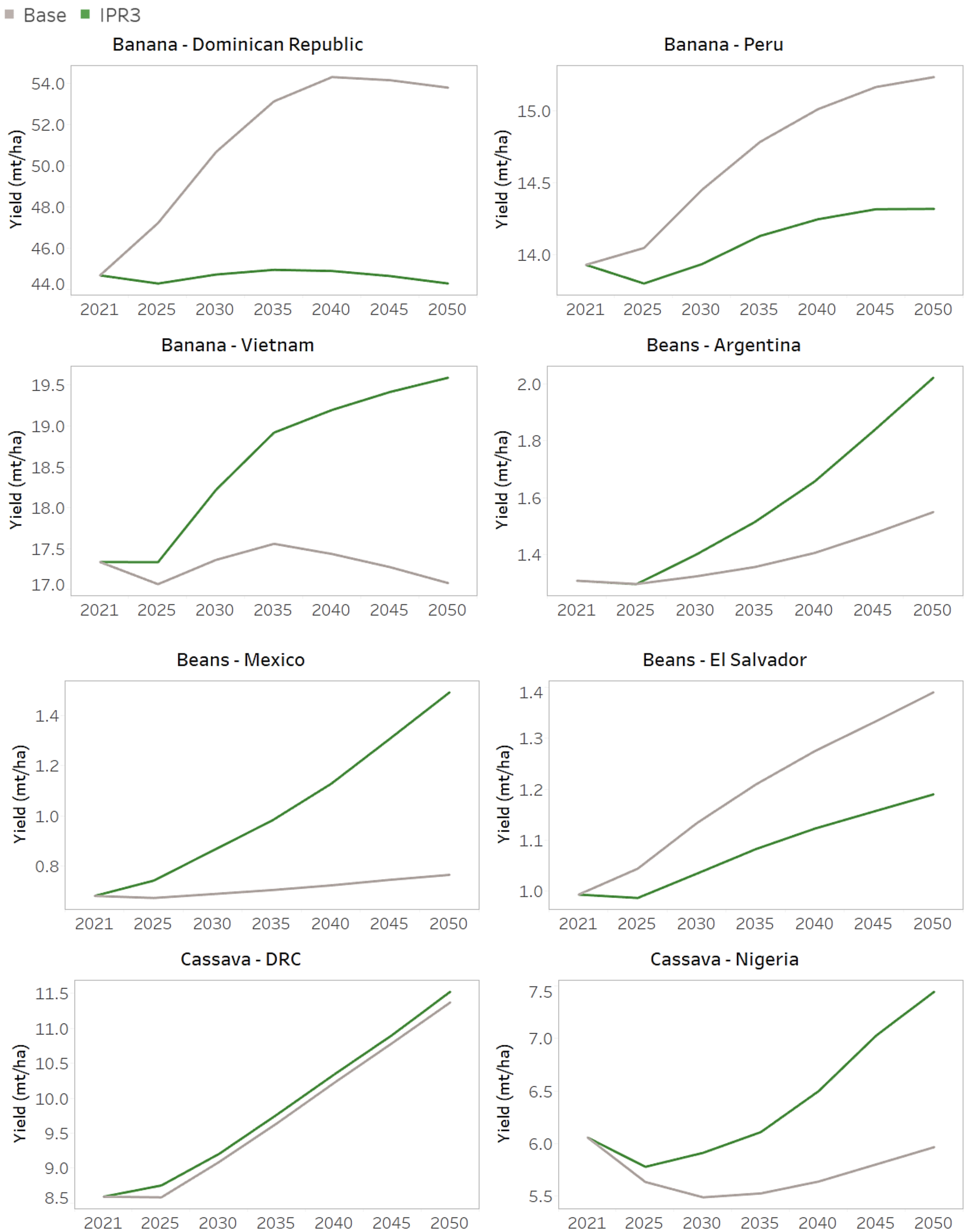
The information displayed for crops is different than for livestock. For crops (pages 2 and 3), the tool displays information on yields in its main panel and additional information on areas and total production in side panels. For livestock (pages 4 and 5), the main panel includes information on numbers of animals associated with the selected commodity, while a side panel displays yield information for that commodity.

