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What do we know about THE FUTURE OF FOOD SYSTEMS?

CHAPTER 31

What do we know about THE FUTURE OF PULSES IN GLOBAL AND REGIONAL AGRIFOOD SYSTEMS?

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Key messages

- Low- and middle-income countries (LMICs) account for about 55 percent of global pulse production. Nearly one-half (48 percent) of global production occurs in 16 low- and lower-middle income countries in the drylands of South Asia and sub-Saharan Africa.
- The gap between pulse demand and supply is increasing in South Asia.
- Most recent foresight studies on pulses are focused on climate change impacts, adaptation, and mitigation.
- Future foresight studies on specific pulse crops should target regions where these pulses are important in human diets.
- Pulse trade should be promoted between countries that encompass the drylands of South Asia and sub-Saharan Africa.

RECENT TRENDS AND CHALLENGES

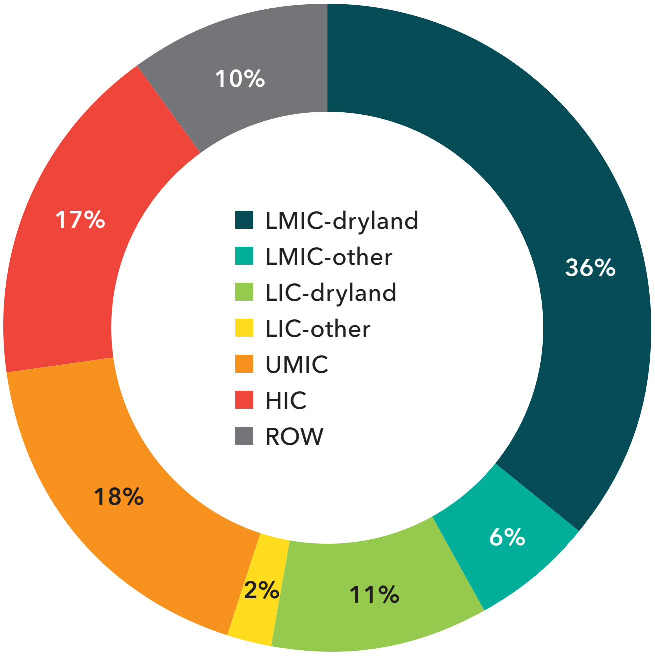
Global production of pulses averaged around 87.7 million metric tons annually between 2019 and 2021, with 39 countries accounting for 90 percent and India alone accounting for 27 percent of the total volume (Figure 1). Among the 39 major pulse producers, 8 high-income countries account for 17 percent of global production. Another 8 upper-middle-income countries account for 18 percent of global production. Low-income and lower-middle-income countries account for about 55 percent of global production. Most of these countries encompass the drylands in South Asia and sub-Saharan Africa. More specifically, 11 low-income countries account for 13 percent of global pulse production; 8 of them encompass drylands in sub-Saharan Africa and together account for 11 percent of global pulse production. Similarly, 12 lower-middle-income countries account for 43 percent of global pulse production, but 8 of them encompass the drylands in South Asia and sub-Saharan Africa. Together, these 8 countries account for 37 percent of global production (Figure 1).

Between 2000 and 2021, world pulse production increased by about 60 percent, while the world population increased by about 30 percent. For the countries encompassing the drylands of sub-Saharan Africa and South Asia, population has grown by about 50 percent since 2000 (Figure 2). By contrast, pulse production in these regions doubled over the same period, although this growth was subject to higher variability over the years, as pulses here are primarily grown in low-input, rainfed conditions. An interesting trend is that the growth in the value of pulse production was slightly higher than that of the volume of production over the last two decades in South Asia, reflecting a persistent supply-demand gap for pulses there (Figure 2). This supply-demand gap reflects increasing scarcity, which pushes local prices up. Net pulse imports for South Asia stood at around 400,000 tons in 2000; by 2021, net imports had risen to about 4 million tons, equivalent to about 14 percent of pulse production for the region.

In West Africa – which accounts for about 20 percent of pulse production in the countries encompassing the drylands in sub-Saharan Africa and South Asia – population increased by about 75 percent between 2000 and 2021. In contrast, pulse production nearly tripled over the same period. Changes in the value of pulse production closely followed those of the volume of pulse production between 2000 and 2021, reflecting the region's self-sufficiency in pulses. By 2021, the region's net imports amounted to about 53,000 tons, equivalent to less than 0.6 percent of its pulse production.

