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Bulbs and Biopower: Managing Produce and Price in the Age of Agri-Logistics

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Abstract: This paper deploys the material and discursive politics of storage as a lens into agrarian change in rural India. Focusing on onions (*Allium cepa*), a price volatile crop and a kitchen staple, it maps out the contested meanings of and motivations for storage among growers, governments, and agri-logistics companies. Specifically, this paper asks why storage is increasingly positioned as a key solution to the problem of price instability. This emphasis, I argue, represents a distinct regime of agrarian biopower that seeks to intervene into the physical properties of the bulb to extend its material life, and thereby, manage produce, prices, and populations. In doing so, however, fundamental issues of social inequality and guaranteed prices are bypassed. Moreover, innovations in storage technologies lay the grounds for the entry of corporate capital into agriculture. Ultimately, techno-capital-intensive biopolitical infrastructures of storage portend the restructuring of India's agrarian economy in favour of elite farmers and agri-logistics firms by circumventing the issue of a fixed and fair price for producers and consumers.

Keywords: storage, agrarian change, Indian agriculture, food stocks, speculation and accumulation

Introduction

With dark clouds looming on a humid July day in 2023, I accompanied my friend Lalit to visit his cousin, Sagar, whose family had erected a warehouse a few years prior.[1] A towering structure amidst vast soybean fields, the warehouse had a large metal gate at the front and grilled windows on each wall. Behind a blue tractor lay the raison d'être for the construction: a mound of pink onions piled high against the wall (Figure 1). Sagar's family built the warehouse through a Madhya Pradesh state government subsidy programme intended to expand storage infrastructures in the region.[2] Loose hanging wires messily strung across the room are connected to makeshift fans placed above, amidst, and adjacent to the bulbs, offering protection from the heat and humidity that grip this central Indian region between April and September, the period when *rabi* (winter) onions are usually stored.

Sagar's household is what the Indian government would define as a medium-scale agricultural household. Owning 35 *bighas* of irrigated land (roughly nine hectares), his Balai (oppressed caste) family is quite prosperous. A few days

Figure 1: A heap of onions surrounded by fans in Sagar's warehouse (Photo by author)

earlier, Sagar had sold a part of their onion stock that was spoiling, saying "*kamzor maal nikal rahe hai*" ("everyone is removing their poor-quality produce"). His family received Rs. 7 per kg at the wholesale market in the city of Ujjain—a low price in his estimation but standard for the summer and early monsoon months.[3] His remaining produce too was deteriorating quickly: skin peeling, discoloured, moist, owing to unseasonal rain during the harvest period. Nonetheless, Sagar declared boldly that he would only sell when prices hit Rs. 20, a possibility after August when stored supplies dwindle and the new *kharif* (monsoon) harvest is yet to arrive in the market.

Sagar's investment in and expectations from storage are increasingly commonplace among agriculturalists across Malwa and elsewhere. His situation brings to the fore the socio-ecological complexities of agricultural storage in contemporary India: expectations of a good price, deteriorations in quality, state subsidies, the seasonality of supply. But it is not simply individual farmers who are concerned with the storing and pricing of onions—so too is the Indian state and, increasingly, agri-logistics and agri-tech companies. This speaks to the material politics of the Indian onion, a crop distinct in its biophysicality, uneven seasonality, price volatility, and political sensitivity. To these myriad challenges, proper storage is increasingly presented as a crucial panacea.[4] The government is incentivising

agri-tech firms to develop innovative storage technologies even as it subsidises warehouse construction for farmers. What does this emphasis on storage-as-solution reveal and occlude, and with what material effects?

This paper shows that diverse actors and institutions—farmers, governments, and, increasingly, private companies—are engaging in onion storage, but with distinct and often conflicting aims and aspirations. Much like the village grain heap, the stock is "the material centre of moral dilemmas" around questions of welfare, fairness, efficiency, and accumulation (Krishnamurthy 2018:31). Storage has always been central to the postcolonial state's biopolitical management of the agrarian milieu—silos and *godowns* (warehouses) were central to Green Revolution-era procurement and distribution of grain at fixed prices. Unlike wheat, however, onions are neither regularly procured by the Indian government nor covered by a guaranteed support price despite its political-economic significance. Yet, the question of price is central to debates around storage, and in turn, were at the heart of the historic 2020–21 farmers' protests against a proposed set of agricultural marketing laws that farmers believed would dismantle the system of Minimum Support Prices (MSP) for their crops. A key demand of farmers' groups has been a legal guarantee of MSP which, functioning as a floor price, would serve as a mechanism of price stabilisation within volatile markets (Krishnamurthy 2024).[5] Although onions do not figure within pan-Indian debates around price supports, this paper emphasises the shallowness of technological solutions of storage in the absence of political solutions such as state-mediated price support mechanisms that would minimise market risk for cultivators.

In the current moment, state investment largely takes the form of subsidies for warehouses and partnerships with agri-tech firms to develop new tools to reduce spoilage. According to this logic, improved storage facilities can stabilise prices for both producers and consumers by extending the life of the onion and stretching out supplies over a longer period. By reducing the problem of price to one of supply and technological "backwardness", these state interventions not only sidestep issues of power and inequality that structure who stores, for how long, and with what consequences, but also re-envision agrarian environments as a "site of technological innovation and entrepreneurial and market rationalities" (Moulton and Popke 2017:721).

Drawing on Foucauldian theories of biopower, this article deploys contestations around onion storage as a lens into processes of agrarian change in rural India. As articulated by Michel Foucault, biopower can be understood as a distinct form of power associated with the modern administrative state in the 17th and 18th centuries, which conceived of humans as biological beings who could be managed at the level of a population. Foucault (1988:160) writes, "The population and environment are in perpetual living interrelation, and the state has to manage those living interrelations between those two types of living beings". Building on this, Alex Moulton and Jeff Popke (2017:719) argue for a concept of agrarian biopower which acts "not on human processes alone, but on the proper metabolism between multiple social and natural forces working in the interest of agricultural production". Control over this metabolism lies at the centre of ongoing efforts to reorganise storage arrangements in the Indian countryside.