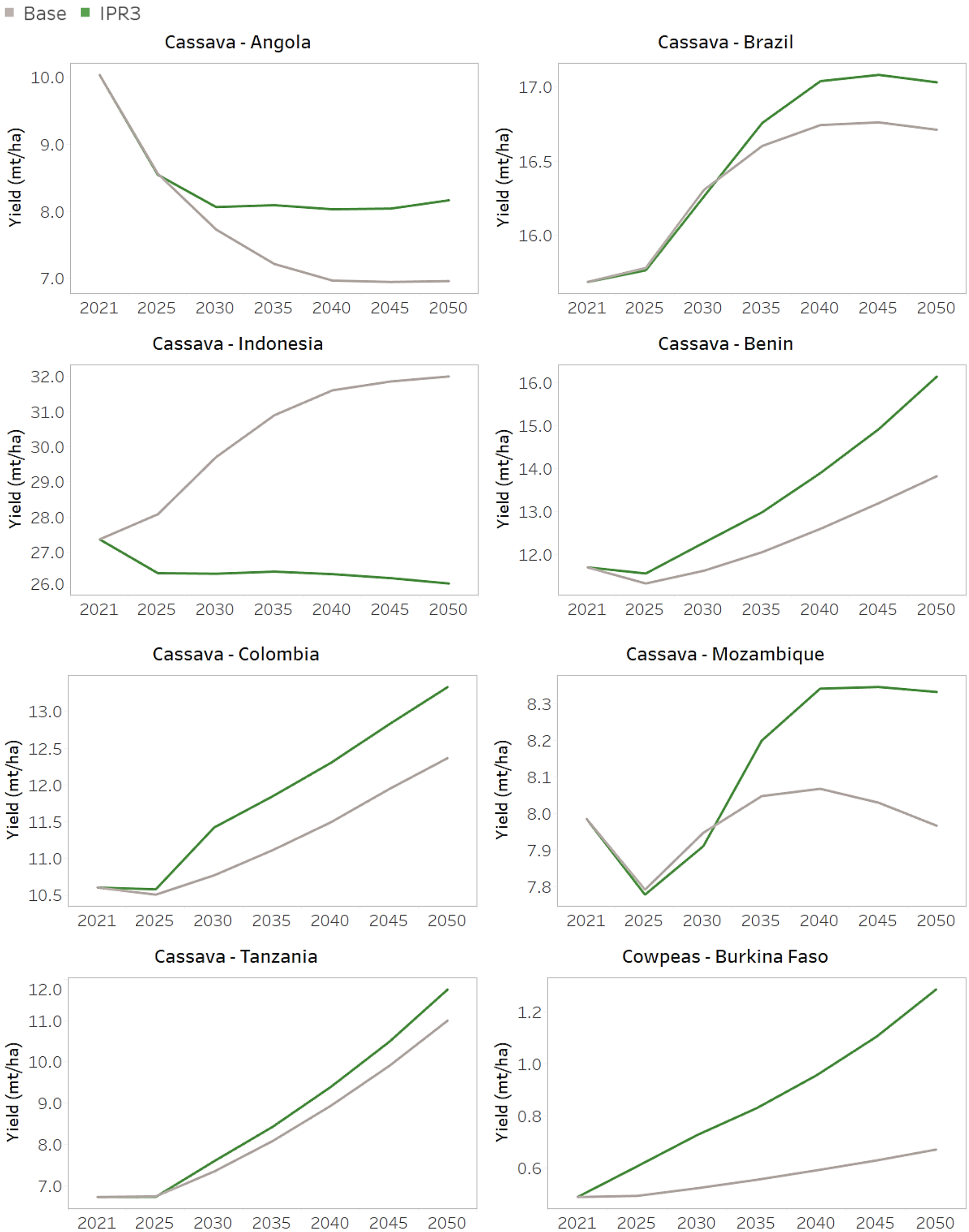
The IMPACT projections (in Figures 2 and 3 and Appendix B) are based on scenario positing RCP7.0 – SSP2 assumptions, whereby climate data for RCP7.0 in the Power BI tool are obtained from five different Global Circulation Models (GCMs). The upper and lower bounds for crop yield projections presented in the Power BI tool correspond respectively to the maximum and minimum yields simulated across all five GCMs. In other words, the amplitude in the yield projections corresponds to a single future climate scenario and reflects the uncertainty inherent in the GCMs from which the climate date was obtained. It is included in the Power BI tool as an indicative illustration of the likely effect of climate on yields, but it is not meant to characterize the full uncertainty related to future yield projections.

