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## **Improving the Equity and Effectiveness of Nepal's Fertilizer Subsidy Program**

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## ABSTRACT

Increasing agricultural productivity is fundamental to long-run growth, but failures in agricultural input markets can be a significant constraint on meeting this objective. Many developing countries therefore subsidize the costs of agricultural inputs. This paper examines the equity and effectiveness of the fertilizer subsidy program in Nepal. Using an original household survey of more than 1,000 households across rural Nepal, we find that although the fertilizer subsidy program has been effective in increasing the overall supply of fertilizer in the country over time, 75 percent of farmers still report that they cannot purchase enough fertilizer to meet their needs. Further, fertilizer subsidies overwhelmingly benefit larger farmers in Nepal's central valley region at the expense of poorer, more food-insecure farmers in its western regions. The subsidies are also poorly coordinated with crop extension services, with the result that the farmers who are able to obtain fertilizer often fail to apply it in optimal ways. On the other hand, we also show reason to be hopeful that many of the inequities and inefficiencies in the program can be improved over time. One of the primary reasons that many countries fail to reform subsidy programs is fear of political backlash, yet we find that Nepali farmers overwhelmingly prioritize access to extension services over paying low prices for fertilizer. This preference provides suggestive evidence that the government may be able to build the political will to improve the program.

**Keywords:** Nepal, service delivery, governance, fertilizer subsidies, policy preferences, inequality

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# 1 INTRODUCTION

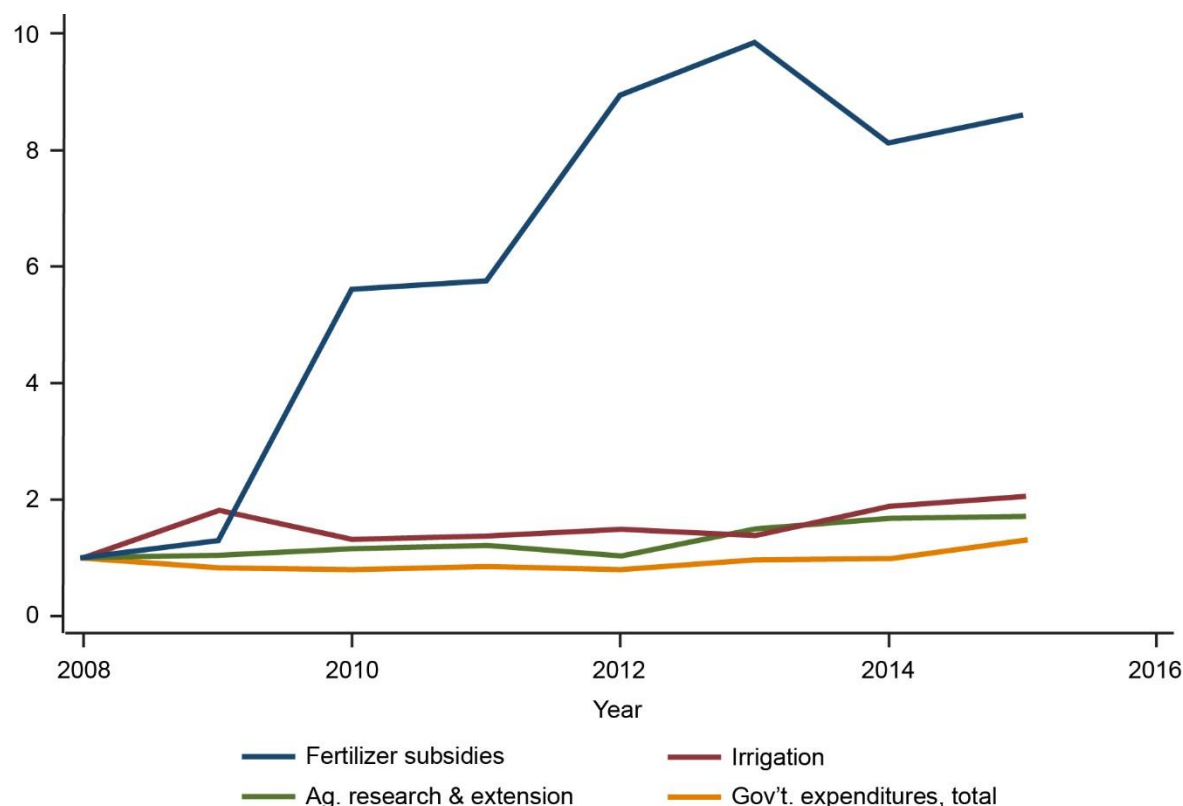
Increasing agricultural productivity is fundamental to long-run growth, but failures in agricultural input markets can be a significant constraint on meeting this objective. Farmers in many developing countries, including Nepal, face high input prices, lack of credit to facilitate purchasing inputs, and low knowledge about how to use them optimally. In this context, agricultural input subsidies can play a role in improving access to and increasing use of important agricultural inputs such as fertilizer and seeds. For input subsidy programs to be effective, however, there must be adequate overall supply, the inputs must be targeted to reach the most constrained farmers, and they must be linked with agricultural extension to ensure that farmers have enough information to use them effectively.

Concerns about increasing agricultural productivity reached an apex following the food and commodity price spikes in 2007 and 2008, and many governments responded by providing price support to farmers through fertilizer subsidy programs. Due to relatively high levels of food insecurity, Nepal was one of many countries that introduced a fertilizer subsidy program in the wake of the food price crisis. As in many countries, the provision of agricultural input subsidies in Nepal is a complex and highly political issue, particularly because it is linked to Nepal's long-term goals of commercializing the agricultural sector and improving food security.

Fertilizer subsidies have increased significantly in Nepal in recent years, growing to become one of the most significant spending items in the agriculture sector. In the 2016/2017 budget speech, the country directed approximately 20 percent of its agricultural resources toward subsidies on fertilizer. The budget for fertilizer subsidies, at 5.47 billion Nepalese rupees (Rs), stands at more than double the budget for agricultural research (Nepal, MOF, *Budget Speech 2016/2017*; Nepal, MOF, *Red Book Fiscal Year 2016–17*). Moreover, growth in spending on fertilizer subsidies is far outpacing growth in other spending items in the sector. As Figure 1.1 shows, by 2015, spending on fertilizer subsidies in real terms was more than eight times its level in 2008/2009, when the fertilizer subsidy was initially reintroduced. In the meantime, spending on important public investments in the sector, such as irrigation and agricultural

research and extension, increased as well, but by far less. The increasing share of fiscal resources devoted to the fertilizer subsidy program provides an important motivation for reviewing the program now, almost 10 years since its inception.

**Figure 1.1 Index of real agricultural spending in Nepal, 2008–2015**



**Source:** Nepal, MOF, *Budget Speech* (2008/2009, 2009/2010, 2010/2011, 2011/2012, 2012/2013, 2013/2014, 2014/2015, 2015/2016); Nepal, MOF, *Red Book* (2008/2009, 2009/2010, 2010/2011, 2011/2012, 2012/2013, 2013/2014, 2014/2015, 2015/2016); Bista, Dhungel, and Adhikari (2016).

**Note:** Data for fertilizer subsidies are taken from budget speeches; data for agricultural research and extension, irrigation, and overall government expenditures are drawn from Red Books. For years in which the budget for the fertilizer subsidy program was not included in the budget speech, figures are drawn from Bista, Dhungel, and Adhikari (2016). All figures are converted to constant 2008 Nepalese rupees. 2008 = 1 for all variables.

This paper examines the fertilizer subsidy program in Nepal from two different angles, both important for policy makers in the country. First, it analyzes who is benefiting from the program, and second, it examines how farmers rank the importance of public spending on fertilizer subsidies compared with other potential public investments. Whereas the former question is important for judging whether the program is meeting its objectives, the latter is essential to understanding the scope for reform, in



particular the extent to which we could expect citizens to resist reforms to the subsidy program. We draw on these analyses as well as on examples from other countries to make policy recommendations to improve program implementation.

This research uses several different data sources, including the 2010/2011 Nepal Living Standards Survey (NLSS) III (Nepal, CBS 2012b); the 2011/2012 Nepal National Census of Agriculture (Nepal, CBS 2013); 2015/2016 administrative data on fertilizer distribution by district from Agriculture Inputs Company Limited (AICL); and the Nepal Rural Household Survey (NRHS), a representative survey of rural households conducted by the International Food Policy Research Institute (IFPRI) and the Institute for Integrated Development Studies (IIDS) in 2016. It also uses information from a series of stakeholder interviews conducted in Nepal in early 2017 with representatives from different government agencies, nongovernmental organizations, foreign donors, and private-sector actors.

The analysis identifies three main challenges in the implementation of Nepal's fertilizer subsidy program. First, although supply has improved over time, the country still faces significant supply constraints. Improvements in supply over time mean that most farmers who want to purchase fertilizer can do so, but only 25 percent report that they can purchase in sufficient quantities, with poorer households more constrained. Second, subsidized fertilizer is poorly targeted to address poverty, food insecurity, or nutrition status. The program primarily benefits larger farmers in the Central Region, rather than small and marginal farmers in Nepal's Far-Western, Mid-Western, and Western development regions, which are poorer and suffer more from food insecurity. Third, the fertilizer subsidy is poorly coordinated with crop extension services, limiting how effectively farmers use fertilizer.

The study concludes with a set of recommendations on some of the entry points for improving the design and efficiency of the program. Policy makers should continue to focus on increasing the overall supply of formally traded fertilizer in Nepal, and doing so may require greater involvement from the private sector. The program should be better targeted to address poverty and food security, which would entail distributing more subsidized fertilizer in Nepal's western regions and ensuring that subsidized fertilizer reaches the farmers who face the greatest constraints, primarily small and marginal farmers.

Policy makers should pursue the fertilizer subsidy program as part of an overall effort to manage soil fertility in Nepal that includes expanding access to extension services, coordinating between extension services and input subsidies, and ensuring that fertilizer is applied in a balanced way that maintains long-run soil quality.

The paper proceeds as follows. The second section provides a brief history of fertilizer policy in Nepal. The third section examines the data on fertilizer distribution to determine which districts and which farmers capture most of the subsidies. The fourth section focuses on how rural households view expenditures on fertilizer subsidies in light of other potential government expenditures in the sector. Finally, Section 5 provides policy recommendations, and Section 6 concludes.

## 2. POLICY MILESTONES IN FERTILIZER DELIVERY IN NEPAL

Despite impressive progress over the last decade, Nepal's food insecurity remains a concern during part of the year, and more than one-third of the country's children are stunted (Nepal, MOH; New Era; and ICF International 2017). Low agricultural productivity partially contributes to this challenge. Because most arable land in Nepal has already reached capacity, enhancing agricultural output will require greater farming intensity rather than an increase in area cultivated (Devkota and Upadhyay 2013). Along with improved seeds and expanded irrigation, fertilizer could play an important role in increasing agricultural yields in Nepal.<sup>1</sup> Thus, increasing fertilizer use has been a central goal in Nepal for many decades. In the following section, we review many of the policy milestones in fertilizer delivery in Nepal.

### Historical Fertilizer Policies in Nepal (1950–2008)

Chemical fertilizers were introduced to Nepal during the 1950s.<sup>2</sup> At the time, chemical fertilizer was primarily imported by private traders from India and by National Trading Limited from Russia. Overall usage was low across the country. In 1966, the government began a more concerted effort to import fertilizer and increase its use with the establishment of the Agricultural Input Corporation (AIC), a public enterprise under the Ministry of Agriculture. AIC was fully responsible for importing and distributing chemical fertilizers in Nepal. At the time, the government fixed fertilizer prices across the country but did not subsidize fertilizer. A key lesson drawn by policy makers during this period was that the high cost of fertilizer was a barrier to expanding its use, particularly in the hilly and mountainous regions (World Bank 2016).

When the price of oil—and fertilizer—spiked on international markets in 1973–1974, the government introduced a price subsidy, initially to encourage the use of chemical fertilizers even as international prices rose. The government set prices to be 15–20 percent higher than the price of subsidized fertilizer in India in order to discourage selling subsidized Nepalese fertilizer across the border

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<sup>1</sup> Land consolidation is another policy option in theory (Devkota and Upadhyay 2013) but politically complex in practice.

<sup>2</sup> This section draws from Shrestha (2010) and Takeshima and others (2016).

(Shrestha 2010). Because international fertilizer prices were so high at the time, AIC operated with significant losses, and its constrained budget made it increasingly difficult for the company to import chemical fertilizer. As a result, supply shortages were common, and farmers frequently stood in long lines to purchase marginal amounts of fertilizer.<sup>3</sup> There were also significant geographic disparities in program coverage, with more than 80 percent of subsidized fertilizer sold in the Kathmandu Valley (World Bank 2016, 27).

In the mid-1990s, the government significantly reformed the fertilizer sector. The Agricultural Perspective Plan (APP), adopted in 1995, explicitly linked increasing fertilizer use with improving food security in Nepal (APROSC 1995). The APP set per capita targets for food production (245 kg per capita in the mountains, 380 kg per capita in the hill region, and 482 kg per capita in the Terai) and identified chemical fertilizers as a primary means for achieving these targets. To these ends, the APP envisioned increasing fertilizer usage from around 31 kg per hectare to 131 kg per hectare by 2017. Fundamental to achieving these targets was increasing the overall supply of fertilizer in Nepal.

Given that AIC was operating on significant losses, increasing supply through the AIC budget was not possible. Moreover, a large-scale loan from the Asian Development Bank to support agricultural development in Nepal at the time set as a condition of the loan the deregulation of fertilizer trade as well as a phased removal of fertilizer subsidies (ADB 2004; Shrestha 2010).<sup>4</sup> Consequently, in 1997/1998, the government initiated a significant policy reversal on chemical fertilizer use in Nepal by liberalizing the fertilizer trade—breaking AIC’s monopoly on import and distribution—and completely removing fertilizer subsidies. The removal of subsidies was eased by a decline in international fertilizer prices.