One of the primary examples used by Foucault (2007) was the recurring problem of grain scarcity in France, thereby tying the question of human welfare to the regulation of non-human entities (crops). Thus, as Kregg Hetherington (2020) argues, biopolitics has *always* been agribiopolitics in that the thriving of food crops (especially grain) has enabled the thriving of human populations. Nonetheless, Hetherington laments the lack of discussion of plant life itself in Foucault's writing, stating that the focus on grain markets and prices means that "[g]rain is already an abstraction in the story, already translated into an economic variable bearing very little relation to the stalks and roots of wheat, barley and rye, and the fields in which they grew" (Hetherington 2020:684). However, as this paper shows, an examination of storage—the space-time between production and distribution—enables, indeed *necessitates*, engagement with the realm of plant properties *and* pricing policy, and connections between the two. Indeed, as David Nally (2011) argues, food provisioning is a material expression of biopower, providing a bridge between the political economy of agri-food systems and an understanding of regulation as a vital process of managing life.

Additionally, this paper builds on recent work on the social life of logistics which critically interrogates the "structures of governance, exploitation, dispossession, and domination that underpin logistical logics and practices" (Chua et al. 2018:619). Logistics, rooted in military, industrial, and imperial histories (Cowen 2014), is subsuming the production process to the imperative of circulation. As scholars of agriculture note, how this is reconfiguring agricultural production is an important empirical question to be addressed. For instance, centring the "agrarian question of circulation", Martin Arboleda (2020) calls for attention to mediating spaces between cultivation and exchange that shape agrarian livelihoods in crucial ways. Taking a historical-geographical approach, Daniel Banoub and Sarah Martin (2020) argue for attention to stasis and fixity—as much as flow and mobility—within the "logistical turn". Similarly, rethinking logistical power through friction, interruption, and seams, Nicky Gregson et al. (2017) highlight the importance of the spatialities of storage—from warehouses to distribution centres—to contemporary capital accumulation. Bringing together scholarship on biopolitics on the one hand and logistics on the other, this paper argues that projects to control the speed and cost of holding, moving, and marketing agricultural produce are biopolitical interventions seeking to manage price movements and demanding populations through plant properties.

The onion is a salient crop for producers, consumers, and the Indian state. Onion (*Allium cepa*) production in India is about 26.91 million metric tons (MMT) from an area of 16.28 million hectares (2020–21). This is a five-fold increase in production from 2001. Cultivation is concentrated in a few key states (Maharashtra, Karnataka, and Madhya Pradesh) on millions of small plots of farmland. Currently, India is the largest producer country in terms of area cultivated, second largest in terms of production, and a major exporter of onions, mainly to countries in West, East, and South Asia. In part, this is a consequence of government encouragement of high-value cultivation through the National Horticulture Mission launched in 2000. According to the Ministry of Consumer Affairs, onion consumption has also steadily grown from 2.25 kg (per person per year) in 1961 to

14.7 kg in 2017. On average, it is held that Indians consume 1.3 million tons of the bulb every month.[6]

The unceasing demand for onions throughout the year, however, clashes with the seasonality of supply. Although onions are produced in three cycles in India, it is only the *rabi* (winter) crop that can be stored for long periods of time due to its lower moisture content. This crop is harvested between March and May but satisfies demand until at least September when the fresh harvest of the *kharif* (monsoon) onions arrive in the market. This period can stretch until December if the new harvest is damaged or delayed. Storage, therefore, provides a (fragile) means to extend the temporal horizons of use and exchange beyond seasonal availability.[7] Farmers and traders might take advantage of this temporality by withholding sales to escalate prices. However, when prices rise, so too does consumer discontent.[8] The state often responds to this with export bans, storage restrictions, and direct procurement from farmers.

Storing onions is a challenging and delicate encounter with rain and rot, fungi and bacteria, hoarders and taxmen. Holding onions in place articulates a tenuous relationship to the future. For farmers, this is a future in which prices may rise or fall, produce keeps or rots, and profits accrue or decline. For others, it is one in which prices remain steady, household budgets are maintained, and electoral polls are won. As a crop and commodity, the onion is marked by a curious in-betweenness. It is not an essential food grain whose scarcity threatens large-scale calamity, but it is consumed across class. It is not easily perishable in the way that green vegetables are (days), but it is not nearly as durable as cereals and pulses (years). The unavailability or unaffordability of onions does not portend famine, only disgruntled consumers. As a "staple" food, however, it is "associated with stability, with the consistent rhythm of the everyday, the meeting of basic needs" (Barnes 2022:19). And although it is not as closely regulated as grain, "the ramifications of allowing the market to deliver the goods are not consistently, politically tolerable" (Guyer 2016:46). It is this in-betweenness that makes onions "good to think with" in that its circulation is a contested site of political legitimation, economic experimentation, and technological innovation.

My argument builds on ethnographic research carried out in western Madhya Pradesh, India's second-largest onion producing state (2018–19, 2023). During this period, I was based in one village, but carried out research in neighbouring villages, district-level government offices, and agricultural markets across Ujjain, Dewas, and Shajapur districts. Research included observation of the decision-making of agricultural households, particularly cropping patterns and marketing practices as well as observation of onion auctions at the Shajapur and Indore *mandis* (regulated agricultural markets). At the market, I conducted interviews with onion farmers, commission agents, traders, and *mandi* officials. Additionally, this paper draws on a close analysis of reports on storage challenges and solutions published by policymakers and private consultancies, crop science journals, and the mainstream media. Rather than traversing through each site along the supply chain from production to consumption, this paper focuses exclusively on spaces and practices of storage but situates these in relation to sites of cultivation (farms), trade (agricultural markets), and governance (law and policy).

