EVERGREEN INNOVATION PLATFORM

SMALLHOLDER FARMERS' NEEDS REPORT 2024

Authors

Amos Shtibelman, Head of Research, Evergreen Innovation Platform
Anton Lahaie, Research and Analysis, Evergreen Innovation Platform

Contributors

Sumit Pal, Scientific Officer , Syngenta Foundation India
Charles Chigemezu Nwokoro, Consultant, Evergreen Innovation Platform
Francesca Knoell-Harris, Impact and Communications, Evergreen Innovation Platform
Daniela Kandel, Founder and CEO, Evergreen Innovation Platform

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Foreword

It is with great pride that we present our second farmers' needs report, another milestone in our mission to transform smallholder farming through innovation and collaboration. Since our last report, we have expanded to three states, added insights from Agri Entrepreneurs, and conducted a deep dive into soil testing—an essential area for improving agricultural outcomes.

EIP has grown significantly, now with 12 companies in our portfolio, and we are in the commercialization stage for a validated soil testing kit. This progress highlights our ongoing commitment to aligning practical, scalable technologies with the needs of smallholder farmers, ensuring greater productivity, resilience, and climate adaptability.

This report reflects our progress and the power of partnerships to scale solutions that drive real impact. As we continue our journey, we look forward to working together to foster a sustainable and prosperous future for smallholder farmers, empowering them through innovation.

Thank you for your support and engagement with EIP as we move forward in this exciting phase and invite you to reach out to us to explore potential collaboration.

Contact

Email: info@evergreen-innovation.com
Website: www.evergreen-innovation.com

Executive Summary

Smallholder farmers are major contributors to the food value chain, producing a third of the global food supply and half of India's food. Despite their importance to local and global food security, they are a very vulnerable population exposed to a variety of challenges that threaten their livelihoods, including the growing impacts of climate change. The challenges are compounded by smallholders' limited access to modern agricultural technologies that could help improve their productivity and resilience.

Smallholder farmers present the opportunity of a huge and largely untapped market: 600 million farmers globally and 150 million in India alone, but few technology companies are designing products and business models tailored to smallholders' specific needs. The Evergreen Innovation Platform (EIP) was founded to bridge the trust gap between smallholder farmers and agricultural innovators by de-risking the market entry process for the technology companies and creating a reliable connection with SHF.

Addressing smallholders' challenges requires a mix of innovative technologies, logistic solutions, and business models. Across the board, relevant solutions will need to be simple, able to operate with limited infrastructure, and highly cost-effective. Further, they need to address farmers' specific needs and operating constraints—which differ significantly from one locale to another. The Farmers' Needs Reports are a way for us to deepen our understanding of the challenges that Indian smallholder farmers face, to help us better define the agricultural technology needs and source the right solutions. Following our first report in 2023, the current publication expands in scope, covering 3,088 farmers across 22 districts in 3 states. This time, we focus on farmers' challenges and potential solutions (summarized on the next page) and devote a special section to soil testing. Soil is the literal underpinning of farming, and a proper understanding of the soil's condition and chemical composition is crucial to optimizing fertilization and the rest of the farming cycle. Hence, we prioritize soil testing in both EIP's work on the ground and in this report

- Irregular rainfall: unpredictable and shorter rain season damages crops and complicates planning for rainfed farms. This challenge was at the top of the farmers' concerns, possibly influenced by the increased frequency of both droughts and flooding in recent years.
- Soil health data gaps: insufficient soil testing options contribute to over-fertilization, which degrades soil health and productivity.
- Post-harvest losses: inadequate storage solutions result in spoilage and loss of produce. Inadequate storage is a particularly prominent challenge that we see throughout our network
- Market access: limited buyer and market connections result in unfair pricing for farmers.
- Crop damage by wild animals: wildlife intrusion to fields causes significant crop losses, and existing repellents are ineffective, unsafe, or environmentally harmful.
- Irrigation disruptions: unstable electricity and water access delay irrigation, stressing crops and reducing yields. Over 20% of farmers surveyed resort to the more expensive and polluting option of diesel-powered irrigation.

The Evergreen Innovation Platform (EIP) fosters a sustainable global innovation ecosystem that empowers entrepreneurs to tackle the challenges faced by smallholder farmers. Our mission is to enhance farmers' productivity, resilience, and climate adaptation and mitigation capacities through a holistic approach that identifies, develops, evaluates, and adapts technologies and services tailored to their unique needs. Currently, our portfolio encompasses a diverse range of companies, and through our partnerships, we have access to approximately 2 million farmers across multiple regions in India.

Challenges

Irregular rainfall damages crops and causes lower yields in rain-fed farming systems

We are seeking climate-smart solutions that improve farmer planning, shore up financial security, and fortify crops against water stress:

- Weather forecasting
- Insurance and finance mechanisms
- Soil moisture retention and evaporation regulation methods
- Rainwater harvest and storage methods
- Methods to preserve yield and increase plant resistance under water stress

Unstable electricity supply and limited access to water cause irrigation interruptions.