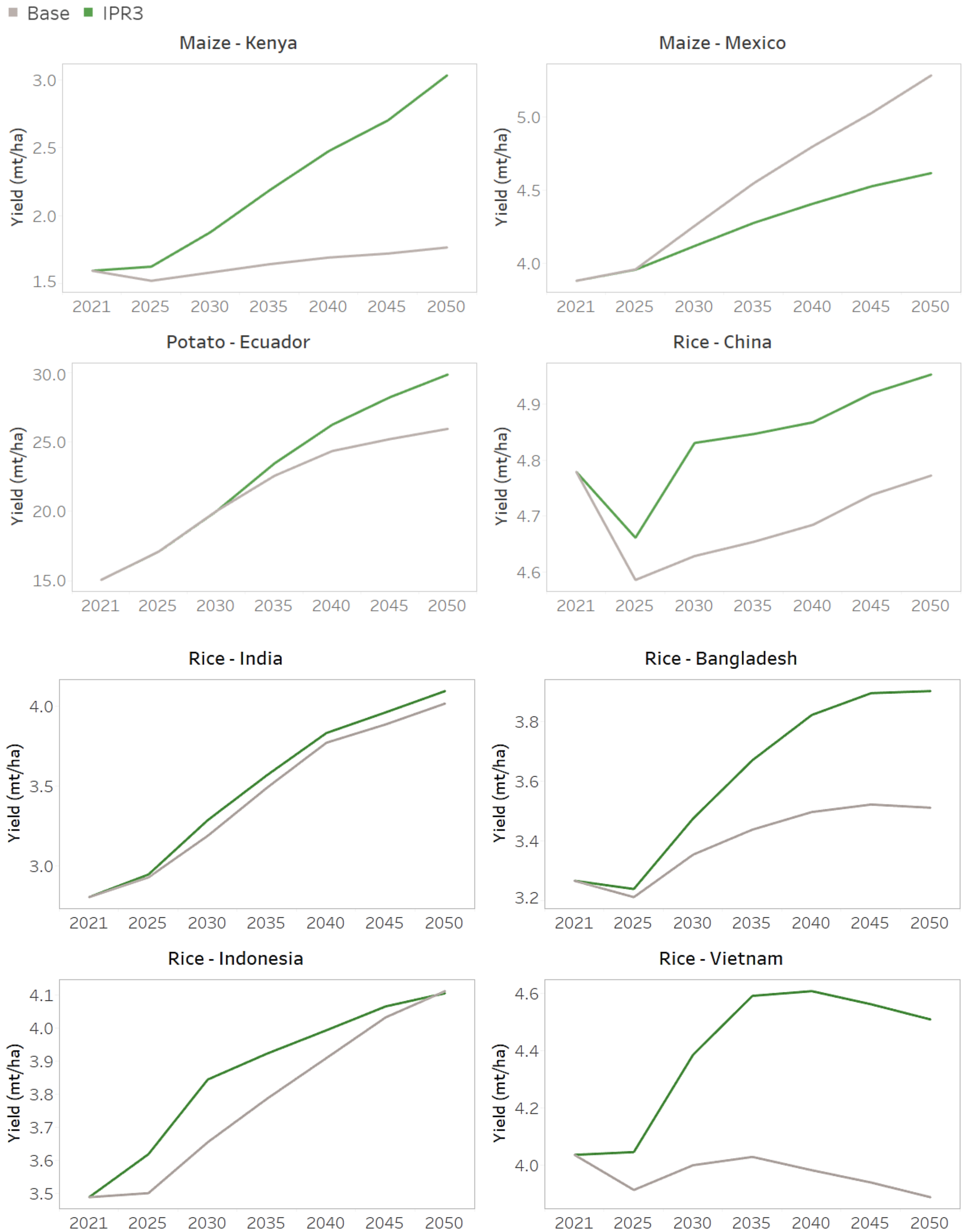
[7] Although the team agreed that this two-step approach would be the ideal way of conducting the consultations, in practice this has not always possible because of the large number of country-commodity combinations that needed to be covered in a limited amount of time.

