Agriculture and Food Justice in Peru: Scenarios for 2030

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Introduction

What will agriculture look like in the year 2030? How will the global food system respond to a growing human population, increased urbanization, shifts in food prices, changing consumption patterns, climate change effects, and competing demands for land? What will happen to those communities that do the bulk of the agricultural work today? Will they remain as farmers or will they seek new opportunities in other industries and sectors? For those who remain in farming, what will their lives be like, and what new skills will they need to be successful? How will all of these factors shape consumers' relationship with food and with the food system?

This report seeks to explore uncertainties such as these – with a distinct perspective and scope:

- The perspective is that of "food justice," which has become more prominent in recent years as an aspiration for the global food system. Oxfam's GROW campaign is a leading promoter of food justice. The meaning of "food justice" is explored in greater detail below.
- The scope is the country of Peru, as the scenarios included in this report describe alternative futures of agriculture in Peru in the year 2030.

This context raises the additional question: What will "food justice" mean in 2030, and to what extent will it have been achieved in Peru? By exploring this question, organizations working toward "food justice" in Peru can gain a better understanding of what may happen in the future so that they can make wiser decisions about what they do today.

While no one can predict the future with certainty, there are tools available that can help us think more systematically about the range of futures that could unfold. One of these tools is scenarios, which provide a powerful way to bound the uncertainty of the future so that expectable, challenging, and visionary scenarios within those bounds can be more effectively explored. Scenarios account for the larger forces bringing change, which may otherwise be ignored or discounted by planning processes focused on the short-term.

By exploring multiple scenarios, organizations and individuals are better positioned to develop a sense of where current trends may take them. They can then proactively respond to changes at the macro and micro levels, pursuing strategies they may otherwise not have seen and mitigating risks that might otherwise have surprised them. Furthermore, people and organizations that work with scenarios which delve deeply into the future tend to generate more creative options than those who develop plans based only on the past and present.

When developing scenarios of the future, it is useful to apply two different lenses. An objective lens defines the probability space in which the future will unfold and helps assess plausibility and likelihood for the range of imagined outcomes. A subjective lens articulates the shared hopes and fears that we often project – consciously or unconsciously – onto the future. Neither lens is sufficient without the other. When a group uses only one of these lenses, the future becomes either an intellectual exercise devoid of meaning, or a playful fantasy devoid of import. However, by applying these two lenses jointly, people can identify meaningful images of surprising success that illuminate strategic insights and invite concerted action.

It is now an opportune time to apply this "dual lens" to the future of agriculture. First, there is a need to understand the current challenges facing agriculture and to connect the future to the past and present

by drawing upon extant research and quantitative analysis. This is essential to gaining legitimacy within the mainstream discussion, especially among policymakers. But there is also a need for a more visionary approach that can create and convey positive images of the future. Such images can prompt action beyond simply reacting to today's crises or prolonging today's debates. For those interested in food justice, there is also a need to articulate what food justice would look like in the specific context of Peru, and how it can be achieved.

This project is based on a partnership between Oxfam and IAF. All through the process, teams in both organizations have contributed their expertise and approaches to this report. Oxfam's rights-based approach to reducing poverty and injustice is reflected in this report, and team members from Oxfam Peru have contributed their country expertise on food justice issues particular to Peru. IAF has challenged assumptions and pushed the boundaries of creative thinking, true to its "aspirational futures" approach (see below). This innovative partnership has allowed cutting-edge thinking to emerge, with room for debates, divergences, and convergences. We hope our readers find as much value reading this report co-authored by Oxfam and IAF as we did when we developed it.

Scenario Methodology

This project used IAF's "aspirational futures" approach (see Figure 1), which describes three "zones" of the future bounded by plausibility (the objective lens) and differentiated by preferability (the subjective lens):

- A "zone of conventional expectation," reflecting the extrapolation of known trends, the expectable future;
- A "zone of growing desperation" which presents a set of plausible challenges that may emerge, a challenging future; and
- A "zone of high aspiration" in which stakeholders pursue visionary strategies and achieve surprising success.

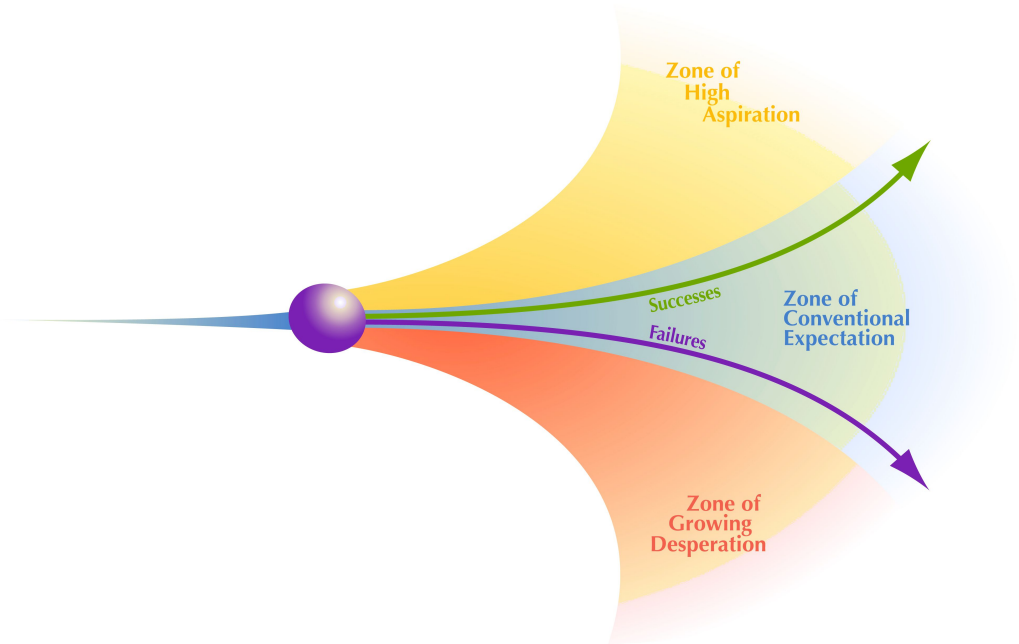

Figure 1. IAF's "Aspirational Futures" Approach

IAF began developing this report by conducting futures research on global trends and on trends and developments specific to Peru. Our research focused on six drivers identified in collaboration with Oxfam, but included other areas as well. The six drivers were: Climate Change; Land and Water Use and Governance; Food Distribution; Technology and Innovation; Infrastructure; and Access to Funding. IAF's research captured a wide range of sources, including government and institutional reports, academic papers, media articles, and online resources.

Based on this research, IAF described what each of the six drivers would look like in four different preliminary scenarios – one in each of the zones described above, *plus* an extra scenario in the "zone of high aspiration." IAF typically describes two scenarios in this zone in order to offset the natural bias to focus more on catastrophic threats than on visionary opportunities.

IAF used these four preliminary scenarios in two futures workshops in Peru in March 2013. One of the workshops was held in Lima, the capital. The other was held in Cusco, in the Andean region. The participants at these workshops included academics, policymakers at the national and regional levels, NGO staff, and farmer representatives. The objectives of the workshops were: to facilitate exchanges and dialogues among participants; to explore and refine IAF's preliminary scenarios; and to collect participants' aspirations about the future of agriculture in Peru. The workshops included individual, small group, and full group activities to meet these three objectives. During the workshop, participants also had the opportunity to learn about a quantitative model developed by the Frederick S. Pardee Center for International Futures.

Following these workshops, IAF incorporated the input received during the workshops into the scenarios, resulting in the versions included in this report. During this process, IAF conducted additional research on topics highlighted by workshop participants. IAF also interviewed Peruvian experts on relevant topics, and incorporated their comments into the final scenarios. The scenarios are:

#1 Progress at the Margins – Peru makes some progress in poverty reduction and food justice, but these efforts are inadequate to address challenges related to climate change and food prices. This scenario is in the "zone of conventional expectation."

#2 A Harvest of Inequity – The gap widens between large-scale agribusinesses, which own ever more land and are able to deploy advanced technologies, and smallholder farmers, who face climate change effects and lack access to these advances. This scenario is in the "zone of growing desperation."

#3 Sustainable Future, Timeless Past – Facing an increase in social unrest at the local level, policymakers set the goal of establishing an equitable distribution of productive resources between large-scale and small-scale agriculture. This scenario is in the "zone of high aspiration."