Making (Onions) Live

Agriculturalists and traders often insist that their profits are legitimate in view of the labour entailed in making onions live. Indeed, farmers maintain that it is due to their foresight and efforts that onions remain in circulation between agricultural seasons. Disputing allegations of hoarding during the 2019 supply crunch, one wealthy farmer protested, "If we [producers] don't store, how will you [consumers] get onions 12 months a year?" His argument was premised on the biopolitical logics of food provisioning—their work as producers is never solely driven by monetary gain, but also always about sustaining human populations. As Julie Guthman (2017:111) notes, agricultural work is inherently biopolitical in that "agriculture is about making plant and animal life live in order to make human life live". And making onions live is no simple task. In this section, I explore the intersections between the biophysical properties of the onion and the socio-material arrangements of storage to highlight the intricacies of maintaining its material form and value in the face of hostile elemental forces.

Although storage is often characterised as "arresting the processuality and eventfulness of matter" (Folkers 2019:505), this framing does not fully account for the vitality of matter itself. As geographers have pointed out, the specific biophysical qualities of commodities both enable and constrain strategies of accumulation (Bakker and Bridge 2006; Martin 2020). Indeed, onions in storage are characterised by both spatial fixity (staying in place) and biophysical dynamism (changing form) (Randle 2022). Significantly, though, this immobility does not imply impermeability or inertness. The onion is lively and generative.

As a semi-perishable crop-commodity or *kacchi fasal* (raw crop), onions constitute unstable and mutable matter acted upon by the sun, wind, and moisture as well as bacteria, fungi, and pests. The onion is composed of almost 90% water which means that the longer it is stored, the more it gets dehydrated and shrinks in size. While not all these conditions necessarily preclude exchange, they do pose a threat to the economic value and physical durability of the stock. Given that onions are stored in the summer and monsoon months when temperatures and humidity levels are high, the longevity and integrity of the bulb is always in peril. Onions can rot, sprout, bruise, and decay. They get mouldy and mushy. Onions themselves respire and transpire, releasing and imbibing heat and moisture which require an outlet through proper ventilation. Failing this, decay and disease ensue. A range of storage diseases afflict onions, including black mould (*Aspergillus* spp.) leading to sooty black masses under surface scales; Fusarium rot (*Fusarium* spp.) producing white fluff and soft rot at the neck and base, which spreads across bulbs; blue mould (*Penicillium* spp.) creating greenish masses under the scales; and a range of bacterial rots (*Pseudomonas* and *Erwinia* spp.) which cause a watery rotting. Certain diseases spread quickly—a single rotting bulb could cause devastation to a whole warehouse if left unattended. But not all these diseases are dire—black mould does not preclude consumption but they can reduce the market price of bulbs.

Among the crops commonly grown in Malwa, the storage of onions poses the biggest challenge. Wheat and soybeans are kept in large plastic drums or jute sacks around the house—their main enemies are hungry rats. Potatoes are stored

in the many cold storage units proliferating across the countryside. Onions are different. According to the Directorate of Onion and Garlic Research, the ideal storage conditions for the bulb are between 25 and 35°C (or 0–2°C in cold storage) with a humidity of 65–70%. However, most of India's onions are not stored in such rigid climate-controlled environments. Temperature and humidity levels are often far higher than these ideal conditions. Storage is primarily "on farm" through naturally ventilated structures (called *kanda chawls*). In Malwa, I encountered two specific types of onion storage structures. The larger structure, described at the beginning of this paper, is constructed by big farmers to store up to 50 tons of onions, although the structures are also used to store other produce, park tractors, and so on. The smaller unit comprises a cylindrical structure (about 5 ft in diameter) made of wire mesh—this is used by farmers with limited produce to store (Figure 2). Others store onions in jute or plastic mesh sacks arranged side by side in a room equipped with fans. These are ambient environments in which temperature and humidity can be moderated but not fully controlled.[9]

Yet, such structures are regarded as "backward" and "unscientific" by policymakers and entrepreneurs owing to the considerable wastage and loss that occurs in storage. The Indian Council of Agricultural Research (ICAR) estimates annual

Figure 2: Cylindrical mesh storage structure for onions (Photo by author)

storage losses at anywhere between 25% and 40% of production, causing an economic loss of Rs. 11,000 crores.[10] These losses are both quantitative and qualitative. The former entails a loss to physical weight and numbers through dehydration and weight loss, rotting and sprouting. The latter involves declining quality through mould, discoloration, and peeling of the outer skin. High temperatures cause weight loss, low temperatures speed up sprouting, and high humidity and heat furthers rotting (Tripathi and Lawande 2019). At the same time, excess ventilation—too much dry and hot air—may cause onions to shrink.

Beyond architectural and atmospheric arrangements, storage entails the organisation and enactment of labour—it is an active process involving laborious activities from drying and curing to grading. As one farmer explained, "Onions must be cared for like a child. They need constant attention. Just as your child can be led astray if you look away, so too can your onions spoil if you are not vigilant". The delicate nature of the onion—relative to other crops grown in Malwa—is cited by both producers and traders as the principal reason for the absence of large-scale and collective storage infrastructures. Such facilities, I was told, would be too "risky" for owner-operators since they would have to guarantee the integrity of the onions housed within their warehouse, a promise that can be difficult to uphold. When the onions are transported to homes and warehouses, they are sorted to remove any bulbs with signs of rot or mould. Then they are generally stacked in a large heap or in individual sacks. In general, they remain untouched until they are sorted and graded again right before the time of sale. Routine inspections may reveal that the height of the heap is falling (an indication of shrinking and soft rot) and/or that a foul smell is being emitted (another sign of rot). When this occurs, the deteriorating sections and bulbs must be quickly detected and separated from the heap, and either discarded or sold.

