

Agriculture: More from Less

Indian agriculture, is in a way, a victim of its own past success—especially the green revolution. It has become cereal-centric and as a result, regionally-biased and input-intensive (land, water, and fertiliser). Rapid industrialization and climate change are raising the scarcity value of land and water, respectively. Evolving dietary patterns are favoring greater protein consumption. To adapt to these changes, agriculture requires a new paradigm with the following components: increasing productivity by getting “more from less” especially in relation to water via micro irrigation; prioritizing the cultivation of less water-intensive crops, especially pulses and oil-seeds, supported by a favorable Minimum Support Price (MSP) regime that incorporates the full social benefits of producing such crops and backed by a strengthened procurement system; and re-invigorating agricultural research and extension in these crops. Finally, we provide evidence of deep segmentation in Indian agricultural markets which, if remedied, would create one Indian agricultural market and boost farmers’ incomes.

INTRODUCTION

4.1 Mahatma Gandhi believed that India lives in villages and agriculture is the soul of Indian economy. These words still ring true today. Agriculture brings home the bread to nearly half of all households and supplies it to the remainder. And, while non-farm activities are becoming increasingly important, there is still a core truth in Theodore Schultz’ Nobel Prize lecture: “Most of the world’s poor people earn their living from agriculture, so if we knew the economics of agriculture, we would know much of the economics of being poor.”

4.2 Indian agriculture has come a long way since independence, with chronic food scarcity giving way to grain self-sufficiency despite a two-and-a-half fold increase in

population. In 1966-67, just before India’s Green and White Revolutions, Indian wheat and milk production were just about one-third of US output. By 2013-14, Indian wheat output was 60 per cent higher than America’s, while Indian milk output was 50 per cent higher. These tremendous increases in aggregate output do, however, mask some disquieting trends.

4.3 At the heart of the problem is one of lack of exit (the theme of Chapter 2). Indian agriculture, is in a way, a victim of its own success, which over time is posing to be a major threat. Indian agriculture has become cereal-centric and as a result, regionally-biased and input-intensive, consuming generous amounts of land, water, and fertiliser. Encouraging other crops, notably pulses (via

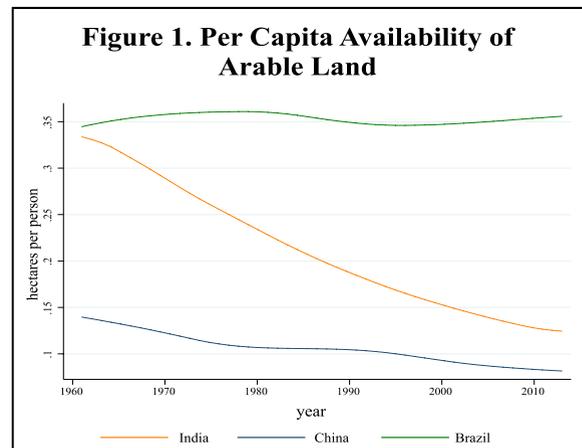
a *Rainbow Revolution* to follow the Green and White Revolutions) will be necessary to match supply with evolving dietary patterns that favor greater proteins consumption. At the same time, rapid industrialization and climate change will require economizing on land and water, respectively—getting “more from less” of these inputs.

4.4 Figure 1 depicts the land challenge, and shows the sharp decline in cultivable land per person in India—much sharper than in other countries. Over the next twenty years, India’s fast population growth will make the cross-country comparison even less favorable for India. Figure 2 highlights the water challenge. It shows that India has much lower levels of water per capita than Brazil, one of the world’s leading agricultural countries. This constraint is exacerbated because, while Brazil and China use approximately 60 per cent of their renewable fresh water resources for agriculture, India uses a little over 90 per cent.

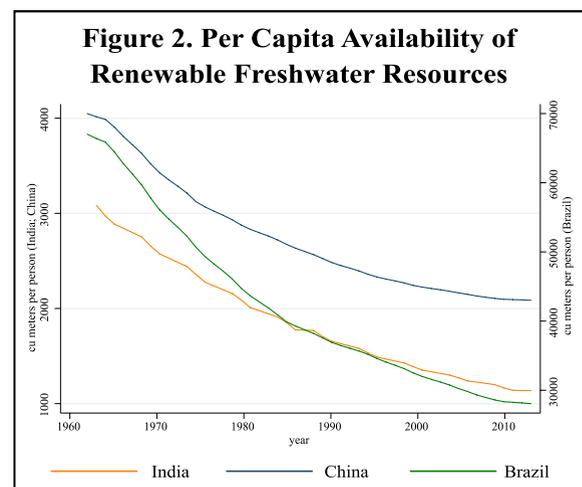
4.5 Agriculture is deserving of several treatises (Niti Aayog, 2015). Given the constraints of space, this chapter focuses on the core issues of engineering a switch toward pulses and the need to economize on the use of water. We first present data on Indian productivity compared with frontier productivity in cereals and pulses. The next section elaborates on the “more from less” imperative with a focus on economizing water via micro irrigation. (The scope for economizing on fertiliser is discussed in Chapter 9). Thereafter, we discuss how the policy on *Minimum Support Prices* (MSP) should be geared towards increasing pulses production, followed by a section highlighting the complementary investments required in *agricultural research and extension*. The final section, building on last year’s Economic Survey, presents some new findings on the *extent of segmentation of Indian agricultural markets*. The findings emphasize the need for expediting action to create one Indian

common market in agriculture, which would increase the returns to farmers substantially.

4.6 Certain very important issues, ranging from crop insurance (where the government has been taking important steps to protect farmers against natural and market shocks) to land leasing, to rural infrastructure, to the livestock sector, are not addressed in this chapter.



Source: FAOSTAT, <http://faostat3.fao.org/>



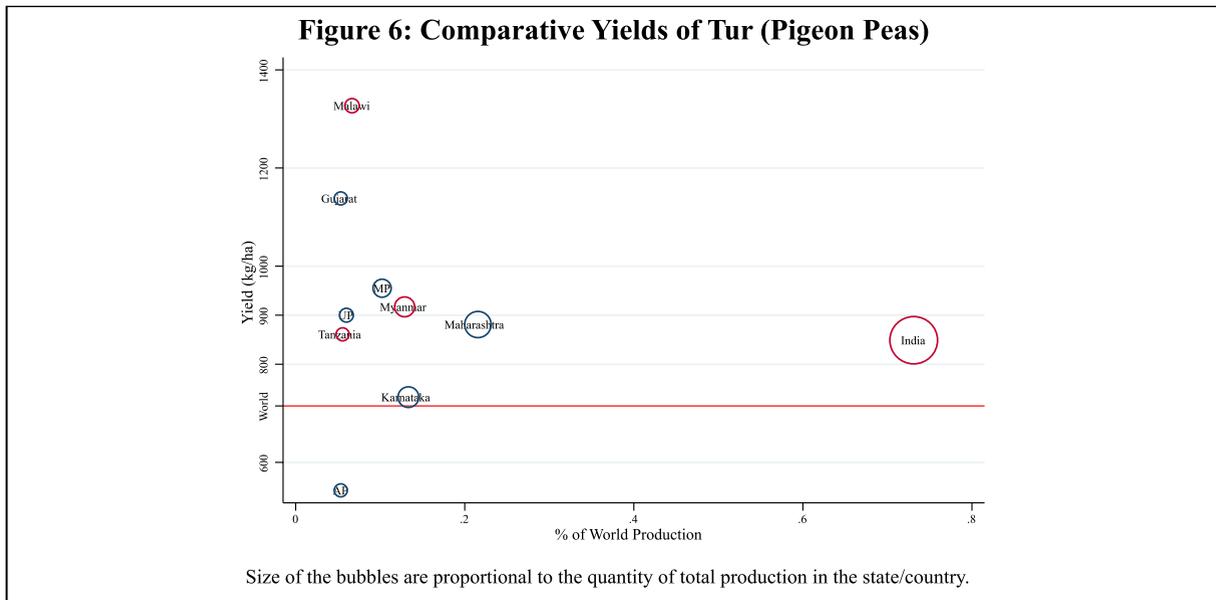
Source: FAOSTAT, <http://faostat3.fao.org/>

Note: Read India, China off left y-axis and Brazil off right y-axis.