#4 The Peruvian Way – Following a series of environmental crises, Peruvians initiate a national dialogue to chart the country's future. A series of efforts, dubbed "the Peruvian way," achieve food justice by combining the best of indigenous techniques with the best of modern technology. This scenario is in the "zone of high aspiration."

As stated earlier, no one can predict the future with certainty. Similarly, there is no reason to believe that the future will exactly match any of the four scenarios described here. Rather, it is likely that several aspects of some or all of the scenarios will prove true. More important than simply predicting a future, however, the scenarios expand our thinking by inviting us to consider how actions taken today will likely

shape the future across a range of topics. Furthermore, the scenarios invite us to articulate a future that we would prefer, one that could be brought to fruition through concerted action. It is in this light that IAF presents these scenarios – to prompt greater exploration of what a group of people working together could achieve.

The Perspective of Food Justice

As noted above, food justice forms the perspective for these scenarios, shaping the expectable, challenging, and aspirational character for each image of the future. Food justice is a recent addition to the ongoing conversation about what sort of agriculture and what sort of food system people would like to have.

This conversation has evolved over time. An earlier aspiration for the food system was *food security*, which the UN Food and Agriculture Organization (FAO) defines as having the following four components:

- Food availability: The availability of sufficient quantities of food of appropriate quality, supplied through domestic production or imports (including food aid).
- Food access: Access by individuals to adequate resources (entitlements) for acquiring appropriate foods for a nutritious diet. Entitlements are defined as the set of all commodity bundles over which a person can establish command given the legal, political, economic, and social arrangements of the community in which they live (including traditional rights such as access to common resources).
- Utilization: Utilization of food through adequate diet, clean water, sanitation, and health care to reach a state of nutritional well-being where all physiological needs are met. This brings out the importance of non-food inputs to food security.
- Stability: To be food secure, a population, household, or individual must have access to adequate food at all times. They should not risk losing access to food as a consequence of sudden shocks (e.g., an economic or climatic crisis) or cyclical events (e.g., seasonal food insecurity). The concept of stability can therefore refer to both the availability and access dimensions of food security.[1]

More recently, the Committee on World Food Security (CFS) has recommended the expansion of food security to include nutrition, noting two definitions of *food and nutrition security*:

- UNICEF: “Food and nutrition security is achieved when adequate food (quantity, quality, safety, socio-cultural acceptability) is available and accessible for and satisfactorily used and utilized by all individuals at all times to live a healthy and active life.”
- FAO: “Food and nutrition security exists when all people at all times have physical, social and economic access to food of sufficient quantity and quality in terms of variety, diversity, nutrient content and safety to meet their dietary needs and food preferences for an active and healthy life, coupled with a sanitary environment, adequate health, education and care.”

In its recommendation CFS noted that many of its members did not support the use of this term for one or more of the following reasons: (a) the policy implications for countries have not adequately been

[1] UN Food and Agriculture Organization (2006, June). *Policy Brief.* Accessed on June 5, 2013 at ftp://ftp.fao.org/es/ESA/policybriefs/pb_02.pdf.

discussed, (b) the possible implications for the mandate of the CFS have not yet been sufficiently explored, and, (c) linguistic reasons.[2]

Food justice goes further. Whereas food (and nutrition) security conveys a right to adequate food, food justice conveys a broader set of rights for all participants in the food system. Food justice requires that the systems through which food is grown, produced, transported, distributed, and consumed are equitable. But what does it mean for a system to be equitable?

An equitable system is one that is free from bias or favoritism, where there are no systemic factors (e.g., unfair access to assets, institutions, and processes) that tend to promote the success of some participants and the failure of others. In effect, there is a "level playing field" for everybody. It is important to note that equity is not the same as equality. In an equitable system, participants may achieve varying degrees of success, but that variation does not result from structural bias or advantage.

In developing this report, IAF defined the following five components of food justice:

- Equity across actors in food production and distribution: There is a level playing field for all actors in food production and distribution with respect to the allocation of resources, such as infrastructure investments, new technologies, and research funding.
- Equity across consumers: There is a level playing field for all consumers – that is, no one faces systemic difficulties in accessing high-quality, nutritious foods.
- Equity across generations: The system is not biased toward the people who are living right now, but rather ensures that future generations will have opportunities at least as good as those that are available today. That is, the system is sustainable (socially, ecologically, culturally, etc.).[3]
- Equity across genders: The system is not biased with respect to gender.
- A societal consensus that sustains food justice: People across society value food justice to the point that they exercise formal or informal governance over the system to ensure that structural bias and advantage are not introduced, and that those with duties with respect to the food system are held to account.

How to Read This Report

In the next section, you will have an opportunity to explore four different scenarios of agriculture in Peru in the year 2030 and to consider what it means for today's policies. For each scenario, there are three personal stories and one scenario narrative. The three **personal stories** present "a day in the life" for three people in the year 2030, one from each of Peru's three agricultural zones: Coastal, Andes, and Amazon. You will meet Fernando Cabanillas, an agricultural engineer based in Trujillo in the Coastal region; Chaska Jaillita, a woman farmer living outside Cusco in the Andean region; and Paco Torres, a farmer living in the Amazon basin. Like all of us, these three people have very different futures ahead of them depending on what happens now and in the years to come.

The **narrative** that follows each set of three personal stories describes how that scenario unfolds through the events that occur between now and 2030. The scenario narratives include content from

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[2] Committee on World Food Security (2012, October 15-20). *Coming to Terms with Terminology.* Accessed on June 18, 2013 at http://www.fao.org/docrep/meeting/026/MD776E.pdf.

[3] This concept is reflected in the Brundtland Commission's definition of "sustainable development." See Report of the World Commission on Environment and Development: Our Common Future (1987). United Nations. Accessed on June 18, 2013 at http://www.un-documents.net/our-common-future.pdf.

within the field of agriculture, as well as broader national and global trends that would shape what agriculture would look like in that scenario. As you read each narrative, consider the following questions:

- What implications would follow from the events in the scenario but are not stated explicitly in the narrative? For example, what would change for you and for your work?
- How likely do you think the scenario is? If you think the scenario is highly unlikely, then ask yourself why you think it is unlikely. One important value of scenarios is that they help us identify our implicit assumptions about the future so that we can subject them to analysis.
- Would you like to live in this future? Is the scenario preferable? If the scenario you would prefer is not the scenario you believe to be most likely, then ask yourself what you and the groups of which you are a part could do to make your preferred scenario more likely.

Following the personal stories and scenario narratives, there is a **matrix** that allows you to compare the scenarios side-by-side along key dimensions, such as the relevant technologies and innovations, shifts in the economy, etc. Vertically, the matrix shows the breadth of factors that must be considered as a coherent whole when thinking about the futures of agriculture described by the scenarios. Horizontally, the matrix shows the differences in each factor across the four scenarios. Many readers will likely find this matrix useful as they try to differentiate the scenarios in their own minds.

The first row of the matrix assesses the four scenarios in terms of the achievement of food justice as defined above. We have asked the question, to what extent could food justice be achieved in Peru by 2030, and what would it look like? Having explored a wide range of trends that can be expected to shape the future of agriculture between now and 2030, and having described four different scenarios for 2030 that our research suggests are plausible, we are now in a position to propose some answers to this question. These answers can be found in the first row of the scenario matrix.

To be ready for the future we must explore a broader range of possibilities than a mere linear extrapolation of current data would allow. This report will help you do so. As you read the scenarios, be willing to entertain possibilities that you have not considered before, or that you would be tempted to reject based on the data with which you are familiar. Many people have engaged in the process that created these scenarios, and many have given their input. Trust that the possibilities described in this report are sufficiently plausible to warrant your consideration. Whether or not they actually *happen* may be up to you.

Agricultural and Food Justice in Peru: Scenarios for 2030

Scenario 1: Progress at the Margins

Personal Stories: Life in 2030

Fernando Cabanillas, a Trujillo-based agricultural engineer, maneuvered the remotely operated aerial drone down toward the crops to inspect the storm damage. The damage was not extensive, and anyway Fernando knew that the genetically modified crops the company had planted in that sector were more resilient under extreme weather conditions than non-GMO varieties. Satisfied that the effect on the company's bottom line would be minimal, Fernando put his mobile device back on the table and turned his attention back to the Deputy Minister of Agriculture, who was briefing a group of industry representatives on the government's expectations for corporate social responsibility.