In East Africa – which also accounts for about 20 percent of pulse production in the countries encompassing the drylands in sub-Saharan Africa and South Asia – population increased by about 80 percent between 2000 and 2021, while the production of pulses more than doubled. Between 2000 and 2009, growth in pulse production was lower than that of the population for most years; from 2010 to 2021, growth in production was generally higher than that of the population (Figure 2). Growth in the value of pulse production in the region has been slightly smaller

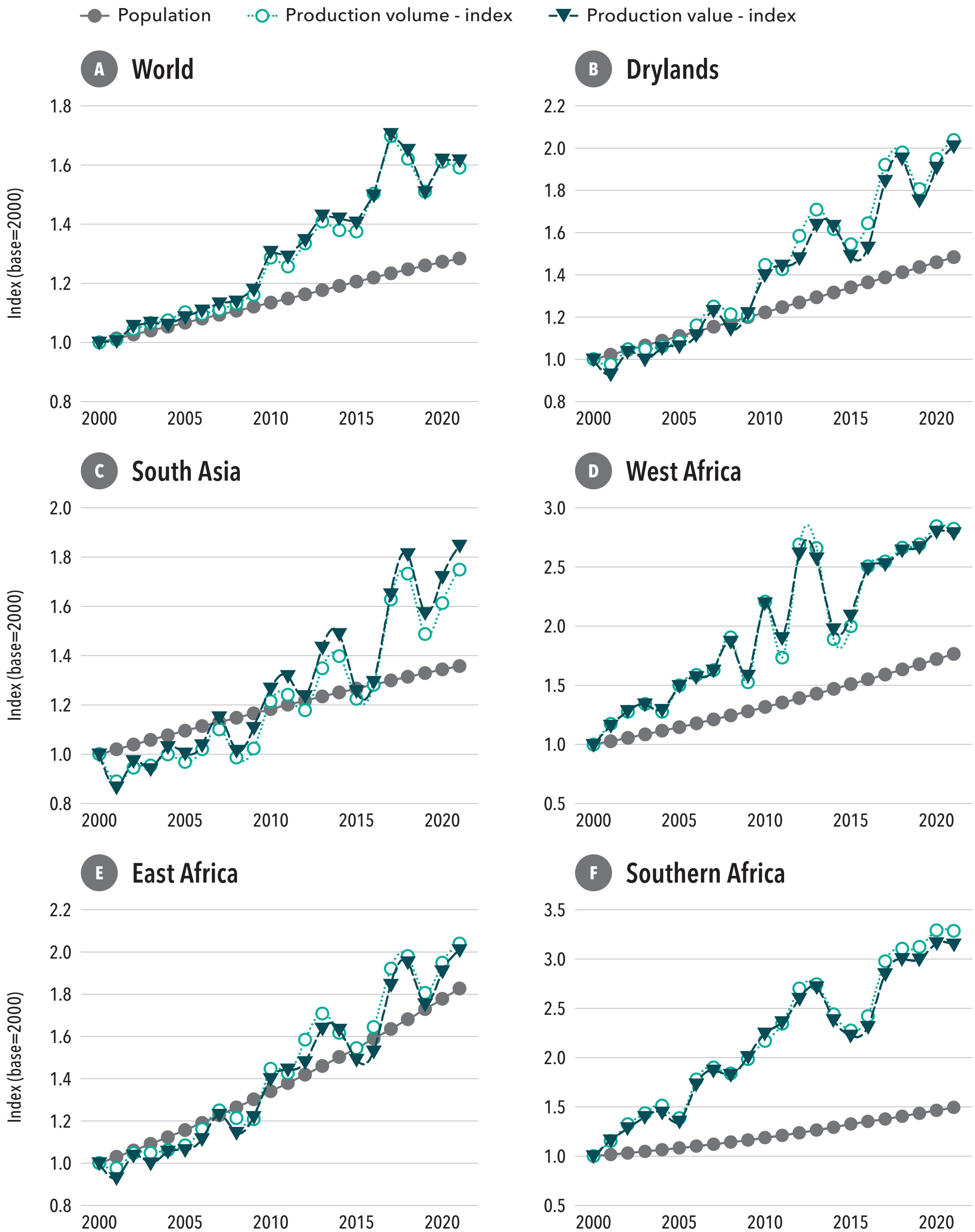
FIGURE 1 Distribution of world pulse production, 2019–2021 (average)



Source: Data from FAOSTAT.