PRODUCTIVITY

The macro picture

4.7 The central challenge of Indian agriculture is low productivity, evident in modest average yields, especially in pulses. First, consider the main food grains – wheat and rice. These two cereals are grown on the most fertile and irrigated areas in the country. And

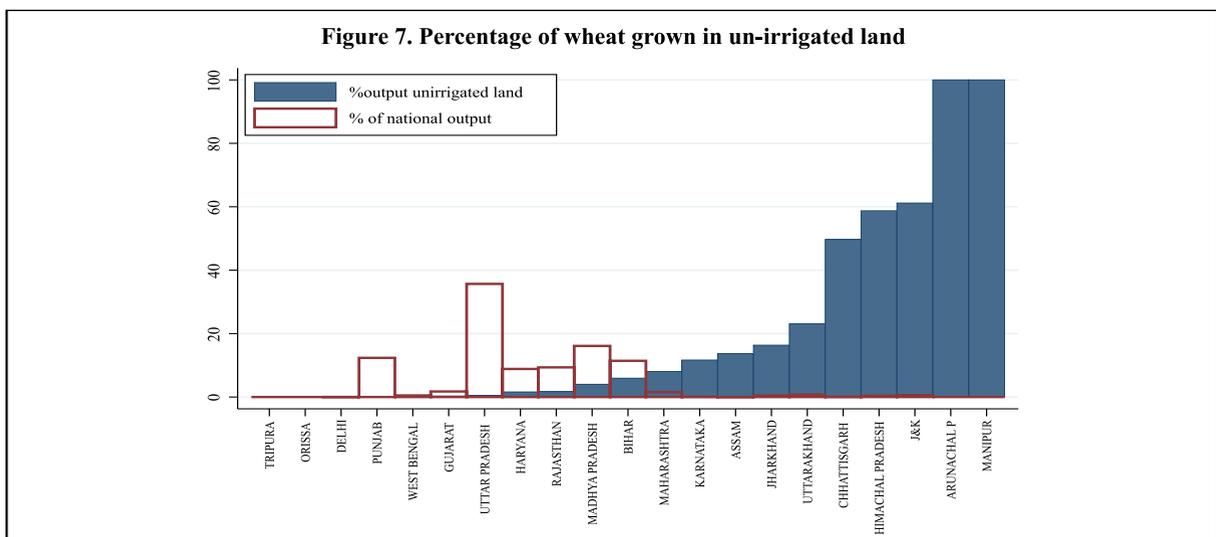


Source: FAOSTAT for the world and Agriculture Statistics at a Glance 2014, GOI for India. All estimates for year 2013-14.

4.11 All four figures carry one important message: India could make rapid gains in productivity through convergence *within* India. For example, in pulses, if all states were to attain even Bihar's level of productivity, pulses production would increase by an estimated 41 per cent² on aggregate.

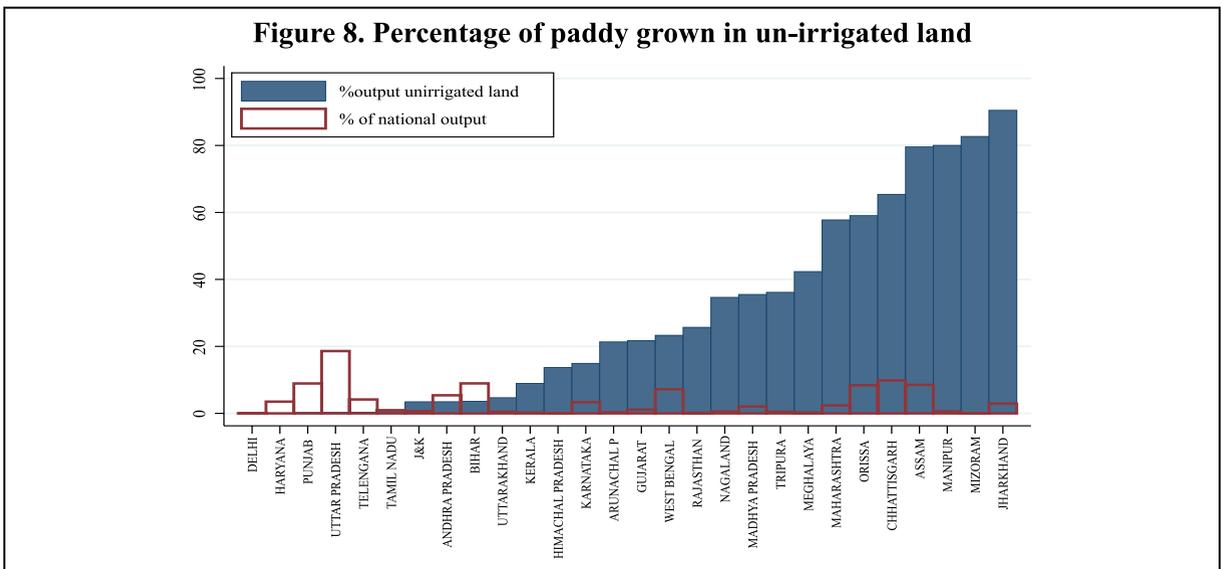
WHERE ARE CROPS GROWN? A DOUBLE BLOW FOR PULSES

4.12 To better understand the productivity challenge, an analysis of the allocation of irrigated land by crop is instructive. Data from the "Situation of Agricultural Households Survey, 2013" by the NSSO allows an estimation of the percentage of crops grown on un-irrigated land across different states. The data is summarized in Figures 7-10.

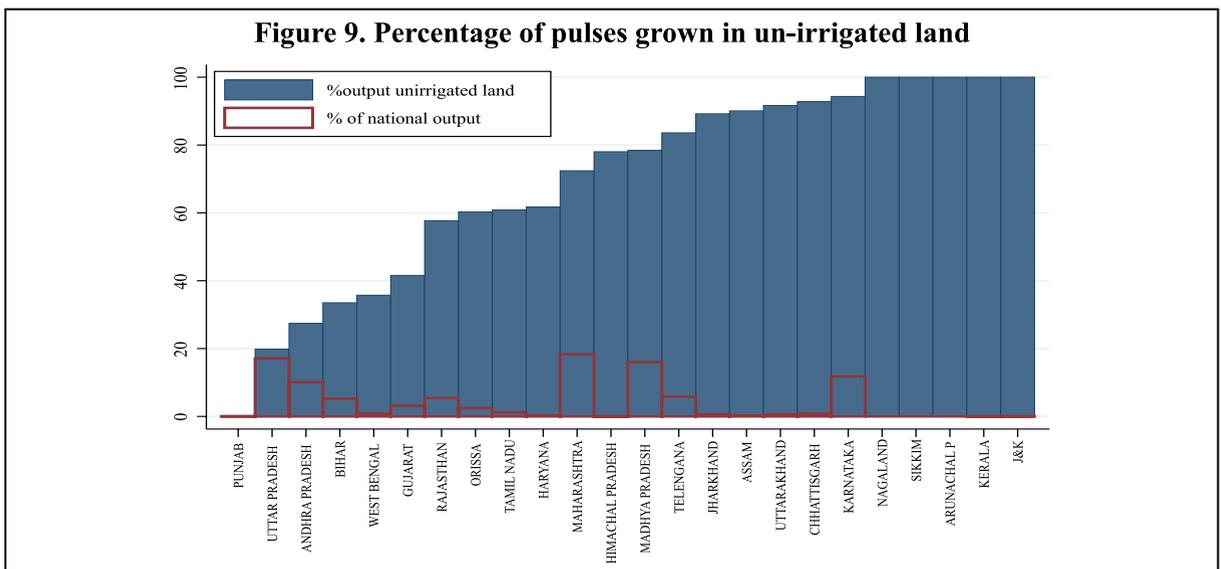


Source: NSS SAS Round 70. July 2012 - June 2013.