As a set of "pluri-temporal arrangements enabled by ongoing human labor" (Randle 2022:2285), storage is poorly paid and gendered work. All sorting is done exclusively by women—unwaged household labour alongside wage labourers from Dalit (oppressed caste) communities (the daily rate is Rs. 200–300). Although this labour is premised on exploitative relations of production, it is a vital source of income for many. That is, Dalit women who perform this work are deeply critical of labour conditions and remuneration, but also acknowledge its importance in the absence of alternative opportunities for work. For these women, the labour-intensity of onion cultivation is recognised and valued. Growers too emphasise this as an important contribution to the rural economy. Pointing to his onion sacks stacked in the back of a large truck at the Shajapur market, one farmer insisted, "*Isse pachas aadmi ke ghar chalte hai* [these onions run 50 households]. If we don't plant onions, then everyone will stay at home. There would be no work for *mazdoor* [farm labourers], for *hammali* [market porters], for truckers". In this account, without the cultivation, storage, and sale of onions by farmers, there would be limited work and wages for the rural poor. In contrast, for women who perform this labour unwaged for their households, this work is often done reluctantly, and they can be more eager to sell rather than store (Matthan 2023).

While this labour is essential to maintaining the use-value of the bulb—as an edible product—its exchange-value is not always correspondingly preserved. The volatility of the onion market is such that high-quality and well-kept onions might become (economically) worthless while poor-quality and decaying onions can acquire new value, as I describe below.[11] This demonstrates that storage entails its own iterative practices of value production as a range of social groups work with and against the various human and nonhuman forces that threaten the integrity of the harvest and the in/stability of price. However, as I show in the next section, it is primarily producers from dominant castes and classes who can organise and profit from these spatio-temporal arrangements of capital, labour, and space.

Speculative Stocks

In June 2019, Lalit drove his tractor-trolley from his village to the Shajapur market to sell his onions. He had faced a water shortage that year, leaving his onions rather small. He did not expect to receive a high price for his bulbs, which is why he was selling through the Bhavantar Bhugtan Yojana, a government programme which offered farmers a guaranteed price for their onions—regardless of quality. Like the hundreds of farmers lined up at the market in the sweltering heat, Lalit wanted to sell before the arrival of the monsoon rain. Not only did Lalit need the cash to plant the next crop, he also had nowhere to keep the onions safe from the impending wetness. "*Bhandaran nahi hai*" ("I have no storehouse"), he explained.

When I returned in 2023, Lalit's situation was both similar and different. It was July but Lalit had not yet taken his onions to the market. His onions were large, round, and pink this time around and he had found shelter for the bulbs. They were stacked in the now empty home of his uncle who had migrated to the city, resolving his storage problem temporarily (Figure 3). Yet, Lalit was anxious. He wanted to hold off on selling but other obligations and pressures made this difficult. As the head of a multigenerational household, Lalit was wholly dependent on agriculture to meet expenses. That July, he had to pay his children's school tuition fees and buy pesticides for the soybean crop. Waiting longer to sell was a luxury he could scarcely afford. Yet, onion prices were still low, and the government price support programme was no longer operational. In the absence of a guaranteed price promising collective security, individual storage within an unpredictable market was Lalit's only alternative.

Entering the homes of Malwa farmers in 2023, after a gap of several years, I was struck by a prominent new physical addition: one or two towering cylindrical bins constructed with wire mesh and stacked to the ceiling with onions. These bins now occupy domestic space across the region, a small-scale storage alternative to private warehouses meant for larger stocks. Short- and medium-term storage has become surprisingly common across class and caste, a pattern that represents a significant shift in the social patterns of storage. In this section, I explain how patterns of storage—who stores, for how long, and with what expectations—are tied to an emergent climate of speculation in agrarian life, even as its

Figure 3: Lalit's onions stored in mesh bags in a relative's empty house (Photo by author)

rewards are predominantly garnered by dominant groups. The ability to bear—and profit from—the inherent risks of storage are highly differentiated. It is primarily wealthy farmers and traders who can store the largest quantities for the longest periods of time to receive the highest possible price—or conversely, bear the loss in the event of a crash. Why then are so many farmers beyond this narrow demographic deeply invested in storage, and with what social and material effects?

Historically, agrarian speculation—trading on expected fluctuations in price—through storage has been the preserve of elite farmers (Harriss-White 2008). Market exchange is fundamentally shaped by social class—indebted producers engage in "distress sales" first regardless of price; middle peasants sell sporadically in instalments as a risk-minimising strategy; and finally, big farmers with holding power delay bringing crops to the market and speculate on price to the fullest (Sarkar 1981). Although traders and wealthy farmers still possess the greatest holding capacity, small and marginal farmers are increasingly following suit, signalling the spread of storage as a widespread practice of agrarian accumulation. There are several explanations for this shift, but it is especially indicative of: rising class aspirations of small farmers who hope to partake in and profit from speculative frenzy; an increased reliance on non-farm employment which meets daily expenses and offers a buffer against price risks; the expansion of *pucca* (brick and mortar) homes in which onions can be safely stored; and a growing belief that it is *only* through such storage that farming can provide a remunerative income.

In the face of stagnating agri-commodity prices and rising costs of production, speculation is viewed as a necessary means of both survival and accumulation (cf. Bear et al. 2015). That so many producers continue to invest in storage—both materially and imaginatively—despite the risks involved is revealing. The expansion of storage underscores Akhil Gupta's (2017) argument that farming has become an entirely speculative enterprise, with even smallholder farmers betting

on small probabilities in the hope of making a fortune. They hope that the price hike will more than compensate for any potential decline in the quantity and quality of produce (Matthan 2022).

Even for small farmers, there are several benefits to storage, particularly since they rely on low-cost domestic storage and household labour. At harvest time (April–May), prices hover around Rs. 7 (and can dip as low as Rs. 2). Waiting a few months (until August or later) can see prices often rise to around Rs. 13–15, and occasionally much higher. For example, consider a situation in which the market price for 1 quintal (100 kg) of high-quality onion is Rs. 800 in June. A farmer might decide to wait to sell that 1 quintal until August when the price rises to Rs. 1,500. Even if, by this time, the same 1 quintal has declined in weight to 90 kg and is longer top-quality, this would still be a gain, fetching the farmer about Rs. 1,350 for the same 90 kg, or Rs. 550 more per quintal. However, these calculations do not fully account for the costs of storage or the ever-present possibility of a substantial decline in quality and price.

