



Pakistan Policy Note 6

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Increasing Agricultural Productivity

Agriculture remains a socioeconomically and politically important sector in Pakistan, even as its share in the overall economy continues to fall. Sluggish growth in productivity has constrained farm income growth, limiting its potential for reducing poverty. There remains, however, substantial scope for accelerating broad-based agricultural growth to boost returns, which requires stimulating productivity growth through technology and innovation, better water use management, and the right trade policies.

More specifically, the national agricultural research system requires fundamental institutional reforms to make it more efficient and effective. For water, the most important intervention is institutional reform of the entire management system, including completing the devolution of authority to the appropriate scale with provision of sufficient resources and capacity building to the devolved authorities. Finally, improving agricultural trade will require removing discretionary instruments like the statutory regulatory orders and simplifying the trade regime. Distortions in domestic commodity markets also need to be removed. Food price stability is important, but it can be achieved through mechanisms more cost-effective than those in use today. Further, food security for the most vulnerable can be supported more efficiently through well-targeted social safety net programs.

Pakistan's real GDP has grown substantially over the past decade, at an average of about 4.9 percent a year. Growth in agricultural value added has been lower at 3.3 percent a year. As is the case in transforming economies, transitioning from an agrarian to a developed economy is

accompanied by a decline in the share of primary agriculture and a commensurate increase in the share of manufacturing and services. Pakistan has experienced this trend, with the share of agricultural value added in real GDP declining from 46 percent in 1960 to 26 percent in 2000 and to 21 percent in 2010 (World Bank 2011a).

Nevertheless, agriculture remains a socioeconomically and politically important sector in Pakistan's current transformation. Agriculture directly accounts for more than 40 percent of employment, but the sector's contribution to overall employment is likely much higher, considering the downstream activities through the supply chains, transportation, and processing sectors to which it contributes (World Bank 2011a). Agriculture also contributes substantially, directly and indirectly, to foreign exchange revenue. Its exports account directly for more than 11 percent of total exports, with exports of downstream industries like textiles accounting for more than another 40 percent (Planning Commission 2009).

While the poverty rate has continued to fall in the past decade, agriculture's poor performance has limited its contribution to poverty reduction. The proportion of the population below the national poverty line declined from 34.7 percent in 2001/02 to 21.9 percent in 2005/06—and to 17.2 percent in 2007/08 (World Bank forthcoming). Of the 12.8 percentage point decline in the

poverty headcount ratio between 2001/02 and 2005/06, growth in farm income accounted for 2.8 percentage points (Inchauste and Winkler 2012). When 2001/02–2007/08 is considered, farm income growth accounted for 3.2 percentage points.

The Planning Commission (2009) estimates that average yields tend to be far below the achievable upper bound of progressive farmer yields.¹ The national average yields of major crops like rice and wheat are only about 55 percent of progressive farmer yields, the highest achievable yields in Pakistan (Figure 1). The yield gaps are even greater for some commercial crops, like sugarcane in Sindh (73 percent). Despite the large potential for improvement, yield growth has slowed. For example, rice yields grew at an average annual 5.2 percent in the 1960s but just 3.2 percent in the 1990s and 1.7 percent in the 2000s. A similar pattern can be seen with wheat, which had average annual yield growth of 2.9 percent in the 1960s, 2.0 percent in the 1990s, and 1.1 percent in the 2000s.

These crops and others represent major shares of the country's crop production, and narrowing the yield gap for major cereals (rice and wheat) and for high-value crops (cotton and sugarcane) would boost agricultural GDP substantially (Figure 2). High-value agricultural products, in particular, have been increasing their contributions to Pakistan's exports. Agricultural exports account