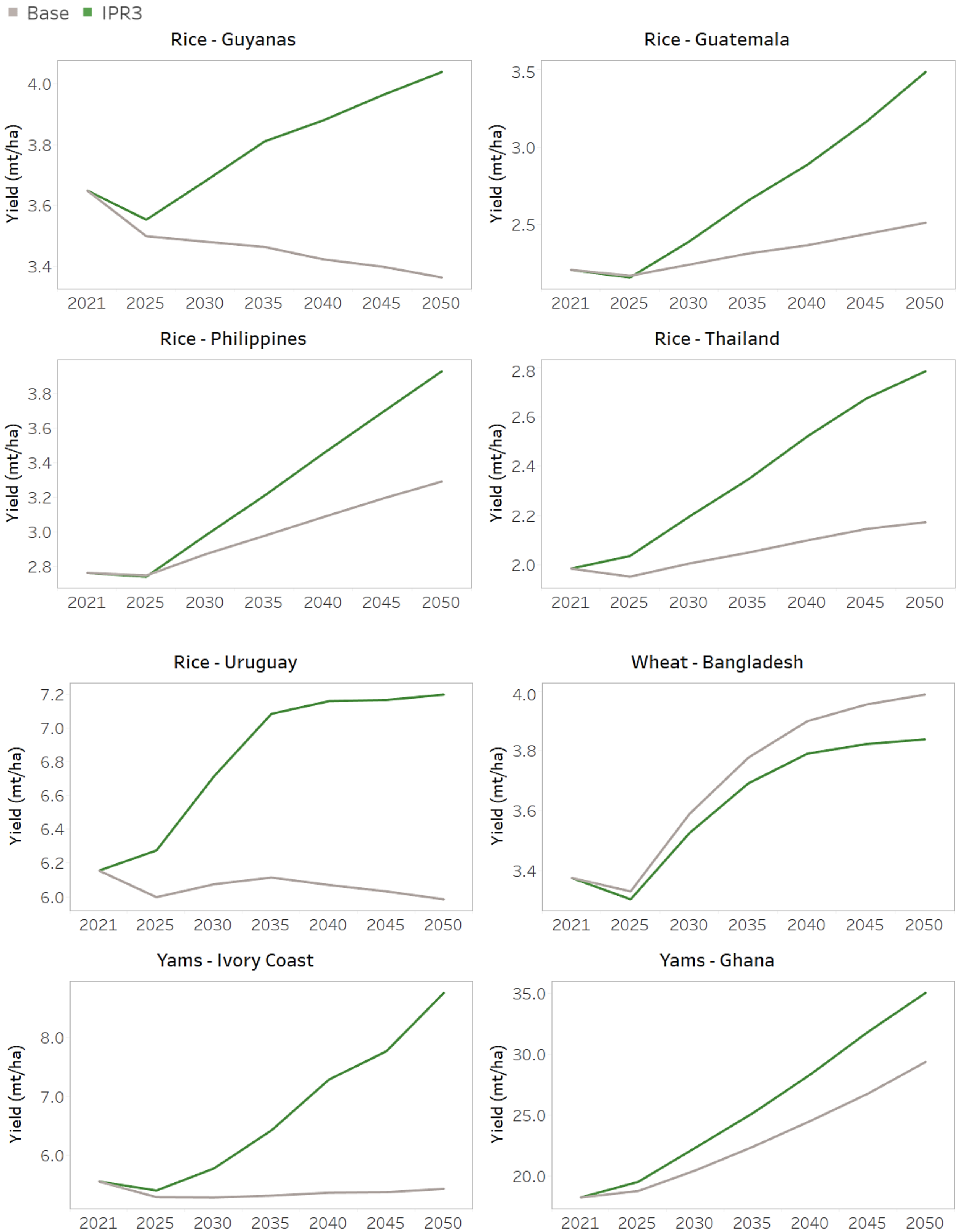
Appendix B.

Crop yield projections – old (base) and new (IPR3) incorporating expert estimates




Base
IPR3
Cassava - Angola
Yield (mt/ha)
10.0
9.0
8.0
7.0
2021 2025 2030 2035 2040 2045 2050
Cassava - Brazil
Yield (mt/ha)
17.0
16.5
16.0
2021 2025 2030 2035 2040 2045 2050
Cassava - Indonesia
Yield (mt/ha)
32.0
31.0
30.0
29.0
28.0
27.0
26.0
2021 2025 2030 2035 2040 2045 2050
Cassava - Benin
Yield (mt/ha)
16.0
15.0
14.0
13.0
12.0
2021 2025 2030 2035 2040 2045 2050
Cassava - Colombia
Yield (mt/ha)
13.0
12.5
12.0
11.5
11.0
10.5
2021 2025 2030 2035 2040 2045 2050
Cassava - Mozambique
Yield (mt/ha)
8.3
8.2
8.1
8.0
7.9
7.8
2021 2025 2030 2035 2040 2045 2050
Cassava - Tanzania
Yield (mt/ha)
12.0
11.0
10.0
9.0
8.0
7.0
2021 2025 2030 2035 2040 2045 2050
Cowpeas - Burkina Faso
Yield (mt/ha)
1.2
1.0
0.8
0.6
2021 2025 2030 2035 2040 2045 2050


Base
IPR3
Maize - Kenya
Maize - Mexico
Potato - Ecuador
Rice - China
Rice - India
Rice - Bangladesh
Rice - Indonesia
Rice - Vietnam
Yield (mt/ha)
2021
2025
2030
2035
2040
2045
2050



Base
IPR3
Rice - Guyanas
Rice - Guatemala
Rice - Philippines
Rice - Thailand
Rice - Uruguay
Wheat - Bangladesh
Yams - Ivory Coast
Yams - Ghana
Yield (mt/ha)
2021
2025
2030
2035
2040
2045
2050