We are seeking solutions that will allow timely irrigation under limited electricity supply and improve management and access to water sources:

- Cost-effective solar powered irrigation systems
- Irrigation continuity methods
- Small-scale irrigation technologies that are water-efficient, and highly economical
- Low-cost technologies for treating saline water, capturing and storing water, and accessing and utilizing limited water resources

Farmers lack actionable methods for analyzing the nutrient makeup of their soil prior to applying fertilizer

We are seeking solutions that will provide fertilizer management suggestions based on accurate, rapid, low-cost soil testing and analysis technologies:

- Mobile and in-field soil testing
- Rapid soil testing and diagnosis technologies
- Remote sensing-based solutions
- Soil health and nutrient analytics

Farmers have difficulty accessing markets and selling their produce at a fair price

We are seeking “farmer-to-market” solutions to connect farmers with markets, buyers, and off-takers while securing fair prices:

- Platforms, marketplaces, and enabling technologies for the sale and aggregation of produce
- Low-cost solutions and services for transportation and storage of crop produce and milk
- Affordable on-farm machinery for crop processing and value addition
- Simple on-farm grading and sorting solutions

Wild animals damage crops

We are seeking effective solutions to protect crops from wild animals that are safe for humans, animals and the environment:

- Odor or taste-based repellents
- Plant-based repellents
- Ultrasonic or sonic repellents

Farmers lack storage solutions for produce and suffer from damage to stored produce

We are seeking solutions that will allow farmers to store grains, vegetables, and fruits near the point of harvest that are more cost-effective and resilient than standard refrigeration:

- Storage bags and boxes
- Shelf- life extension technologies
- Small-scale off-grid cooling and temperature-controlled storage

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Introduction

Smallholder farmers, typically defined as farmers cultivating less than two hectares of land, are major contributors to the food value chain, producing a third of global food supply and nearly half of India's food. They are also responsible for an outsize global share of specific crops, including 63% rice and 47% pulses.[1] Despite their importance to local and global food security, they are a very vulnerable population, exposed to a variety of challenges that threaten their livelihoods, including the growing impacts of climate change.

Farms under 2 ha in size make up 84% of the number of farms globally and produce 32% of the world's food.

600M farmers globally, 150M in India alone.

Produce 60%-80% of the food supply in Asia and sub-Saharan Africa.

Farms under 10 ha (including < 2 ha) make up 97% of global farms and produce 55% of the world's food.

There are significant challenges for agri-tech companies looking to work with the smallholder market. To start off, it is not a single market—smallholders in India have different needs and capacities from those, say, in Kenya or Nigeria, and even India's smallholders vary dramatically from state to state and even from district to district. A large majority of smallholders are located in the Global South with weak physical and financial infrastructure, exacerbating the fragmentation of this market. Many of them live on the verge of destitution; they have little cash on hand to invest in new technology, and their limited resources make them highly risk averse. Yet these challenges are not insurmountable, and there is a strong business case for working with smallholders.

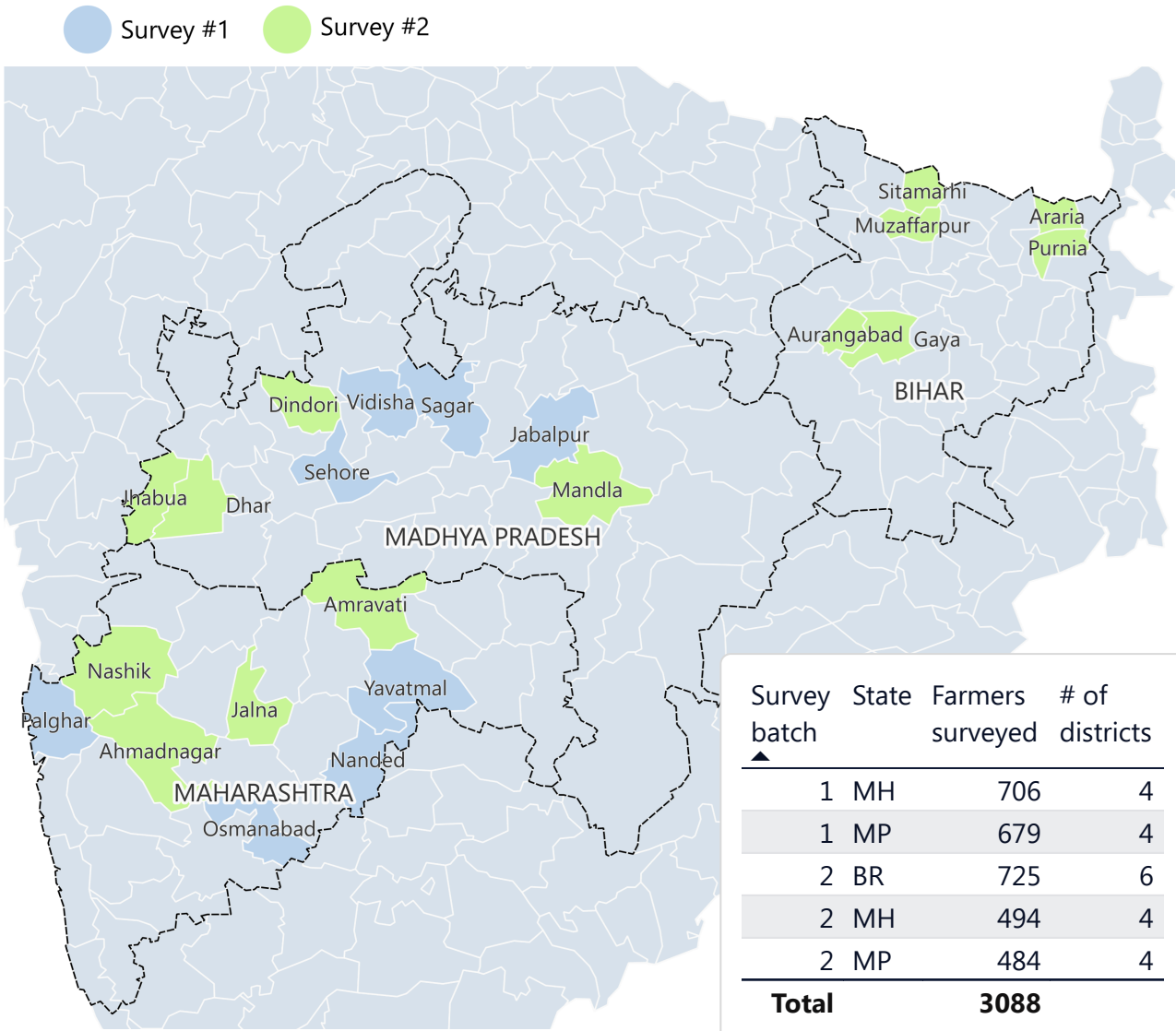
Smallholder farmers are a huge market: 600 million farmers globally and 150 million in India alone. This is a largely untapped market, too: while smallholders, as resilient and resourceful actors, are already working to adapt existing agricultural technologies to their needs, few technology companies are designing products tailored to smallholders' specific needs. The Evergreen Innovation Platform (EIP) was founded to bridge the trust gap between smallholder farmers and agricultural innovators by de-risking the market entry process for the technology companies and creating a reliable connection with SHF. To reach the farmers, EIP is working closely with partners like the Agri Entrepreneur Growth Foundation (AEGF), who have curated an ecosystem of support and trust for smallholder farmers in India.