"Lupin, lupin, lupin," groaned Chaska Jaillita, a woman farmer who lived in the Acopia District outside Cusco. Eager to profit from Peru's fast-growing meat demand, Chaska and her husband had decided to plant nothing but lupin, which they sold as feed to poultry farmers growing food for the country's middle class. Chaska was nostalgic for the days when they used to make money by growing food for people. Unable to buy land for herself, she had to rely on a tiny garden to grow vegetables, while all she could afford with her Juntos payments[4] was cheap, processed foods that her children seemed to like, but that she knew didn't have the vitamins they needed to grow up strong and healthy.

"This isn't my soil," thought Paco Torres as he ran his fingers along the ground near the river's edge. Paco and his community had been relocated to this area south of Tarapoto when the lands they had long occupied were auctioned off to a foreign company for oil exploration. Some of his friends liked it better here; they were closer to roads and could grow coffee and cocoa to sell in the markets in the city. But for Paco, it took generations to make a place a home. And anyway, who knew when the government would give away this land too?

Scenario Narrative

Throughout the 2010s, leaders in most countries pursued economic growth and increased consumption. In Peru, the national government relied on extractive industries as a growth engine. By contrast, the agriculture sector remained a secondary priority, particularly smallholder farming.

The government supported existing and new extractive projects as a way to boost exports and meet a domestic energy demand that doubled between 2000 and 2030. Large investments were made in pipelines and transportation routes linking the mining areas of the Andes and Amazon to coastal seaports. Under scrutiny from the civil society, mining companies were increasingly required to engage with local communities and authorities and invest in social and environmental programs. However, these engagements were not part of a coordinated program at the national level. As a result, depending on each mining company's strategy, some locations saw improvements in social and environmental impacts while others suffered pollution and forced displacement of rural indigenous communities, sometimes generating international scandals.

[4] Juntos is a conditional cash transfer program for Peru's poorest people.

The overall amount of land available for cultivation kept declining as extractive industries, large irrigation and electricity projects, urbanization, and tourism claimed more and more land. A few large agribusinesses controlled most of the remaining arable lands as the national government encouraged large-scale private land investments along the coast. Agribusinesses were required to provide financial and technical assistance to smallholder farmers, as well as to contract with them. But insufficient law enforcement and contestations by company lobbyists prevented these efforts from compensating for infringements on self-sufficient farmers' land rights. Meanwhile, in most of the Amazon, land titling to the benefit of indigenous communities continued to stagnate amid opaque large-scale purchases and illegal land grabs.

International governance over climate change mitigation and food price regulation improved, but remained insufficient. A global climate fund agreed upon at Cancun in 2010 was active by 2015, but the endowment did not match the intensity of climate-related crises around the world. Rapid global responses to higher food prices were limited by powerful corporate lobbying, protectionist policies in the face of sluggish economies, and policymaking communities focused on the short term. Worldwide, declining crop yields and growing populations combined to increase average global food prices by 70% between 2010 and 2030, pushing many marginal communities into poverty.

As the 2020s approached, climate change, which unfolded as most experts had anticipated in 2013, created new challenges to food production in Peru. Average temperatures rose 1.1^{o}C by 2030 relative to the period from 1980 to 1999, causing rain to increasingly replace snowfall in most of the Highlands. This disturbed alpacas used to colder temperatures. The intensity and timing of precipitation also changed significantly across the country. In many parts of the Andes and the Amazon, droughts alternated more frequently with heavy rainfalls, negatively affecting existing crops as well as new crops that farmers had planted to diversify their production. On the Coast, rising sea temperatures leading to changing fish migration patterns depleted the stock of anchovies, which had already been threatened by overfishing. Devastating effects of El Niño phenomena struck the northern end of Peru unpredictably yet often enough and with enough rain and flooding to cause serious damage in the agricultural sector as well as on roads and bridges.

Climate change and insufficient water management intensified water stress over the years leading to 2030, primarily affecting small farmers. Glaciers continued to retreat as temperatures rose, putting at risk future water availability in the whole country. Hydropower, which remained the main source of electricity for internal demand and increased exports to Brazil, was developed through hasty and opportunistic projects that disrupted the Amazon's biodiversity and reduced downstream water availability. On the coast, improvements in irrigation systems reduced losses to inefficiencies from 65% in 2012 to 40% in 2030, but local water shortages were exacerbated by the production of water-intensive crops such as sugarcane, rice, mangos, asparagus, and bananas. Meanwhile, in the Andes and the Amazon, mining projects in many different watersheds contaminated sources of potable water. While judicial rulings usually ensured industries and agribusinesses could access water, irrigation water for smallholder farmers' crops became ever more difficult to access on the coast and in the Andes.

The government of Peru responded to water scarcity and climate change effects by improving the existing monitoring systems on geophysical threats and climate change effects. Detailed risk maps were updated with increasing frequency using open-source risk-modeling platforms such as CAPRA, a free, open-source platform for experts conducting probabilistic hazard and loss assessments. Aerial drones sent to emergency settings to monitor damages and provide food and medical supplies also helped improve responses to natural catastrophes.

However, while technologies for disaster risk monitoring and response improved, institutions supporting emergency preparedness lagged behind. Subnational governments gained in financial resources and developed programs to plan for rural development and climate change adaptation. But these programs remained constrained by a lack of coordination with the national and subnational governments, due to insufficient mastery of administrative processes. Moreover, the decentralization of power largely ignored the traditional power structures of peasant and native communities, creating alternative governmental structures that often proved redundant.

In order to cope with water- and climate-related challenges to agriculture, large agribusinesses invested in technological improvements. Robotics in agriculture rapidly improved in the 2000s and 2010s, and increasingly replaced human labor in capital-intensive agricultural settings for site-specific spraying and selective harvesting. “Motes” (interconnected sensing nanotechnological devices) were spread across fields to monitor conditions at the plant level. Nanotechnological low-weight materials in food packaging and real-time in-transit temperature monitoring also helped improve the manipulation, storage, and transportation of agricultural production. Throughout the 2020s, these agricultural technologies helped maintain yields for irrigated staple crops such as rice, maize, potatoes, and sugarcane.

However, smallholder farmers lacked the financial resources to invest in these technologies. A few projects sponsored by international donors tried to expand access to mechanization, basic productive resources (livestock vaccines, fertilizers), and training on farming methods and economics. Innovative groups like Digital Green used mobile technologies to help farmers teach one another about techniques and technologies they were using effectively. But the technological gap between agribusinesses and smallholder farmers continued to grow throughout the 2010s and 2020s. Similarly, the financial system continued to neglect smallholder farmers, and informal loan systems were inadequate for the more severe shocks related to food prices and extreme weather events. As a result, yields for many rain-fed crops declined due to the effects of climate change, including a 10% drop for maize cultivated in the Andes.

GMOs offered another technology that could be used to maintain crop yields, but not without drawbacks. During the decade before the Peruvian moratorium on GMO cultivation expired in 2022, the government explored the possibilities for GMO use in Peru. Global research provided greater assurances of the safety of many GMO crops in terms of human health, genetic stability over time, and environmental impact. Thus, in 2022 the government of Peru allowed GMO cultivation to proceed, but enacted strict safety regulations and mandatory monitoring to identify negative effects, including long-term effects. However, many GMOs, such as pest-resistant asparagus, were patented by multinationals that required smallholders to buy the seeds on an annual basis or to continue planting crops that were more vulnerable to the effects of climate change.

Despite the challenges to food production, macroeconomic growth in Peru led to a significant improvement in food security. Public policies aimed at reducing poverty, in particular conditional cash transfers such as the Juntos program, aggressively targeted child and maternal health and nutrition. The proportion of children under five suffering from malnutrition fell from 22% in 2008 to 14% by 2021. Similarly, anaemia among women of reproductive age fell from 29% in 2005 to 20% in 2030. However, among poorer, rural Peruvians, progress in nutrition levels was not as dramatic. In 2030, just like in 2009, the level of stunting among children in Peru remains three times as high in rural areas as in urban areas.

At the same time, food consumption patterns changed considerably as the proportion of the Peruvian population belonging to the middle class[5] increased from 30% in 2005 to more than half by 2030. As the population itself grew by 19% between 2010 and 2030, this means that in 2030 nearly 20 million Peruvians out of a national population of 36 million belong to the middle class. These consumers demand more diversified and protein-rich food, as well as more imported Western foods. Meat production in Peru increased by 40% from 2010 to 2030 and was increasingly sold domestically. As a result of unhealthy diets and a more sedentary lifestyle, the obesity rate increased from 28% in 2010 to over 40% by 2030.