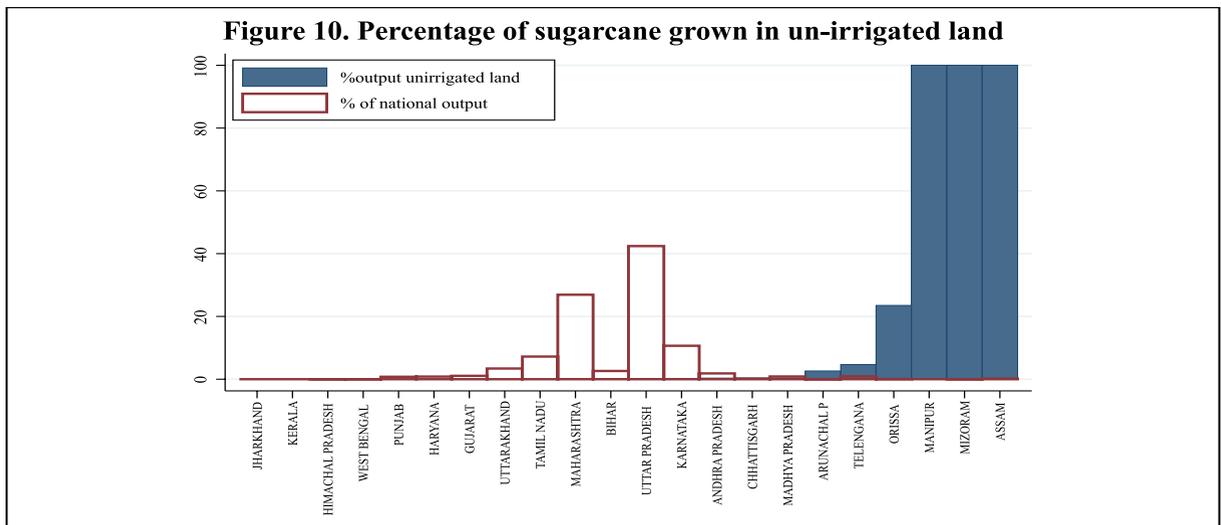
² We arrive at this rough estimate by applying Bihar's pulses productivity level from Figure 5, to the aggregate area under pulses production in a state and comparing it to its current quantity produced. The latter two data points were obtained from data.gov.in (<https://www.data.gov.in/catalog/district-wise-season-wise-crop-production-statistics>).



Source: NSS SAS Round 70. July 2012 - June 2013



Source: NSS SAS Round 70. July 2012 - June 2013



Source: NSS SAS Round 70. July 2012 - June 2013.

4.13 It is immediately apparent that the production pattern for pulses is very different from other crops. Not only is most of the land dedicated to growing pulses in each state un-irrigated, but the national output of pulses comes predominantly from un-irrigated land. In contrast, a large share of output in wheat, rice and sugarcane – in Punjab, Haryana and UP – is from irrigated land. In water scarce Maharashtra, all sugarcane is grown on irrigated land. Meeting the high and growing demand for pulses in the country will require large increases in pulses production on irrigated land, but this will not occur if agriculture policies continue to focus largely on cereals and sugarcane.

WHAT DOES THIS MEAN FOR FARM INCOMES?

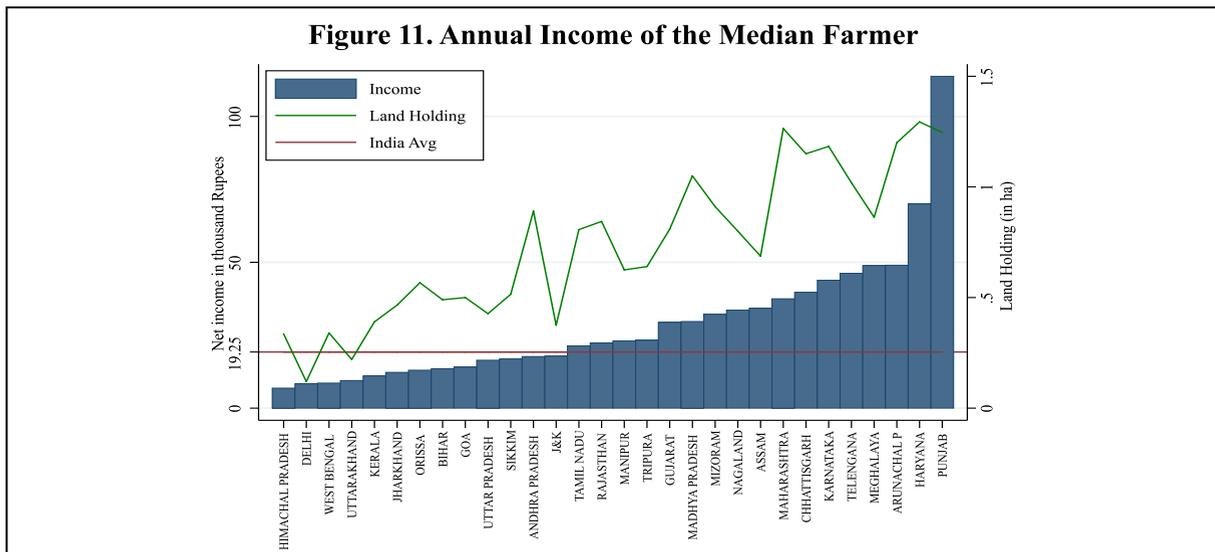
4.14 The negative consequences of low agriculture yields extend from precarious incomes of farmers to large tracts of land locked in low value agriculture, despite growing demands for high value products such as fruits, vegetables, livestock products

because of consumption diversification with rising incomes and urbanization. According to NSS data, the average annual income of the median³ farmer net of production costs from cultivation is less than ₹20,000 in 17 states (Figure 11).⁴ This includes produce that farmers did not sell (presumably used for self-consumption) valued at local market prices. Given high wedges between retail and farm gate price, this might underestimate income but it is still low. Moreover, the variance in agriculture income between the more and less productive states is also very stark.

CRITICAL INPUT: WATER

4.15 Although water is one of India's most scarce natural resources, India uses 2 to 4 times more water to produce a unit of major food crop than does China and Brazil (Hoekstra and Chapagain [2008]). Hence, it is imperative that the country focus on improving the efficiency of water use in agriculture.

4.16 Since independence India has invested numerous resources on irrigation, both



*Data from NSS SAS Round 70. Sample restricted to households surveyed in both Rabi and Kharif. Income only from cultivation net of costs. Unsold produce valued at local market rate.

³ Median refers to the median farmer of each state by net income. We have subsequently backed out the corresponding land holding size of farmers from the NSS data.

⁴ Ideally this net income estimates should be conditional on the monsoon. However, data for such analysis was unavailable.

public (canal irrigation) and private (tube wells). In both cases the water has been deployed via “flood” irrigation, which is an extremely inefficient use of water. Irrigation investments must shift to adopting technologies like sprinkler and drip irrigation and rainwater harvesting (leveraging labour available under the MGNREGS where possible). In order to facilitate this shift, the new irrigation technologies need to be accorded “infrastructure lending” status (currently accorded to canal irrigation) and both the centre and states need to increase public spending for micro irrigation. The consolidation of ongoing irrigation schemes – the Accelerated Irrigation Benefit Programme (AIBP), Integrated Watershed Management Programme (IWMP) and On Farm Water Management (OFWM) – into the Prime Minister’s Krishi Sinchayi Yojana (PMKSY) offers the possibility of convergence of investments in irrigation, from water source to distribution and end-use.