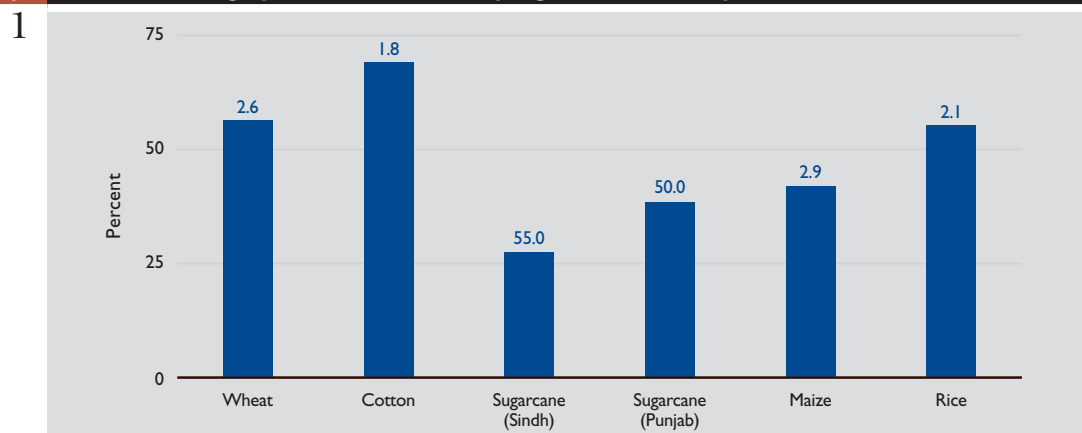
for a quarter of annual export revenue, and their share is increasing rapidly. In 1990, for example, dairy, eggs, and meat had virtually no exports (Hazell and others 2011). But in 2011, exports of dairy and eggs were valued at \$30.1 million (real 2000 dollars), while those of meat and livestock were valued at \$106 million.² Fisheries grew 45 percent a year over 2008–11, while fruits, vegetables, and oilseeds collectively grew just 15 percent.

Sluggish Productivity

Pakistan's agricultural output growth rate has been decelerating, reflected in its declining total factor productivity (TFP) growth rate.³ In the 1980s, average annual output growth reached 4.8 percent, making the country an international leader in agricultural growth. However, the rate slowed to a more modest 3.3 percent over the past decade, driven by more complex changes in input use and TFP.

In earlier decades, TFP growth was responsible for substantial shares of output growth (Figure 3). For example, TFP accounted for 44 percent of output growth in the 1960s, 67 percent in the 1980s, and 37 percent in the 1990s. By contrast, TFP now accounts for less than a fifth of the growth. Relative to other countries, agricultural TFP growth since 1990 and especially since 2000 has been very slow (Figure 4). Pakistan's TFP growth has gone from among the best in the world in the 1980s to

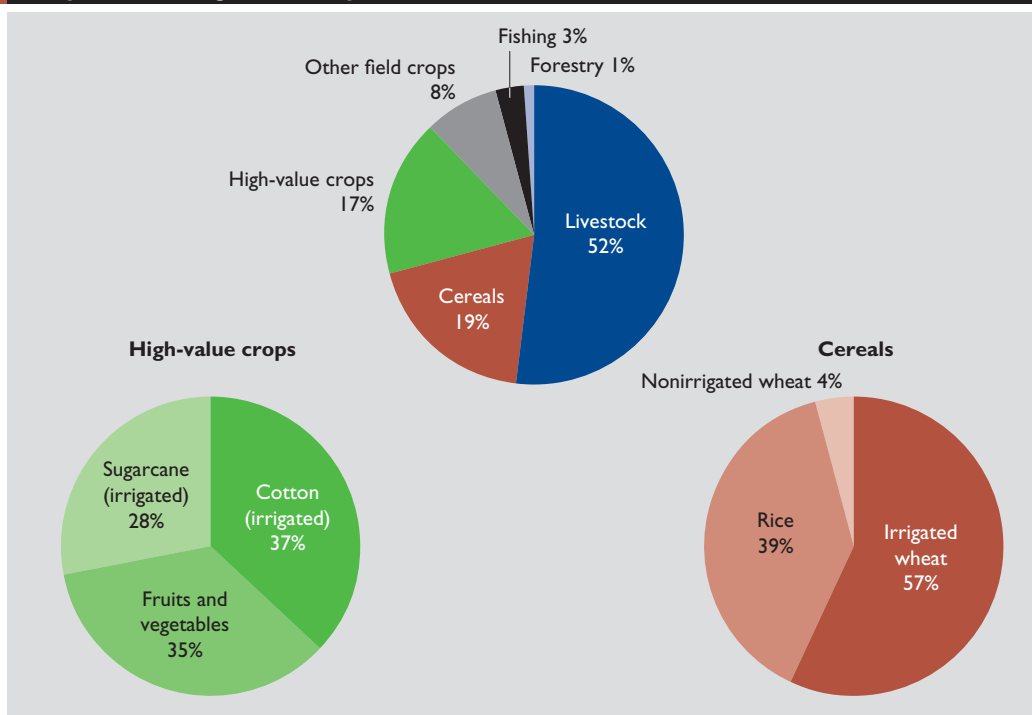
Figure 1 National average yields as a share of progressive farmer yields



Note: Numbers above columns indicate national average yields in tons per hectare.
Source: Planning Commission 2009.