Since information barriers are a particularly prominent challenge in working with smallholders, EIP is committed to building up a strong knowledge base both to guide internal operations and, through frequent publications, to invite additional players into this field. In partnership with AEGF, EIP has launched its first farmers' needs survey in Fall 2023 and published the results in February 2024. The report covered a general characterization of smallholder farmers, the common barriers preventing innovators from working with that population, and the business case for viewing smallholders as a valuable untapped market. It also presented a detailed summary of farming practices, challenges, and needs across six categories: land and soil management, crop production and management, irrigation and water management, livestock management, postharvest activity, and market access and linkages. The first report is available here.

A second iteration of the survey was launched in Summer 2024 with expanded geographical coverage, refined questions, and a new section collecting data from AEGF's Agricultural Entrepreneurs, resident experts working closely with over 100 farmers each. To avoid duplication, the present report is much more narrowly focused on farmers' challenges as well as on the specific topic of soil testing. The result is a highly summarized overview of the data collected. If you are interested in learning more, feel free to reach out: EIP firmly believes in the value of collaboration and is always looking out for potential partners in our mission to revolutionize the future of smallholder farmers through the transformative power of innovation.

Methodology

Geographical respondent distribution



Survey batch	State	Farmers surveyed	# of districts
1	MH	706	4
1	MP	679	4
2	BR	725	6
2	MH	494	4
2	MP	484	4
Total		**3088**	

An extensive survey totaling about 300 questions was delivered to Indian smallholders on the ground. Across six broad areas—soil and land management, postharvest activity, market access and linkages, crop production and management, irrigation and water management, and livestock management—the survey covered specific farming practices, challenges, and farmers' willingness to invest in innovative technologies addressing those challenges. Each farmer was interviewed for at least 30 minutes by a trained AEGF surveyor with a good knowledge of agriculture and the Hindu language, possessing at least secondary education. Farmers' responses were logged on an Open Data Kit (ODK) digital platform and further verified by AEGF's experts.

The first survey included 1357 farmers from Madhya Pradesh (MP, districts: Jabalpur, Sager, Sehore, Vidisha) and Maharashtra (MH, districts: Nanded, Osmanabad, Palghar, Yavatmal). The second survey included 1703 farmers from MP (districts: Dhar, Dhindori, Jhabua, Mandla), MH (districts: Ahmednagar, Amravati, Jalna, Nashik), and Bihar (BR, districts: Araria, Aurangabad, Gaya, Muzaffarpur, Purnia, Sitamarhi). Due to the altered definitions in the second survey, some data from the first survey—including per-practice satisfaction rates—could not be merged with the new responses. Hence, while the section on general farming challenges, as well as summary

farming data such as crop distribution, are derived from the full dataset, satisfaction levels and reasons for dissatisfaction only represent the second sample.

Survey locations were chosen for the maturity of AEGF presence and outreach to better support EIP's efforts in validating and commercializing relevant technologies. We especially targeted cash crop growers on the assumption that farmers producing crops for the market would be the most likely first adopters of new technologies. After encountering a very low rate of female respondents in the first survey—under 10%, despite the fact that women constitute more than half the population employed in agriculture—we also oversampled female farmers in the second survey to learn more about this crucial and yet often overlooked segment of Indian smallholders.

A few notes on the report's structure and definitions. The report opens with general challenges, issues brought forward by farmers when they were asked about challenges threatening their farm productivity. A more detailed list of challenges emerged in the sections drilling down on each of the six main farming practices. Farmers were asked to rate their level of satisfaction in each practice, and the farmers who expressed any level of dissatisfaction were asked to provide three reasons for dissatisfaction. Despite the difference in phrasing, both "challenges" and "reasons for dissatisfaction" effectively indicate farmers' pain points—and at the same time point to opportunities for relevant innovative solutions.