Note: LMIC-dryland: lower-middle-income countries encompassing the drylands of sub-Saharan Africa (SSA) and South Asia (SA); these countries are among the world countries accounting for 90 percent of pulse production. LMIC-other: other lower-middle-income countries among the world countries accounting for 90 percent of pulse production. LIC-dryland: low-income countries that encompass drylands in SSA and SA; these countries are among the world countries accounting for 90 percent of pulse production. LIC-other: other low-income countries among the world countries accounting for 90 percent of pulse production. UMIC: upper-middle-income countries among the world countries accounting for 90 percent of pulse production. HIC: High-income countries among the world countries accounting for 90 percent of pulse production. ROW: Rest of the World.

FIGURE 2 Growth trends in global and regional human population, pulse production volume, and pulse production value



Source: Authors' estimations using data on population from World Bank and other data from FAOSTAT.

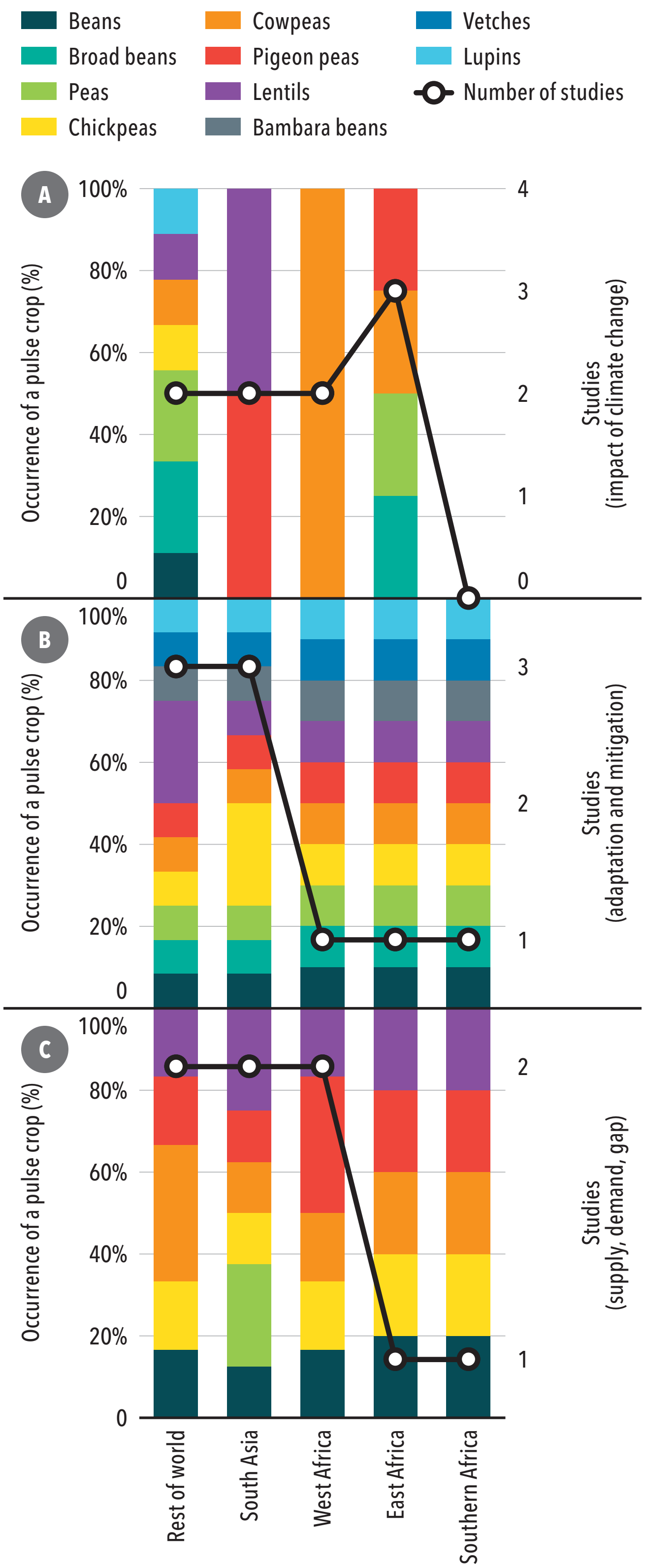
than the growth in volume for most years since 2000. This gap reflects a net surplus in the region, where pulse production tends to exceed consumption levels. Indeed, East Africa has been a rising net exporter of pulses since 2010. By 2021, its net exports amounted to 5 percent of its total production. A similar pattern is found in Southern Africa, also a net pulse exporter since 2011. As of 2021, its net exports amounted to 24 percent of pulse production. The volume and value of pulse production in that region more than tripled between 2000 and 2021, although the growth in value was slower than growth in volume from 2016 onward. In that region, population growth has been slower than that of production volume since 2000 (Figure 2).