Figure 2 Composition of agricultural production

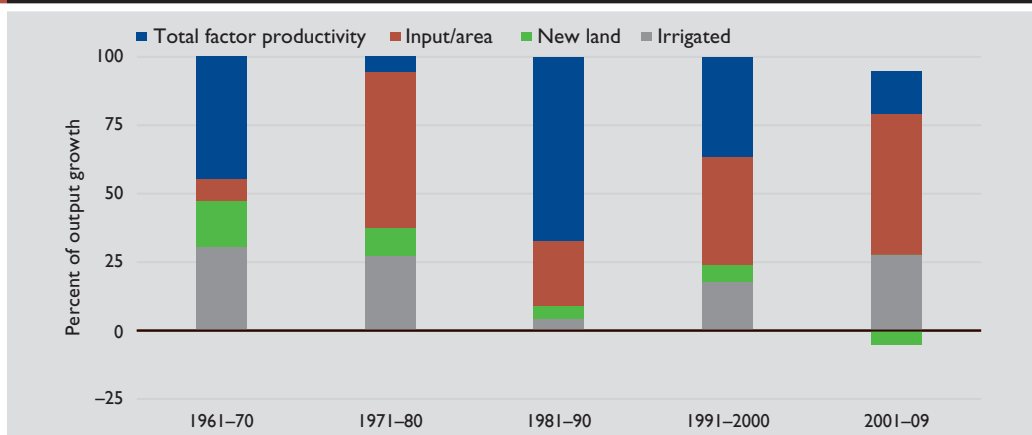
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Source: Debowicz and others 2012.

Figure 3 Decomposition of output growth in agriculture by land, input intensity, and total factor productivity, 1961–2009

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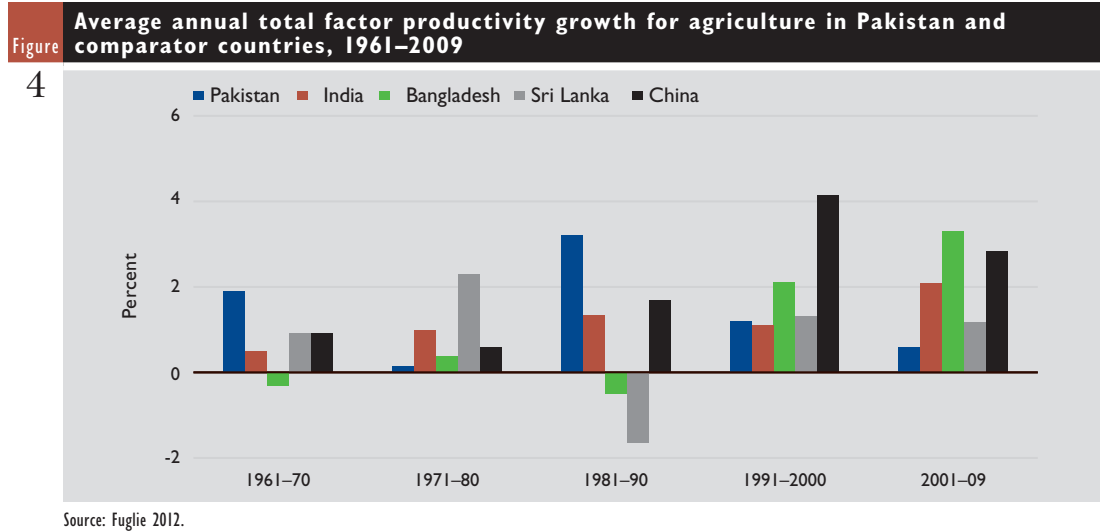


Note: Land quality is adjusted by converting rainfed cropland, permanent pasture, and irrigated cropland into rainfed equivalents.
Source: Fuglie 2012.

the lowest among such Asian comparators as Bangladesh, China, India, and Sri Lanka. Until the mid-1990s, Pakistan had even higher TFP growth than China and almost the same rate as Brazil—two of the world’s outstanding long-term agricultural performers. Since the mid-1990s, however, Pakistan’s TFP has been flat while the comparators (including high-performing Indonesia, Thailand, and Vietnam) have done markedly

better. With TFP growth progressively slowing, output growth has been driven increasingly by input use (fertilizer, labor, livestock, and machinery) and irrigation, highlighting the importance of using these inputs efficiently and sustainably.