By 2030, food production has increased overall, ensuring food security for more and more Peruvians. But the technological and revenue gap between small farmers and large agribusinesses has grown. Access to local markets has partially improved for smallholder farming communities thanks to better access to infrastructure and productive resources, and more medium-scale farmers are able to access the export market. But most farming revenues are still collected by large agribusinesses, even though they employ fewer people than the smallholder farming sector which still makes up the majority of the farming workforce. Moreover, climate change effects and market demands have reduced the diversity of cultivated crops. Those more isolated farming communities, which have continued to rely on biodiversity and traditional products, have not been able to move out of poverty.

[5] Persons belonging to the middle class are defined as those households with daily expenditures of USD 10 to 100 per person in purchase power parity (PPP) terms.

Scenario 2: A Harvest of Inequity

Personal Stories: Life in 2030

"You can't go to Lima for at least another two months," Fernando Cabanillas told his employees. Another three cholera cases had been discovered, just after the World Health Organization had declared the city safe to enter again. Fortunately, he had plenty of work for the workers to do in Trujillo, repairing parts of the roadwork that had melted during a summer of record-high temperatures and upgrading irrigation systems to be more efficient, which had become a much higher company priority given recent water shortages. The company's profits had been increasing as it controlled more arable land than ever before and as food prices had soared, but Fernando couldn't help feeling like he was standing on the highest deck of a sinking ship.

"I'll never get used to the light and the noise," thought Chaska Jaillita as she pulled up her blanket and turned her head away from the door to her stall in Cusco, where she sold handicrafts to foreign tourists on their way to see Machu Picchu. Chaska was nostalgic for her home in the Acopia District outside the city, where she and her family had lived for so many years. But when the river dried up and the rains stopped, Chaska realized that farming was no longer the answer. Life in the city was cruel, and Chaska lacked many of the skills that other city dwellers seemed to have, but fortunately her cousins in the handicrafts business had managed to set her up with a new livelihood – at least for now.

It was amazing to Paco Torres that he had been an environmental refugee for two years already. Along with other members of their community, Paco and his family lived in a makeshift camp near Tarapoto that had been set up to accommodate refugees from the Amazon who had suffered destroyed crops, dying livestock, and increased cancer rates caused by pollution and by a more extreme climate. Paco dreamed of helping his family move on, yet life in the camp was difficult and he had little time even to mourn the cherished way of life his community had lost.

Scenario Narrative

By the mid-2010s, it became clear that the effects of climate change were beginning to prove more disastrous than even the most pessimistic models of 2013 had anticipated. By the early 2020s, glacier melt and temperature and precipitation change had considerably depleted the water resources available for human consumption. This prompted a resurgence in infectious diseases as poor communities in coastal cities consumed more and more non-potable water. Epidemics increased, such as malaria and dengue fever which spread into valleys that were previously too cold for the transmitting insects to survive. The most virulent disease outbreak occurred in Chimbote, the largest city in Ancash and home to nearly 600,000 people, where in 2028 floods overwhelmed sewage systems, causing a cholera epidemic that killed 500 people. Some Chimbote locals travelling to other parts of Peru then spread the disease to other cities, killing nearly 1,500 in total. By 2030, temperatures have risen by 1.7^{o}C relative to 1980-1999 levels and all glaciers below 5,500 meters above sea level have disappeared.

Over the decade leading to 2030, increasingly severe droughts caused by El Niño phenomena brought an increase in insect infestations, while heavy rainfalls led to increased crop diseases caused by fungal pathogens. Andean alpacas and llamas also contracted diseases due to water scarcity and changes in the timing of snowfall and precipitation, affecting the livelihoods that many Andean communities derived from the animals' fiber, dairy, and meat.

All along the coast, beaches, harbors, and agro-industrial activities were regularly damaged by storms and flooding, placing a great burden on the national finances. Ports used by small fishermen (caletas) were the most affected. As summer temperatures rose along the coast, the surface of some roads began to melt, as had already been seen in Australia in 2013. Periodic storms and seismic activity also caused localized damage to roads, dams, and irrigation systems.

The national government of Peru was overwhelmed in the face of these climate change effects, growing food demand, and a global context of trade policies that favored rich countries. The government failed to design and implement a comprehensive, long-term strategy to ensure food security for the Peruvian people. By 2020, most of the Peruvian national budget was consumed by short-term fixes and emergency interventions, leaving little for investments in long-term resilience. Even worse, as government finances crumbled in the mid-2020s, even the emergency funding became unavailable, cutting short the initiatives of subnational governments to address food insecurity and climate change. By the late 2020s, Peru was among the world's top 10 recipients of foreign humanitarian aid.

Craving revenue, the Peruvian government sought to attract extractive industries, but in the absence of land and water use regulation, extractive projects often occupied the upper parts of watersheds, increasing the risk of water pollution for the communities downstream as the streams and rivers combined. Conflicts over water resources started pitting smallholder farmers not only against mining companies and large agribusinesses, who often controlled the majority of water wells, but also against small farmers from neighboring communities using the same water resources.

The proportion of Peruvian land devoted to food production declined significantly throughout the 2010s and 2020s. Along the coast and in the Andes, the effects of water scarcity, climate change, and erosion severely limited the options to expand agricultural frontiers, while mining concessions grew chaotically. In the Amazon, extensive areas were also devoted to highly profitable biofuels. Moreover, urban sprawl was poorly managed, especially in Lima and in fast-growing jungle cities, resulting in exponential growth of slums and a reversal of the downward trend in urban poverty from 2020 onwards.

Complications caused by climate change led to greater numbers of rural Andean and coastal populations migrating to the Amazonian jungle where, in comparative terms, land and water were less affected. As a result, four jungle cities surpassed half a million inhabitants by 2025, whereas in 2012, only the city of Iquitos had as many as 460,000 inhabitants. Most of the immigrants settled at the outskirts of cities and attempted to make a living off agricultural wage labor or in informal retail and services. The cities and villages receiving this additional population influx were ill-prepared, which resulted in deficiencies in education, health services, and water and sewage infrastructure. Migrants' slums in the jungle thus became the iconic image of the country's most persistent and extreme poverty.

Deforestation in the Amazon accelerated as the coast and the western side of the Andes became increasingly arid and inhospitable for agriculture and as mining and oil projects were encouraged. Illegal logging also occurred in support of subsistence farming, timber production, and coca cultivation for drug production as Peru maintained its place as the world's leading cocaine producer. This patchy deforestation compounded the effects of climate change.

During the ten-year Peruvian moratorium on GMOs enacted in 2012, a series of GMO-related health scandals soured the opinion of GMOs in developed countries and produced a consensus there that the risks associated with GMOs outweighed the benefits. By contrast, in 2022, Peru's government bet on GMOs as a blanket solution to food challenges and legalized the cultivation of GMO crops, with

encouragements from multinational companies eager to profit from GMO investments they had already made. Ineffective regulations failed to prevent a rash of scandals in the following years. In 2024, thousands of small farmers producing Cusco's unique giant maize kernels for export to Japan claimed that infestation by GMO pollen had altered their crops and destroyed their export niche.

Another disaster a few years later reinforced doubts about advanced new agricultural technologies. From the early 2020s, a large NGO had run a program providing Andean potato farmers in the Arequipa region with interconnected sensing nanotechnological devices called "motes" in order to better manage water resources that had become scarcer and more polluted. But in 2027, it was found that some of the microscopic carbon materials that made up the motes had travelled down to the sea and intoxicated the fish, causing the death of a large number of anchovies. As a result, by 2030, the level of trust of the Peruvian population toward the potential of new technology has fallen to all-time lows, particularly as a means for climate change adaptation. Popular pressure has forced the government to issue prohibitively tight regulations on biotech and nanotech application to agriculture, and to effectively shut down public research investments in these areas.

Focused on these new technologies from abroad, the government failed to support traditional agricultural knowledge and practices adapted to natural climate cycles and biodiversity, particularly those used by women. Mechanization and access to productive techniques did not improve. In particular, access to funding deteriorated throughout the 2010s even though microfinance agencies sprouted up across Peru. Competition drove interest rates down, but the government failed to prevent over-indebtedness, which reached unprecedented levels by the 2020s. This reinforced the low levels of trust among rural borrowers. By 2028 most microcredit providers in rural areas had gone bankrupt as their non-repayments increased. As a result, rural farmers found it increasingly difficult to cope with climate change effects. In the Andes, the economic returns of breeding llamas, alpacas, and vicuñas diminished as death rates exceeded birth rates due to climate-related diseases. Furthermore, more and more varieties of maize and potatoes became uncultivable. By contrast, large agribusinesses along the coast leveraged their larger financial resources to invest in adaptation technologies such as deep tube wells and electric pumps to successfully limit the impact of climate change on their bottom line. However, these practices also used up groundwater to the point where in 2030, the long-term viability of agribusiness is threatened in these coastal valleys.