4.17 It has long been recognized that a key factor undermining the efficient use of water is subsidies on power for agriculture that, apart from its benefits towards farmers, incentivises wasteful use of water and hasten the decline of water tables. According to an analysis by National Aeronautics and Space Administration (NASA)⁵, India’s water tables are declining at a rate of 0.3 meters per year. Between 2002 and 2008, the country consumed more than 109 cubic kilometers of groundwater, double the capacity of India’s largest surface water reservoir, the Upper Wainganga.

4.18 It is also noteworthy that India, a water-

scarce country, has been “exporting water” as a result of distorted incentives. Goswami and Nishad (2015) estimate water content embedded in crops at the time of trade. This is different from water used in production, which is much higher. Water “embedded” in crops is the water content of each crop and once the crop is exported, it cannot be recovered. In 2010, India exported about 25 cu km of water embedded in its agricultural exports. This is equivalent to the demand of nearly 13 million people.

4.19 India was a “net importer” of water until around 1980s. With increases in food grain exports, India has now become a net exporter of water – about 1 per cent of total available water every year. The ratio of export to import of such virtual water is about 4 for India and 0.1 for China. Thus China remains a net importer of water. This is also evident in China and India’s trade patterns. China imports water-intensive soybeans, cotton, meat and cereal grains⁶, while exporting vegetables, fruits and processed food. India, on the other hand, exports water-intensive rice, cotton, sugar and soybean.⁷

MICRO IRRIGATION

4.20 A promising way forward, to increase productivity while conserving water (more for less), is to adopt micro irrigation methods. In drip irrigation for example, perforated pipes are placed either above or slightly below ground and drip water on the roots and stems of plants, directing water more precisely to crops that need it. An efficient drip irrigation system reduces consumption of fertiliser (through fertigation⁸) and water

⁵ “NASA Satellites Unlock Secret to Northern India’s Vanishing Water”. December 2009. http://www.nasa.gov/topics/earth/features/india_water.html

⁶ Gale, Fred; Hansen, James; and, Jewison, Michael. *China’s Growing Demand for Agricultural Imports*. February 2015. United States Department of Agriculture (<http://www.ers.usda.gov/media/1784488/eib136.pdf>) and *Agriculture and trade policy: Background note*. <http://tinyurl.com/z3gecmx>

⁷ *India’s Agricultural Exports Climb to Record High*. August 2014. United States Department of Agriculture. <http://tinyurl.com/glng3nf>

⁸ Fertigation is the process of introducing fertiliser directly into the crop’s irrigation system.

lost to evaporation, and higher yields than traditional flood irrigation.

4.21 The key bottlenecks in the adoption of this technology are the high initial cost of purchase and the skill required for maintenance. However, the increase in yields and reduction in costs of power and fertiliser use can help farmers recover the fixed cost quickly. Provisions for credit to farmers can incentivise greater adoption of this technology.⁹

4.22 Results from an impact evaluation of National Mission on Micro Irrigation (of the Ministry of Agriculture, Government of India) conducted in 64 districts of 13 states – Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Haryana, Karnataka, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Sikkim, Uttar Pradesh and Uttarakhand – are revealing on the benefits of drip irrigation.

4.23 There were substantial reductions in irrigation costs and savings on electricity and fertilisers (Figure 12). This is because water is efficiently supplied and hence pumps are used for a limited time. Moreover, water soluble fertilisers are supplied directly to the roots

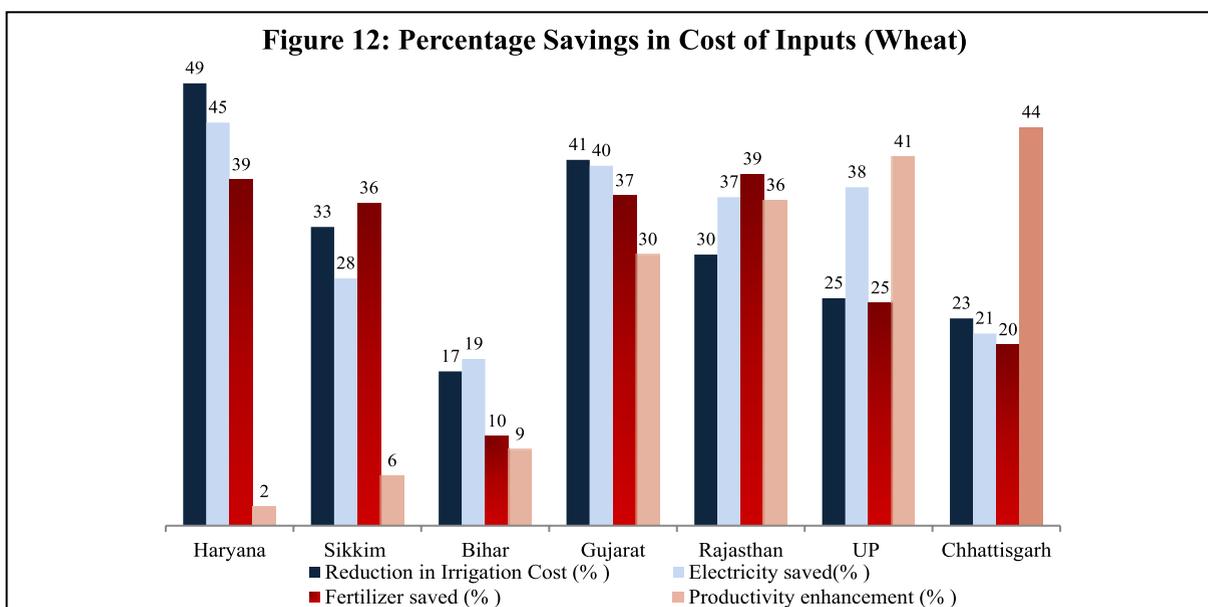
of the plant and hence there is less wastage. Yields of crops also went up – up to 45 per cent in wheat, 20 per cent in gram and 40 per cent in soybean. The resulting improvement in net farm incomes is substantial. Until now micro-irrigation techniques, owing to high fixed costs of adoption, have mostly been used for high value crops. However, recent research has shown its feasibility even in wheat and rice.

POLICIES

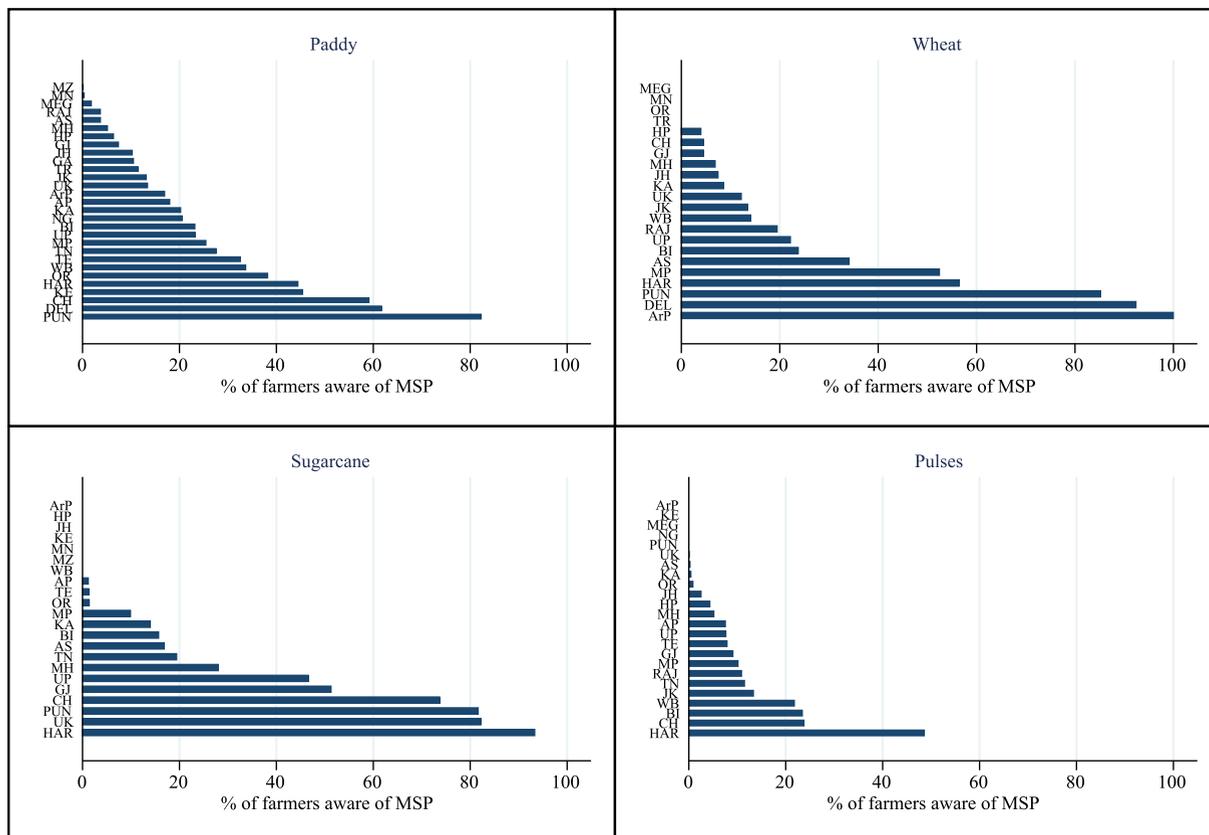
Minimum Support Price and Procurement Policy