Farmers' satisfaction was rated on a three-point scale: "satisfied," "neutral," and "unsatisfied." "Neutral" is an ambiguous term, but we chose to treat it as evidence of moderate dissatisfaction since "neutral" respondents chose not to pick "satisfied." This is supported by the data: on average, "neutral" respondents were in fact slightly more willing to invest in technological solutions addressing their problems than "unsatisfied"—74% vs. 70%—against a dramatic drop to 45% with "satisfied." For better readability, we relabeled "neutral" as "less satisfied" in this report.

Farmers who gave an answer other than "satisfied" in any practice were asked for their first, second, and third reasons for dissatisfaction, providing an implicit ranking of importance between those reasons, though it is hard to quantify a precise ratio. In our analysis, we address the aggregate count of reasons given and the ranked count as complementary but distinct perspectives rather than attempt a weighted summation.

Starting with the second survey, we also include a section polling AEGF's Agricultural Entrepreneurs (AEs) about the services they provide to farmers, the challenges farmers are facing, and farmer expenditures in different categories. Each AE works closely with around a hundred farmers, providing them with inputs, crop advice, market linkages and financial services, and therefore has especially valuable insights into smallholder agricultural practices and needs. While the scope of the AE survey is relatively limited, with 200 respondents so far, their grounded expertise makes up for the smaller sample number.

Our surveys deliver a rare, granular insight into the practices, challenges, and needs in a market critically hampered by information gaps. The diversity of India's agricultural landscape—thousands of ethnic groups, varying geographical conditions, and multiple biodiversity hubs—complicate attempts to generalize from a sample of this size to India as a whole. This challenge is confirmed in the patterns of geographical variation shown in our results. From a strict statistical perspective, our data best represents farmers in the specific states and districts who can be reached through AEGF's network of AEs. Still, significant trends emerge from the data. Further, a sample of Indian smallholders, despite its limitations, is a far stronger starting point for designing relevant solutions than the status quo of large industrialized farms in the Global North. There is always more to learn, and EIP will expand the survey in the coming years, but we already have valuable knowledge that we are happy to share.

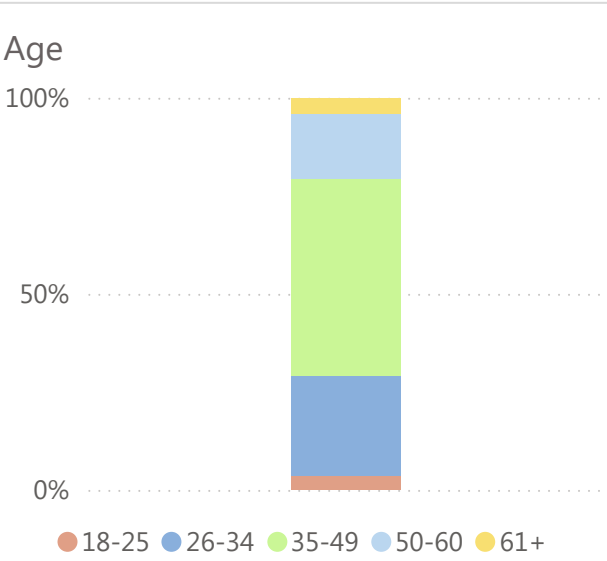
Demographics and Farm Statistics

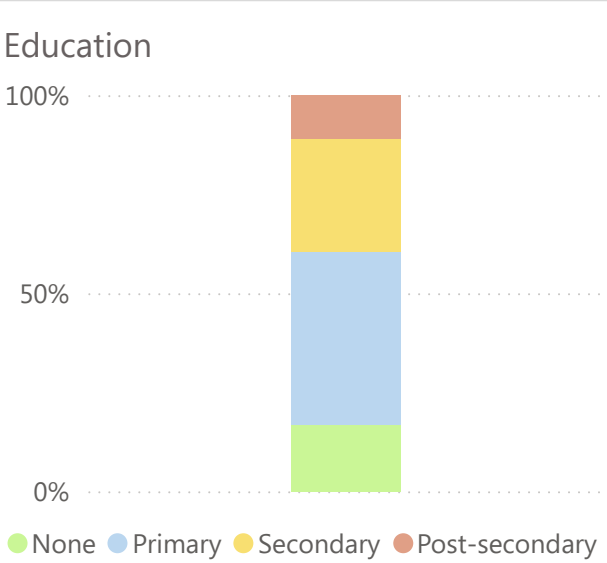
The survey collected standard demographic data from the respondents. Note, of course, that the profile generated represents either farm owners or workers with enough expertise and authority to be speaking to the surveyors rather than the average laborer. This aligns well with the likely decision-makers regarding new technology adoption, but can skew the data, as for example regarding age and gender below.

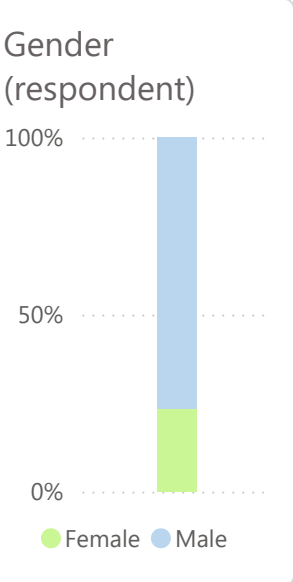
Farmers are relatively young: about 80% are under 50 (and the general agricultural laborer population skews even younger). The majority have only primary education or none at all. This, however, still means that over a third have secondary education or higher. Some locations have significantly better-educated farmer populations, such as MH, where 39% of farmers have secondary education and a further 15% have postsecondary education.