Throughout this period, the global economic order remained focused on economic growth, with limited attention to social equity or ecological sustainability. Increasing inequities prompted social unrest around the world. Commodity speculation and agricultural protectionism went largely unabated, and food prices soared, with real prices for most staples doubling between 2010 and 2030. Heightened food prices had a profoundly negative impact on the Peruvian food system, which increasingly relied on food imports as yields for both irrigated and rain-fed crops declined.

The impact of higher food prices was inequitably distributed, due to the lack of a comprehensive government strategy on the issue and degraded physical infrastructure especially in the most remote areas. Between 2013 and 2030, the Peruvian population grew by 25% and the middle-class grew with it. By 2030 many in this middle class have lost the cultural attachment to nature that in the past had been so pronounced. Many now reject local and traditional foods in favor of processed foods with high caloric content but little nutritional value, as well as meat products the demand for which has also increased pressure on land use and has elevated Peru's own carbon emissions. Peru now suffers a double burden

of malnutrition. On the one hand, the prevalence of obesity and diabetes among the middle class has soared. On the other hand, infant mortality and child malnutrition rates have increased in both rural and urban areas, and the prevalence of deficiencies in iron and vitamin A among children and mothers has remained as high as in the 2000s.

By 2030, small farmers have lost the resources and resilience on which they had depended for so long, and hope has given way to despair. Unable to cope with drastic reductions in fish, livestock, and plant reserves, many smallholder farmers have been forced to give up their subsistence livelihoods, which has forced them to migrate to the cities or slip into extreme poverty. As a result, rural and urban poverty and extreme poverty levels have stagnated at 2012 levels, with sharp increases in those places most affected by water stress and hunger. With insufficient support in the face of climate change and food price shocks, the workload of women farmers has increased. Across Peruvian society, a materialistic individualism has supplanted the sense of community and solidarity that had always been part of the culture. The country continues to sink in the international human development and happiness indexes, and emigration to wealthier countries such as Brazil reaches worrying levels.

Scenario 3: Sustainable Future, Timeless Past

Personal Stories: Life in 2030

"Thank you very much for coming," Fernando Cabanillas said to the members of the Community Advisory Council, who had come to give input to the company's planned construction of a new aeroponic facility on the Trujillo site. While this level of community engagement was not required by law, as general manager he had found it highly effective for preventing conflicts with the public – and it often provided the company with good ideas they had not considered. For example, it was a group of local subcontractor farmers who originally suggested that the company plant kiwicha, which has now become an important niche product for the company, and has entered the food culture in places as far away as Italy and Japan.

"I think this is the first time I've ever received an award," Chaska Jaillita told her colleagues in the Acopia Peasants Association, which had decided to honor her for her long-standing contribution to their grassroots campaigning. Chaska had been instrumental in obtaining government funding for drip-feed irrigation and rainwater collection systems, as well as getting new roads built so that Andean farmers could trade directly with their neighbors across the border in Bolivia. What Chaska had enjoyed the most, however, was attending a 2029 conference in Montevideo, Uruguay, where farmers from around the world had celebrated the strides that had been made toward achieving food justice and set a strategy to achieve 100% online access for all farmers everywhere by 2040.

As Paco strolled along the river, he smiled to see so many of the indigenous plants he remembered hearing about as a child. Several years earlier, he had signed up for a program of the subnational government to subsidize the cultivation of ancient species. As he looked around, he saw the fruits and tubers he would sell to nearby urban markets, the medicinal plants he was growing for a pharmaceutical company recently established near his community, and other niche species he would sell to markets abroad. He was pleased that he had preserved not just the species planted by his ancestors, but also their way of farming. In fact, the farming practices of the Amazon had spread across the country, offering important means for adapting to a changing climate and preventing biodiversity and genetic losses.

Scenario Narrative

Few in 2013 would have anticipated that grassroots efforts across Peru could prompt the policy reforms necessary to bring about food justice by 2030. To the surprise of many in 2014, a prominent Chinese mining consortium decided to suspend mining operations indefinitely in Peru, after nearly 70 civilians and policemen died in the Northern Amazon region near Chachapoyas during a particularly violent protest against mining and oil projects. By 2015, similarly violent protests led by Andean and Amazonian farmer communities had erupted elsewhere in the country. Social unrest became a chief concern of the Peruvian government, and increasingly volatile global mineral prices shook political support for extractive industries.

During this time, communities and civil society groups became more sophisticated and vocal in advocating for improving direct citizen participation in policy-making. They adapted mobile apps and online games developed in other countries to tap into historical aspirations rooted in indigenous culture, and to provide information on participatory democracy processes and the political issues at stake. Communities' growing sense of their own voice and power made them an increasingly formidable player

in Peruvian politics. Farmer organizations in Peru were also able to leverage a growing global movement that included indigenous federations. Via Campesina and other groups advocating for the defense of sustainable production practices and small farmers' land and economic rights began to have a greater impact on multilateral trade negotiations.

By the late 2010s, the national government responded to this grassroots power by setting a goal of establishing an equitable distribution of productive resources between large-scale agribusiness and smallholder farmers. Women's leadership in the agriculture sector was identified as a priority for action and investment. The government also began to rein in the worst human-rights and environmental abuses of the extractive industries. Subnational governments conducted local needs assessments to develop better policies to address community concerns. Most importantly, smallholding farming came to be recognized as an essential part of the economy that warranted greater investment in infrastructure, technology, and extension of agricultural knowledge. In 2018, a national decree was passed requiring that 10% of the public budget be devoted to promoting and supporting small-scale agriculture.

Subnational governments, in which more and more women held leadership positions, played a key role in advancing food justice. Many local leaders became informed on administrative processes and gained substantial financial and decision-making powers for initiatives in food security, water management, and emergency preparedness and response. These initiatives often leveraged traditional power structures within peasant and native communities. Greater inclusion of women in these structures promoted new mechanisms to address their specific rights and needs.

Local universities partnered with subnational governments to implement new approaches to climate change adaptation, which had continued in line with the mainstream expectations of 2013 and led to an increase of 1.1°C by 2030 relative to 1980-1999 levels. In the Andes, academics and farmers collaborated on research focusing on local crop varieties that were suitable in warmer temperatures. Technical information was also disseminated on the possibilities for farmers in the highlands to move potato fields to higher, colder locations. Subsequently, irrigation infrastructure was also redirected to those shifting crop zones. Farming families were also able to control livestock diseases using techniques supported by the Ministry of Agriculture.

In the early 2020s, reaching out to its neighbors, Peru spearheaded South American regional integration. To avoid significant increases in food prices fueled by global financial speculation on agricultural commodities, South American countries signed a much-publicized agreement in 2022 to build up food reserves and regulate food exchanges throughout the continent. Peru played both a political and a technological leadership role in South American agriculture.

Peru gave priority to sustainable agricultural practices in order to preserve nature, the source and habitat of human life. This led to the indefinite extension in 2022 of the 2012 moratorium on GMO cultivation. Agroforestry was promoted, whereby Amazonian shade trees, protected by strict regulations, facilitated perennial cultivation of coffee and cocoa, with the tree leaves being commercialized as natural mulch. In the early 2020s, a governmental program began to distribute seeds for productive trees bearing nuts or fruits such as pijuayo, "tree tomatoes", and papayas. A re-greening program was launched at a smaller scale in order to improve soil nutrient retention and combat salination and erosion. Water management techniques like drip-feed irrigation and rainwater harvesting, used by some farming communities in the Andes and the Amazon, spread to other communities to help them adapt to the change in precipitation patterns from steady rains to concentrated showers.

Peru also invested public funds to improve access to financial services and productive resources (livestock vaccines, organic fertilizers) and to secure land tenure for small farmers by building on existing indigenous land ownership structures. Gender equity initiatives increased formal land ownership for Peru's women farmers. Improved roads, railways, and waterways also helped connect second- and third-tier cities to rural areas, with a particular focus on creating links to the country's most remote areas. Energy-efficient small-scale storage systems, such as modular solar-powered refrigeration devices, ensured the cold chain was not broken post-harvest. Mobile apps began incorporating long-term weather forecasts to help farmers choose optimal crops each season. Farmers could understand soil fertility patterns and plan the timing of planting, harvesting, and delivering their produce to market. These apps also provided a platform for mobile financial management. The design of the devices and the apps was adapted to illiterate or semi-literate farmers and seamless simultaneous translation served as an incentive for increasing numbers of indigenous children to communicate in their native languages, including Quechua, Aymara, and Asháninka.