4.24 When planting crops, farmers face several uncertainties in terms of their realized prices in the several months following their harvest. In principle, a farmer could buy an option contract to reduce this price uncertainty and make corresponding cropping decisions, but in reality this option is unavailable for all but a miniscule fraction of India's farmers.

4.25 Instead, future prices are guaranteed by the government through the MSP. But while the government announces MSP for 23 crops, effective MSP-linked procurement occurs



⁹ However, ensuring that credit effectively reaches target groups in agriculture is not a small challenge (see Box 5.2 in Economic Survey 2014-15).

Figure 13. Crop-wise Awareness about MSP among Farmers

Source: NSS Situation Assessment Survey of Agricultural Households Round 70

mainly for wheat, rice and cotton. While there is no government procurement per se in sugarcane, a crop with assured irrigation, mills are legally obligated to buy cane from farmers at prices fixed by government, an effective MSP-like engagement. But even for these crops MSP is restricted to a subset of farmers in a few states. This can be clearly observed in large gaps in the percentage of farmers who are even aware of the MSP policy (Figure 13).

4.26 In Punjab and Haryana, almost all paddy and wheat farmers are aware of the MSP policy. However, very few farmers who grow pulses are aware of an MSP for pulses. Even for paddy and wheat where active procurement occurs, there is a substantial variation across states – with only half or less paddy and wheat farmers reporting awareness of MSP, especially in states such as, Gujarat, Maharashtra, Rajasthan, Andhra Pradesh and

Jharkhand. This points to the possibility that procurement in these states may be happening in some districts and not in others.

4.27 Thus, while in principle MSP exists for most farmers for most crops, its realistic impact is quite limited for most farmers in the country. Public procurement at MSP has disproportionately focused on wheat, rice and sugarcane and perhaps even at the expense of other crops such as pulses and oilseeds. This has resulted in buffer stocks of paddy and wheat to be above the required norms, but also caused frequent price spikes in pulses and edible oils, despite substantial imports of these commodities.

4.28 The absence of MSP procurement for most crops in most states implies either that farmers are selling their products to private intermediaries above the MSP or the converse, i.e., farmers have little option but to sell their produce at prices below the MSP,

resulting in a regional bias in farm incomes. There is a general sense that the latter is a more prevalent phenomenon, highlighting the need for reorienting agriculture price policies, such that MSPs are matched by public procurement efforts towards crops that better reflect the country's natural resource scarcities.

4.29 One way of rationalizing MSP policy is to make these price signals reflect social rather than just private returns of production. Table 1 provides an illustrative example for quantifying these private and social returns to cultivating different crops.

4.30 Table 1 estimates the returns to growing wheat, sugarcane or paddy, taking account of the negative externalities from using chemical fertiliser (soil depletion and health), water (falling water tables), and from burning crops (adverse health consequences). Conversely, the social returns to pulse production is higher than the private returns, because it not only uses less water and fertiliser but fixes atmospheric nitrogen naturally and helps keep the soil porous and well aerated because of its deep and extensive root systems. These positive social benefits should be incorporated into MSP estimates.

4.31 Farmers could also be assured a

floor price for their crops through a "Price Deficiency Payment" (Niti Aayog [2015]). Under this system if the price in an Agriculture Produce Market Committee (APMC) mandi fell below the MSP then the farmer would be entitled to a maximum of, say, 50 per cent of the difference between the MSP and the market price. This subsidy could be paid to the farmer via Direct Benefits Transfer (DBT). Such a system would keep the quantum of the subsidy bill in check and also be consistent with India's obligations to the WTO.

AGRICULTURAL RESEARCH AND EDUCATION

4.32 Addressing India's multiple challenges in agriculture will require significant upgradation of country's national agriculture research and extension systems.

4.33 India's National Agricultural Research System (NARS) (comprising the Indian Council of Agricultural Research (ICAR), other central research institutes, and national research centres set up by ICAR), together with agriculture research universities played a key role in the Green revolution. In more recent years, however, agriculture research has been plagued by severe under investment and neglect.

Table 1: Crop-wise return in Punjab during TE 2010-11

Crop Name	Season	Return at market prices (Rs/ha)	Return based on social contribution (Rs/ha)	Difference in social and private returns (Rs/ha)*	Difference in social and private returns (% of market prices)*
Chick-pea	Rabi	2633	5295	2,662	101%
Lentil	Rabi	11349	13584	2,235	20%
Blackgram	Kharif	1564	3057	1,493	95%
Wheat	Rabi	36244	27017	(9227)	(25%)
Paddy-non Basmati	Kharif	46198	32412	(13786)	(30%)
Paddy-Basmati	Kharif	53377	40534	(12843)	(24%)
Sugarcane(Planted)	Kharif	98384	82163	(16221)	(16%)
Sugarcane(Ratoon)	Kharif	118676	103779	(14898)	(13%)

Source: Niti Aayog. The estimates were undertaken as part of the Regional Crop planning for improving resource use efficiency and sustainability at ICAR-NIAP, New Delhi.

* negative(positive) value in the column indicates adverse (favourable) social externalities.

4.34 The system has been sapped by three weaknesses. One, in states where agriculture is relatively more important (as measured by their share of agriculture in state GDP), agriculture education is especially weak if measured by the number of students enrolled in agricultural universities (Figure 14). This is especially true in states in the Northern (except Punjab and Haryana) and Eastern regions. The agriculture universities have been plagued by: (i) resource crunch, (ii) difficulty in attracting talented faculty, (iii) limited linkages and collaborations with international counterparts, (iv) weakening of the lab-to-land connect; and, (v) lack of innovation (Tamboli and Nene [2013] and Niti Aayog [2015]).

4.35 The weaknesses of state agriculture universities (SAU) imply that extension systems critical for the diffusion of new agricultural innovations and practices, or even dissemination of information about public programs such as MSP, are unable to achieve their intended objectives. Urgent intervention in this respect is therefore currently required of the states.

4.36 Second, investment in public agricultural research in India needs to be augmented. Given the large externalities, the centre needs to play a more important role. India's current spending on agriculture research is considerably below that of China and as a share of agriculture GDP even less than that of Bangladesh and Indonesia (Figure 15).

4.37 Third, resource augmentation can go only so far unless accompanied by changes in incentives. There is a strong need to take steps to enhance research productivity among the scientists in public agriculture research institutes by instituting performance indicators "as the majority (63.5 per cent) of scientists [had] low to very low level of productivity." (Paul et. al. [2015]). For example, the rapid

rate of innovation required in pulses can be achieved by securing participation from the private sector, which hitherto, has remained largely limited due to the small scale of pulse production in the country. This can potentially be of the form of a pull system of research, similar to Kremer's HIV/AIDS vaccine idea, albeit with a smaller quantum of reward. In such a system, the winner is offered a proportionately large enough award for innovating desirable agricultural traits, but the intellectual property rights of the innovation are transferred to the government. The policy should however, seek to level the playing field for private, public and citizen sector participation.