However, the private sector did not develop as robustly as had been hoped. The prevalent supply of subsidized—and often adulterated—fertilizer from India made supplying fertilizer for the Nepal market relatively unprofitable for private traders. Therefore, the anticipated increase in supply did not materialize

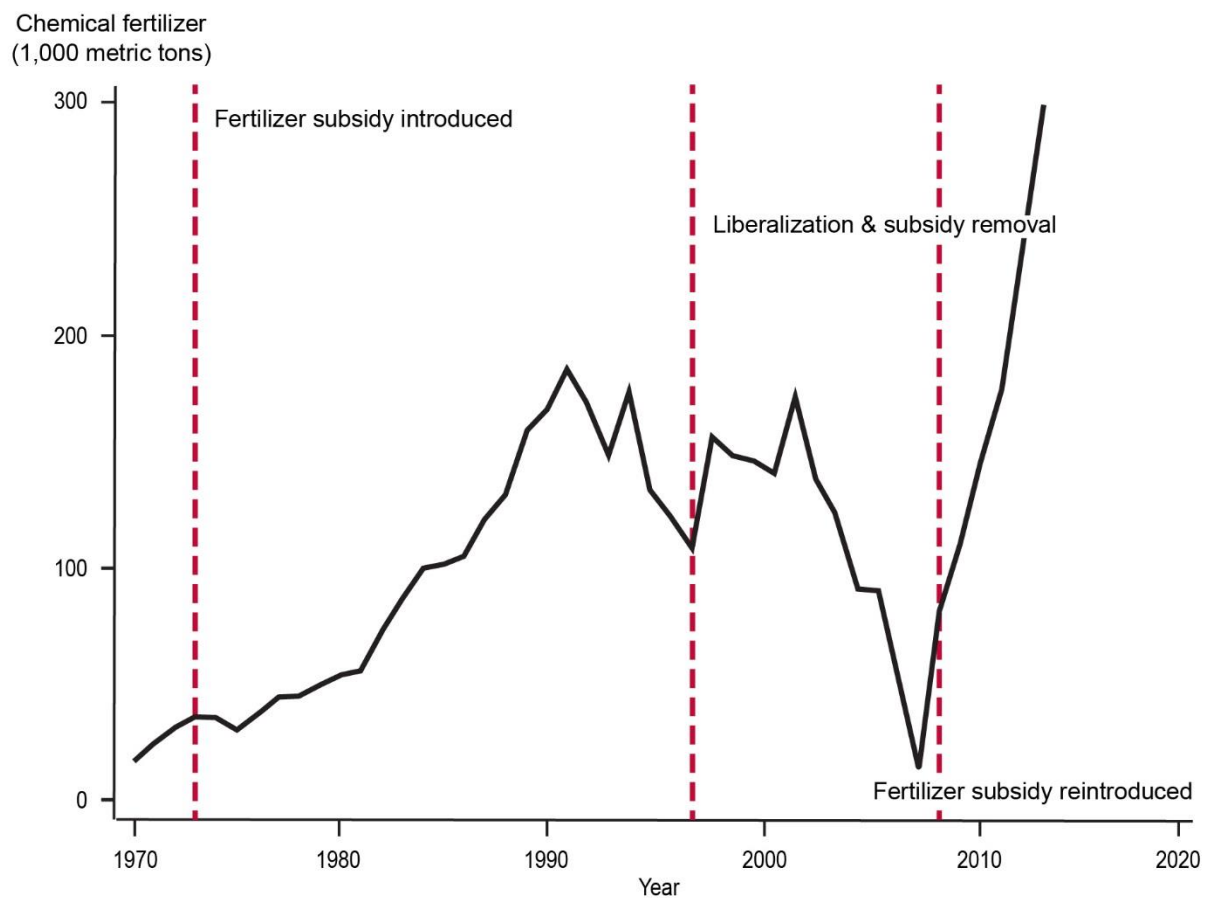
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<sup>3</sup> Interview with Centre for Natural Resource Analysis, Management, Training and Policy Research (NARMA), Kathmandu, January 2017.

<sup>4</sup> Interview with NARMA, Kathmandu, January 2017.

under liberalization. As shown in Figure 2.1, which plots the annual supply of chemical fertilizer distributed throughout Nepal from formal sources, by the first decade of this century, the country's supply of fertilizer was plummeting. It is important to note that the data shown in Figure 2.1 do not account for informal trade in fertilizer across the porous India-Nepal border, which was substantial but raised concerns about fertilizer quality (Shrestha 2010). Distrust of private-sector involvement in fertilizer trade and distribution is a lasting legacy of the problems that arose during liberalization.<sup>5</sup>

**Figure 2.1 Formal distribution of chemical fertilizer in Nepal, 1970–2014 (metric tons)**



**Source:** Bista, Dhungel, and Adhikari (2016); Shrestha (2010).

<sup>5</sup> Interview with Agro-enterprise Center, Kathmandu, January 2017.

## **Contemporary Fertilizer Policy in Nepal**

In 2008/2009, the government revisited fertilizer policy, ultimately reintroducing a fertilizer subsidy program as well as government control over fertilizer imports. This policy reversal was motivated both by dissatisfaction with the lackluster effects of liberalization on supply and by the rapidly escalating international fertilizer price. High prices were pushing small and marginal farmers out of the fertilizer market altogether or pushing them toward informally imported fertilizer of variable quality.

The new fertilizer policy, adopted in 2009, had several important features. First, it reestablished the government's monopoly on importing fertilizer, giving AIC's successor, AICL, and Salt Trading Company (STC) sole responsibility for importing the fertilizer to be distributed at a subsidized rate throughout the country. Second, it subsidized the price of fertilizer, with subsidized prices set at 20–25 percent higher than that of subsidized fertilizer in India, again in order to discourage the sale of subsidized Nepalese fertilizer across the border (Shrestha 2010). By involving public enterprises in importing and by setting prices below market levels yet above levels in India, the government intended to increase overall fertilizer supply while also reducing reliance on informal Indian imports. Initially, the policy aim was to target marginal farmers, holding less than 4 hectares in the Terai and less than 0.75 hectares in the hills. However, targeting rules were relaxed in 2011/2012 (World Bank 2016).

The current policy, in theory, is implemented as follows. First, cooperatives are responsible for collecting information on farmers' demand for fertilizer. This information is then submitted to regional AICL offices in 41 locations across 35 districts, which then submit the figures to the National Planning Commission (NPC). Based on overall budgeting priorities, the NPC sets a ceiling for the fertilizer subsidy program, always lower than the submitted demand figures. Thus, there is a need to revise how much fertilizer will be distributed to each regional office after the budget has been fixed. Although the size of the program cannot yet meet the demand of Nepali farmers, it is also clear that formal supply of fertilizer has increased manifold under the new policy (Figure 2.1). Once fertilizer has been procured and distributed to regional AICL offices, these offices are responsible for releasing the fertilizer to cooperatives. In theory, farmers then purchase fertilizer from the cooperatives. Given that supply is still

far lower than demand, chief district officers are responsible for setting any local targeting rules and for managing potential conflicts over inadequate supply.<sup>6</sup>

In practice, there are challenges with both supply and distribution. Supplying high-quality fertilizer in sufficient quantities remains a challenge in Nepal. Although the current policy has seen a tremendous increase in the supply of formally traded fertilizer (Figure 2.1), formal supply still covers less than 25 percent of total fertilizer use in Nepal (Pandey 2013), indicating that informal supply—with the associated quality problems—remains a significant source of fertilizer. In interviews with the World Bank (2016), cooperatives widely reported being undersupplied and not receiving enough fertilizer to fill their trucks, adding to the per-unit transport costs incurred to get subsidized fertilizer to farmers (a cost that is passed on to farmers).

There are also significant challenges with distribution. Cooperatives often lack funds to purchase fertilizer from AICL offices in advance as well as facilities to store it for farmers to purchase. Low storage capacity can push cooperatives to sell their fertilizer quotas to agrovets (dealers of a variety of agricultural and veterinary products), who may then repackage and mark up subsidized fertilizer before selling it to farmers.<sup>7</sup> Small and marginal farmers can be motivated to purchase repackaged fertilizer through agrovets because subsidized fertilizer sold at cooperatives is sold only in large packages that often exceed both their available budget and their fertilizer needs. Agrovets may also provide credit to farmers for fertilizer purchases, whereas cooperatives frequently require up-front payment.<sup>8</sup>

The recently adopted Agricultural Development Strategy (ADS), which in 2015 succeeded the APP as the guiding vision for agricultural development policy in Nepal, seeks to address some of these challenges (Nepal, MOAD 2015). The ADS discusses the possibility of expanding private-sector participation in fertilizer import and distribution. It also advocates a pilot program to evaluate using vouchers and other methods of farmer registration to better target fertilizer subsidies to small and

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<sup>6</sup> Interview with the Ministry of Agricultural Development, Kathmandu, January 2017.

<sup>7</sup> Interview with Agro-enterprise Center, Kathmandu, January 2017.

<sup>8</sup> Interview with Nepal Fertilizer Association, Kathmandu, January 2017.

marginal farmers. However, it emphasizes piloting new strategies for improving the program to meet the government's goals of increasing agricultural production through better fertilizer supply and distribution, and leaves many policy details open, suggesting that it provides an important policy window for testing new strategies.



### **3. WHO BENEFITS FROM FERTILIZER SUBSIDIES IN NEPAL?**

Although fertilizer application rates have increased over time in Nepal (Takeshima et al. 2016), they are still low compared with those of neighboring countries. The World Bank (2016) estimated that rates of fertilizer application in India are nearly three times those in Nepal. We analyze use of fertilizer and benefits from fertilizer subsidies using three different sources: (1) the 2010/2011 NLSS III (Nepal, CBS 2012b); (2) the 2011/2012 Nepal National Census of Agriculture (Nepal, CBS 2013); and (3) the NRHS, a representative survey of rural households conducted by IFPRI and IIDS in 2016.

The NRHS captured data from 1,054 randomly sampled rural households spread across Nepal, including across all of its agroecological zones. To draw the survey sample, we randomly selected 75 Village Development Committees (VDCs). Within each sampled VDC, we randomly selected 2 wards to be enumeration areas and sampled 7 households on average from each selected ward to be interviewed, for a total sample of 1,054 rural households. Full information on the sampling procedure is available in Appendix A. Red dots in Figure 3.1 indicate VDCs where households were surveyed. In the districts shaded in gray, we additionally conducted a survey of District Agricultural Development Officers (DADOs) and District Livestock Service Officers (DLSOs). Our analysis includes only those households that grew crops during the preceding 12 months (96 percent of the sample). Although the 2016 survey asked households about their fertilizer use and their preferences regarding agricultural policy investments, it did not ask about intensity of usage. Therefore, all analysis examining intensity of usage relies exclusively on the NLSS III.

**Figure 3.1** Location of survey respondents, 2016



**Source:** Authors.

**Note:** Red dots indicate the location of surveyed VDCs. Districts shaded in gray are areas where DADOs and DLSOs were interviewed.

### Fertilizer Use in Nepal

Overall, use of nitrogen—whether from manure or chemical fertilizer—in Nepal is low compared with that of other countries, even those with similarly mountainous topographies (Takeshima et al. 2016). It is fairly common for manure to account for a higher share of nitrogen use in mountainous countries than in flat ones, but Nepal relies relatively more on manure as a source of nitrogen than other similarly rugged countries—particularly in the mountain and hill regions of the country, as compared with the flat Terai, where inorganic fertilizer is more prevalent (Takeshima et al. 2016). The prevalent use of manure in the hill and mountain regions should be kept in mind when considering demand for inorganic fertilizer, because demand per hectare of cultivated land in these more rugged regions will likely always be lower than in the Terai. Accordingly, the use of inorganic fertilizers has increased over time in Nepal, with the

majority of increases accruing in the Terai region, where total use of inorganic fertilizer doubled between 1995 and 2010/2011. Rates of increase were much lower, and not statistically significant, in the hills and mountains (Takeshima et al. 2016).

Although differences in the use of inorganic fertilizer across differing topographies and agroecological zones likely reflect, to some extent, differing farming practices and underlying demand, there are also significant geographic inequities in the use of inorganic fertilizer *within* agroecological zones. For example, the increasing use of inorganic fertilizers over the past 15 years has accrued almost entirely to the Central and Eastern regions of the country, with barely perceptible changes in the western regions (Takeshima et al. 2016, 6). Below, we discuss this geographic inequity in the use of inorganic fertilizer and how it relates to Nepal's fertilizer subsidy program. Additionally, we examine the use of inorganic fertilizer by land quintile in order to understand varying usage patterns between small-, medium-, and large-scale farmers.