While extractive industries continued to provide a large share of Peru's fiscal revenues, the government ended most environmentally destructive projects and enforced land zoning to specify which areas could be sustainably used for natural resource extraction. By 2020, all 24 regional governments had issued binding ordinances that specified areas apt for mining, agriculture, industries, and protected ecosystems. Although Peru's energy mix has not changed considerably by 2030, the long-term strategy ensures future energy security without depleting environmental riches. Peru now relies on distributed networks of energy production and large-scale renewable energy production, particularly solar and wind energy for which the government doubled investments between 2010 and 2030. Most projected mega-dams that failed to meet standards for environmental stewardship have been abandoned. The government also passed a law in the late 2020s regulating how much land can be devoted to specific biofuel crops.

By the late 2020s, Peru had strengthened sustainable agriculture to gain global ascendance for its organic, biodiverse food culture, which had already been anticipated by the success of quinoa in the early 2010s. Highly nutritious grains and fruits such as kiwicha (also called "mini-quinoa") became global staples while Peruvian cuisine received rave reviews in the world's capital cities. Agriculture's share of Peru's exports rose from 10% in 2008 to 40% in 2030, mostly to neighboring countries. Back at home, the excitement around Peruvian food helped reduce consumption of fast-food and other processed foods as Peruvians chose locally-grown, organically-produced, tasty foods. From the late 2010s, Peru imposed penalties on polluting activities and used the revenue to subsidize the prices of organic foods, further encouraging their consumption. By 2022, consumers commonly used a smartphone app for detecting unhealthy chemicals in foods. The high degree of pesticides and fertilizer residue in many agro-industrial foods contributed to lowering the domestic demand for conventional food products and heightening demand for organic products. Some foreign agribusinesses decided to leave the market altogether. The decline in high caloric, low nutrition foods helped reduce the obesity rate from 28% in 2010 to 12% in 2030. Stunting, which affected nearly half of the children under five in the Highlands and the Amazon in 2011, is almost eradicated by 2030.

Being a smallholder farmer in 2030 is very different from what it was in 2013. Peru has become recognized as the global leader in biologically diverse organic production. Peruvian cuisine is renowned not only for its diversity and taste, but also for the agricultural system on which it is based – where Peruvian farmers supported by the government have control over productive resources and techniques and over their business model. Urbanization slowed dramatically after 2020 as more of the Peruvian

population began to enjoy living in rural areas and as revenues from ecotourism and agrotourism became attractive.

Scenario 4: The Peruvian Way

Personal Stories: Life in 2030

"Big news today!" Fernando Cabanillas began writing a blog post to announce the $12 million in financing he had just received from his parent company, the WHO, and the Zuckerberg Foundation to support his project to cultivate a genetically modified banana with anti-malarial properties. He had many people to thank, since he owed the project's success thus far to the large number of Peruvian farmers who had contributed their expertise – sometimes on-site, but more often via online knowledge exchange. Fernando felt personally fulfilled by work that was both creating new business opportunities for his company and meeting an important global need.

"So farmers all over Quechua will see this?" Chaska asked the "connector" who had helped her make a short video about how she had organized communities across the Andean region to outfit their local warehouses with "smart" sensors that could indicate food shortages in real time so that supplies available in another area could immediately be shipped there. The connector told her that anyone in Peru could watch the video through the ChasquiNet, an online knowledge network that enabled self-organization among Peruvians with common interests – particularly those in agriculture. Chaska wondered if her daughter, who had left the farm in her teens and now worked in computer animation in Lima, would see the video and be proud of her dear old mother.

"We just picked these coffee beans yesterday. Take a handful if you'd like," called Paco Torres to the American and European tourists visiting his farm. "In ten minutes we'll start our walk through the farm so you can see first-hand the biodiversity it has to offer." Paco marveled at the widespread interest in his farm, which resulted from the prominence of Peru's organic and diverse food culture in global markets. He thought back to his childhood, when many had feared that the Amazon would be devoured by deforestation and by mining, oil, and natural gas. Looking back, it seemed unimaginable that Peru would have put at risk such an invaluable and irreplaceable asset.

Scenario Narrative

As Peru approached its bicentennial in 2021, excitement grew about how far the country had come in recent decades. The Shining Path terrorist movement had been virtually eradicated, democracy was flourishing, and GDP had grown at over 6% per annum for a decade. A number of community movements had forced large multinationals in the agribusiness and mining sectors to adopt more responsible policies on social and environmental issues. The success of Peruvian crops like quinoa and the global interest in Peruvian gastronomy spoke to Peru's promise for the future.

However, a series of disasters threatened to undermine this success. Climate change proved more intense and destructive than had been expected in 2013; by 2030 average temperatures in Peru increased by 1.7^{o}C compared to 1980-1999 levels. Many glaciers were melting, some rivers were drying up, and droughts became a greater concern. In 2015, a series of extreme climate events struck places around the world, and Peru was no exception. The same year, a 7.0-magnitude earthquake struck the Lima-Callao metropolis, devastating many buildings and killing several hundred people – mostly in slum areas. The following year, the temperature of the Paita Sea in northern Peru rose by 6^{o}C, producing an El Niño phenomenon similar in severity to that of 1997-1998. Between 2015 and 2017 agricultural output dropped 43%. Peruvians dubbed these successive catastrophes "la rabia de Dios" ("the rage of God"), and began to question their earlier faith in Peru's future.

Most experts agreed that the damage could have been a lot worse had it not been for local and regional efforts in the areas of climate change adaptation, community organization, and resilience building, particularly in rural areas. By contrast, the national government was seen as having done little to prepare for the crisis. In 2018, an opposition group used this widespread perception as the impetus for a campaign to recall the president, a procedure that became constitutional in 2014. However, an alternative campaign was launched when millions of Peruvians responded favorably to a video posted online by a group of college students calling for a national, inclusive dialogue to explore how to build an ideal future for Peru. After agreeing to convene this dialogue, the president easily survived the recall election and the national dialogue came to life soon thereafter. The diversity of the participants prompted an unexpectedly creative conversation that included the articulation of a shared vision for Peru's food system – what would come to be known as "the Peruvian way."

At the core of "the Peruvian way" was a reinterpretation of the long-standing, meaningful relationship between Peruvians and "Pachamama" – the Mother Earth that provides nourishment and deserves care and respect. The new interpretation retained a spiritual approach to nature, but also recognized the value of modern technology as a means to expand nature's bounty while preserving biodiversity for generations to come. This led Peruvians to rethink their food system in a more holistic way, to invest in new technologies, and to challenge many of the assumptions underlying other sectors of Peruvian economic and political life. In particular, policies and strategies for energy, food production, and water were redesigned to address these three components as a system, in order to achieve environmental preservation and food justice.

In energy, the government aimed to develop alternative energies using the current revenues from extractive industries while also winding down major mining projects throughout the 2020s. In 2022, the government partnered with private companies to make major investments in wind and solar energy development. In 2023, Peru and Brazil amended their 2010 energy agreement such that Brazil transferred its expertise on third-generation algal biofuels so that Peru could take advantage of the microalgae now found in the warmed-up Paita Sea. As a result of these aggressive investments, in 2030 the alternative energy sector in Peru provides affordable electricity to virtually all urban residents and the vast majority of rural residents, and the level of soil, water, and air pollution has dropped dramatically.

In food production, the government invested in technologies with the potential to improve agricultural productivity, risk management, and resilience. Women's leadership was leveraged across all these areas. The government supported the creation of a knowledge network, named the "ChasquiNet", providing best agricultural practices drawn from government databases, academic research, private sector case studies, and – a few years later – peer-to-peer studies conducted by farmers themselves. Peru combined the best of indigenous methods and the best of modern technology with the ChasquiNet covering topics like localized responses to climate shocks, post-harvest management, indigenous growing methods, and the use of precision-farming tools. This knowledge was also disseminated freely through Massive Online Open Courses (MOOCs), often led by the farmers themselves. Cohorts of human "connectors", funded by the national government and donors, fanned across the country to engage one-on-one with rural farmers to show them how to use the network.