But even the poorest quality onions can fetch a high price in the market under certain conditions. This was Sagar's hope, as I discovered while walking around his storehouse, described in the introduction. Explaining his refusal to discard a heap of rotting bulbs, Sagar laughed, "They can be thrown out anytime—now or later! But if the price rises, then this too can be sold". Sagar had no shortage of space—to him, holding onto the rot was little more than a minor inconvenience. Storing these onions—rather than allow them to decompose into the soil or be digested by livestock—was viewed as a pragmatic move. During periods of shortage, *every* onion could be sold to the right buyer.

This was the case in the final months of 2019 when onion prices spiked dramatically. In Shajapur market, even semi-rotten produce was being sold on the auction floor. One farmer admitted that he had gathered up previously discarded onions to bring to market, even though the bulbs were sprouting green shoots and emitting a foul smell. Rumours were rife that sweeper staff were reaping a handsome profit by gleaning stray onions that had been disposed of by farmers or previously rejected by traders. This reclamation and revaluation of the rot—or conversion of waste into value—signals the non-linear relationship between quality and price as well as the potentialities of the onion as the source of unexpected profit.

After we toured Sagar's warehouse and visited his home, Lalit and Sagar took me to a nearby village. If it was warehouses that I was interested in, then this village had plenty. They introduced me to an acquaintance, Ravi. A middle-aged Anjana (dominant caste) man, Ravi was a large landowner but also active in local politics and the owner of a construction business and a dairy. He showed us his storehouse (built sans any government subsidy) stocked with onions which he would only sell after Diwali, a Hindu festival usually in the month of November. Ravi anticipated a supply crunch that year and expected prices to rise substantially. More than a physical space to store, however, Ravi possessed the capacity to play with time in a way that Lalit and even Sagar could not. Waiting several more months to sell was possible since he has a steady source of income from his business ventures. For agricultural businessmen like him, price fluctuations are

irrelevant, and the stakes are intentionally high. Engaging with the onion market as a high-stakes gamble, Ravi proudly proclaimed that he stores onions until November every single year with no exceptions. He could bear the risk of financial loss in case prices crash, or indeed, if his stock spoils. Many big producers like Ravi also function as petty agri-commodity traders in their villages, buying cheap from poorer farmers, storing, and selling dear. Holding off sales for the longest possible time—stretching out the life of the onion to its absolute biological limits—is their primary mode of accumulation.

Even as more small- and medium-scale growers have taken to onion storage, the odds remain stacked in favour of large-scale landowners. This belies the government's insistence that it is primarily the absence of physical storage infrastructures that prompts distress sales by farmers. The focus on storage-as-solution erroneously assumes that farmers' decisions to hold or release are based exclusively on access to storage facilities, rather than a range of factors including quality of produce, non-farm sources of income, price expectations, access to market information, among others. Embedded in this idea are "technologically deterministic notions of power that do not consider the broader context within which market exchange takes place" (Kumar 2014:1336). At the same time, the volatility of the onion market, particularly the unpredictable relationship between quality and price, make storage a potentially lucrative endeavour, even for the smallholder. But these attempts to profit through *individual* subsidies for storage structures and *private* speculation on price ultimately deflects from the *collective* struggle for a state-guaranteed minimum price which could offer stable remuneration to all growers.

States of Storage

The surplus and the storehouse are central to the deep history of state formation. Stockpiling was not simply a means to ensure food security but served as a technology of governance through the concentration of surplus, taxes, and therefore, power (Mann 1986). Moreover, the price of grain is always tied to state responsibility and social welfare. In his discussion of food riots in 18th century England, E.P. Thompson (1971) brilliantly argued that soaring prices and trade malpractice were viewed as a violation of customary social norms and obligations, or the "moral economy" of the poor.

In postcolonial India, the strategic stockpiling of grain was tied to the maintenance of the nation's food security interests. This was especially vital owing to the devastating famines during British colonial rule (Siegel 2018). This biopolitical imperative of the state—to feed its people—was exemplified by the grain silo, built to store wheat that could be distributed to its hungry populace. The state's buffer stock policy became a civil engineering project to build cheap, replicable, and durable storage for grain, spurring designs for steel and concrete shell roofs as well as debates around the relative merits of godowns (horizontal units) and silos (vertical units) for stocking (Khorakiwala 2022). As "the concrete means through which the state could instantiate a politics of care in keeping its subjects well-fed" (Khorakiwala 2017:8), these storage infrastructures served as a crucial

buffer stock not only to prevent famine but also to correct for imbalances in market price. To this day, silos and warehouses for storing wheat and paddy remain at the heart of India's public food distribution system. In other words, storage facilities function as a key technology of food security, incentivising farmers to produce certain crops while also regulating the price of food (Barnes 2022).

The biopolitical terrain of storage reveals that the state's agribiopolitical imperative does not begin with the management of "abstract" grain (Hetherington 2020). Rather, it has always been concerned with more-than-human processes and relations. Through specific storage infrastructures, the state hoped to transform grain "from being alive to being inert" through containment within an "abiotic environment" that could keep the wheat unspoiled and resistant to breakdown (Khorakiwala 2022:352). So too with onions. For example, a government report describes the challenges posed by onions to post-production operations thus: "the produce continues to live and breathe, and thereby, itself generate heat through continued metabolic activity, throughout its saleable life cycle" (Committee for Doubling Farmers' Income 2017:79). Viewed through the framework of biopower, this statement is indicative of a keen interest in the vital properties of (plant) life as a site of control.

Although the politics of onions is quite distinct from that of grain, its price has become a matter of national political concern, fuelling opposition rallies and electoral contests since at least the 1980s. When prices plunge, growers take to the streets in protest. As prices rise so does consumer discontent—decrying the escalation of household budgets, the long lines at shops, the blandness of meals prepared without the pungent bulb. In response, however, state intervention has largely been ad-hoc and reactive. India's agricultural pricing policy for onions focuses on two core elements: controlling exports on the one hand and initiating procurement and distribution on the other (Rutledge 2020).