Land ownership and poverty have a strong inverse relationship. The majority of the rural poor are landless or own very small plots. Anwar,



Qureshi, and Ali (2004) estimate the poverty headcount of rural nonfarm households at about 48 percent, second only to that of landless farmers (55 percent) but greater than that of farmers with less than a hectare (32 percent). Poverty among farm households with more than a hectare is virtually absent. Moreover, agricultural performance is constrained by the highly unequal distribution of land in rural areas. In 2000, 61 percent of farm households owned less than 2.0 hectares of land (15 percent of total land holdings). Only 2 percent of households had holdings greater than 20.2 hectares, but in stark contrast they accounted for 30 percent of total land holdings (World Bank 2007). Yet past evidence suggests that land productivity on smaller farms may be higher than that on larger farms and that small farms generate higher profits per hectare than large farms (World Bank 2004). This suggests that greater access to land by smallholders leads to higher overall agricultural productivity. Further, the land market rigidities that perpetuate the historical inequity in land distribution also seriously affect the development of the nonfarm sector (Safavian, Aftab, and Shaikh 2013).

Land is rarely bought and sold, so the status quo of unequal land distribution tends to hold, and land rental markets are highly inefficient. The inequality in landholdings by province remained mostly unchanged from the 1970s to 2000 (World Bank 2007). The low rate of transactions is largely attributable to high transaction costs and, possibly, speculative prices in excess of the

discounted value of potential agricultural earnings from the land. An important constraint for the landless is a lack of access to credit due to a lack of collateral—land is the most commonly accepted collateral for formal loans.

Given the land limitations, increased crop yields accounted for much of the past growth and can be attributed to major scientific breakthroughs in technology. Major contributions came during the Green Revolution, from the investments in agricultural research undertaken by the national agricultural research system. While helping achieve national food security, past research efforts focused primarily on technologies relying on modern inputs but did not attend to issues of sustainability and efficiency, such as integrated crop management, soil health, economical use of inputs and resources, and the balancing of external input use with internal nutrient sources. About 52 percent of public research expenditure is on crops, 25 percent on natural resources, about 14 percent on livestock and fisheries, and about 9 percent on social sciences (World Bank 2011c).

Public agricultural research has historically been successful. Estimated internal rates of return from investments in it have ranged from 57 percent to 65 percent, with most of the returns from Green Revolution research (Ahmad and Nagy 2001). After a period of nationalization of large and medium-size private agribusinesses in the mid-1970s came a slow process of their denationalization and deregulation. Investment in

private agricultural research and development (R&D) was thus curtailed severely for a long time, with only recent outreach to the private sector through programs like the Ministry of Science and Technology's Science and Technology for Economic Development program.

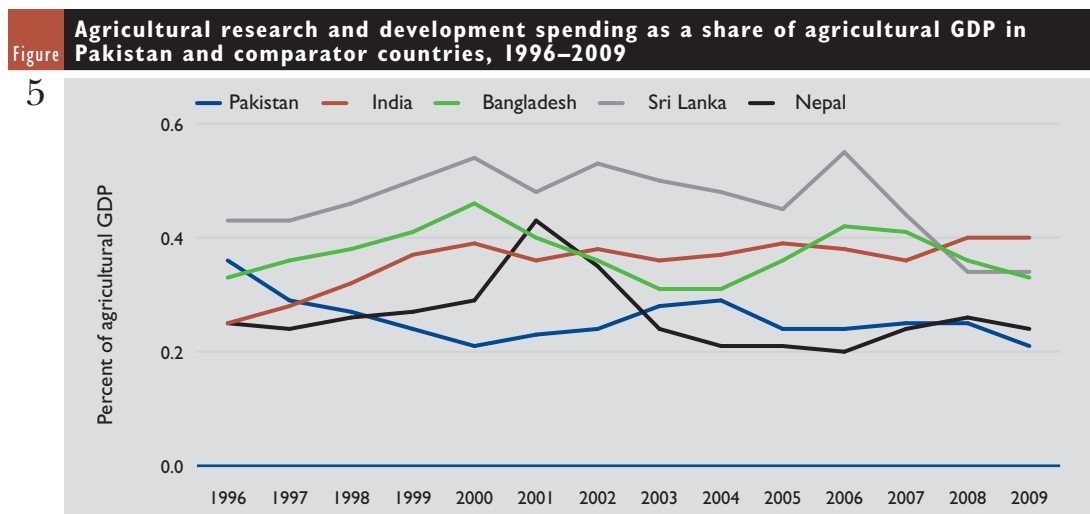
However, the current agricultural research system labors under severe technical capacity constraints. Pakistan's public investment in agricultural research has been on the decline, and in 2009 stood at about 0.21 percent of agricultural GDP and ranked at the bottom of agricultural R&D spending as a share of agricultural GDP in the region (Figure 5; ASTI 2012). The Planning Commission (2009) notes that persistent funding constraints may have contributed to limited technology advancements (by limiting research activity)—for example, the wheat cultivar that has dominated production since 1991 is susceptible to rust disease. Another critical constraint is the limited human resource capacity: only 15 percent of agricultural research staff hold PhDs, lower than in the rest of South Asia (Beintema and others 2007). Qualified researchers are discouraged from public research agencies because of institutional disincentives, such as few promotion opportunities and low salaries.