The advent of microlocal water management put an end to inefficient irrigation systems. In 2030, mobile devices connected to billions of "motes" (interconnected sensing nanotechnological devices) allow farmers to monitor water usage in agriculture at a localized scale in real time, on top of providing other

microlocal agricultural intelligence. The development of cheap, energy-efficient innovations in desalination and wastewater recycling, such as the Saltworks technology that uses membranes to sort out salt and other pollutants, has also helped cope with water scarcity. In cities, the water-creating billboard developed in the early 2010s by the University of Engineering and Technology, which condenses Lima's humid air into drinkable liquid water, was deployed at a large scale by the early 2020s.

Urban residents used the ChasquiNet to support a growing interest in urban farming, which they saw as a means to better health and wellness and as a vehicle for self-expression. The government saw urban farming as an opportunity to reduce urban poverty and as a way to increase the amount of "land" under cultivation. Building on the experiences of organopónicos in Cuba and Ecuador, Peru built a network of multi-story urban agricultural facilities that used vertical farming, aeroponic and aquaponic technologies, solar-powered lighting, and water circulation and cleansing, making agriculture a key sector of the urban economy. These facilities also used waste water as nutrient-rich irrigation and food garbage as compost. By 2030, a surprising 25% of the country's food supply comes from urban agriculture.

In 2014, a comprehensive framework extended the 2006 UN regulatory document on biotechnologies, adding technical guidelines for trial protocols. In addition to prudence, another guiding principle of global biotech governance was affordability. Patent protections for crops that were costly to small farmers were increasingly limited in scope and duration. As governance improved, biotechnologies, including GMO crops, gained public approval globally and in Peru. In 2022, as the moratorium on GMO cultivation ended, the National Institute for Agrarian Innovation with help from the International Potato Center led participatory roundtables that resulted in the legalization of GMO cultivation under careful regulation. In 2025, as declining revenues from patented GMO crops proved inadequate to support further GMO research, a global agricultural biotechnology company set up an online crowd-sourcing platform for GMO research. By 2030, this platform has produced a handful of safe biotech breakthroughs that the company manufactures and sells at reasonable prices.

These new systems transformed agriculture from a subsistence livelihood to technically complex and personally rewarding work. In 2030, farmers use climate models as complex as those used by UN officials, and exercise great care in choosing their crops and managing their land. For some, this has made farming an exciting way of life. For other farmers, the greater links between urban and rural realities have made them or their children aware of other opportunities besides farming. Many farmers have sent their children to better schools in urban or semi-urban areas. Most observers project that a much smaller proportion of the population will be engaged in agriculture, livestock, and fishing activities as the years go on. Other sectors, in particular services, have grown to provide additional opportunities for employment.

Food consumption evolved as traditional Peruvian cuisine interacted with global cuisine and modern technology. Peru had developed blended Chinese Peruvian cuisine in Lima decades earlier. In the 2020s, in all the large cities chefs updated traditional Peruvian dishes with flavors from other cuisines and by integrating other ethnicities from within Peru itself. Some of these chefs crowd-sourced new recipes from food-lovers in other countries who had begun to use traditional Peruvian ingredients. Some innovators in urban and rural areas alike created online environments in which people around the world could experience Peruvian food culture in "virtual reality." By 2030, Peruvian cuisine is considered among the finest in the world, "the Peruvian way" has received high praise, and leaders from Latin America and from around the world are coming to Peru to learn the secrets of its success.

Scenario Matrix

	Scenario #1: Progress at the Margins	**Scenario #2: A Harvest of Inequity**	**Scenario #3: Sustainable Future, Timeless Past**	**Scenario #4: The Peruvian Way**
Food Justice *This row assesses each scenario in terms of the five components of food justice defined in the Introduction: equity across actors in food production, across consumers, across generations, and across genders, as well as the societal consensus in support of these.*	• Technology and productivity gaps persist between large-scale and smallholder producers. • Inequities persist in consumers' access to high-quality, nutritious foods. • Corporate social responsibility improves but environmental degradation continues. • Moderate efforts to increase land ownership by women. • A small proportion of Peruvians value food justice by 2030.	• The gap widens between large-scale and smallholder producers. • Many consumers fall into poverty and food insecurity. • Natural environment severely threatened by resource exploitation and by poor responses to climate change. • Efforts to increase land ownership by women stagnate. • Desire for economic growth trumps consumer concern for food justice.	• Government policy and grassroots activism create level playing field for producers. • Community focus provides greater equity across consumers. • Sustainability achieved through an emphasis on traditional practices and technologies. • Women take leadership roles in community organizations and in national and subnational governments. • Food justice becomes commonly held value throughout Peruvian society.	• Knowledge network allows all farmers to self-organize to reach their full potential, pursuing "the Peruvian way." • The spread of agriculture and agricultural knowledge, particularly in urban agriculture, helps reduce consumer inequities. • Humans – and their technologies – are integrated into the natural ecosystem. • Significant strides toward gender equity in land ownership and in policy influence. • Food justice viewed as a prerequisite for self-expression within the food system.
Demographics	• Pop.: 36 million, up 19% from 2010 to 2030. • Urbanization continues, with over 85% of Peruvians living in cities in 2030. • 12% of the population works in agriculture in 2030.	• Pop: 38 million, up 25% from 2010 to 2030. • Climate refugees and ill-managed urban sprawl contribute to increase in urban poverty. • 10% of the population works in agriculture in 2030.	• Pop.: 36 million, up 19% from 2010 to 2030. • Urbanization slows as rural habitats and livelihoods are better appreciated. • 16% of the population works in agriculture in 2030.	• Pop.: 34 million, up 14% from 2010 to 2030. • By 2030, the large majority of Peruvians living in cities enjoy a less polluted environment and the ability to grow some of their own food. • 7% of the population works in agriculture, although many more grow some crops of their own.
Climate Change	• 1.1°C average temperature rise over 1980-1999 levels. • Reduced precipitation with high variation across the country. • Recurring El Niño phenomena produce storms, droughts, *huaycos* and landslides with heavy damage.	• 1.7°C average temperature rise over 1980-1999 levels. • All glaciers below 5,500 meters above sea level disappear. • Climate-related epidemics, insect infestations, and fungal crop and animal diseases.	• 1.1°C average temperature rise over 1980-1999 levels. • Reduced precipitation with high variation across the country. • El Niño phenomena produce storms, droughts, *huaycos* and landslides with heavy damage.	• 1.7°C average temperature rise over 1980-1999 levels. • Many glaciers melt and rivers dry up. • Major El Niño phenomenon coincides with 7.0 earthquake in 2015.

Economy	• Mining increases as proportion of GDP, to 15%. • Agriculture's share of GDP declines from 6% to 2%. • Services increase from 57% to 60% of GDP.	• Mining doubles as proportion of GDP. • Agriculture and manufacturing both decline. • Services expand, but productivity stalls. • Unemployment increases due to fiscal and climatic stresses.	• Mining declines as several large projects are abandoned. • Agriculture booms, particularly smallholder farming, and accounts for 40% of exports. • The services sector expands, particularly in eco- and agrotourism.	• Mining declines precipitously to less than 3% of GDP. • Agriculture portion of GDP declines slightly but accounts for 25% of exports. • Growth in health care, IT, education, and entertainment increase services portion of GDP significantly.
Extractive Industries	• Government continues support for mining projects, but increases requirements for corporate social responsibility.	• Largely unrestrained growth in mining, with increasing social and environmental impacts.	• Mining continues, but environmentally destructive projects are abandoned.	• Most mining operations wound down during the 2020s. • Mining revenues used to accelerate development of renewable energy sector.
Agricultural Production & Smallholding Farming	• Global food prices rise by 70%. • Stable yields for irrigated staple crops but declining yields for rain-fed crops. • Reduced water in lakes and rivers and pollution reduce availability of fish in the Andes and the Amazon. • Andean alpacas contract diseases. • Small farmers' access to local markets improves, but most farming revenues still collected by large agribusinesses.	• Food imports soar while food prices double. • Domestic agricultural production and yields decline. • Overfishing and climate change deplete fish reserves across Peru. • Andean alpacas contract diseases. • Poverty and hunger levels among smallholder farmers increase; many migrate to city slums.	• Food imports decline as domestic productivity increases. • Crop diversity increases, with some traditional crops rediscovered. • Successful climate change adaptation protects livestock and fish reserves. • Smallholder farmers' land ownership and access to productive resources improve significantly.	• Rural and urban farming meet Peru's food demand. • Increased productivity, urban agriculture, and GMO use reduce poaching of natural plant, fish, and livestock resources. • Some farmers produce foods for high-quality Peruvian cuisine for domestic and global markets. • Many smallholder farmers or their children leave agriculture to pursue other opportunities.
Land Use	• Land under cultivation reduced by extractive industries, hydroelectric projects, urbanization, and tourism. • Continued concentration of arable land in the hands of a few large agribusinesses. • Landing titling in the Amazon to the benefit of indigenous communities stagnates.	• Arable land reduced by climate change effects, reduced soil quality, water contamination from mining operations, and ill-managed urbanization. • Deforestation increases for mining and logging, and to make new land available for agriculture, including coca cultivation.	• Government zoning regulations ensure land is available for smallholder farming and environmental protection. • New emphasis placed on preserving soil quality and increasing long-term productivity rather than expanding the total area under cultivation.	• Decline of extractive industries opens some land for cultivation. • National land-use strategy developed to support "the Peruvian way." • Improved environmental monitoring allows for optimization of land use. • Agricultural frontier blurs as urban farming expands.