Who uses subsidized fertilizer in Nepal? Unfortunately, it is difficult to examine the use of subsidized fertilizer directly, because the NLSS III did not ask directly about subsidized fertilizer purchases. Even if it did, farmers may not be aware of whether they are purchasing subsidized or unsubsidized fertilizer. Therefore, for the NLSS III data, we estimate access to subsidized fertilizer based on where farmers reported having purchased fertilizer. When farmers reported purchasing fertilizer either directly from the government or from cooperatives, we assume they purchased from the stock of fertilizer supplied for AICL and STC distribution.<sup>9</sup> In reality, if cooperatives are additionally selling fertilizer secured through informal trading networks, this methodology could overestimate access to subsidized fertilizer. Therefore the 2016 NRHS survey asked both generally about the location where farmers purchased fertilizer and directly about their purchases of subsidized fertilizer. Indeed, farmers reported

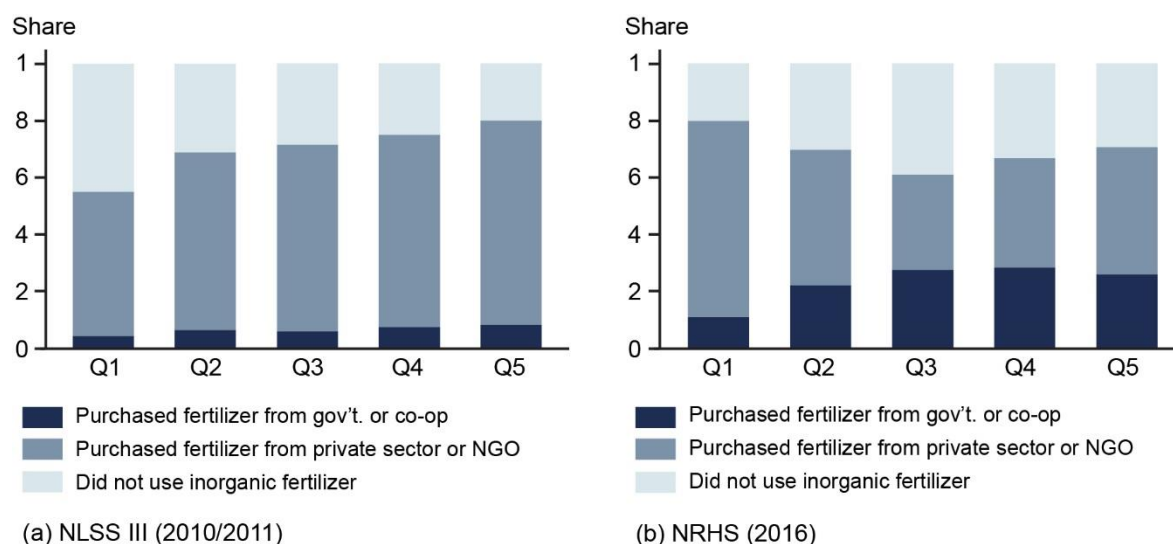
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<sup>9</sup> In practice, only cooperatives are directly involved in selling subsidized fertilizer to farmers. However, an important share of respondents indicated in both the NRHS and the NLSS III that they received their subsidized fertilizer from the government. This finding could suggest that they believed the subsidized fertilizer was ultimately supplied by the government, even if in reality they directly purchased it from a cooperative.

purchasing subsidized fertilizer almost exclusively from the government or from cooperatives, justifying our decision to use purchase location as a proxy for subsidy status in the NLSS III data.

Figure 3.2 looks at rates of inorganic fertilizer use, dividing farmers into five equal groups (quintiles) by the total amount of agricultural land they cultivated during the preceding agricultural year. Whereas Panel (a) of Figure 3.2 uses data collected in 2010/2011 via the NLSS III (Nepal, CBS 2012b), Panel (b) relies on data collected in 2016 via the NRHS. Quintile 1 groups farmers with the smallest plots, whereas quintile 5 groups those with the largest plots.<sup>10</sup> Several factors are of note. First, more small and marginal farmers reported purchasing inorganic fertilizers in 2016 than in 2010/2011. In 2010/2011, rates of use among the poorest land quintile were less than 60 percent, compared with almost 80 percent in 2016. In comparison, rates of use among other land quintiles remained relatively steady. It should be noted, however, that the lower sample size for NRHS ( $n = 1,054$ ) means that these figures are estimated with low precision.<sup>11</sup>

**Figure 3.2 Rates of inorganic fertilizer use by land quintile**



**Source:** Nepal, CBS (2012b); Nepal Rural Household Survey 2016.

**Note:** NLSS III = Nepal Living Standards Survey III; NRHS = Nepal Rural Household Survey.

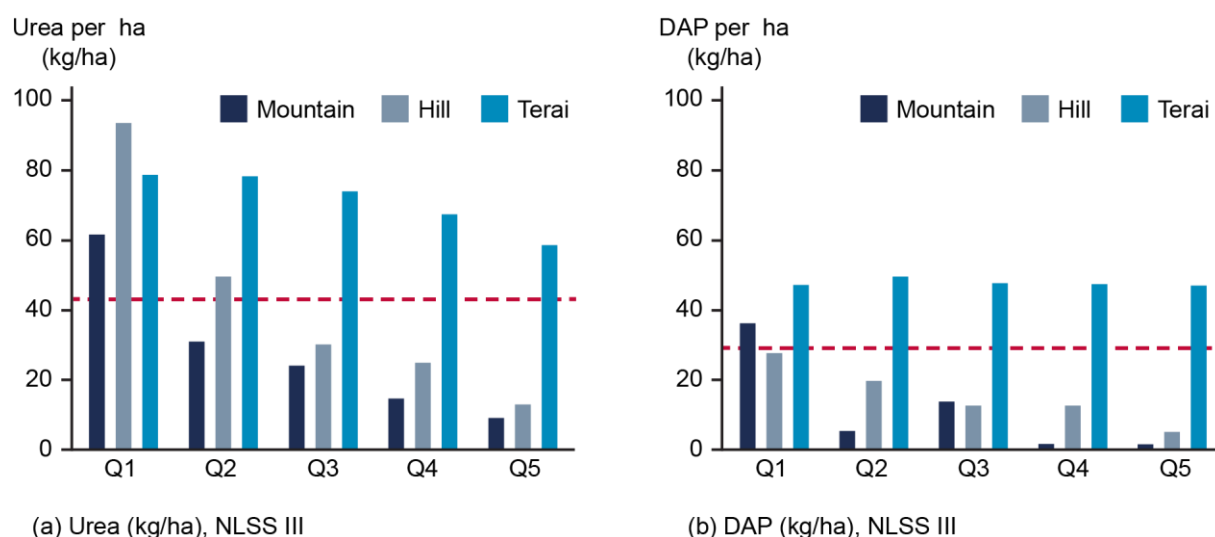
<sup>10</sup> The land size variable includes total cultivated land for farmers who either owned, rented, or sharecropped their land.

<sup>11</sup> The sample size for NLSS III is 7,020 households.

Second, farmers across all land quintiles are increasingly purchasing chemical fertilizers through official distribution channels rather than through private and informal channels. Overall, by 2016, 36 percent of those who purchased fertilizer did so either through government channels or through cooperatives, compared with only 9 percent in 2010/2011. This finding no doubt reflects the dramatic increase over the same time period in fertilizer imported through formal channels (Figure 2.1). However, farmers across all land quintiles were still significantly relying on fertilizer purchased through informal, private channels to meet demand. It is important to note also that when asked directly about subsidized fertilizer purchases (rather than location of purchase), farmers still reported remarkably low access (Panel [b]), with only 9 percent having purchased subsidized fertilizer during the preceding agricultural year.

How much fertilizer is used in Nepal? On average, in 2010/2011 farmers used 43 kg per hectare of urea and 29 kg per hectare of diammonium phosphate (DAP). However, as shown by Takeshima and colleagues (2016), use varied dramatically by agroecological zone. Figure 3.3 plots average fertilizer use—Panel (a) for urea and Panel (b) for DAP—by land quintile and by agroecological zone, where dark blue represents the mountains, medium blue the hills, and light blue the Terai. Across almost all land quintiles, usage rates are highest in the Terai, often by a significant margin, primarily because land use intensity is higher in the Terai, with many farmers cultivating in two seasons. Further, farmers in the hills and mountains rely more on livestock manure for farm nutrients (see Takeshima et al. 2016 for a full discussion). Across all land quintiles and agroecological zones, average fertilizer use in 2010/2011 remained far below the 131 kg per hectare targeted by the APP.

**Figure 3.3 Amount of inorganic fertilizer used by land quintile, 2010/2011**

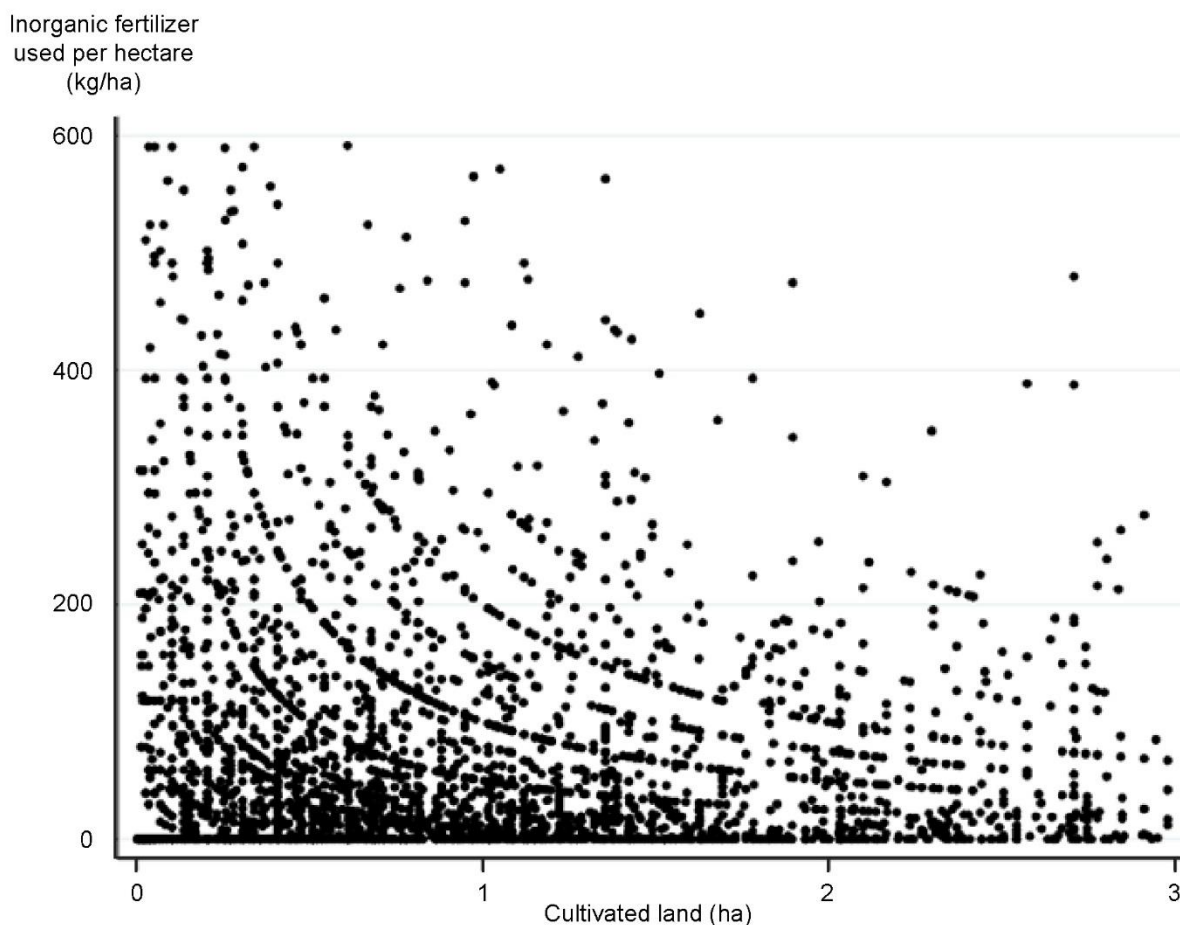


**Source:** Nepal, CBS (2012b).

**Note:** DAP = diammonium phosphate; NLSS III = Nepal Living Standards Survey III. The red dashed line indicates the mean.

However, average fertilizer use conceals significant underlying variation in the intensity of fertilizer use. Figure 3.4 plots the total amount of inorganic fertilizer households used per hectare of cultivated land in 2010/2011—including urea, DAP, complex, and other chemical fertilizers—by the amount of land they cultivated in the preceding year. In spite of a high concentration of households that did not use fertilizer, particularly among the lower land quintiles (as seen in Figure 3.2, Panel [a]), there are also many households using fertilizer with high levels of intensity, again particularly among the lower land quintiles. Nearly 30 percent of households using inorganic fertilizer are doing so with intensity rates above the APP's target threshold of 131 kg per hectare (Figure 3.4). Overuse of fertilizer could reflect small and marginal farmers' substituting urea for other agricultural inputs (such as better seeds) due to challenges in markets for these other inputs. Alternatively, it could reflect poor information about optimal fertilizer use. We discuss these two issues—low access to fertilizer among small and marginal farmers and overuse of fertilizer among those who do have access—in more depth in the following sections.

**Figure 3.4 Inorganic fertilizer used per hectare of cultivated land, 2010/2011**



Source: Nepal, CBS (2012b).

### Access to Fertilizer

To what extent is low average fertilizer use driven by poor access? Rather surprisingly given the overall supply constraints, 90 percent of respondents to the NLSS III who purchased inorganic fertilizer reported that they could purchase their desired amount (Takeshima et al. 2016, 14). However, only respondents who purchased inorganic fertilizers during the preceding year were asked this question; therefore, it is not possible to ascertain how many farmers who wished to purchase fertilizer were unable to purchase any due to supply constraints.