The technical capacity constraints are compounded by inefficiencies generated by a complex institutional environment. Beintema and others (2007) identified 111 agencies involved in agricultural R&D, employing more than 3,600 researchers

and spending nearly PRs 2.4 billion (2000 PRs). Of these, 37 were federal agencies, 44 were provincial agencies, 17 were higher education institutions, and 13 were private entities. The Pakistan Agricultural Research Council (PARC) coordinates the activities of a large network of public national and provincial agricultural research bodies, institutes, and experimental stations. PARC does not conduct agricultural research itself, but it is responsible for the administration of the National Agricultural Research Centre (NARC). Since the 18th Amendment to the constitution passed in 2010, the public agricultural system has been devolving from the federal to the provincial level, creating new opportunities for reenergized public agricultural research. With the research agenda moving down, agricultural research can potentially have a greater focus on the needs of local farmers and environmental conditions, though challenges of coordination, duplication, and cost-effectiveness could arise.

Inefficient Water Use Management

A critical factor in improving crop yields (besides technology) is water availability and the performance of irrigation. Pakistan's irrigated land as a proportion of cropland is the highest in South Asia, with about 95 percent of arable land equipped for irrigation.⁴ Historically, Pakistan's rate of irrigation expansion was the slowest in South Asia. Indeed, in the 1970s the average annual rate was 1.2 percent, against a South Asian



Source: ASTI 2012.

average of 2.2 percent. In the past decade, however, Pakistan's rate of irrigation expansion accelerated to 1.4 percent a year, exceeding the 1.1 percent South Asian average.⁵

But cropland expansion has been slow—a phenomenon common to the region. From the 1970s to the 1990s, Pakistan maintained a cropland expansion rate of 0.6 percent a year, even when such growth was almost stagnant in South Asia as a whole. In the past decade, though, the country's cropland has been shrinking at an average 0.4 percent a year, faster than the 0.1 percent in South Asia as a whole.⁶

Despite the high irrigation intensity, average farmers' access to water is less than it could be due to limitations of the water allocation system. At the farm level, access to canal water is determined by physical location along the canal and through the *warabandi* water allocation system of administratively set rotations. Access to canal water then becomes contingent on access to land and the location of that land. There might not be enough water by the time it gets to land at the tail end of distributaries or watercourses, especially if upstream farmers are accessing water illegally (Yu and others 2012).

The irrigation system is highly inefficient, with steep seepage losses in almost every component of the delivery system. Of the 106 million acre-feet (MAF) of irrigation water that goes into the system,

only 41 MAF reaches crops, a loss about 61 percent of the water delivered at the head. Of this 106 MAF, about 25 MAF are lost in watercourses and 17 MAF in fields, the most vulnerable components of the irrigation system (Yu and others 2012).

Improving the efficiency of water use is therefore a high priority—not only to boost current productivity but also to mitigate the impending risks associated with climate change (Box 1). Yu and others (2012) simulate various climate change scenarios for 2020–80 and estimate the sensitivity of the 2008 benchmark economy to future climate risks. They find that, faced with future climate risks, overall GDP could decline 1.1 percent from its benchmark year value and agricultural GDP 5.1 percent. They also find that improving canal system efficiency to save just an additional 12 MAF could not only mitigate the adverse impact of climate change but further boost overall GDP 0.9 percent and agricultural GDP 4.2 percent, on average, relative to the benchmark.