When supplies dwindled and prices rose in late 2019, the central government attempted to ease public anger by halting all onion exports and importing onions from Egypt and Turkey. Truckloads of onions headed for neighbouring countries such as Nepal and Bangladesh were being turned back at India's borders. The geographical boundaries of the country were effectively sealed, transforming the nation itself into a massive storehouse into which onions could enter but not leave. Some years later, in August 2023, when this situation recurred, the government imposed an export duty of 40%. In 2019, the government also invoked the 1955 Essential Commodities Act, which allows the state to impose restrictions on storage of any commodity in the public interest. In times like this, the stock is transformed into a hoard, that which is secret, hidden, and excess (cf. Newell 2018), and in need of containment by the state. Controlling stocks is especially tricky since modest stocks are spread across numerous warehouses in market towns and villages, escaping the calculative gaze of the state. In November 2019, traders at the Shajapur vegetable market were subjected to raids by the Income Tax Department which revealed an illegal stock worth over Rs. 37 lakh and unaccounted income of Rs. 5 crore (Dwary 2019). According to newspaper reports, this evidence suggested a range of illegal cash transactions among brokers and traders tied to the manipulation of stocks and inflation of retail prices.

Unlike grain, however, the Indian government does not have a history of organised onion procurement and its wholesale price is not fixed by the Commission for Agricultural Costs and Prices (which recommends Minimum Support Prices for 23 major crops). However, the national Price Stabilisation Fund gives state governments and central agencies access to capital to "protect consumers by supplying such [horticultural] commodities at reasonable prices through calibrated release of stock" (Department of Consumer Affairs 2016:2). Through this, the National Agricultural Cooperative Marketing Federation of India (NAFED), one of India's largest agricultural procurement and marketing agencies, purchases onions from producers at a fixed price to enhance the national buffer stock. Functioning as a "benevolent hoarder in an imperfect market" (Khorakiwala 2022:348), NAFED built up a record "strategic stockpile" (Collier and Lakoff 2015) of 2.5 lakh tons in 2022–23, part of which was then sold through a network of fair price shops. Regional governments have also initiated their own pricing programmes, such as Madhya Pradesh's Bhavantar Bhugtan Yojana which paid farmers the difference between market price and a fixed minimum price of Rs. 8. Nonetheless, despite repeated farmer agitations, the demand for a guaranteed minimum price for onions has gone unheeded.

Instead, the central government increasingly espouses improved storage as a technical solution to the problem of supply shocks and price volatility. This is evidenced by state subsidy schemes such as the one that funded Sagar's warehouse —even as these same arrangements, based on designs by state engineers, are also deemed inadequate. As one bureaucrat explained in a presentation to the Ministry of Consumer Affairs, Food and Public Distribution, onion storage is organised around exhaust fans and halogen lights, "but there is no scientific study about the air flow rate, there is no scientific study about how much time that fan should run, there is no scientific study about how much power that fan should have…".[12] This comment emphasises the apparent imprecision in the operation and impacts of these simple technologies. Although they may be reasonably effective in managing heat and humidity, the bureaucrat insists that there is no clear scientific basis for their current deployment, thus establishing the need for research into ideal rates of air flow, speed, and force.

This presentation was made at a 2022 event to discuss the central government's "Onion Grand Challenge", an open call for proposals (from universities, industry, and start-ups) to develop "Technologies for Primary Processing, Storage and Valorization of Onions". The call states, "Due to improper storage systems, annual losses amount to about Rs 11,000 Cr. It is prudent to invest a decent amount in the development of technological solutions to the problems plaguing the Onion sector and dividends will be attractive" (Ministry of Consumer Affairs, Food and Public Distribution 2022). Participants in this "challenge" are judged based on criteria such as novelty, feasibility, scalability, and cost effectiveness. Winners receive prize money but more importantly, their products may be deployed by state agencies, or marketed to any external entity.

Novel technologies of storage appear to herald a win-win situation. By extending the life of the onion, the argument goes, storage can prevent distress sales by growers and curb the power of market intermediaries. Presumably, access to

improved storage (at an affordable price) would allow farmers to store longer and sell at remunerative prices. Simultaneously, consumers can purchase onions at affordable prices made possible by minimal spoilage and the gradual release of onion stocks. Within this imaginary, storage lubricates the supply chain, enabling smooth, continuous, and cross-seasonal circulation of agri-commodities. It enacts a perfect calibration of demand and supply through an extended—but carefully controlled—pause in flow. In many ways, this is a quintessential project of agricultural modernisation, introducing new technologies to improve and develop rural communities. Indeed, this is indicative of "a long-standing evolutionary narrative in which farmers must make a transition away from the outdated farming methods of the past and embrace a future defined by technological sophistication" (Moulton and Popke 2017:722). It represents an attempt to modernise infrastructure *and* people by reorienting the attitudes and conduct of farmers in more entrepreneurial directions.

However, an enhancement of storage infrastructures without guarantees of procurement or a fixed support price represents a wholly technological solution to a social and political problem. It naturalises the problem as one that is wholly tied to the biophysical deterioration of the bulb—caused by inadequate or "unscientific" storage—rather than to social inequalities of class and caste manifested in differential capacities to forestall sale. This reveals a deep misalignment between the stated objectives (price stabilisation and the welfare of producers and consumers) and proposed means of achieving them (reducing losses in storage). This intervention is reminiscent of Aaron Kappeler's (2023:253) discussion of a Venezuelan cow breeding project, which converted "the thorny *political problem* of land poverty into a *scientific problem* for biology" (cf. Li 2007). It does so by framing the problem of price as one based on demand and supply. However, considerations of quality, consumer tastes, and geographies of supply also influence price. At the same time, these proposed solutions do not simply circumvent the relations of power and inequality that shape practices of storage and marketing. As I discuss in the next section, technological innovations in storage also implicitly facilitate projects of capital accumulation as well as centralised surveillance (of both plants and people).