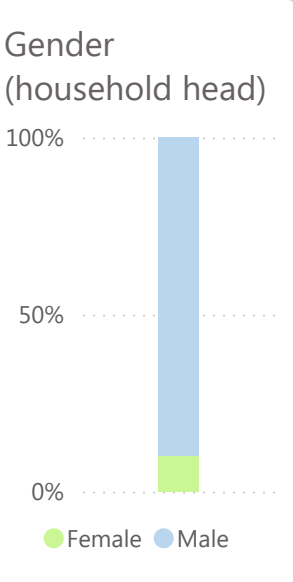
Despite the fact that women constitute over half of the population employed in agriculture, the results overwhelmingly skew male even after oversampling female farmers in the second survey. This is partly a matter of women being less likely to be farm owners and partly that local norms make surveyors less likely to approach a woman.

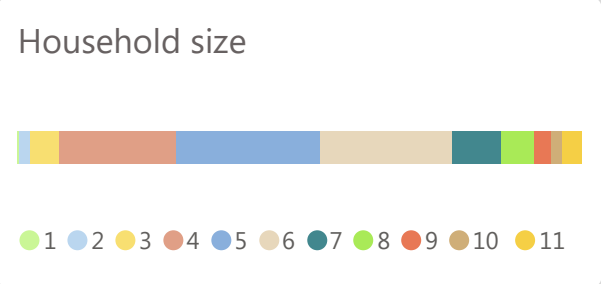
Households tend to be large, with over half reporting 6 or more members. On average, about half of any household's members are employed in agriculture.









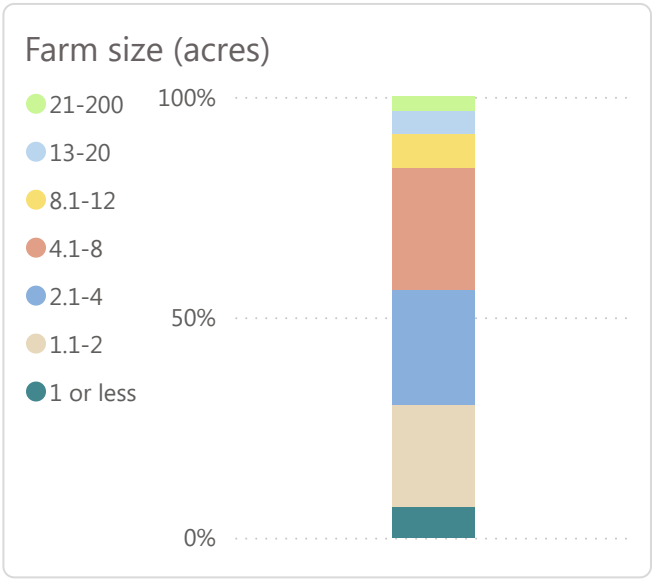


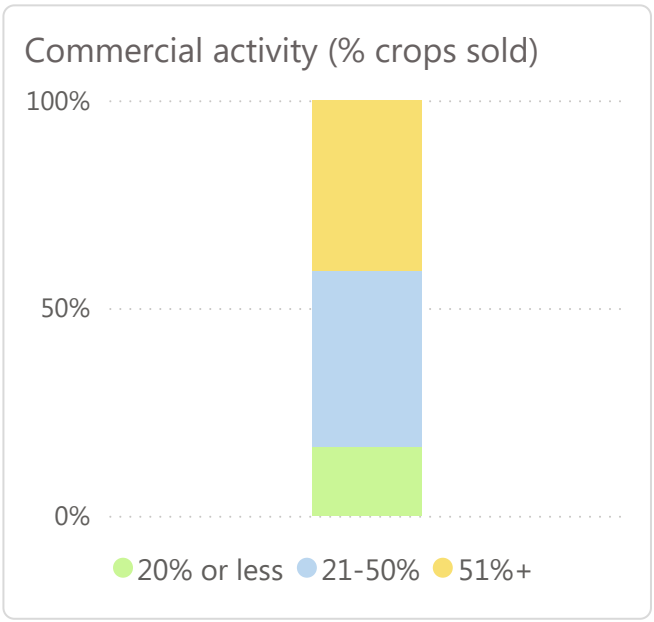
The farms are, as expected, quite small: over half fit under the common benchmark for smallholders of 2 hectare (~5 acre), and nearly all fit under the expanded 10 hectare (~25 acre) definition.