Financial unsustainability is another critical challenge to the irrigation system under the current water management system. The canal irrigation management system recovers only a quarter of its annual operating and maintenance costs, with the shortfall expected to increase with rising costs and stagnant *Abiana* (water charges) per acre of crops irrigated (Planning Commission

Box 1 Water management reform—promising but incomplete

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Recognizing the importance of a robust and efficient water management system, the government pushed through reforms in the 1990s. These reforms restructured the public irrigation departments to provincial irrigation and drainage authorities; to area water boards to manage main and branch canals; and to farmers' organizations and water user associations to manage distributor and minor canals. They aimed to enhance water use efficiency, streamline water resource management, and facilitate user participation.

These reforms have not been completely successful, however, owing to problems at the provincial and local levels. Provincially, the devolution of autonomy from the irrigation departments is incomplete. For example, in Punjab's public irrigation department and public irrigation and drainage authority, the secretary of the department is also the managing director of the authority. Another example is in Sindh, where even though the posts of irrigation department's secretary and irrigation and drainage authority's managing director are held by different people, the latter has a direct reporting relationship to the former. Locally, the farmers' organizations do not have the resources or the capacity to fulfill their roles. Nor do they have input into the *Abiana* setting process, even though they might be responsible for collecting charges. Farmers' organizations also vary widely in their role as charge collectors, because this role is determined by management that these organizations may not have any voice in. The lack of clarity in the role of the farmers' organizations and their widely varying mandates by local government has contributed to the *Abiana* collection inefficiencies that are damaging the system's financial sustainability.

2012). The collection rate of assessed *Abiana* is also low—at only 60 percent of assessed values. The Planning Commission (2012) estimates that the overall budget gap is about PRs 5.4 billion annually, with the system subsidized by the federal government.

The current Abiana for different crops might also be distorting farmer decisions. The national average *Abiana* per acre in 2000–09 was PRs 126–214 for cotton, PRs 185–428 for sugarcane, PRs 125–210 for rice, PRs 69–136 for maize, and PRs 75–131 for wheat. But though rice requires 60 percent more water than cotton—both major export crops—their irrigation charges per acre are about the same, and so may not reflect the crops’ relative profitability, leading to possible overproduction of rice.

Policy Distortions to Trade

International and domestic trade are critical to improving agricultural production but face challenges to growth. Policy changes since 2006 have steadily eroded the effects of trade liberalization that Pakistan implemented over 1996–2003. During this period, the government simplified the tariff structure and abolished its state trading monopolies for agricultural products. But it introduced exceptions in 2006 and reversed several of the more important liberalizing reforms in agriculture, particularly for wheat, sugar, and fertilizer. The use of statutory regulatory orders (SROs) has also expanded since 2006. SROs and new regulatory duties have been used to provide exemptions to normal tariffs in some cases and to raise tariffs in others. The resulting trade regime has thus become highly discretionary and uncertain, leading to input-price distortions and highly variable output prices. The expanded ad hoc use of SROs also has fiscal implications, as preferential provisions provide the beneficiaries of the orders with special tax and duty concessions and exemptions, leading to a loss of potential tax revenue (Lopez-Calix and Touqeer 2013).⁷

In most years, major crops like wheat, rice, sugar, and cotton are implicitly taxed by the various price distortions introduced by policies. The policy-induced

implicit tax on crop production serves to depress production, despite implicit net input subsidies. Basmati rice, for example, had negative effective rates of protection in 2008–10, when farm income would have been 21–40 percent higher under a no-intervention regime (Valdes and others 2012). The case of sugar is also illustrative: the surge in the world price of refined sugar raised the parity price, but the increase in the general sales tax applied to sugar offsets higher border prices. Sugar’s parity prices are roughly twice the observed farm-gate prices, with this price wedge discouraging production.