The 2016 NRHS asked all respondents, including those who did not purchase fertilizer, whether they were able to purchase their desired amount and, if not, whether they were constrained by fertilizer supply or by their own budget. Figure 3.5 examines the share of rural households that grew crops in the

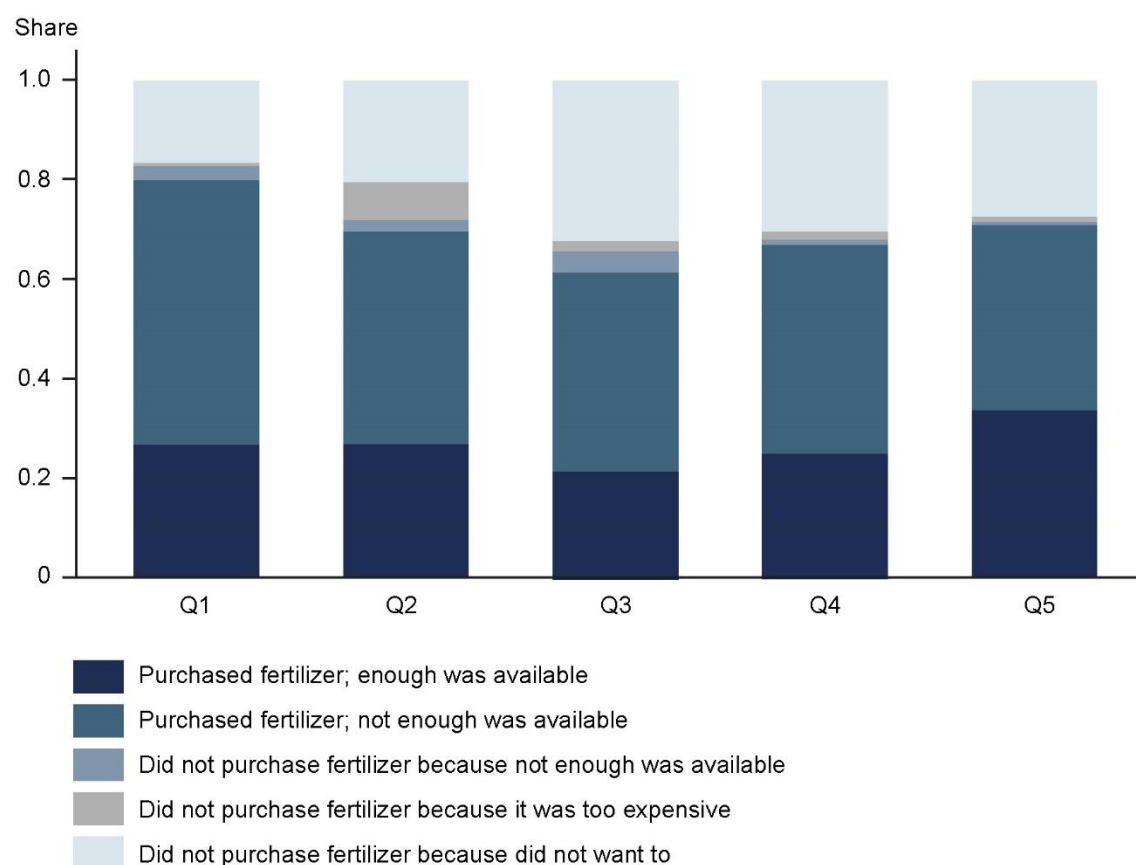
past year, by land quintile, (1) that purchased their desired amount of fertilizer, (2) that purchased fertilizer but not as much as they desired, (3) that did not purchase any fertilizer because it was not available locally, (4) that did not purchase any fertilizer because they lacked the budget to do so, and (5) that did not purchase fertilizer because they did not want to or thought they did not need to. Overall, only 25 percent of respondents reported that they were able to purchase fertilizer in sufficient quantities. Those in the largest land quintile reported the most access, with 33 percent reporting being able to purchase in sufficient quantities.

In contrast, although 80 percent of those in the smallest land quintile did report using fertilizer during the past year, two-thirds of those households reported that they were not able to purchase as much fertilizer as they wanted. The stark contrast between these figures and those from NLSS III could stem in part from the expanded access that occurred on the extensive margin over the time period: between 2010/2011 and 2016, more and more farmers reported using at least some inorganic fertilizer, but perhaps these gains occurred among the small and marginal farmers, who struggle most to purchase sufficient amounts.

Interestingly, across all land quintiles, the primary reason for not purchasing fertilizer at all was that farmers did not wish to do so, rather than due to supply or budget constraints (Figure 3.5). This result suggests that supply rather than pricing is a more significant constraint in the context of Nepal. Further, the supply constraints seem to affect farmers who are already purchasing some fertilizer, rather than prohibiting farmers from purchasing any at all.



**Figure 3.5 Constraints on fertilizer purchases by land quintile, 2016**



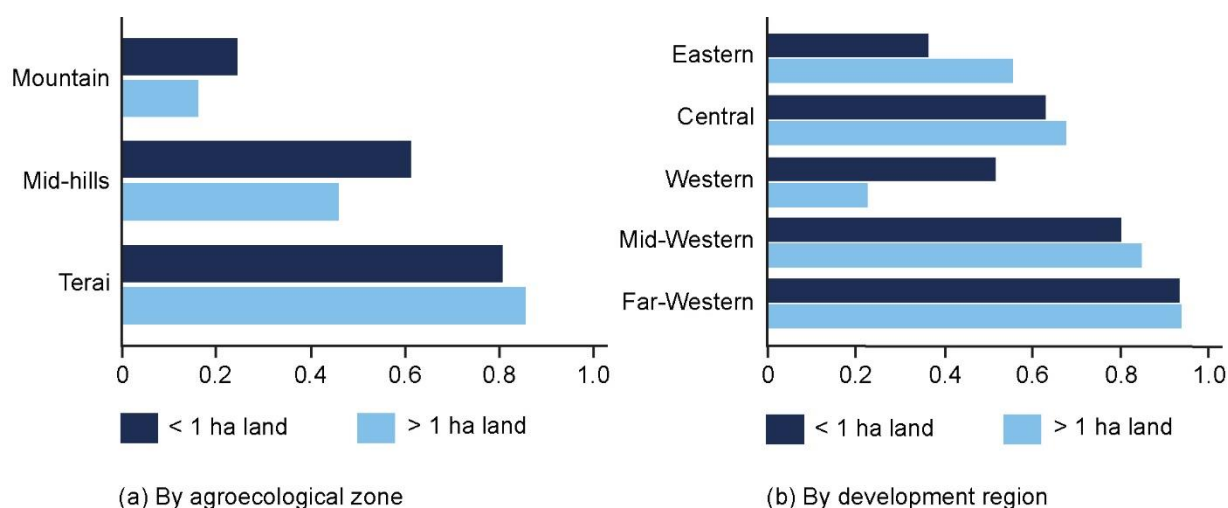
**Source:** Nepal Rural Household Survey 2016.

### Geographic Variation in Access and Targeting

There is significant geographic variation in access to sufficient fertilizer quantities. For one, despite its proximity to India, a source of fertilizer through informal trade, fertilizer shortages are still most significant in the Terai region, with more than 80 percent of farmers from all land quintiles reporting that they were unable to purchase the desired amount of fertilizer during the preceding year (Figure 3.6, Panel [a]). In part, this is due to the lower shares of farmers in the hill and mountain regions who want to purchase fertilizer at all. Whereas only 14 percent of Terai farmers reported that they did not wish to purchase fertilizer in the previous year, 40 percent of farmers in the hill region and 70 percent in the mountain region reported not wishing to purchase fertilizer. The large population of the Terai, combined with high land intensity and high fertilizer use, means that many farmers there face supply constraints.

However, local shortages could also be affected by how AICL distributes fertilizer across districts, which we explore below.

**Figure 3.6 Geographic variation in share of farmers reporting supply constraints, 2016**



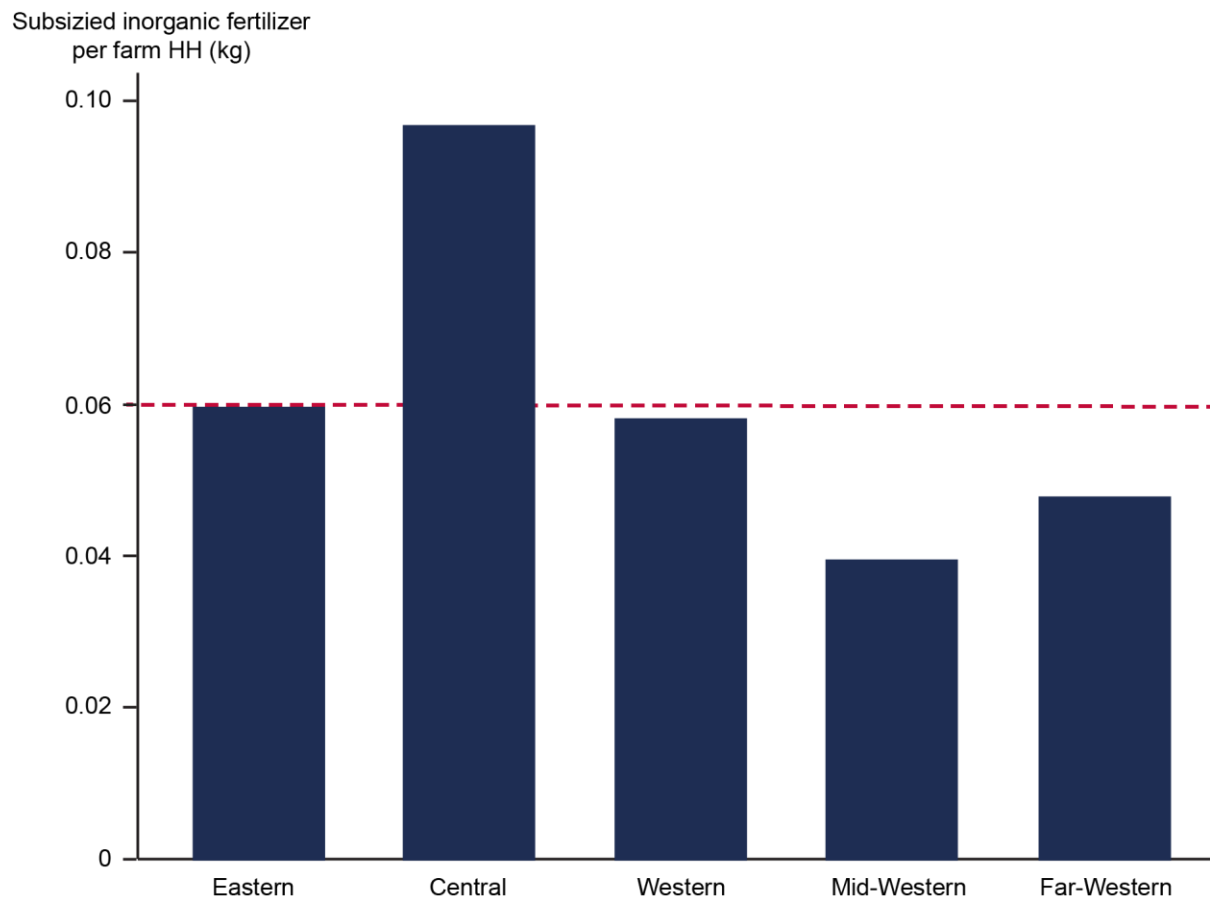
**Source:** Nepal Rural Household Survey 2016.

Examining supply constraints by development region reveals significant geographic inequities in fertilizer access. More than 90 percent of households in the Far-Western Development Region reported that they were unable to purchase the desired amount of fertilizer. In comparison, supply constraints are much lower in the Eastern, Central, and Western regions. These geographic inequities no doubt stem in part from the poor infrastructure in Nepal's western regions, which likely limits the amount of informal trade in fertilizer there. However, there are also significant geographic disparities in AICL fertilizer distribution.

Figure 3.7 reports the amount of fertilizer distributed by AICL per farm household by development region in the 2015/2016 fiscal year. The dashed line represents the amount of fertilizer that would be distributed per farm household in each development region if distributions were even across the regions. The Central Region receives a disproportionate share of Nepal's limited stock of formally supplied fertilizer, whereas the Mid- and Far-Western regions receive significantly less than would be expected under equitable distribution. Although differences in farming practices may explain different

distribution levels across agroecological zones, they are unlikely to explain different distribution levels *within* agroecological zones.