LATEST FORESIGHT RESEARCH

The latest foresight research on pulses includes 26 publications covering various regions of the world (Figure 3). The pulses considered include dry beans, dry broad beans (fava beans), dry peas, chickpeas, cowpeas, pigeon peas, lentils, Bambara beans, vetches, and lupins (GPC n.d.). All relevant studies can be classified into three themes: the impact of climate change on pulse production; climate change adaptation and/or mitigation strategies related to pulses; and future projections on the supply, demand, or supply-demand gaps for pulses.

Two studies targeted high-income countries (Europe, France). The other studies mainly targeted the countries that encompass the drylands of sub-Saharan Africa and South Asia. More specifically, three studies targeted East Africa, and two studies targeted West Africa and South Asia. Among the studies targeting high-income countries, one aimed to quantify the impact of climate change on crop suitability in Europe for common beans, broad (fava) beans, chickpeas, lentils, lupins, peas, and cowpeas (Manners, Varela-Ortega, and van Etten 2021). The study projected that northern Europe becomes more favorable for pulse production, unlike southern Europe. The other study targeted yields of peas and broad beans in France; it projected increasing yields for both crops under most climate change models (Falconnier et al. 2020). The studies for South Asia targeted lentils and pigeon peas. The study on lentils targeted a specific site/soil in West Bengal, India (South Asia); it projected yield reductions of 12 percent to 31 percent by mid-century

FIGURE 3 Number of pulse crop studies and types of pulse targeted, by world region



Source: Authors, using data extracted from literature.