4.38 Similarly, private sector innovation and high yielding variety in seeds can result in productivity gains. Currently, the seed replacement rate for pulses are in the range of 19 per cent to 34 per cent,¹⁰ highlighting the need for greater private sector engagement in order to spur innovation and high yields.

4.39 India should also fully leverage new low-cost technologies that have wider benefits for agriculture. Cellphones have been creatively used by countries like Ghana, Kenya, Nigeria and Thailand to provide information on prices and cultivation to farmers which has led to massive increases in farm incomes. Since the costs of drones have fallen sharply, they can be used by SAUs to provide crucial information on crop health, irrigation problems, soil variation and even pest and fungal infestations that are not apparent at eye level to farmers. Small efforts can go a long way in mitigating farm losses and risks and maximizing income.

4.40 A host of studies has demonstrated significant net benefits of GM crops (Kathage and Qaim [2012]) with leading countries such as Brazil and now China opening up to new GM technologies and aggressively building

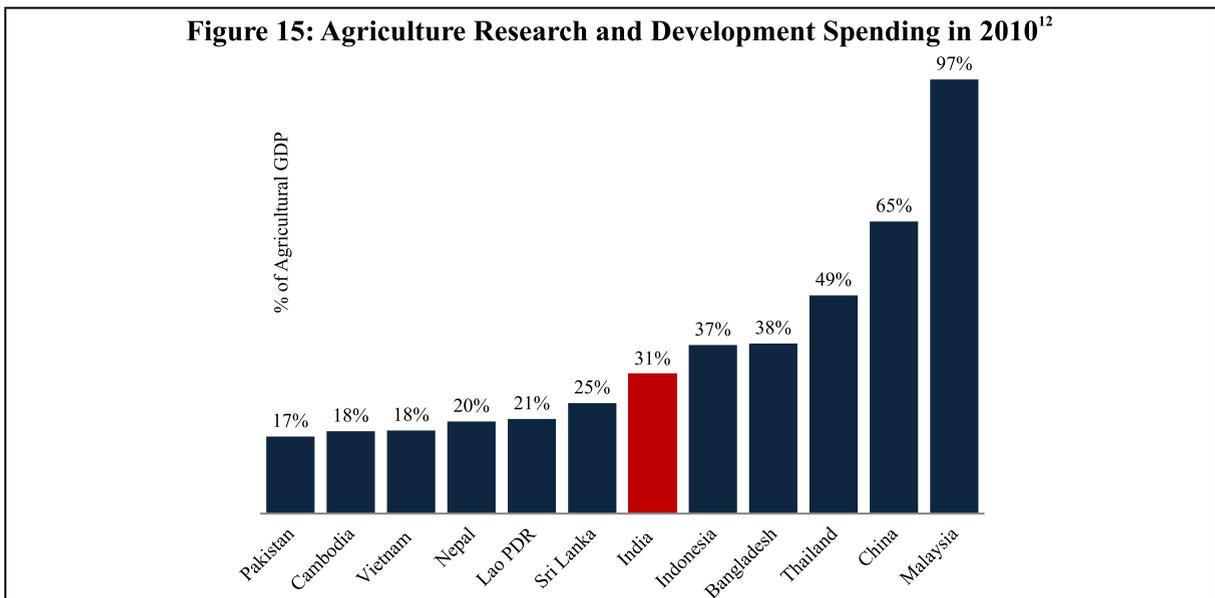
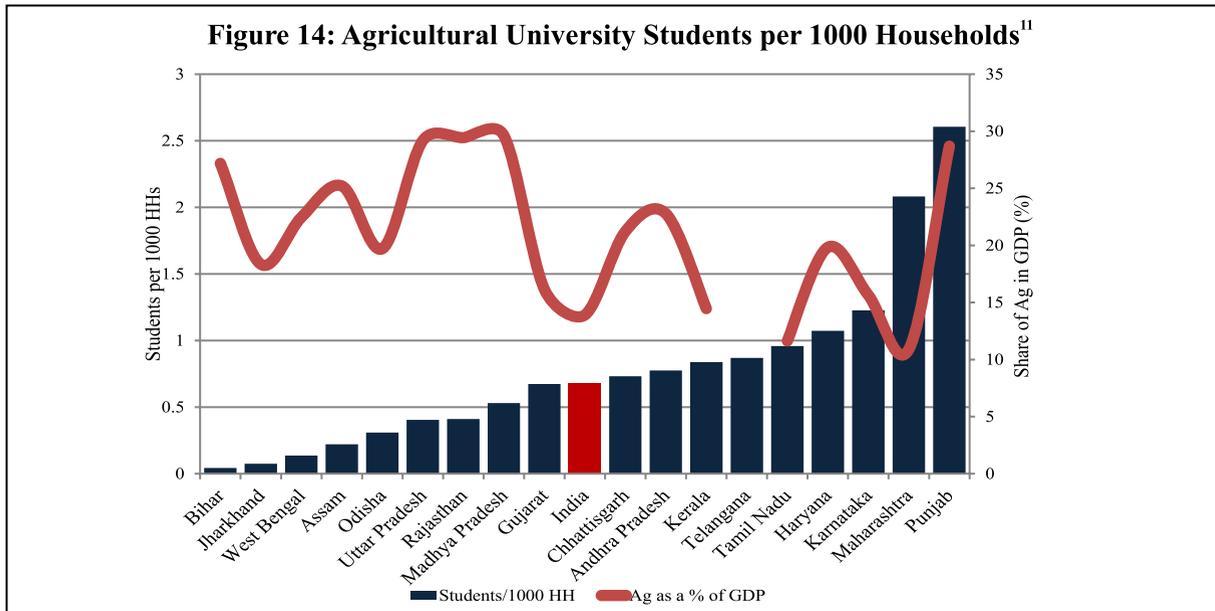
¹⁰ State wise seed replacement rates are from Seednet, <http://seednet.gov.in/PDFFILES/SRR-13.pdf> ; Data cited is for 2011-12, the latest available estimates.

their own research capacity. Nonetheless there are good reasons for some of the public apprehensions on GMOs. Therefore, the regulatory process in India needs to evolve so as to address the concerns in a way that does not come in the way adapting high yielding technologies and rapidly moving towards the world's agro-technological frontier.

MARKET FAILURE FOR AGRICULTURAL OUTPUT

Market Segmentation

4.41 Market segmentation reduces overall welfare because it prevents gains through competition, efficient resource allocation, specialization in subsectors and fewer



¹¹ Source: Lok Sabha unstarred question number 5645, dated 28.04.2015, NSS SAS 2013 and Agriculture Statistics at a Glance 2014.

¹² Source: Stads, G.J. 2015. *A snapshot of agricultural research investment and capacity in Asia.* "ASTI Resource Paper for the Asia Pacific Association of Agricultural Research Institutions' High Level Policy Dialogue, Bangkok. December 2015. Washington, DC: International Food Policy Research Institute.