**Figure 3.7 Agriculture Input Company Limited distribution per farm household by development region, 2015/2016**



**Source:** 2015/2016 administrative data from Agriculture Inputs Company Limited.

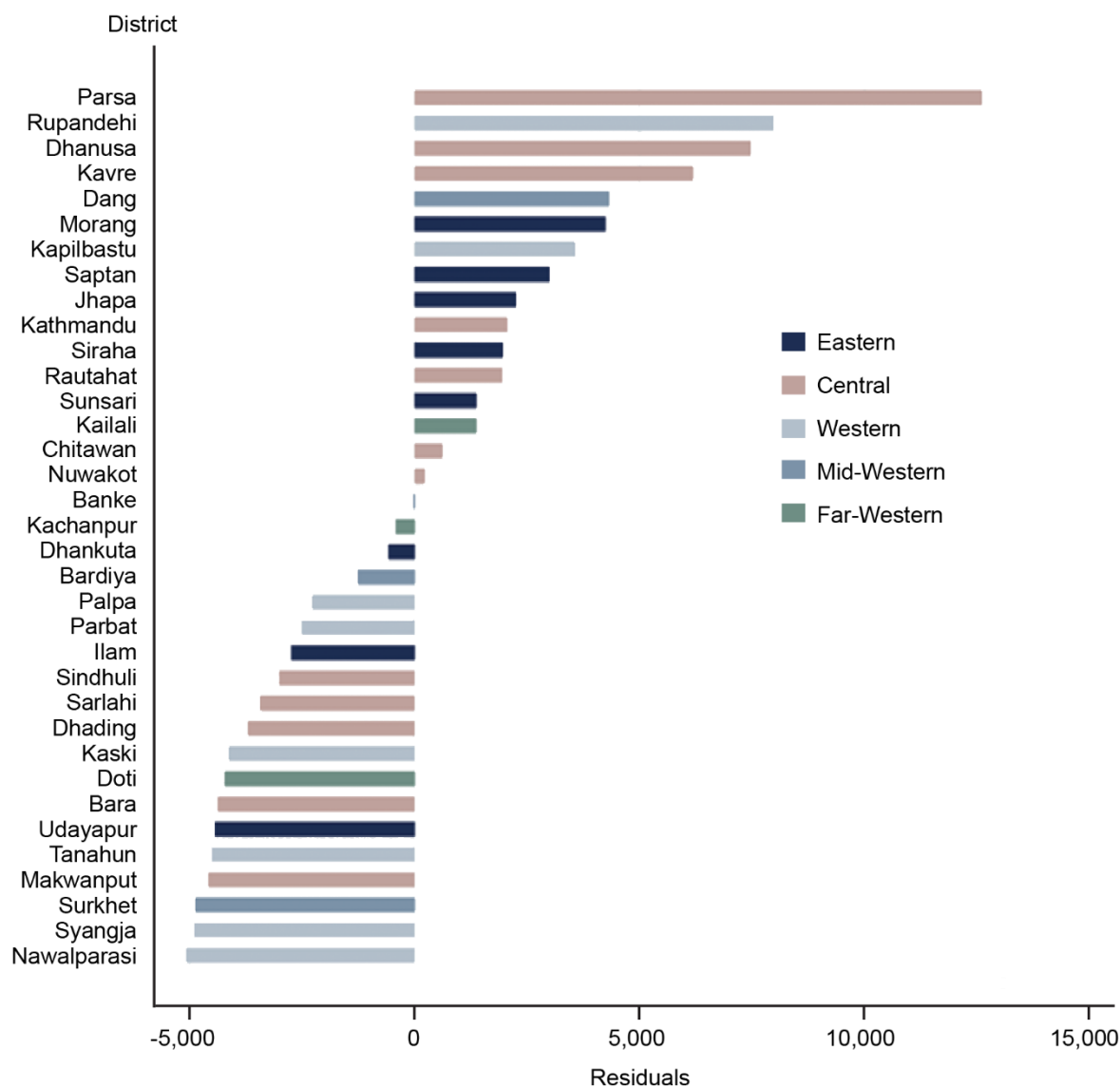
**Note:** HH = household.

Another equity concern is whether those areas with relatively more small and marginal farmers—those most in need of the input subsidy—receive more subsidized fertilizer. It is difficult to examine how subsidized fertilizer is distributed within Nepal at a lower level of granularity than the development region because administrative data track subsidized fertilizer to the regional AICL offices—41 in total—and not its distribution from there to the district level. However, if we look just at those districts that have AICL regional offices (35 districts, because several districts have more than one AICL regional office),

we can examine whether districts with more small farmers indeed receive more subsidized fertilizer, as would be expected. This analysis is not perfect because regional offices no doubt distribute fertilizer to neighboring districts that lack regional AICL offices. It also does not account for the fertilizer STC supplies to districts. Nonetheless, it is revealing with regard to regional disparities in subsidized fertilizer distribution.

Figure 3.8 reports the residuals from a regression of the total amount of inorganic fertilizer—including urea, DAP, and potash—distributed within a district by AICL in the 2015/2016 fiscal year on the total number of farmers in the district with less than half a hectare of cultivated land. The districts with large positive residuals are those that received more subsidized fertilizer than would be expected based on the number of small farmers, whereas the districts with large negative residuals are those that received less subsidized fertilizer than would be expected based on the number of small farmers. It is notable that many of the districts receiving more than would be expected are in the Eastern and Central regions, whereas many of the districts receiving less than would be expected are in the Western, Mid-Western, and Far-Western regions. Likely these disparities are even more dramatic than shown here because the few AICL offices in the three western regions are responsible for distributing to farmers in neighboring districts, whereas there are many more AICL offices in the Central region.

Figure 3.8 Residuals from regression of Agriculture Inputs Company Limited fertilizer (metric tons) on number of farmers in the district cultivating less than 0.5 hectare of land



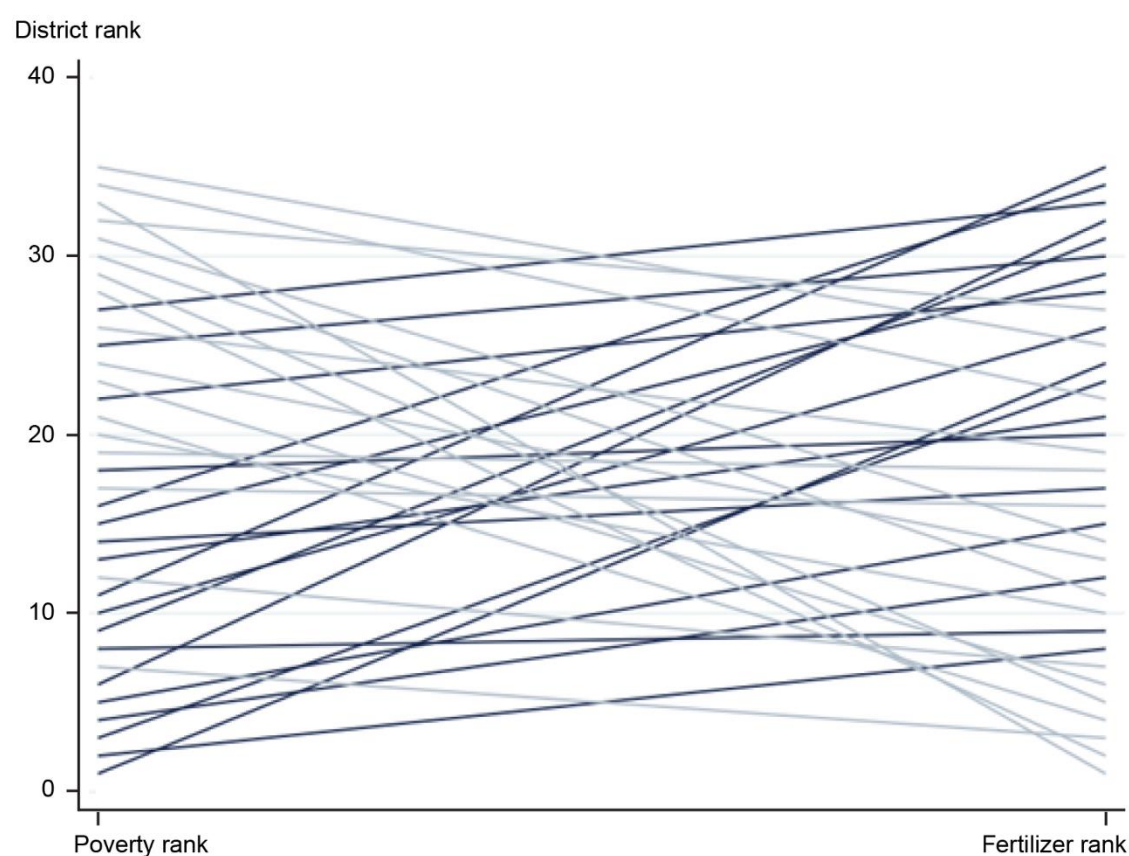
**Source:** Nepal Rural Household Survey 2016; Nepal, CBS (2013); 2015/2016 administrative data from Agriculture Inputs Company Limited.

**Note:** The graph shows the variation in district-level Agriculture Inputs Company Limited distribution data, controlling for the number of small farmers per district.

Beyond geographic disparities, another question is whether poorer districts receive greater shares of the subsidized fertilizer distributed through AICL. Figure 3.9 compares districts' poverty levels in terms of per capita gross domestic product with the amount of subsidized fertilizer that they receive. First, we rank the 35 districts from richest to poorest (richest = 1, poorest = 35). Second, we rank the 35

districts with AICL offices based on the total amount of subsidized fertilizer that they received in 2015/2016. The lines offer rank comparisons, with dark blue lines representing districts that receive more fertilizer in relation to their poverty level and light blue lines representing districts that receive less fertilizer in relation to their poverty level. If the program were targeted according to poverty levels, the lines would be relatively flat. However, in almost all cases, richer districts tend to receive more fertilizer and poorer districts less.

**Figure 3.9 Ranking of districts by poverty and by distribution of subsidized fertilizer**

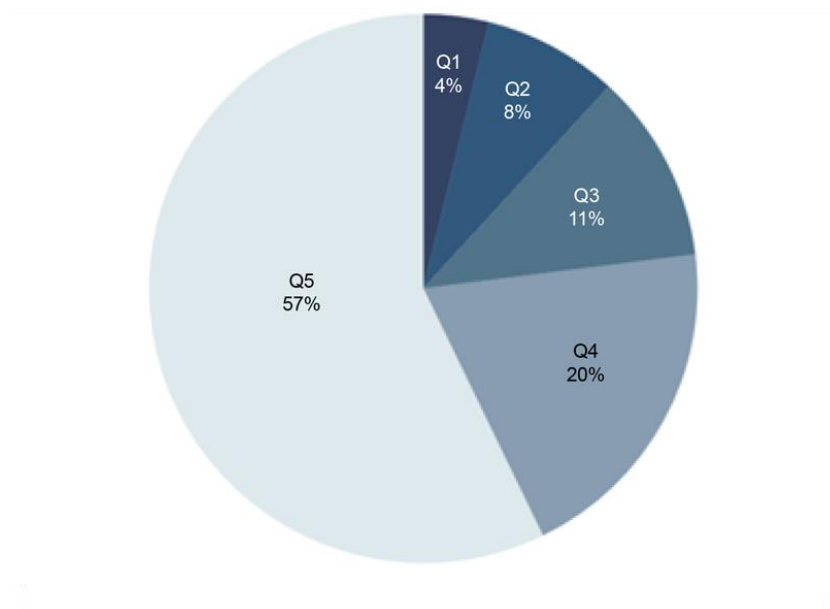


**Source:** Fertilizer: 2015/2016 administrative data from Agriculture Inputs Company Limited; poverty: UNDP (2014).

**Note:** On the left, districts are ranked according to gross domestic product per capita, with the poorest districts receiving higher rankings (that is, the poorest district among the 35 districts that have Agriculture Inputs Company Limited regional offices is ranked 35, and the richest district is ranked 1). On the right, districts are ranked according to the amount of fertilizer they received (districts that received more fertilizer are ranked higher). Districts ranked lower in poverty and higher in fertilizer receipts are denoted by the dark blue lines, and districts ranked higher in poverty and lower in fertilizer receipts are denoted by the light blue lines.

One result of not targeting the program based on need is that the vast majority of the benefits of the fertilizer subsidy program are likely captured by farmers in the largest land quintile. It is difficult to quantify this imbalance in the Nepal context, however, given that it is difficult to identify which households are actually purchasing subsidized fertilizer. However, if we take the weighted sum of all fertilizer purchases by each land quintile from either government offices or cooperatives—the formal distribution channels of the fertilizer subsidy program—then we can estimate the share of all formal purchases by each land quintile. As shown in Figure 3.10, by this accounting, the two largest land quintiles (roughly, those cultivating at least 1 hectare) purchased 77 percent of all fertilizer distributed through these channels. Larger farmers use greater quantities of fertilizer, which means they also absorb more public resources.

**Figure 3.10** Share of fertilizer purchased at government offices or cooperatives by land quintile, 2010/2011



**Source:** Nepal, CBS (2012b).

**Note:** The share is calculated by taking the weighted sum of all inorganic fertilizer purchased at government offices or cooperatives by each land quintile.

In order for the fertilizer subsidy program to better link with the government's goals to improve food security and the livelihoods of small and marginal farmers, different means of geographic targeting

may be warranted. For example, increasing distribution to Nepal's poorer, western regions would improve program equity but may require a different mechanism for planning how to distribute Nepal's limited supply of subsidized fertilizer across its districts, giving preference to areas with poorer access as well as capping purchase amounts to ensure that more of the program benefits accrue to smaller farmers. Section 5 discusses policy options to address these challenges.

### **Coordinating Input Subsidies with Extension Services**

Beyond who has access to inorganic fertilizers in Nepal, an equally important consideration is whether those with access have the information necessary to use fertilizer in an optimal way. Overusing inorganic fertilizers can cause significant imbalances in soil nutrients, with deleterious effects on soil quality (on this issue in Nepal, see, for example, Raut, Sitaula, and Bajracharya 2010). Overuse of fertilizer was a challenge in 2010/2011 (Figure 3.4), and that challenge has likely grown given the expansion in fertilizer use in the past seven years and continued land fragmentation in Nepal.