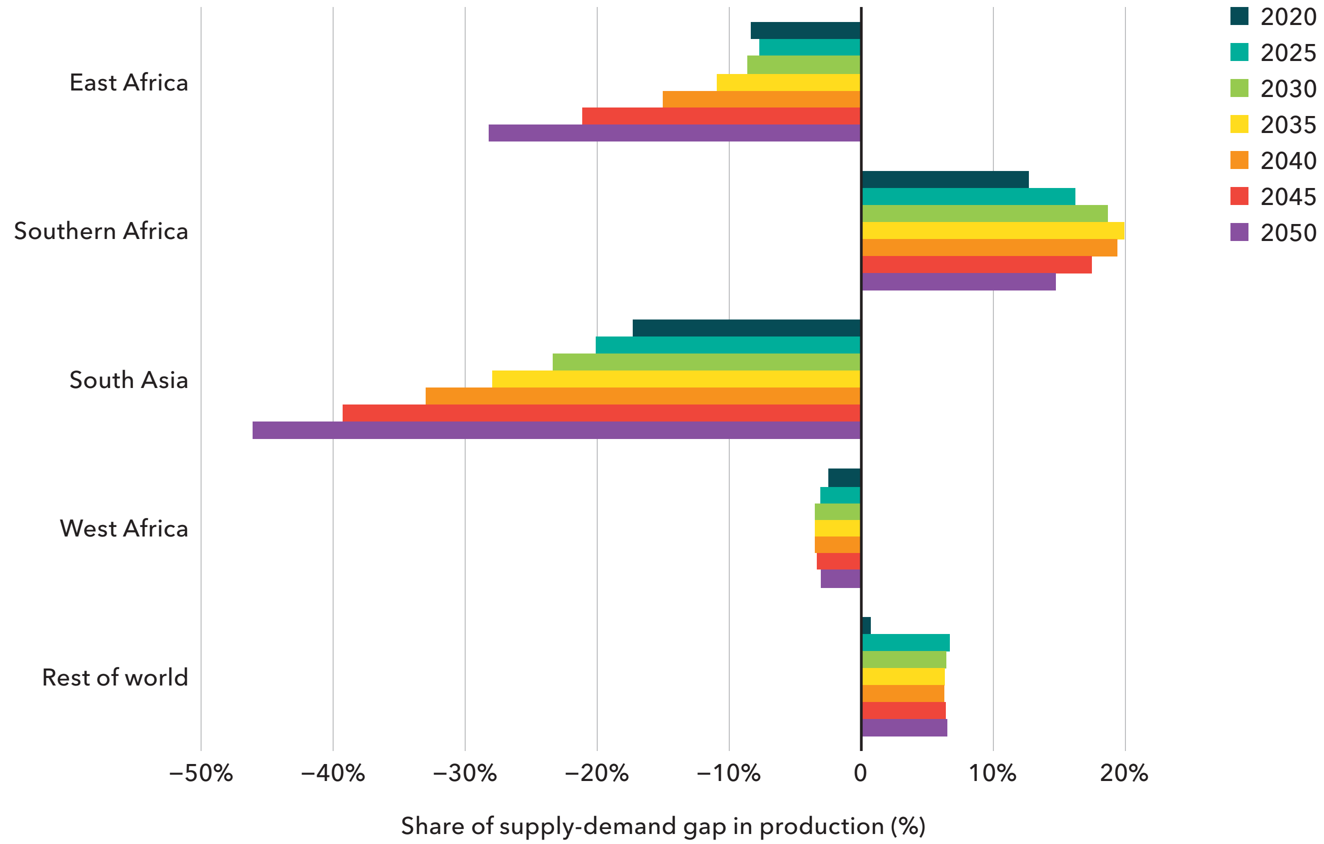
(2050s) (Chandran et al. 2022). The other site-specific study in northern India also projected decreasing yields for pigeon peas (Yadav et al. 2021). Both studies for West Africa were on cowpeas only, and both projected increases in yield and biomass under long-term climate change (Adusei et al. 2022; Alvar-Beltrán et al. 2023). Studies in East Africa targeted four pulses: dry broad beans, dry peas, cowpeas, and pigeon peas. A geospatial study in Ethiopia found that the total amount of land suitable for cowpea production is projected to decrease slightly under climate change by the 2050s (−4.9 to −6.9 percent) and 2070s (−1.9 to +3 percent) compared to the current acreage (Kagnew, Assefa, and Degu 2021). A site-specific study in Kenya projected decreasing yields for pigeon peas under long-term climate change (Kwene et al. 2021). For dry broad beans, a site-specific modeling study in Welmera district in the Oromia Regional State of Ethiopia (East Africa) found mixed results on the performance of early- and late-maturity varieties under long-term climate change (Bogale et al. 2021). For mung bean (dry pea), a geospatial study in Ethiopia (East Africa) projected an increase (0.21 percent to 3.00 percent) in the land suitable for mung bean production under long-term climate change (Kagnew, Assefa, and Degu 2021).

In terms of climate change adaptation and mitigation, one study targeted all pulse crops across all regions of the world. It showed that legumes in general could play a substantial role in climate change mitigation if they become the major source of dietary protein for humans (Semba et al. 2021). Another study had a similar finding for lentils in Canada (Chaudhary and Tremorin 2020). For Europe and Turkey, a study used predictive learning to identify rust-resistant populations of lentils, which are also likely to remain rust-resistant under long-term climate change (Civantos-Gómenz et al. 2022). Two other studies targeted chickpeas in Iran (South Asia). The first showed that dormant deeding management combined with mid-maturity varieties of chickpeas was a potential strategy to increase grain yield and water use efficiency for chickpeas in northwest Iran (Amiri, Deihimfard, and Eyni-Nargeseh 2020). The other study projected increasing chickpea yields under climate change in Iran, and showed that the right combination of cultivars and management under long-term climate change (genotype x environment x management) could enhance yields (Amiri et al. 2021).

Future projections of supply, demand, and supply-demand gaps targeted many pulses and all world regions. One study used results from IFPRI's International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) model to estimate future supply-demand gaps for targeted legumes in all world regions (Nigam et al. 2021). For each pulse, the study identified key countries and regions that would be most affected by a supply-demand gap by mid-century if mitigation policies maintain temperature and precipitation in 2050 at levels equivalent to the early 2000s. The authors recommended that future research on improved varieties should target countries and regions with the largest gaps. Another study projected an increasing supply-demand gap to 2025 for all pulses in the Assam region of India, except for two: black gram and peas (Barman et al. 2020). The authors proposed various options for reducing the supply-demand gap: bringing more pulse area under irrigation; increasing adoption of recommended farm technologies; and replacing lentils with black gram for dal (food) processing. A study on pigeon peas in Oyo state in Nigeria projected slight increases in the size of pigeon pea farms and called for additional institutional support to promote pigeon pea production in the region (Fatokimi and Tanimonure 2021).