Logistical Fantasies

In 2013, a report in *The Economist* magazine headlined "Lords of the Rings" traced the journey of the Indian onion from a field in Maharashtra through Asia's largest onion market in Lasalgaon to vendors in Mumbai. Describing the supply chain as "volatile" and "inefficient", the report argues for the entry of big retail such as Walmart and Tesco into India. Such corporations, the anonymous author writes, could make large investments in storage technologies, remove "middlemen" traders, and consolidate the country's small and fragmented landholdings. The short article mentions storage several times (alongside transport and trade): first describing one farmer's facilities as "amount[ing] to a wooden basket inside a shed", later citing a commission agent's firm belief that storage facilities ("as China has") were the answer to India's onion price woes.

While such foreign investment has not quite materialised, the report draws out connections between the improvement of storage and broader transformations in agricultural supply chains. If modern storage is the solution to price volatility, and it is principally agri-tech startups and logistics firms (facilitated by the state) that are developing these infrastructures, then it is highly likely—and even encouraged—that these entities will exert greater control over the value chain. If storage is a critical "site for value-creation and value-destruction" (Banoub and Martin 2020:1107), then what is posited as a technological solution intended to stabilise the value of the bulb portends a political-economic transformation in agrarian relations of production. "Scientific" storage practices come to be equated with "efficient" agribusiness, and the "welfare" of both farmers and consumers affixed to the "free market". To government officials and industry representatives, these technological innovations promise to extricate the onion not only from the unruly ecologies and temporalities of heat, moisture, bacteria, and fungi but also from the dense and often opaque socialites of trade (characterised by "middlemen") by subjecting it to temporal, spatial, and social discipline (Krishnamurthy 2018, White-Nockleby 2022).

The thrust of technical innovation is the development of storage structures that can precisely monitor and moderate atmospheric conditions. As noted earlier, most farmers use their sensory skills to assess loss and damage—gauging rot visually through declining height of the stacks and olfactorily by the foul smell emitted from deteriorating bulbs. New technical tools aim to replace sensorial modes of assessing quality, now deemed inaccurate and imprecise. For instance, a "Controlled Atmosphere Storage Structure" developed through a public-private partnership between the Directorate of Onion and Garlic Research and Kala Biotech Ltd. deploys an IoT (Internet of Things)-based system—a network of physical objects embedded with sensors and data processors to capture and exchange data—with the aim of extending onion shelf life to eight months and reducing losses to 15%.

Similarly, Godaam Innovations, an agri-tech start-up and one of the winners of the Onion Grand Challenge, is building "smart community warehouses" using sensor-based devices that can closely—and more quickly—monitor micro-climatic conditions and detect rotting through gaseous emissions. This data is analysed algorithmically and passed on in "real-time" to the farmer who can decide whether to remove the damaged bulbs or immediately sell them. Rather than only build entirely new warehouses, Godaam's model also aims to retrofit existing warehouses to improve ventilation and install sensors which can potentially reduce onion wastage by 20–25%.

These solutions form part of what is called "precision agriculture", an assemblage of technologies that use localised data from the farm and storehouse to enable more "precise" farming (or in this case, storage, sorting, and sales) decisions. As "an ecological modernization and accumulation strategy" (Stock and Gardezi 2021:195), precision agriculture enacts a form of biopolitics through which agri-tech firms—aided by the neoliberal state—scientifically manage human producers but also crops, pests, weeds, and weather in the name of improvement. In the "smart" warehouse, centralised monitoring of the bulb forms part of

a surveillance apparatus through which climate and disease can be controlled and the circulation of value optimised. This minute tracking of metabolic processes is presumed to facilitate the scientific control of price and thereby, of populations, both rural and urban. Currently, thousands of small storerooms and warehouses across the countryside lie beyond the gaze of the state. As "an apparatus of environmental security" (Moulton and Popke 2017:722), the centralised warehouse thus promises oversight of inventory, exact estimations of, and strict control over, vital commodities (cf. Scott 1998).

As Moulton and Popke (2017:719) write, "the 'living interrelation' between rural population and environment has progressively become not only a target of governmental intervention, but also a site of capital accumulation". Indeed, "smart" storage is positioned as a technical innovation that both enacts and justifies private corporate investment. If these modern technologies are essential to stabilising price and ensuring food supply and it is corporate actors who can best deploy these technologies, then capital investment too becomes a crucial element of the solution. This is reminiscent of mid-20th century shifts in US grain storage (Cronon 1991) wherein managers applied technologies such as mechanical dryers and agri-chemicals in ways that "reconfigured grain management at an industrial scale, and away from fields and growers" (Banoub and Martin 2020:1112). What is perhaps unique about current and future modalities of "corporate biopower" (Nally 2011) is the expanded control over the biophysical elements of agrarian production. From transgenic seeds to climate sensors, the molecular, the genetic, and the metabolic are further drawn into circuits of capital accumulation. While not entirely novel, this form of biopower "intervenes with ever-greater precision into the metabolism between human and non-human life forces" (Moulton and Popke 2017:722).

These new infrastructures also facilitate the creation and expansion of new financial products. Firms within the emerging agri-logistics field are attempting to link the provision of financial services, warehousing infrastructures, and digital marketing channels to farmers. Take the example of Arya, a post-harvest services platform with 2.5 million tons in warehousing capacity. Apart from offering storage services, the company also connected farmers to consumers through its digital platform and offered credit against warehouse receipts, resulting in a jump in its credit portfolio (Accel and Omnivore 2020). Warehouse receipt financing, a system of agricultural credit, could potentially deepen rural indebtedness as well as corporate control over agricultural commodities. It also portends a deeper financialisation of agriculture wherein the stock becomes collateral against a loan, potentially producing a situation akin to the Chicago grain futures market wherein speculators bought and sold grain receipts in response to fluctuating prices, leading to intense boom and bust cycles (Cronon 1991). Credit against produce has been a longstanding practice in informal lending markets across rural India—the crucial difference here is the explicit link being made between warehouse receipt financing and the expansion of futures markets in agri-commodities.[13]

As such, new systems of storage do not necessarily prevent speculative hoarding or stabilise price. Rather, it heralds a "privileging of private capital as an alternative to existing arrangements of patronage and exploitation" (Koshy

et al. 2021:294). The predicament of apple growers in the hill state of Himachal Pradesh offers an instructive comparison. There, the state government offered subsidised land to Adani Agri-Fresh, a subsidiary of the Adani Group, to set up cold storage facilities for apples. The logistics company made significant investments in apple storage and is now one of the major buyers of apples, setting benchmark market prices. Despite promises of "free market" benefits to growers, the region witnessed increased corporate control over prices, resulting in frequent price crashes. As this case shows, storage is a crucial node around and through which broader market restructuring is imagined and enacted (Singh et al. 2021).