The benefits of some domestic trade policies have also been unclear, as illustrated by the public procurement of wheat. Government procurement of wheat is extensive, involving federal, provincial, and district agencies. The government sets the procurement price with targets that the Pakistan Agricultural Storage and Services Corporation and provincial food departments are responsible for meeting. Provincial governments (mainly Punjab and Sindh) and the corporation procure about 20 percent of total wheat production each year (Prikhodko and Zrilyi 2012). This federal and provincial procurement is absorbing the price transmission that would otherwise prevail in open markets, contributing to a price stabilization effect. Indeed, because the government controls domestic wheat prices and procurement volumes, as well as the international wheat trade, price transmission from world to domestic markets is minimal.

The impact of these procurement policies on consumer welfare is ambiguous, and they can become fiscally unsustainable while also leading to perverse outcomes like subsidized exports. All procured wheat is bought and then sold to flour millers in the same wheat-marketing year, with the government absorbing the costs of procurement, storage, and financing. Millers can buy the subsidized wheat at below market prices and then sell the flour at open market prices, which would be the prices for consumers. This price stabilization role is perhaps one reason for the recent rise in wheat stocks, which has led to exports at subsidized prices in years of high wheat production.

Policy Recommendations

Broad-based agricultural growth can be achieved through narrowing the wide yield gaps and diversifying toward high-value agricultural products. This growth can improve the agricultural incomes of farmers (and especially of smallholders), as well as improve rural incomes more generally, through higher returns on land and labor—the latter benefiting the many rural landless poor. Actions are needed in the following key areas to enhance agricultural growth and improve farm incomes (Table 1).

Improve agricultural productivity

Substantial reforms to the national agricultural research system are needed. First, the system requires fundamental institutional reforms to make it more efficient and effective. With efforts under way to develop provincial agricultural research institutions, the role of the PARC and the NARC needs to be adjusted to exploit their comparative advantage of being a federal institution able to facilitate federal funding, intraprovincial knowledge, and capacity building. Second, with the shift in primary activities from federal to provincial levels and from policy coordination to agricultural research,

there is a need to reflect these activities in human resource and performance incentives. This may require moving personnel from the center to provincial institutions, or even changing the composition of the staff, to increase the proportion of scientific research staff, for example. Third, these reforms will require additional spending in agricultural R&D, whether for supporting agricultural research in provincial research centers or capacity building of science staff, with the exact composition of the additional spending depending on the nature of the institutional reforms.

These reforms to the R&D architecture, by their nature, would be very wide ranging and require substantial groundwork prior to execution. The first step (of two)—a stocktaking of the current agricultural research system—would need to include a detailed institutional audit that examines the system as a whole and to clearly delineate the roles, functions, and mandates of the public federal and provincial bodies that govern and conduct agricultural research. More broadly, this stocktaking would also need to account for the current roles of (and environment for) private R&D, including those of domestic and multinational agribusinesses. It should then lead to a strategic road map for

Table 1 Policy matrix

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Objective	Short-run action	Medium- to long-run action
Improve agricultural productivity	Initiate reform of the national agricultural research system to make it more efficient and effective Develop plans for building scientific research capacity	Carry out reforms of the national agricultural research system (clarify mandate, shift personnel from federal to provincial institutions, shift budget, provide appropriate performance incentives) Increase budget for agricultural research Plan and implement long-run capacity-building program for scientific research capacity
Improve water use efficiency	Identify mechanisms for institutional reform of the management system: <ul style="list-style-type: none"> Complete devolution of authority to the appropriate scale (including provincial and farmers' organization) Clarify the roles and mandates of each authority 	Implement institutional reform Provide sufficient federal and provincial resources for transition and capacity building Set up a third-party watchdog to evaluate the state of institutional reform and to monitor for rent seeking
Remove protection variability and bias against agricultural exports	Identify timetable for removal of statutory regulatory orders, tariff reduction and harmonization, and export-barrier removal Identify World Trade Organization—compliant instruments that may be appropriate to use instead, such as special safeguard mechanisms	Remove statutory regulatory orders, reduce and harmonize tariffs, and dismantle export barriers
Reduce distortions in domestic grain markets while protecting food security	Identify minimum volume of public wheat procurement (federal and provincial programs) Identify floor and ceiling prices to follow world prices for wheat prices Identify food-insecure groups for social protection programs	Implement rules-based adjustable tariffs to maintain designated price bands Develop and roll out social protection programs for food security, with clear triggers and graduation requirements

overhauling the national agricultural research system, with particular emphasis on future budgets, human resources, and capacity building. In keeping with the spirit of the 18th Amendment, this strategic planning would need to have the input and buy-in of provincial and local government institutions and should not be left to just the PARC and the NARC. The second step would be to roll out the appropriate reforms over the next one or two budget cycles.