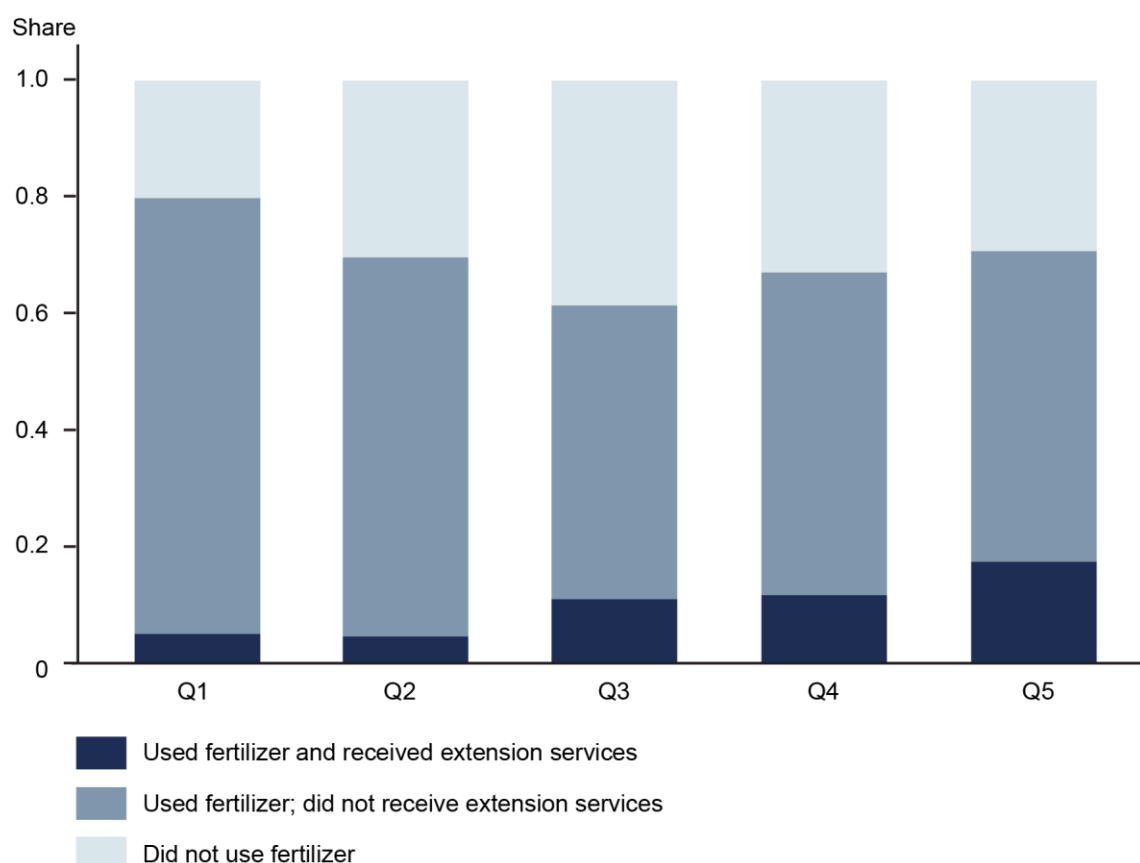
Spreading information on optimal fertilizer use is critical in combating overuse and preventing soil degradation. However, access to crop extension services in Nepal is low. According to the 2016 NRHS, only 24 percent of households received crop extension services from any advisory agency, government or otherwise, and only 9 percent reported receiving crop advisory services specifically from governmental extension agents.<sup>12</sup> More telling is that only 17 percent of households that used inorganic fertilizer received advice from a government extension agent on how to use it effectively, with the lowest rates among the smallest land quintile (Figure 3.11). These data suggest that information on optimal usage is scarce, particularly among small and marginal farmers.

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<sup>12</sup> See Kyle and Resnick (2017) on why some VDCs receive better access to crop extension services than others.



**Figure 3.11 Access to crop extension services and subsidized fertilizer use by land quintile, 2016**

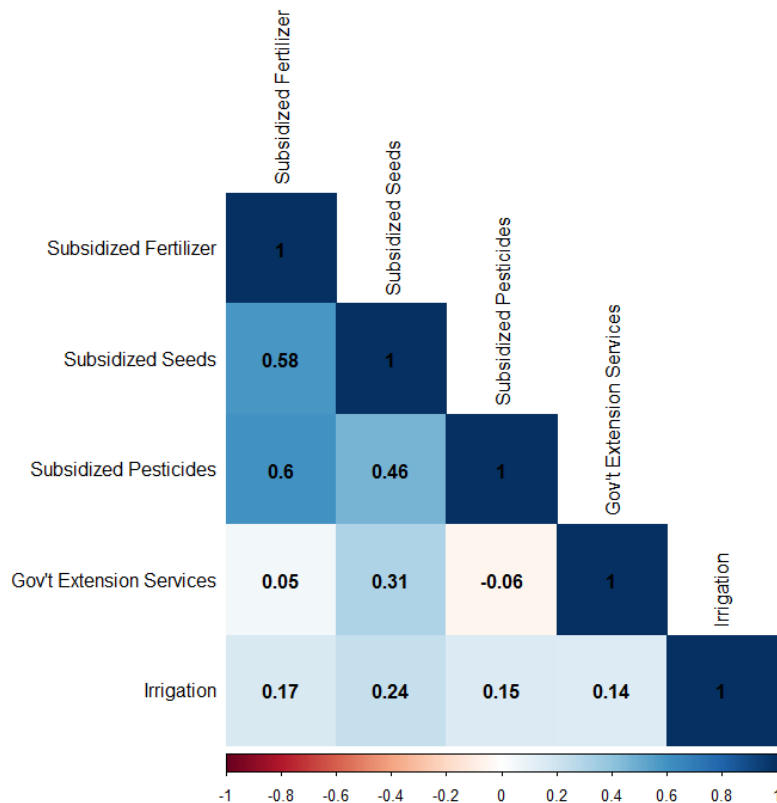


**Source:** Nepal Rural Household Survey 2016.

In addition to the importance of farmers' receiving information on optimal fertilizer use, there are other significant complementarities between the different agricultural input programs, extension services, and irrigation investments made by the government. Agricultural inputs, for example, may be most effective when joined with extension services; similarly, access to both subsidized seeds and subsidized fertilizer may combat the tendency to overuse inorganic fertilizers to compensate for not using new seeds. Figure 3.12 depicts the correlations among the government's different agricultural programs. Overall, there is strong correlation among receiving subsidized fertilizer, receiving subsidized seeds, and receiving subsidized pesticides. Given the low rates of receiving any subsidized inputs, however, this correlation suggests that there is a small share of farmers who have strong access to all agricultural input subsidies, and a large share of farmers who do not have access to any subsidized inputs. Consistent with Figure

3.11, the correlation between receiving subsidized fertilizer and receiving extension advice on how to use it effectively is very weak ( $r = 0.05$ ).

**Figure 3.12 Correlations among agricultural programs in Nepal, 2016**



**Source:** Nepal Rural Household Survey 2016.

**Note:** The figure depicts correlations between agricultural programs in Nepal. Correlation coefficients are reported in bold. Blue boxes indicate positive correlations, red boxes negative correlations (see color scale below the figure).

## Summary

This section identifies several key challenges for Nepal's fertilizer subsidy program. First, although most households that want to purchase inorganic fertilizers are able to purchase some, only 25 percent of respondents reported in 2016 that they were able to purchase fertilizer in sufficient quantities. Households in lower land quintiles reported being more constrained. Second, supply constraints are most acute in the Terai as well as in the Mid- and Far-Western development regions, in part because subsidized fertilizer is

distributed inequitably across Nepal, with lower supplies per farmer in the Mid- and Far-Western development regions.

Third, although it is difficult to quantify, there is considerable evidence that richer districts and larger landowners receive disproportionate benefits from the fertilizer subsidy program. Given the significant supply constraints that still exist, large benefits for larger farmers and richer districts translate into few available resources for small and marginal farmers in poorer areas. Finally, among farmers who use inorganic fertilizer, few receive extension services on how to use it most effectively. This lack of information is a particular challenge for small and marginal farmers, who often do not use fertilizer at optimal levels. Given these challenges, a key question is whether farmers themselves are open to program reforms. We explore this question in the following section.

#### **4. CITIZEN PREFERENCES REGARDING PUBLIC EXPENDITURES IN NEPAL**

Whereas the first half of the paper considered who is benefiting from the fertilizer subsidy program—an essential question in evaluating whether the program is meeting its objectives—this section addresses the political scope for reforming the program. A significant concern when contemplating any reform to a subsidy program is popular backlash. The ADS lays this concern out by noting, “Subsidies on fertilizer and irrigation are ingrained in the being of the average Nepali farmer” (Nepal, MOAD 2015, 42).

In the 2016 NRHS, we asked farmers explicitly about their preferences regarding public spending, including spending in the agricultural sector. We detail citizen preferences along two dimensions. First, we examine how citizens ranked different types of potential public expenditures in rural areas. Of particular interest is how highly citizens ranked expenditures on fertilizer subsidies relative to other potential public expenditures. Second, we examine citizens’ willingness to pay higher prices for fertilizer when presented with the opportunity to instead devote more public expenditures to agricultural extension services. Of course, survey-based questions cannot perfectly predict how citizens would react to specific reforms. However, they can provide a representative picture of how citizens view public expenditures directed toward rural areas. The most significant takeaway from analyzing citizen preferences regarding agricultural investments in Nepal is that they place far higher priority on public investments such as roads and irrigation as well as on public services such as agricultural extension than on subsidy programs.

##### **What Types of Public Expenditures Do Rural Citizens Want?**

To assess the policy preferences of rural citizens regarding public expenditures, we asked respondents to think about how they would allocate resources if given the opportunity. Respondents were asked, “If your VDC were going to receive an extra Rs 5 million to spend on development in this VDC, what would be the priority to which you would want to allocate the money?” A list of 11 potential development priorities was offered: (1) improving health care; (2) providing primary education; (3) building and maintaining

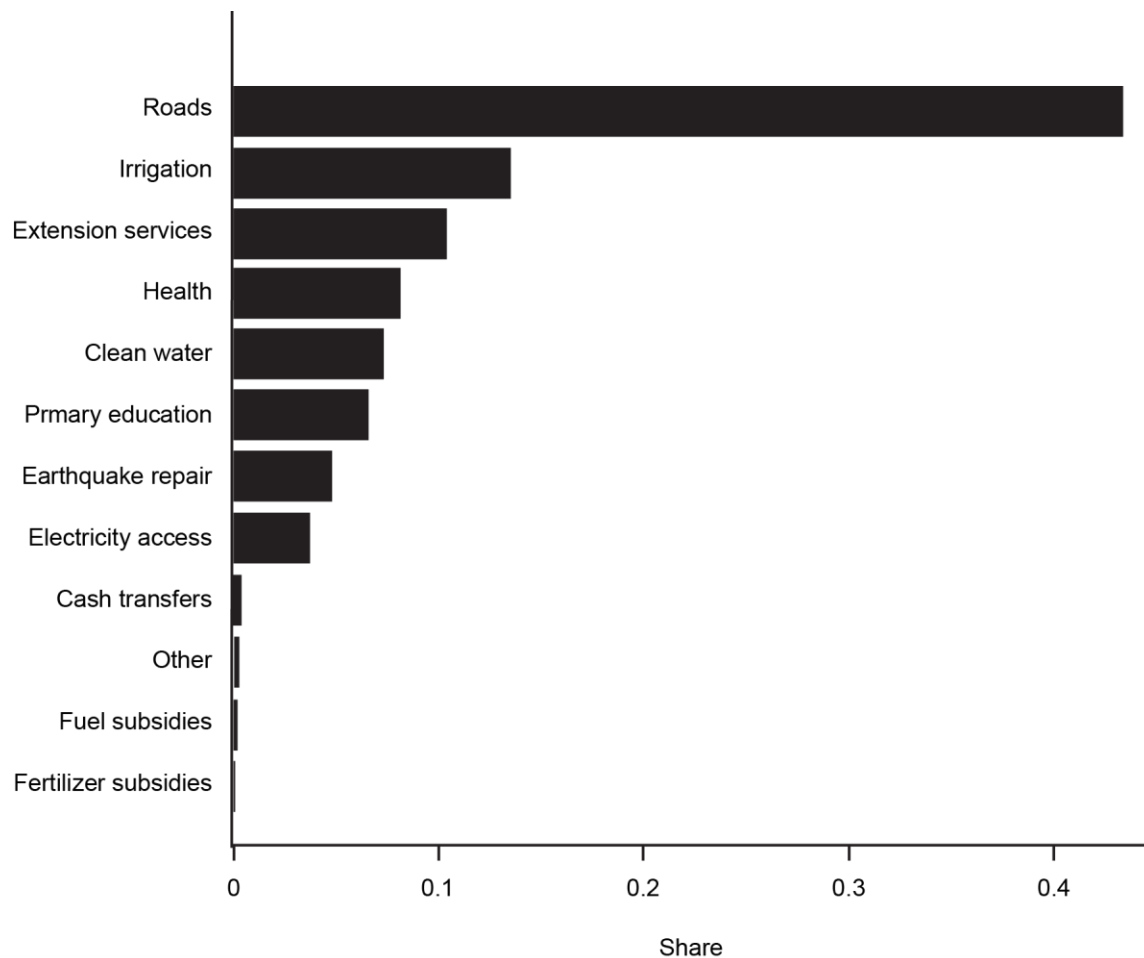
roads; (4) providing social security, such as cash transfers; (5) expanding electricity access; (6) keeping fertilizer prices low; (7) keeping automotive fuel prices low; (8) providing access to clean drinking water; (9) expanding agricultural or livestock extension services; (10) building irrigation projects; and (11) reconstructing earthquake-damaged buildings or infrastructure. An “other” category was also provided. Rs 5 million represents approximately US\$47,000 and is the size of a typical local development project in this context.<sup>13</sup> To ensure that the ordering of the response items did not affect the probability of selection, we randomized the order of the answer choices.

Figure 4.1 summarizes the variation in citizens’ preferences across policy domains. Building and maintaining roads was most frequently selected as the priority for local development expenditures, with 43 percent of households choosing it. Irrigation was prioritized by 14 percent of households. Agricultural and livestock extension services also drew significant support, as the third-most-popular area for local development expenditures, with 10 percent of responses. Notably, fertilizer subsidies drew very limited support, with less than 1 percent of the sample selecting it as the priority for their VDC. These responses suggest that relative to other public expenditures the government could make to benefit rural areas, citizens place low priority on lowering fertilizer prices.