Water	• Improvements in irrigation system efficiency. • But water-intensive crops and hydroelectric projects use large volumes of water.	• Many water resources depleted by 2020. • Lack of potable water prompts resurgence in infectious disease. • Widespread competition and conflict over water resources.	• Indigenous practices for water management spread across Peru. • Expanded use of drip-feed irrigation and rainwater harvesting.	• Water management at local level using mobile devices connected to nanotech sensors. • Cheap, energy-efficient methods for desalination and wastewater processing help overcome water shortages.
Agricultural Technology	• Robots displace human labor in some settings, particularly along the coast. • Nanotechnological devices enable real-time field monitoring and reduce post-harvest losses. • Aerial drones improve emergency responses. • Smallholders have increased access to mechanization, vaccines, and fertilizers, but cannot afford other, newer technologies.	• Poorly regulated GMOs and nanotechnologies pose risks to agricultural productivity and human health, leading to a halt to public R&D funding for these technologies. • By 2030, many distrust technology as a means for climate change adaptation. • Technology gap widens between large-scale and smallholder producers.	• Increasing use of sustainable agricultural practices such as agroforestry, often drawing upon indigenous techniques. • Government investments in re-greening and productive tree planting.	• Large investment in environmental monitoring, real-time risk mapping, and a knowledge network to help all farmers draw upon the best of traditional practices and the best of modern technology. • Farmers begin to self-organize online to improve productivity and exchange best practices. • Technology gaps across large-scale, smallholder, and urban agriculture narrow significantly. • Urban agriculture benefits from advanced technology.
Genetically Modified Organisms	• Moratorium on GMO cultivation allowed to expire in 2022 once regulations for health and safety are in place. • Smallholder farmers forced to choose between buying patented GMO seeds or planting non-GMO crops that are more vulnerable to climate change effects.	• Multinational corporations push national government to allow GMO cultivation. • Several highly publicized scandals involving negative effects of GMO cultivation produce new restrictions by 2030.	• In 2022, moratorium on GMO cultivation is extended indefinitely as country shifts focus to sustainable practices.	• Improved global governance for biotechnology throughout the 2010s. • Moratorium on GMO cultivation allowed to expire in 2022. • Many GMOs are crowd-sourced by companies and by nonprofits to meet specific health or climatic needs.
Infrastructure	• Improved transport infrastructure to connect mines and dams to seaports. • Mobile phone penetration gives farmers better access to monitoring and training.	• Heavy damage to infrastructure from climate change creates burden on national finances and increases isolation of remote populations.	• Better roads connect most remote rural areas to urban centers. • Mobile penetration allows for new apps to optimize farming. • Intelligent storage systems used throughout the country.	• Strong IT infrastructure across the country. • Government and private sector fund transport and renewable energy infrastructure.

Food Consumption	• A growing middle class increases demand for Western-style processed foods. • Nutrition improves overall, with mixed results for poorer, rural populations. • Obesity rate increases from 28% in 2010 to 40% in 2030.	• Peruvian consumers lose the taste for healthy foods. • The middle class favors cheap processed foods, while poor populations rely on survival foods. • Severe "double burden" of obesity and malnutrition.	• Higher demand for nutritious and locally and sustainably produced foods lowers demand for meat and processed foods. • Substantial reduction in obesity and malnutrition.	• Peruvian consumers express themselves through their choice of high-quality, healthy foods. • Gastronomic innovations combine traditional Peruvian flavors with elements from other cultural cuisines. • Substantial reduction in obesity and malnutrition.
Dominant Actors	• The public, private, and civil sectors are all active but lack common vision and coordination.	• Multinational corporations and their promoters within the government.	• Grassroots organizations and the policymakers who respond to their demands.	• Citizens and farmers self-organizing through knowledge networks, with the involvement of the public, private, and civil sectors.

Conclusion

What will Peruvian agriculture look like in the year 2030? How will Peru's food system respond to a growing population, increased urbanization, shifts in food prices, changing consumption patterns, climate change effects (particularly with respect to water), and competing demands for land? What will happen to those communities in Peru that do the bulk of the agricultural work today? Will they remain as farmers or will they seek new opportunities in other industries and sectors? For those who remain in farming, what will their lives be like, and what new skills will they need to be successful? How will all of these factors shape Peruvian consumers' relationship with food and with the food system?

Each of these questions has an uncertain answer. The scenarios you have just read help to capture some of that uncertainty, and point toward outcomes you may not have considered before. This is an important value of scenarios, since the "most likely" future – what most people are expecting today – rarely happens. We saw this in our workshops in Peru when we asked participants to describe the future they would likely have predicted for their country had they been asked to do so two decades ago, back in 1993. Most participants offered something very different from what actually occurred. Few envisioned a healthy democracy, the virtual elimination of the terrorist threat, and steady GDP growth in excess of 6% per annum. Similarly, Peru two decades from now will likely not match the future that most would expect based on what they know today.

The scenarios you have just read contain some content that many readers may find surprising. Examples include the use of aerial drones to monitor storm damage (Scenario #1), a resurgence of infectious diseases like cholera (Scenario #2), major policy reforms driven by grassroots efforts by farming communities (Scenario #3), and the creation of a knowledge network for agriculture that combines the best of indigenous techniques with the best of 21st century technology (Scenario #4). The scenarios describe a wide range of challenges and opportunities that warrant consideration by all those in a position to shape the future of agriculture in Peru. (See Box 1 for specific applications of these scenarios highlighted by workshop participants.)

Box 1. Uses of these scenarios.

During the workshops in Peru, we asked participants how this report should be used after its release, and they offered the following suggestions, which we now pass on to you:

- Use the scenarios as the basis for crafting a policy vision for municipalities and for key agencies of the state.
- Relate the scenarios to other efforts to look at the future, such as a recent book on Peru in the year 2062, the work of government planning agencies (e.g., CEPLAN) and NGOs (e.g., Soluciones Prácticas), strategic planning by subnational governments, etc.
- Engage a broad range of civil society organizations in the alternative futures conversation so that common interests can be identified and pursued.
- Apply the same level of systems thinking that is required for futures thinking to better understand Peru's recent past.

The range of outcomes is also wide with respect to food justice, which is the perspective from which these scenarios were developed. The scenarios have translated this abstract phrase into concrete outcomes that Peruvian stakeholders at the national and local levels have found to be relevant and useful. For example, participants at the workshops in Peru responded favorably to the equitable access to advanced technologies, resource funding, agricultural knowledge, and productive resources that is described in Scenarios #3 and #4.

However, the scenarios also point to emerging value sets that may go beyond food justice and that may become explicit aspirations applied to the food system in the years to come. These too warrant consideration by those in a position to shape the future of agriculture in Peru. They include:

- A value set that focuses on the role of food in relationships among people – the collective value of food that is captured by the Spanish word *compañeros* (or companions in English), which literally means those who break bread together. For example, Scenario #3 describes a growing desire for foods grown by the local community, while Scenario #4 offers opportunities to form new relationships by sharing food through "virtual reality."
- A value set that focuses on the self-expression of the individual, which can be accomplished through a person's interactions with food. This aspiration comes out particularly in Scenario #4, where many who were farmers in 2013 have left agriculture by 2030, many in the cities express themselves through urban agriculture, and people around the world are creating new tastes by combining different culinary traditions.

With these and other potent possibilities, the future beckons us forth and commands our attention. But to manifest the best of what the future has to offer, we must first challenge our own assumptions and open our minds to the future we would prefer. These scenarios for 2030 have given you an opportunity to explore a broader range of possibilities than you might otherwise have considered. As you reflect upon these possibilities and assess their likelihood based on the broader body of evidence they may have brought into your awareness, endeavor to describe your own preferred future. And once you have done so, engage with others to make that future happen.