Improve water use efficiency

The most important intervention would be institutional reform of the entire water management system. Given the system's high dysfunction, clarifying the institutional environment would be a prerequisite for any other intervention under consideration, such as revising the *Abiana*. The reforms to the water management system include completely devolving authority to the relevant scale, clarifying the roles and mandates of each authority, and providing sufficient resources and capacity building to allow the devolved authorities to fulfill their mandates.

As with the reforms to the national agricultural research system, reforms to the whole water management system will require action over multiple years and will need to be carefully considered. Water management systems show wide divergence in budgets, capacity, and extent of devolution from the federal to provincial level. The reforms need to first identify their current state, from public irrigation departments down to the farmers' organizations and water user associations, which will help clarify the roles and mandate of each authority and outline a devolution plan for each area where devolution has not occurred (such as the public irrigation and drainage authority still managing public irrigation departments). For entities that require capacity building and management reform (such as farmers' organizations), budgets to train and support personnel are needed.

Improve international trade in agricultural products

The trade regime must be simplified. This will require removing unpredictable and discretionary

instruments like the SROs, shifting to a lower set of uniform tariffs, and simplifying the trade regime by removing alternative trade policy instruments like export taxes. These three measures would reduce uncertainty, volatility, and the policy bias against agricultural products like rice and sugar. Valdes and others (2012) also point out that equalizing tariffs across agricultural products, while necessary, is not sufficient for equal effective protection across products, because protection or support in the input markets could still be substantial, at varying levels. Their study argues that the best approach to reducing the variation in effective protection across outputs is to also reduce the variation in protection of all inputs, including raw materials, capital, and tradable inputs. From a practical perspective, the measures will require a realistic timetable, as well as instruments compliant with the World Trade Organization that may still be able to protect national interests.

Improve domestic trade of agricultural products while protecting food security

Distortions in domestic markets of commodities like wheat need to be removed. The simplest set of reforms would be to reduce the wheat procurement volume while designing and implementing complementary social safety net programs. The wheat procurement contraction would reduce the effective subsidy to wheat producers and thus the fiscal burden. If food price stability is important, price bands can be implemented using rules-based adjustable tariffs that set floor and ceiling prices to follow world prices.⁸ In parallel, social safety net programs that target food-insecure groups can be established, with clearly defined triggers and graduation requirements.

Notes

1. "Progressive farmers" refers to farmers in Pakistan who have achieved high crop yields applying the available technology and management practices. They thus provide good benchmarks of what is currently achievable.
2. Estimated from the United Nations Commodity Trade Statistics database.

3. The statistics in this section are authors' calculations based on Fuglie (2012). The TFP estimates in Fuglie (2012) are based on agricultural data on comparable output as well as inputs (labor, land, livestock, machinery, fertilizer, and land quality adjustments due to irrigation) for more than 170 countries. Since TFP estimates are sensitive to model specification and the level of aggregation of inputs included in the calculations, the agricultural TFP estimates in Fuglie (2012) for Pakistan may differ from the estimates from other studies at a more aggregated level, such as Lopez-Calix, Srinivasan, and Waheed (2012), which takes a more multisectoral perspective and uses different input definitions. The trends in both studies are similar, however—rising in the 1980s and declining thereafter.
4. All estimates in this paragraph are authors' estimates based on Fuglie (2012).
5. Pakistan has an irrigation potential of 21.3 million hectares of land, of which 19.3 million are equipped for irrigation: 35.9 percent for surface water, 21.4 percent for groundwater, and 41.3 percent for a mix of surface and groundwater (FAO 2010).
6. All estimates in this paragraph are based on Fuglie (2012).
7. Agricultural incomes are not taxed, and taxing farm income has the potential to increase the tax base and increase revenue. However, Aftab and others (2010) suggest that the poverty impacts of taxing agricultural incomes may be negative, as the tax incidence will be sensitive to the income distributions across agricultural households. Agricultural income taxes may potentially increase poverty if applied too broadly to all households instead of only large farmers.
8. Valdes and others (2012) suggest this approach for wheat and sugar, based on the moving averages of border prices. By keeping the basis of the price band delinked from domestic prices, the policy remains a World Trade Organization-compliant instrument as a variable levy.

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