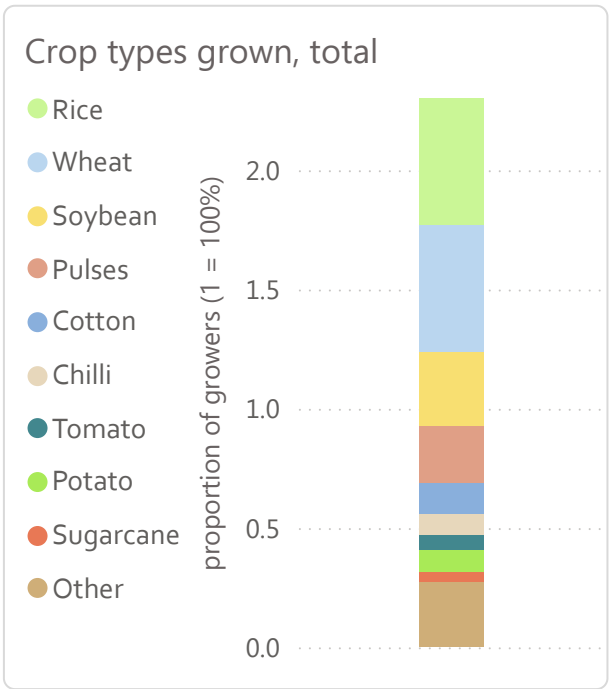
The vast majority of farmers, at 60%, cultivate two crop types on their farms, with an additional 20% cultivating three types. Relying on a single crop or diversifying beyond three is quite uncommon. Rice and wheat are the most common crops by farm, accounting for nearly half the crops grown; soybean and pulses add up to nearly a quarter. Crop distribution varies a great deal by state, with MH farmers growing a much more diverse sample of crops. About half the farmers also cultivate livestock, typically one or two heads of cattle.

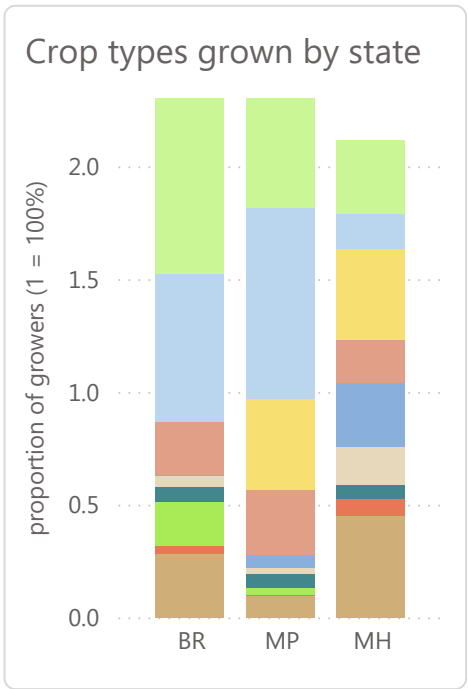
About 40% of the farmers in our sample classify as commercial farmers selling over half their crop produce—but since we had intentionally oversampled cash crop growers, the real share of farmers selling most of their crops is certainly lower; similarly, the graphs of crop types grown below overstate the dominance of the top crops.

About 40% of the farmers sell 20%-50% of their crops. A little over 40% of farmers report engaging in off-farm economic activities to supplement their income.





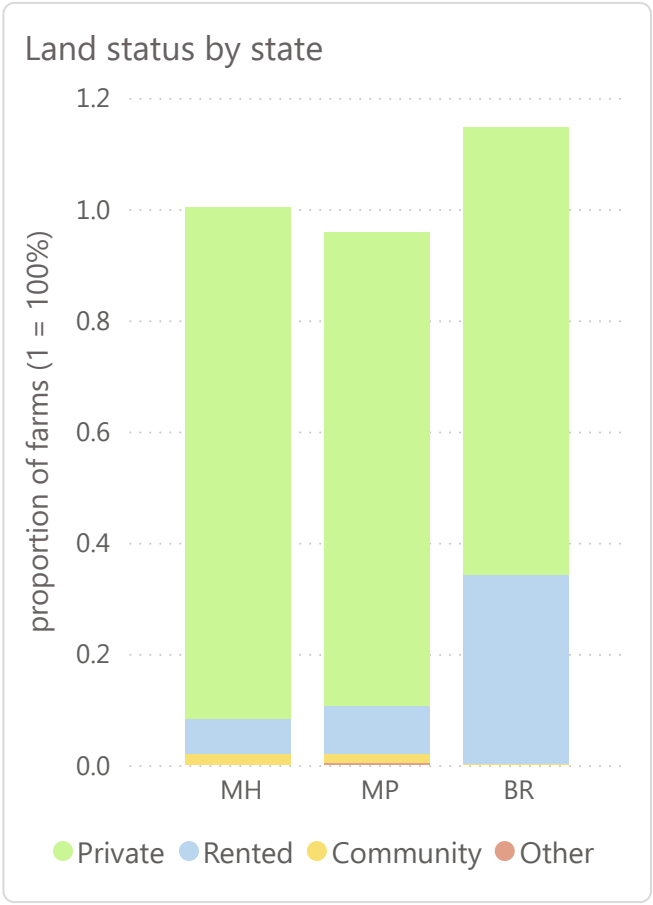




*The graphs to the left, representing the share of farmers growing each crop, sum to over 100% due to the fact that most farmers grow more than one crop.

The second survey included a larger proportion of respondents who lease their farm land, largely due to the addition of Bihar, which has one of the highest rates or leased farmland in India. One might expect tenants to have less incentive to invest in technologies and solutions, but the survey findings showed no substantial differences between groups regarding willingness to pay, except for post-harvest solutions. This may be explained by the farmer's relatively short desired ROI timeframe, which would allow even tenants to benefit from the technology.

Note that the graph represents the proportion of farms using lands of each respective status rather than the comparative size of farmland under each status. Since private farms tends toward significantly larger sizes than rented plots, an accounting of land size would decrease the share of rented land.