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<sup>13</sup> User committees at the VDC level in Nepal—which are formed in order to plan, implement, and monitor local development projects funded through VDC block grants allocated by the national government—can receive project funding of up to Rs 6 million (World Bank 2014).

**Figure 4.1 Rural households' prioritization of public expenditures, 2016**



Source: Nepal Rural Household Survey 2016.

### **Raising Fertilizer Prices to Expand Agricultural Extension Services?**

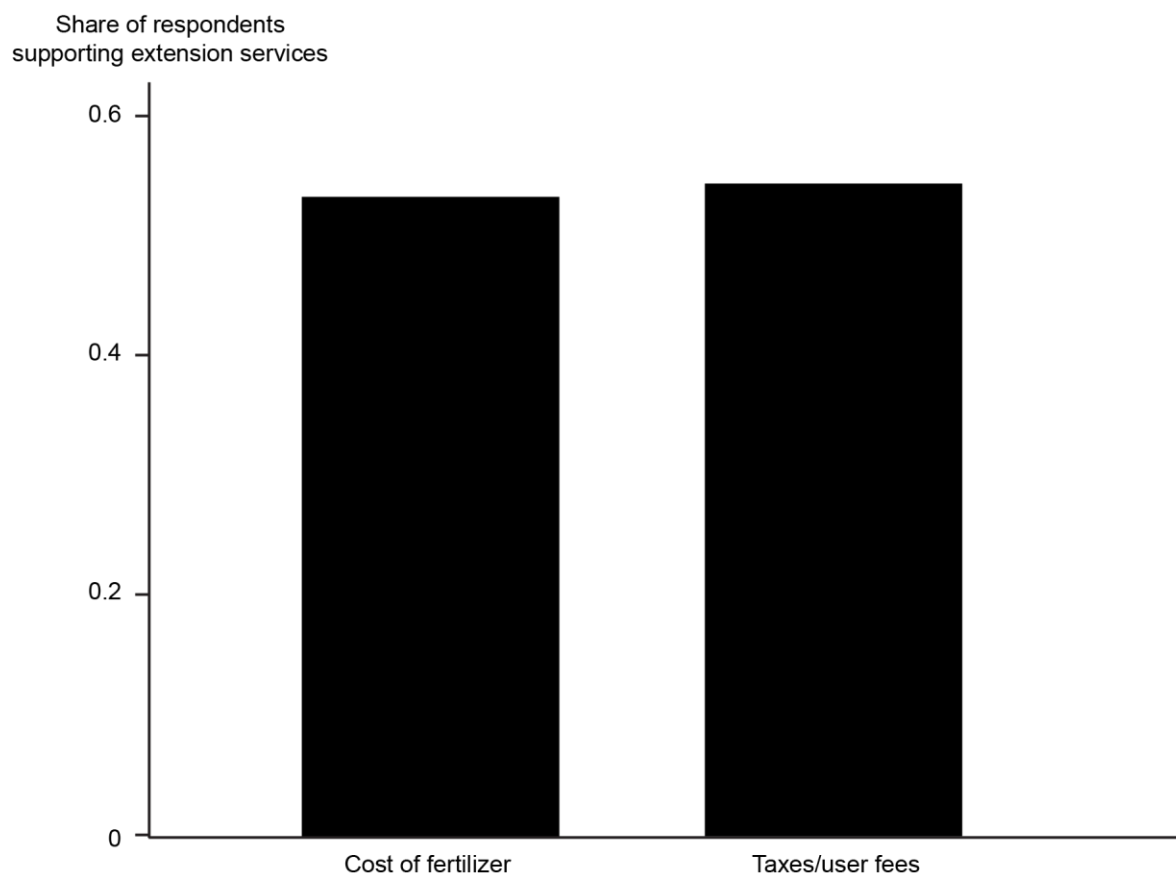
A key question for governments is how to raise sufficient funds to provide expanded access to services and what forms of financing are least likely to face popular protest and citizen rejection. Given rural households' strong preferences for expanding access to agricultural extension services, we implemented a survey experiment to assess whether this support is conditional on how such access is financed.

Additional resources toward service expansion could be harnessed by reducing subsidies or by increasing taxes and user fees. Therefore, in half of the surveys, we asked, "If the government decided to make people pay more taxes or user fees in order to increase spending on agricultural extension services for farmers, would you support this decision or oppose it?" In the other half, we asked, "If the government

decided to increase the cost of fertilizer in order to increase spending on agricultural extension services for farmers, would you support this decision or oppose it?” We randomized which version of the question respondents received. Whether or not citizens resist one form of financing more than another is an increasingly important consideration as many developing countries, including Nepal, face the need to raise their revenues to expand service delivery.

Overall, 54 percent of respondents supported expanding agricultural extension services. If citizens were particularly opposed to fertilizer subsidy reform, we would expect opposition to be significantly higher among those randomly assigned to the survey question that suggested lowering the fertilizer subsidy in order to expand access to agricultural extension services. However, as shown in Figure 4.2, we found no difference in support for expanding agricultural extension services based on how it is financed, suggesting that more than half of rural citizens are relatively open to fertilizer subsidy reform, if coupled with expansion of other public investments in agricultural services.

**Figure 4.2 Citizen support for increasing government spending on agricultural extension services, conditional on financing source, 2016**



**Source:** Nepal Rural Household Survey 2016.

Given the significant regional inequities in the distribution of the program, a relevant question is whether citizens' willingness to exchange higher fertilizer prices for greater government expenditures on agricultural extension services varies by region. For example, are farmers in Nepal's Central Region—who benefit the most from the subsidy—the most reticent to scale it back? Table 4.1 reports mean levels of support for more spending on agricultural extension services by treatment in the survey experiment (that is, financing extension by raising user fees versus by raising fertilizer prices) within each development region.

Several interesting patterns emerge. First, support for expanding agricultural extension services is highest in the Central Region. More than two-thirds of farmers in the Central Development Region



support raising government expenditures on agricultural extension services, even when prompted to consider how the spending would be financed. In contrast, support is lower in the western regions. Second, the effect of the financing treatment on the level of support also varies by region, though not in statistically significant ways. In the Eastern and Central regions, farmers are more supportive of expanding agricultural extension services when this expansion is financed by user fees rather than by raising fertilizer prices. In the western regions, the opposite is true: farmers are more supportive of expanding agricultural extension services when this expansion is financed by raising fertilizer prices rather than by raising taxes and fees.

**Table 4.1 Citizen support for increasing government spending on agricultural extension services, conditional on financing source, by development region, 2016**

Development region	Financing source		Difference (p-value)
	Increasing user fees	Raising fertilizer prices	
Eastern	58.6%	46.2%	12.5% (0.10)
Central	72.4%	67.8%	4.7% (0.40)
Western	37.6%	41.0%	-3.4% (0.58)
Mid-Western	40.4%	44.9%	-4.5% (0.54)
Far-Western	45.1%	47.8%	-2.7% (0.75)

**Source:** Nepal Rural Household Survey 2016.

Importantly, although farmers in the Eastern and Central regions are slightly more reticent to raise fertilizer prices than to raise user fees, they are not very resistant to raising fertilizer prices. In the Central Region in particular, more than two-thirds of farmers support raising fertilizer prices to expand agricultural extension. This finding provides suggestive evidence that reforming the fertilizer subsidy program for more equal distribution (that is, more allocation to the western regions) may be politically feasible, particularly if the government can link such a reform to expansion in access to agricultural extension services.

## Summary

This section identifies the priorities of rural Nepali citizens regarding public expenditures. When asked about what types of public expenditures would most benefit their VDCs, citizens prioritized roads,

irrigation, and agricultural extension services. Almost no one identified lowering the price on fertilizer as a priority for the VDC. Given the large share of the government's budget for the agricultural sector that is consumed by the fertilizer subsidy program, it is worth noting that citizens themselves do not identify this program as the most important public expenditure within their localities.

A key concern when considering reform to any consumer subsidy program is public backlash against raising prices. However, 54 percent of rural citizens stated that they would be willing to accept higher fertilizer prices in exchange for greater public spending on agricultural extension services, the same rate of support for paying taxes or user fees toward expanding extension services. The survey results suggest that citizen views on fertilizer *prices* are not deeply entrenched. However, a key function of Nepal's fertilizer subsidy program is supplying high-quality fertilizer rather than subsidizing the price per se. Price subsidies are at least in part the result of the necessity of reacting to the heavily subsidized Indian fertilizer that flows across Nepal's porous borders, which would otherwise overwhelm fertilizer priced at market levels. Citizens' views on fertilizer subsidies may be different if they were instead asked about the government's role in *supplying* fertilizer rather than in lowering its cost for consumers.

## 5. POLICY RECOMMENDATIONS

Given the rapidly escalating public expenditures on the fertilizer subsidy program, combined with chronically low levels of public expenditures on other ailing parts of the agricultural sector, such as extension and research and development, it is an important moment to revisit the implementation of the fertilizer subsidy program and identify whether it is meeting its goals. Our analysis of the program identifies three significant opportunities for improvement. First, the government should continue efforts to increase the overall supply of good-quality fertilizer in Nepal. Second, better targeting of the program could raise the share of benefits accruing to small and marginal farmers as well as improve the efficiency of program spending. Finally, improved coordination between input subsidies and extension services could ensure that farmers who do get access to inorganic fertilizers are using them at optimal levels.

### **Supply**

The government of Nepal has been able to achieve dramatic increases in the country's supply of inorganic fertilizers. However, demand still far outstrips supply, and increasing the supply of good-quality imported fertilizer is essential to long-run improvements in agricultural yields. The government should explore means of continuing to increase the overall supply of formally imported fertilizer. The most promising means of improving supply are increasing private-sector participation in fertilizer imports and entering into public-private partnerships in neighboring countries to increase fertilizer production.

Neither of these pathways will be easy, and both may take considerable time. Further, efforts to increase private participation may be stymied by vested interests in the current government monopoly on fertilizer imports. One way to ease this constraint could be to imbue the fertilizer subsidy program with a more clear social function (that is, assisting small and marginal farmers) and to retain AICL's and STL's control over fertilizer distribution for the program. Strong government involvement in a subsidy program directed more clearly at small and marginal farmers makes sense because these are the farmers most constrained by failures in agricultural input markets. In contrast, the private sector and public-private

partnerships could take a stronger role in importing and in distributing to the larger farmers in less remote areas, where failures in agricultural input markets are likely less severe.

As private-sector participation in fertilizer supply increases, the government should take a more active role in regulating the quality of imported fertilizers. This approach would require having fertilizer inspectors at the local level as well as obtaining political support from local governments to enable fertilizer inspectors to play an active role in local fertilizer quality management.<sup>14</sup> Because AICL already has regional offices, it could also play an active role in this effort.

## **Targeting**

Currently, the program is poorly targeted to address poverty, food insecurity, or nutrition status. The Central Region receives a disproportionately high share of program resources relative to its number of small farmers and to its poverty level, compared with the Mid- and Far-Western regions, which receive a disproportionately small share of program resources. Reforming this imbalance would involve increasing the overall supply of subsidized fertilizer in the country and directing new resources toward the western regions to compensate for current program imbalances. In the near term, the government should consider redirecting current program resources to the western regions.

In addition to the regional imbalances in the program, larger landholders capture a disproportionate share of the overall supply of subsidized fertilizer. One means of achieving better targeting is to emphasize registration of farmers to ensure that they genuinely meet the poverty and landholding size criteria of the program, thereby preventing nonpoor farmers from benefiting from the subsidy (see review by Houssou, Andam, and Asante-Addo 2017). Such controls have been the primary emphasis of fertilizer subsidy programs in Sub-Saharan Africa. However, targeting based on registration may be more difficult in a country such as Nepal, where commercial farming and large landholdings are relatively rare. Even though poverty may be lower in Nepal than in a country such as Malawi, which is famous for its Fertilizer Input

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<sup>14</sup> Interview with NARMA, Kathmandu, January 2017.

Subsidy Program, Nepal's inequality is also lower.<sup>15</sup> Thus, there may be very little variation in the shares of eligible and ineligible recipients of subsidized fertilizer if poverty or landholding size alone were used. It is possible that cooperatives could play a larger role in formally registering farmers, though it is unclear whether they have the capacity to do so. Moreover, cooperatives themselves may have their own political objectives regarding which farmers receive subsidized fertilizer, which could undermine the overall program objectives of reaching small and marginal farmers.

Rather than relying on registration to target particular farmers based on land size, cooperatives could simply limit the allocation of subsidized fertilizer to a maximum number of bags per farmer. This approach would involve recording who has received inputs already and requiring identification at the time of pickup. Agricultural extension agents could help with training the cooperatives and assist with the distribution. Setting caps on farmer purchases could free up program resources to distribute more subsidized fertilizer in the currently underserved and poorer western regions rather than attempting to meet the high demand of farmers in the Central Region.

Larger farmers would have to supplement their fertilizer supply with fertilizer priced at market levels. However, pushing farmers who can afford it into the fertilizer market could help to develop a more robust market for high-quality, formally supplied (but unsubsidized) fertilizer in Nepal, a crucial step in increasing private-sector participation. Relatedly, packaging and distributing subsidized fertilizer in smaller bags would help ensure that small and marginal farmers could actually purchase subsidized fertilizer in the desired amount rather than having to rely on informal channels for smaller-scale purchases.