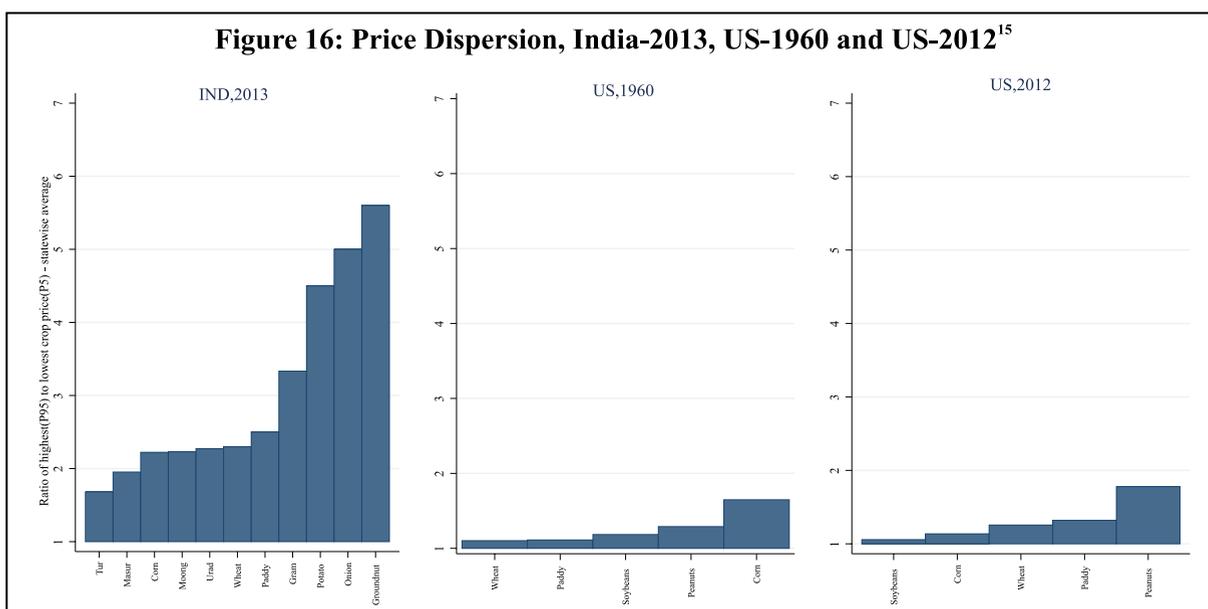
intermediaries. Massive railroad expansion in the late 19th Century changed the landscape of agriculture markets in the United States. The resulting gains due to the increase in market integration is estimated to be around 60 per cent in terms of land value (Donaldson and Hornbeck [2015]) and 90 per cent in terms of output (Costinot and Donaldson [2011]).

4.42 The causes of market segmentation are many – differences in remoteness and connectivity (rural roads), local market power of intermediaries, degree of private sector competition, propensity of regional exposure to shocks, local storage capacity, mandi infrastructure and farmers access to them, storage life of the crop and crop specific processing cost.

4.43 Market segmentation results in large

differences in producer and consumer prices. Although these differences are location-specific, they result in higher costs for both farmers and consumers alike. This is immediately apparent if one compares India to the US. In Figure 16, price¹³ dispersion for prices received by farmers is measured as the ratio between the highest (P95) and the lowest (P5) price of the crop in a country, i.e. if this ratio were to be equal to one, it would imply that there is no price dispersion, and that there is one common market.¹⁴

4.44 India’s price dispersion across commodities (the left-most graph) is a stark contrast to those of the U.S. even in the 1960s. For example, in 2012 in the United States the *maximum* price dispersion is for peanuts, which hardly exceeds 1.75, much higher than the *minimum* observed for any



Source: NSS Situation Assessment Survey of Agriculture Households Round 70, United States National Agricultural Statistics Service

¹³ The prices are constructed as state wise averages of prices received by farmers in that state for India. The US prices were obtained from the United States Department of Agriculture, National Agricultural Statistics Service <http://www.nass.usda.gov/>

¹⁴ We recognize that these estimates should ideally be compared to similar emerging market economies today. We used the US as a benchmark because historical data going back to 1960 was more easily available. Moreover, a comparison between India today and the US in 1960 controls, to some extent, for the stage of development.

¹⁵ India, 2013 farmgate prices were procured from NSS SAS 2013. The data for US-1960 and US-2012 is obtained from United States Department of Agriculture, National Agricultural Statistics Service <http://www.nass.usda.gov/>

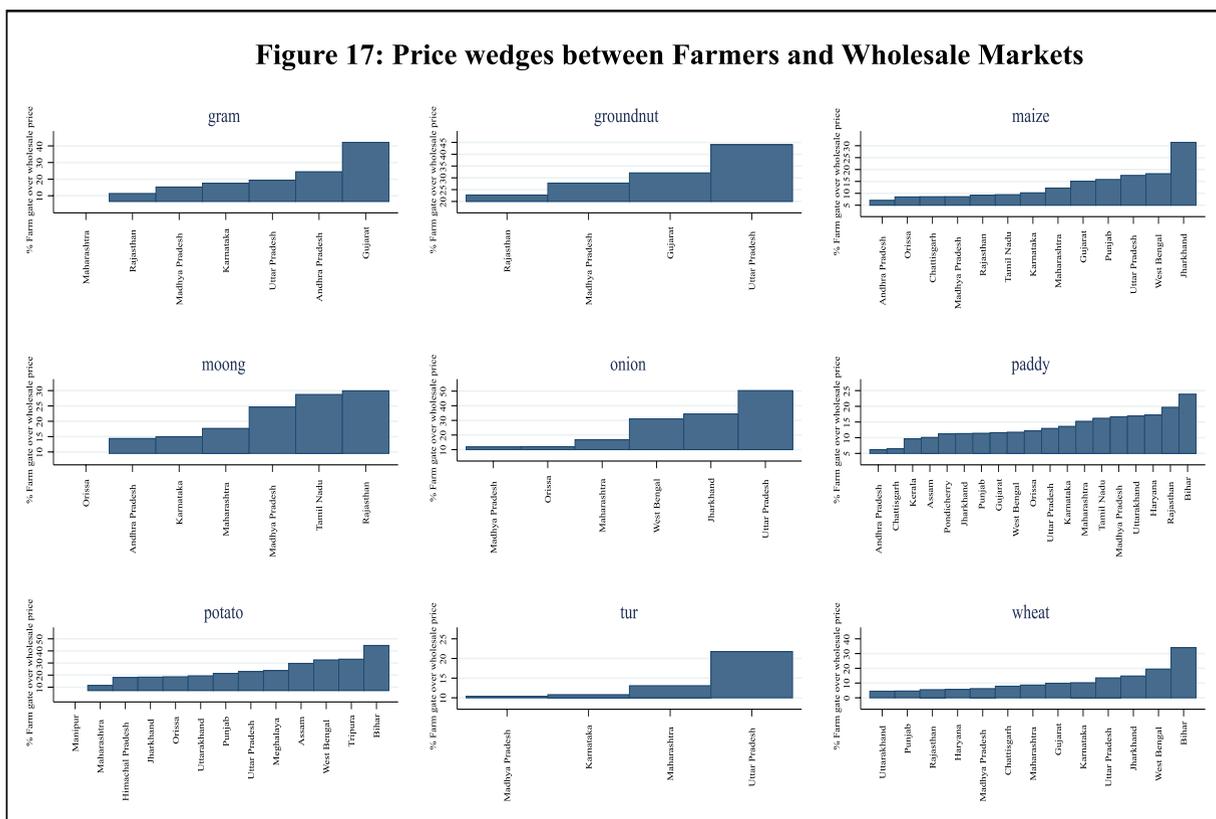
agriculture commodity in India (i.e., tur). In effect, price dispersion in India is about 100 per cent-45 per cent greater than in the US today or the US in 1960.

4.45 As noted earlier, segmentation also creates a “wedge” at various points in the supply chain from the farm-gate to the final consumer in India. Quantifying these price wedges across agents spread over the supply chain is complex given data constraints, but we have attempted some rough estimates.

PRICE WEDGES

4.46 The graphs below quantify the wedges

between farm-gate and wholesale prices and then between retail and wholesale prices for certain crops. Several layers of intermediary networks exist between farmers and wholesale markets and also between wholesale and retail markets, data for which is unavailable. Consequently, this analysis is unable to isolate the contribution of each of these intermediaries and other sources of price wedges such as transportation costs, storage capacity and other factors listed above (see Appendix 6, Technical Appendix, Chapter-4 for a full set of assumptions). With these caveats, the estimates are provided in Figures 17 and 18.