Findings Summary

Primary Challenges

Irregular rainfall and water source problems are the top issues identified as threat to farm productivity overall (rather than challenges to specific agricultural practices). Irregular rainfall, largely referring to crop damage from late-season rain, is the clear top farmer concern, with a plurality among overall reported challenges at 25% and a far higher share of the first ranked challenge at 51%. Financial risk reduction mechanisms such as insurance as well as forecasting services may be relevant solutions to this challenge. Water source concerns (including problems with electricity supply, which most commonly powers water pumps) are also very prominent, and may be addressed through both direct technical solutions and a holistic transition toward more water-efficient crops.

Challenges by Agricultural Practice

Soil and Land Management

Farmers lack actionable methods for analyzing the nutrient makeup of their soil prior to applying fertilizer. Optimizing soil nutrition and crop yields requires an understanding of the soil's current chemical composition—that is, soil testing. Between on-the-ground demand from farmers and government schemes, there is great potential for soil testing solutions in India. The status-quo technology of laboratory testing cannot meet demand at the scale required, and innovative technologies that prioritize access and scale combined with expert recommendations while maintaining a high degree of accuracy will find a huge underserved market among smallholder farmers in India.

On another important note. while overuse of chemical fertilizers is a known problem in India, there is both a significant existing market for organic fertilizers and great room for further growth, driven in part by government support for organic agriculture.

Postharvest Activity

Farmers lack storage solutions for their produce and suffer from damage to stored produce. Postharvest is overall the category with the lowest satisfaction rates. Storage is the most obvious problem: 55% farmers report lacking access to storage for grains and 80% lack access to storage for vegetables, correlating with low satisfaction. Strained physical infrastructure and cost concerns put an especial priority on solutions that can maintain produce freshness without refrigeration and protect the stored produce from spoilage and damage.

Market Access and Linkages

Fluctuating or low prices and distance from markets are the top challenges in this category. Market linkages are close to postharvest in overall low satisfaction rates. Both physical solutions and organizational innovations are relevant for this category. Aggregation platforms and logistical solutions could help farmers sell their produce more reliably and on better terms. Improved storage solutions could give farmers more flexibility to wait for better opportunities and negotiate with dealers.

Crop production and Management

Crop production is significantly challenged by damage from irregular rainfall (which also showed at the top of general farming productivity challenges) and by damage from wild animals. Forecasting and financial risk reduction solutions may be helpful for mitigating damage from irregular rainfall. Various repellant and deterrent solutions can address the wild animals challenge.

Irrigation and Water Management

Problems with electricity supply, the most common power source used for irrigation, are the most common challenge in this category. Diesel-powered solutions, used by a fifth of the farmers in our sample, are significantly more expensive. Cost-efficient application of solar power solutions could find a significant market among Indian smallholders. The low water prices in India do not incentivize efficiency, and the resulting strain on water resources results in limited access to water. Both technological solutions increasing the efficiency of water use and more holistic solutions such as transition to water-efficient crops are relevant in this category.

Livestock

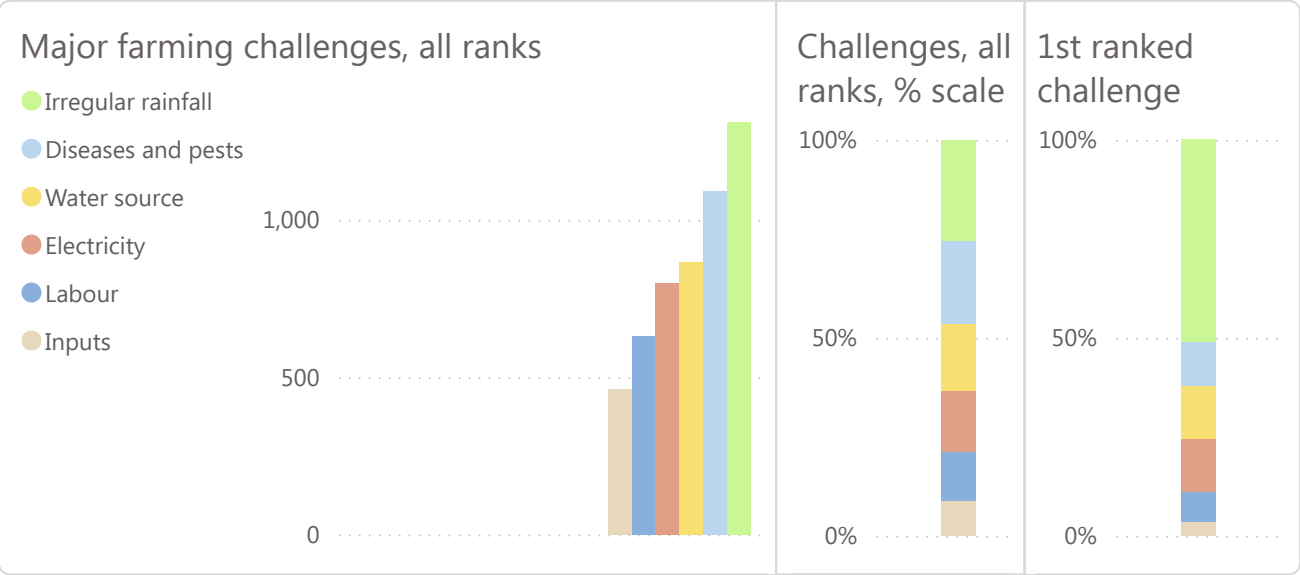
Distance from market and access to veterinary services are the top reasons for dissatisfaction in this category. The limited availability of skilled veterinarians opens an opportunity of remote monitoring and recommendation solutions. Market linkage and storage solutions are also relevant for livestock challenges, especially refrigeration solutions that are both cost-effective and resilient to infrastructure challenges.