Updated results from the IMPACT model project that the supply–demand gap for pulses in South Asia will increase over the years, assuming a reference scenario involving climate change and middle-of-the-road changes in socioeconomic trends (Figure 4) (IFPRI 2024). The pulse supply-demand gap would reach 17 percent of total pulse production in South Asia by 2025; it would then continue to increase to reach about 46 percent of production by 2050. Similarly, the pulse supply-demand gap in West Africa is projected to remain small up to 2050; this opens possibilities for boosting production in that region to meet demand in other parts of the world. Southern Africa is projected to remain a net exporter of pulses up to 2050; however, East Africa is projected to become a net importer of pulses, with a widening supply-demand gap over the years. The supply-demand gap in the rest of the world is projected to remain small and constant up to 2050. These projections do not consider the abiotic and biotic stresses brought on by climate change. Nevertheless, they highlight the importance of trade in filling the gap between food supply and demand and enhancing food security in the drylands where these crops are important. Increasing food production requires adoption of improved varieties that can increase land productivity coupled with improved crop management that reduces yield gaps.

FIGURE 4 **Projected share of the pulse supply-demand gap in production, by world region**



Source: Authors using data from IFPRI (2024).

KEY GAPS AND OPPORTUNITIES FOR FORESIGHT RESEARCH

The most obvious research gap is related to targeting pulse crop research toward regions where they are important in human diets. For example, most pulses in the countries encompassing the drylands of sub-Saharan Africa and South Asia are produced for local consumption; they are not exported (Figure 2). Hence, foresight studies on pulses, which are important in local diets within these dryland areas, are required to support policies to enhance food and nutrition security in these regions. Between 2020 and 2022, foresight studies in East Africa focused on broad beans and mung beans, yet the most produced pulses in the region are dry beans, representing about 50 percent of pulse production, followed by broad beans (about 14 percent). Similarly, in West Africa, cowpeas account for about 80 percent of pulse production, followed by dry beans (12 percent), yet no foresight study in this region has targeted dry beans. Similar mismatches exist for the other regions, including South Asia.

Another gap relates to some regions being neglected in foresight research. Thus, South Asia and East Africa used to be among the least studied dryland regions for foresight on legume (Gbegbelegbe et al. 2021). However, since 2020 South Asia has become the focus region for this research, with five studies undertaken. It is closely followed by East and West Africa, with four studies each. Conversely, Southern Africa remains the least studied region, with only one study conducted between 2020 and 2022.

Future studies should also tackle the issues of trade and demand shifts in the dryland regions. If recent trends are to continue under climate change, some regions and countries within the drylands will experience substantial supply-demand gaps in the near future (Figure 2) and by mid-century (Nigam et al. 2021). Future studies should identify tailored policies to enhance trade between dryland regions and encourage shifts in consumer demand. More specifically, some pulses that are more suitable for production should replace less suitable ones in human diets.

Future studies should also quantify the impact of climate-induced biotic stresses and weather extremes on pulse production to identify options for mitigating the negative impacts of such events. To date, no foresight-related study has analyzed the impact on pulses and adaptation options for the pests, diseases, and weeds related to climate change. Similarly, no study has assessed the impact of weather extremes on pulses.

This chapter was supported by the CGIAR Research Initiative on Foresight and the CGIAR Science Program on Policy Innovations. We would like to thank all funders who supported this research through their contributions to the CGIAR Trust Fund.

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Related chapters on the future of food system drivers and impacts, regional and national perspectives, food commodities, and foresight tools are available in our Table of Contents.

Citation: Gbegbelegbe, S., W. Msukwa, S. Nedumaran, and A. Alene. 2025. "What Do We Know About the Future of Pulses in Global and Regional Agrifood Systems?" In *What Do We Know About the Future of Food Systems?*, eds. K. Wiebe and E. Gotor, Chapter 31. Washington, DC: IFPRI. https://hdl.handle.net/10568/175019

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