Source: NSS SAS Round 70, 2013; Agmarknet

4.47 Figure 17, which examines farm gate-wholesale price wedges,¹⁶ indicates that the biggest price wedges are for potatoes, onions and groundnuts. The wedges are lower for rice, wheat (two commodities that

are produced by a large majority of farmers and where MSP declaration is followed by government procurement) and interestingly for maize. The wedges for pulses (tur and moong) are not as high as potatoes, onions and

¹⁶ The data for farm gate price is NSS SAS 2013. The data for wholesale prices is from <http://www.agmarknet.in> for the same year and season as NSS SAS 2013.

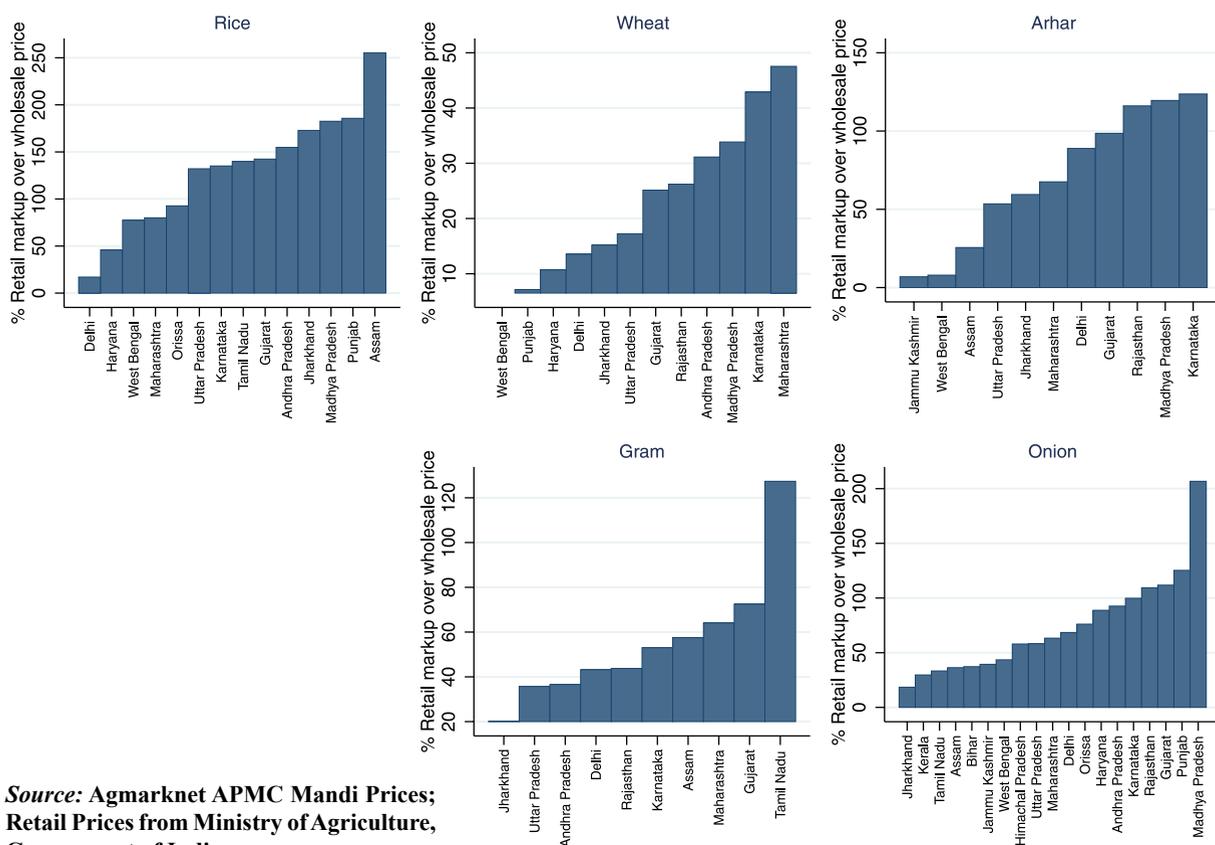
groundnuts. It appears that the perishability of a product is an important factor driving the wedges.¹⁷

4.48 The estimates are qualitatively similar when we look at wedges between the retail and wholesale markets (Figure 18). The analysis (for 2014) finds higher markups in perishables such as onions than in cereals and pulses. Higher markups in rice might reflect the processing cost of paddy. But in addition to the price wedges across commodities there is also substantial variation in wedges for the same commodities across states. If processing and other costs are similar across

states then higher markups for certain states across commodities is a reflection of state specific effects – which could range from rural infrastructure, storage capacities to the rural political economy. For example, Karnataka, Madhya Pradesh, Maharashtra and Karnataka appear to have higher markups across commodities.

4.49 Chapter 8 of last year’s Economic Survey addressed the need for a national market for agricultural commodities India. The analysis above shows the large magnitude of price wedges both across commodities as well as across states¹⁸. It

Figure 18: Wedges between Retail and Wholesale Prices



Source: Agmarknet APMC Mandi Prices; Retail Prices from Ministry of Agriculture, Government of India.

¹⁷ The calculation of wedges does control for crop variety. Given limited information about quality and varieties in the retail and farm-gate price data, we have tried to allay these concerns as best as we could by comparing median prices over similar distances. As a robustness check, in analysis not reported here, we also tried comparing the 80th percentile of wholesale to the 40th percentile of retail prices and the results did not change much.

¹⁸ Statistical tests for market integration, derived from the law of one price, look at whether prices of similar goods in different markets co-move with each other. They can also test for whether the co-movements fail in either the short- or the long-run or both. However, a broader understanding of market segmentation is also whether local shocks do not spread geographically. Hence, the wedges (which measure prices in changes and not in levels) should not be location specific if markets are perfectly integrated. Our analysis should be viewed in that spirit.

illustrates an important point: greater market integration is essential for farmers to get higher farm gate prices. While the GST bill is a step in the right direction, a lot more needs to be done by the states, including, creating better physical infrastructure, improved price

dissemination campaigns, and removing laws that force farmers to sell to local monopolies, etc. Nearly seventy years after Independence, India is still far from being one nation in agriculture.

REFERENCES:

1. Chapagain, A. K., & Hoekstra, A. Y. (2008). The global component of freshwater demand and supply: an assessment of virtual water flows between nations as a result of trade in agricultural and industrial products. *Water international*, 33(1), 19-32.
2. Costinot, A., & Donaldson, D. (2011). How Large Are the Gains from Economic Integration? Theory and Evidence from US Agriculture, 1880-2002. *Massachusetts Institute of Technology. Mimeo.*
3. Donaldson, D., & Hornbeck, R. (2013). *Railroads and American Economic Growth: A "Market Access" Approach* (No. w19213). National Bureau of Economic Research.
4. Goswami, Prashant, and Shiv Narayan Nishad. "Virtual water trade and time scales for loss of water sustainability: A comparative regional analysis." *Scientific Reports* 5 (2015).
5. Kathage, J., & Qaim, M. (2012). Economic impacts and impact dynamics of Bt (*Bacillus thuringiensis*) cotton in India. *Proceedings of the National Academy of Sciences*, 109(29), 11652-11656.
6. Niti Aayog (2015), "Raising Agricultural Productivity and Making Farming Remunerative for Farmers".
7. Paul, S., Vijayaragavan, K., Singh, P., & Burman, R. R. (2015). Research productivity of agricultural scientists: Evidences from high performing and low performing institutes. *The Indian Journal of Agricultural Sciences*, 85(4).
8. Stads, G.J. 2015. "A snapshot of agricultural research investment and capacity in Asia." ASTI Resource Paper for the Asia Pacific Association of Agricultural Research Institutions' High Level Policy Dialogue, Bangkok, December 2015. Washington, DC: International Food Policy Research Institute.
9. Tamboli, P. M., & Nene, Y. L. (2013). Modernizing higher agricultural education system in India to meet the challenges of 21st century. In *XI Agricultural Science Congress held on February*.