Some countries have relied on electronic options to improve program targeting. Many of the electronic approaches that have proliferated recently, including e-vouchers and Visa cards, are intended to improve private-sector engagement and reduce the role of the state in allocating fertilizer. For instance,

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<sup>15</sup> On the one hand, approximately 50 percent of Malawi's population lives below a national poverty line estimated to be equivalent to US\$0.13 per day. Approximately 15 percent of Nepal's population lives below a national poverty line that is about US\$0.45 per day. On the other hand, due to the presence of large-scale tobacco farms and expatriates from South Africa, Malawi's Gini coefficient is 0.43, whereas Nepal's is 0.32 (World Bank 2017).

the pilot Visa card program in Zambia enables eligible farmers to purchase their subsidized inputs from agrodealers using a point-of-sale machine (Resnick and Mason 2016).

These options may be inappropriate at this time for Nepal, for two possible reasons. First, due to ideological opposition to private-sector engagement in the fertilizer subsidy program, enhancing commercial viability is not a major intention of the program; nor is it clear that agrodealer networks are sufficiently established across the country to make this option feasible. Second, such programs require relatively developed information and communication technology (ICT) networks that could be problematic in Nepal's more remote areas, particularly in the mountains. Even in Zambia, there is some concern that the ministry's decision to scale up the Visa card program from 39 to the country's entire 105 districts will falter on weak ICT infrastructure in certain areas of the country.

### **Coordinating between Subsidized Inputs and Extension Services**

Currently, coordination between fertilizer subsidies and crop extension services is remarkably low: according to the 2016 Nepal Rural Household Survey, only 17 percent of households that used inorganic fertilizer received advice from a government extension agent on how to use it effectively, with the lowest rates among the smallest land quintile. As a result, many small and marginal farmers actually overuse chemical fertilizers, which can cause long-run soil degradation. In order to contribute to farmers' long-run livelihoods, fertilizer must be used "as a tool for integrated soil health and fertility management rather than a goal in itself" (Druilhe and Barreiro-Hurlé 2012, vii). In other words, the program goal must be to use fertilizer in concert with other agricultural inputs at optimal levels given the agroecological conditions and soil nutrients, rather than to increase chemical fertilizer use across the board.

Large-scale investments are needed in order to expand access to extension services in Nepal. These investments are important in themselves, but the efficacy of the fertilizer subsidy program is severely compromised by low access to extension services and to information on optimal fertilizer usage. Given the complementarities between inputs and extension, offering them jointly may improve the efficacy of both. For example, in Rwanda, the input subsidy was one of five measures in a comprehensive

crop intensification package, including crop regionalization (matching crops to agroecological conditions), land consolidation services (consolidating nearby plots), extension services, seed subsidies, and fertilizer subsidies (Druilhe and Barreiro-Hurlé 2012).

The fertilizer subsidy program should be one part of an overall soil fertility management program, which could correct the current imbalances in fertilizer use. Nepali farmers frequently overuse urea at the expense of a more balanced fertilizer application. Effectively managing soil fertility requires more public investment in agricultural research, which can help to identify optimal fertilizer use for different agroecological conditions, including, perhaps, more use of organic fertilizers in some areas, and in agricultural extension, which can deliver information to farmers. The remarkably high support among farmers for expanding public investments in agricultural extension—even if it means paying user fees or paying more for fertilizer—suggests that increasing public investment in extension is politically feasible in Nepal.

## 6. CONCLUSIONS

Much of the literature on input subsidy programs in recent years has focused heavily on Africa, where donors have played a strong role in advocating for “smart subsidies” that are well targeted to beneficiaries and do not undermine the private sector (for example, Chirwa and Dorward 2013; Jayne and Rashid 2013; Morris et al. 2007). Although Nepal shares some circumstances with countries in Africa, including relatively low applications of fertilizer and high dependence on imported fertilizer for its subsidy program, its position as India’s neighbor creates unique challenges. The porous border between the two countries means that Nepal cannot autonomously set the price of subsidized fertilizer based solely on the cost constraints faced by poor smallholders. Instead, Nepal must, to some extent, key its fertilizer policy decisions to India’s fertilizer policies and prices.

Despite this limitation, this paper has identified several ways in which the government of Nepal could improve the equity and effectiveness of its fertilizer subsidy program. First, the government can continue efforts to raise the overall supply of formally traded fertilizer in the country. Although the supply could be improved by broadening the market to include private-sector competition, the government would still need to play a strong role in monitoring fertilizer quality and facilitating distribution to some of the poorest and most remote areas, where transport costs may create a disincentive for the private sector. Second, the government can improve program targeting. More subsidized fertilizer needs to be directed to Nepal’s Far-Western and Mid-Western regions, where there are more small and food-insecure farmers (Nepal, MOHP; New Era; and ICF International 2012). More rigorous participation requirements and limits on subsidized fertilizer distribution may be needed in order to ensure that small and marginal farmers can access the program. These measures will be critical to ensure that existing supplies can be made as widely available as possible and targeted appropriately based on varying soil conditions and farming practices. Third, large-scale investments in agricultural extension services are needed because very few farmers who use fertilizer receive any advice on how to apply it optimally.



Reforming fertilizer subsidy programs, however, can be politically challenging. On this front, Nepal may represent a hopeful case for reform. When asked which potential areas of government expenditure could most benefit their villages, rural citizens in Nepal overwhelmingly selected roads, irrigation, and agricultural extension services, and almost none identified maintaining low prices for fertilizer as the most important area of government expenditure. Further, when asked whether they were willing to accept higher fertilizer prices if it meant that the government could increase expenditures on agricultural extension services, more than half of rural citizens were willing to do so. This result provides evidence that Nepali citizens are eager for the government to raise investments in other ailing areas of the agricultural sector, perhaps laying the groundwork for reforms.

## APPENDIX: SAMPLING PROCEDURE

For the 2016 Nepal Rural Household Survey (NRHS), the sample consisted of 75 local government units across 48 districts. There are four types of local government units in Nepal: Village Development Committees (VDCs), municipalities, submetropolitan areas, and metropolitan areas. Because we were interested in rural Nepal, we randomly sampled from the full list of VDCs and municipalities, but excluded Nepal's 11 submetropolitan and metropolitan areas from the sample. Municipalities, in spite of their name, are not necessarily urban areas, nor are they diversified away from agriculture; thus we include them in the sample.<sup>16</sup> The selected units provide important heterogeneity in institutions, culture, and geography by being located across each of Nepal's three agroecological zones and its five development regions.

In selecting local government units to include in the study, we took into account three factors. A first consideration was that the Nepal Living Standards Survey (NLSS) III, collected in 2011 (Nepal, CBS 2012), contained quality data on local infrastructure and socioeconomic conditions for a set of VDCs and municipalities. We made use of these data in selecting our sample, assuming that the sampling for the NLSS was done to ensure that NLSS and non-NLSS local government units were interchangeable in expectation.<sup>17</sup> In practice, this meant restricting the sampling frame to the local government units that were sampled into NLSS III. Table A.1 reports the actual distribution of local government units across the sampling strata and illustrates that restricting the sampling frame to the NLSS III sample does not result in any empty cells. Second, we stratified based on the boundaries of the seven provinces instituted under Nepal's new federal structure (adopted in 2015) to ensure that we had sufficient geographic variation. Finally, we stratified based on agroecological zone.

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<sup>16</sup> The minimum threshold for creating a municipality is a population of only 10,000 in hill and mountain areas and 20,000 in the Terai. In the past several years, the government has been merging VDCs to meet the population requirements to create new municipalities (rather than creating municipalities as VDCs grow economically and in population). There may be a political incentive to create new municipalities in order to give the illusion of economic progress (Devkota 2014).

<sup>17</sup> Gilligan, Pasquale, and Samii (2014) made a similar assumption regarding the NLSS in sampling at the VDC level in Nepal.

Table A.1 reports the distribution of actual VDCs and municipalities over these strata, and Table A.2 reports the distribution of sampled VDCs and municipalities over these strata. We targeted a roughly even number of local government units across each province. Within provinces, the number of local government units targeted in each agroecological zone was determined based on the share of the population in each agroecological zone within the province (reported in Table A.1), so that the overall share of households in the sample in each agroecological zone was roughly equal to the share of the population within these areas.

**Table A.1 Distribution of actual village development committees and municipalities over strata**

<b>Agroecological zone (NLSS inclusion)</b>	<b>Prov. 1</b>	<b>Prov. 2</b>	<b>Prov. 3</b>	<b>Prov. 4</b>	<b>Prov. 5</b>	<b>Prov. 6</b>	<b>Prov. 7</b>
Mountain							
(NLSS III)	9	0	12	1	0	6	9
(Non-NLSS III)	100	0	127	28	0	125	96
<i>Share of prov. pop.</i>	<i>10%</i>	<i>0%</i>	<i>13%</i>	<i>1%</i>	<i>0%</i>	<i>22%</i>	<i>19%</i>
Hill							
(NLSS III)	3	0	45	33	25	21	15
(Non-NLSS III)	327	0	328	347	242	178	173
<i>Share of prov. pop.</i>	<i>39%</i>	<i>0%</i>	<i>77%</i>	<i>76%</i>	<i>34%</i>	<i>78%</i>	<i>37%</i>
Terai							
(NLSS III)	24	58	4	10	38	0	11
(Non-NLSS III)	117	577	13	53	183	0	34
<i>Share of prov. pop.</i>	<i>51%</i>	<i>100%</i>	<i>9%</i>	<i>23%</i>	<i>66%</i>	<i>0%</i>	<i>44%</i>

**Source:** Nepal, CBS (2012a, 2012b).

**Note:** NLSS III = Nepal Living Standards Survey III (Nepal, CBS 2012b).

**Table A.2 Distribution of sampled village development committees and municipalities over strata**

Agroecological zone (NLSS inclusion)	Prov. 1	Prov. 2	Prov. 3	Prov. 4	Prov. 5	Prov. 6	Prov. 7
Mountain							
(NLSS III)	1	0	2	0	0	2	2
(Non-NLSS III)	0	0	0	0	0	0	0
<i>Share of prov. pop.</i>	<i>10%</i>	<i>0%</i>	<i>13%</i>	<i>1%</i>	<i>0%</i>	<i>22%</i>	<i>19%</i>
Hill							
(NLSS III)	4	0	8	8	4	8	4
(Non-NLSS III)	0	0	0	0	0	0	0
<i>Share of prov. pop.</i>	<i>39%</i>	<i>0%</i>	<i>77%</i>	<i>76%</i>	<i>34%</i>	<i>78%</i>	<i>37%</i>
Terai							
(NLSS III)	6	11	1	3	7	0	4
(Non-NLSS III)	0	0	0	0	0	0	0
<i>Share of prov. pop.</i>	<i>51%</i>	<i>100%</i>	<i>9%</i>	<i>23%</i>	<i>66%</i>	<i>0%</i>	<i>44%</i>

**Source:** Nepal, CBS (2012a, 2012b).

**Note:** NLSS III = Nepal Living Standards Survey III (Nepal, CBS 2012b).

Within each sampled VDC/municipality, we randomly selected 2 wards to be our enumeration areas and then sampled 7 households from the population of each selected ward to be interviewed, for a total sample of 1,054 rural households.<sup>18</sup> Within every VDC, there are exactly 7 wards, so it was straightforward to select the enumeration wards in advance. However, municipalities contain a variable number of wards, so it was not possible to determine the number of wards in advance, particularly given the rapidly changing boundaries of municipalities in the past three years. For the municipalities, therefore, field supervisors determined the total number of wards within the municipality upon arrival. Two random numbers between 0 and 1 were drawn in advance, and the enumeration wards were selected by multiplying the random numbers by the total number of wards and rounding up. For example, a municipality with 26 total wards could be assigned the random numbers 0.6091 and 0.8287. The enumeration wards would be wards 16 ( $0.6091 * 26 = 15.84$ ) and 22 ( $0.8287 * 26 = 21.55$ ).

Enumerators used a random walk procedure to sample households within wards. Each ward was randomly assigned one of four possible starting points for the random walk: the ward primary school, the

<sup>18</sup> Five extra households were sampled by accident in the field. Due to poor cellular service, enumerators could not always reach each other to verify how many households had already been surveyed within the village.

ward health post or sub-health post, a body of water located within the ward, or a geographic landmark within the ward. The geographic landmark had to be a natural one (for example, the tallest tree, the highest or lowest point of elevation, or another distinctive geographic landmark) rather than physical infrastructure. We varied the starting points for the random walk procedure to ensure that the overall sample would include houses with varying degrees of remoteness. If it was not feasible to use the randomly assigned starting point for the ward (for example, because the ward did not contain a body of water), then a second-, third-, and fourth-choice starting point were randomly assigned. From the starting point, enumerators were instructed to walk north and select every fifth household to be interviewed in high-density areas and every third household in low-density areas. On even-numbered days, dwellings on the left-hand side were selected. On odd-numbered days, dwellings on the right-hand side were selected. If a street or path ended, then enumerators turned right and repeated the appropriate sampling interval. Interviews targeted either the head of household or the spouse of the head of household. To be eligible to be surveyed, the targeted respondent had to be at least 18 years of age and to have lived continuously in the district for the past 6 months.

Table A.3 reports demographic information on the final sample as well as population information from the 2011 Nepal Census, showing that the final sample matched demographic information well.

**Table A.3 Sample demographics, Nepal Rural Household Survey 2016**

Characteristics	Population (%)	Sample (%)
Agroecological zone		
Terai	46.6	46.1
Hill	46.7	49.0
Mountain	6.7	4.9
Development region		
Eastern	22.7	25.5
Central	36.2	31.4
Western	19.6	18.9
Mid-Western	12.8	13.0
Far-Western	8.7	11.1
Caste/ethnicity		
Chhetri	16.6	20.8
Brahman (hill)	12.2	14.5
Magar	7.1	8.7
Tharu	6.6	10.1

**Source:** Nepal, CBS (2012a); Nepal Rural Household Survey 2016.

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