Conclusion

As a critical link between cultivation and consumption, control over the means of agricultural storage has the potential to reconfigure relations of production, trajectories of accumulation, and networks of distribution. As this paper has shown, interest and investment in onion storage has grown considerably—among producers, governments, and private companies. Even as smallholders take to storing onions, structural inequalities limit their capacity to successfully realise higher prices through this endeavour. That is, although small farmers are increasingly willing and able to store onions for longer periods, they are still considerably limited in this endeavour due to other constraints such as the need for immediate cash or the inability to bear significant losses in the event of a price crash. Rather than guarantee a fixed price for onions (with benefits to both growers and consumers), the Indian government presents new technologies—which can reduce waste and enhance supply—as the solution to price instability. As such, the question of price becomes a technical problem of efficiency and innovation rather than a political problem of fairness and equity. It is not that proper storage is unimportant. Rather, the issue is with the focus on technologies of storage to the exclusion of consideration of broader material capacities to store—with all its attendant risks and rewards.

Biopolitical infrastructures of storage have long served as a crucial means of preventing famine and correcting for market imbalances. What is distinct about the current reconfiguration of storage arrangements, however, is the shifting role of the state. Storage is not accompanied by guaranteed prices and direct procurement but by subsidies and incentives to individual producers and corporate entities. Deploying the language of improvement and betterment, these new infrastructures promote and expand agrarian capitalism, thus deepening elite control over the production and distribution of agricultural commodities. Projects to preserve and extend the life of the bulb not only seek to reshape the dynamics of demand and supply but also portend the restructuring of markets and value chains. Attending closely to the diverse imaginaries and practices around the storage of one commodity-crop, this paper points to the growing significance of (control over) circulation to broader agrarian transformations in India and beyond. At stake in contestations around storage arrangements is not just the preservation of produce but the safeguarding of rural livelihoods and promotion of a just and remunerative price.

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Data Availability Statement

Research data are not shared.

Endnotes

[1] All names have been changed to maintain anonymity.

[2] Under the programme, the regional Horticultural Department reimburses farmers up to half the cost (up to Rs. 175,000) of building a warehouse according to a government-approved architectural design. Additionally, the central government's Gramin Bhandaran Yojana (Rural Godown Scheme) offers subsidies for the construction and renovation of storage facilities. Although intended to enhance the "holding capacity of small farmers", the minimum capacity of 100 tons suggests that it is cooperatives and corporations who can access the subsidy, and then rent warehouse space.

[3] As of mid-July 2024, the exchange rate is $1 to Rs. 83.59 and £1 to Rs. 107.60.

[4] Onion processing (into paste and flakes) is still nascent and has limited uptake.

[5] While some argue that direct state procurement at MSP would place impossible pressures on government budgets, others have put forward alternatives including legally obliging private buyers to purchase at MSP rates (or higher) or paying farmers the difference between MSP and the price farmers receive in the market.

[6] These figures are based on the Consumption Expenditure Survey conducted by the National Sample Survey Organization (2011–12) and the Food and Agriculture Organization (FAO) statistics database.

[7] As scholars have argued, "access to food is a function of social relationships and entitlements of people rather than quantitative availability" (Kumar 2016:80). Attributing price rise and limited access to onions solely to supply scarcity is, therefore, highly simplistic.

[8] During such periods, reports, editorials, and cartoons about the "tears" (real and metaphorical) wrought by spiralling onion prices are common in the Indian media, as is the use of onions as a protest symbol (onion garlands, for example) in rallies by opposition political parties.

[9] In India, existing cold chain infrastructures are limited to certain crops (such as potatoes and chilies). Such units are capital- and energy-intensive to build and operate. As a technology, cold storage is built on the presumption of an entire cold chain—the availability of the requisite machines and energy along the entire supply chain from the farm through the trucks and, finally, retail shops and home kitchens (Freidberg 2010). Moreover, the physiology of onions means that a sudden change in temperature, when taken out of cold storage, causes immediate sprouting.

[10] Volume 3 of the "Report of the Committee for Doubling Farmers' Income" estimated that, at an all-India level, post-harvest losses for fruits and vegetables are about 34% and 44.6% of production, respectively (Committee for Doubling Farmers' Income 2017).

[11] Quality is a nebulous concept in onion markets. Broadly, "quality" is defined in terms of size, shape, colour, and freshness—large, round, pink onions command the highest price. But purchasing patterns and price depend on time of year, consumer tastes, geographies of distribution, export policy, and more.

[12] Interaction between the Department of Consumer Affairs and higher education institutions on "the development of technologies for primary processing, storage and valorization of onions", 5 August 2022: https://www.youtube.com/watch?v=5pQmlNl3zIM (last accessed 16 July 2024).

[13] In 2005, the Department of Banking Operations and Development of the Reserve Bank of India (India's central bank) prepared a "Report of the Working Group on Warehouse Receipts and Commodity Futures". The group was tasked with developing a framework for the participation of banks in commodity futures markets, including through warehouse receipts, which would "give way to output based finance, which are more aligned to the market" (RBI 2005:vii). India has a long history of futures markets, although onions are not among the commodities traded.

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