Variation Patterns

All through the data, we find consistent patterns of variation. When summary measures are broken down by state, they often show different priorities in different locations. The same repeats on higher resolution—district, block, and even village—though we don't go into that level of detail in this report. Other factors, such as a farm's agricultural output, also significantly affect its challenge makeup.

Per-practice satisfaction levels show particularly consistent variation patterns. While average satisfaction counts hover around 50% for all practices, a breakdown by state shows significantly higher satisfaction levels across all categories in MH and much lower satisfaction in MP. A breakdown by crops similarly shows overall higher levels of satisfaction for cotton, sugar cane, onion, soy and pulses, and notably lower than average satisfaction for rice—the top common crop. This is a reminder that relevant solutions will need to be built with the flexibility to work across a range of circumstances and that distribution efforts must be informed by a detailed understanding of local conditions.

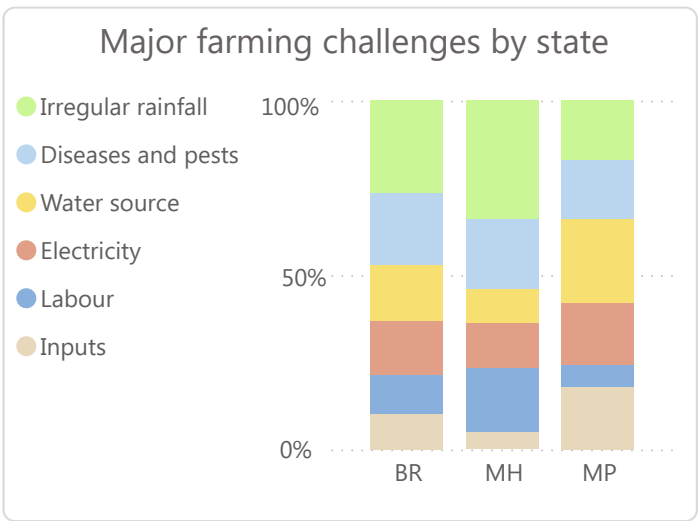
General Farming Challenges



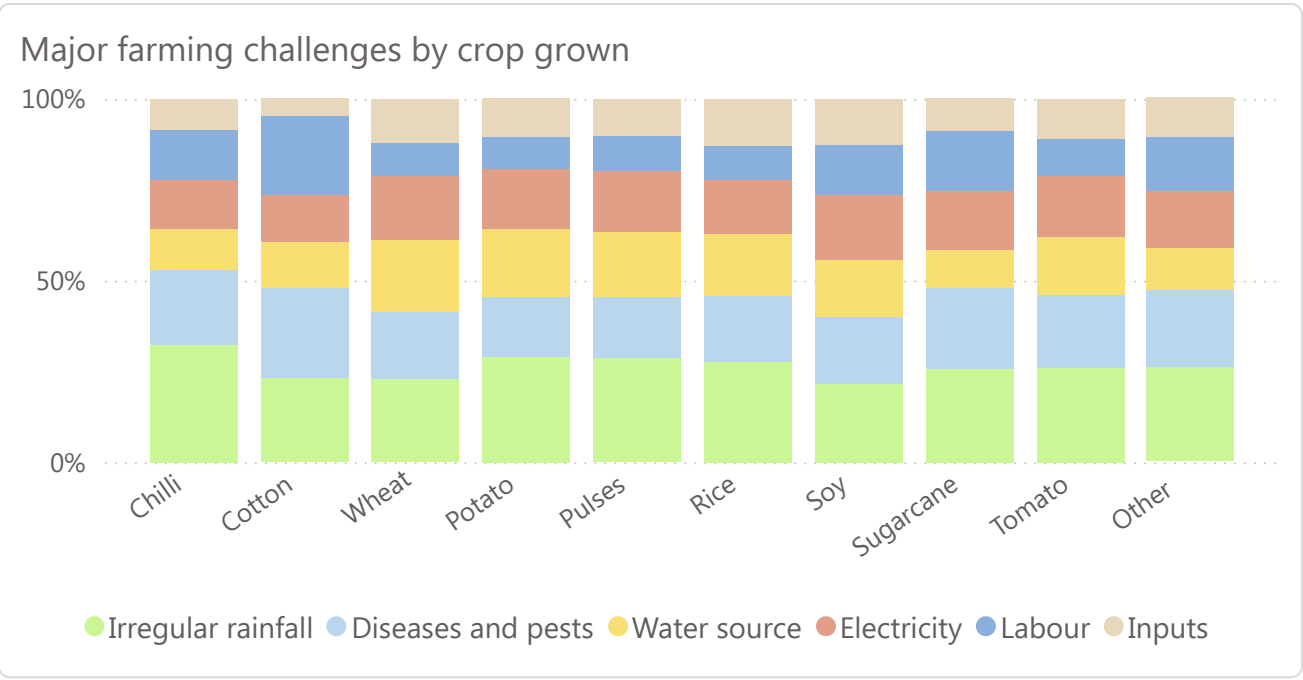
When asked about the major challenges threatening their farm productivity, farmers were most concerned about irregular rainfall. This challenge was especially prominent in the ranked format of the question, where irregular rainfall accounted for over half the responses (as opposed to 25% in the total unordered count). This is likely influenced by the recent delayed monsoons and rainfall deficiency in BR and MH. The latter, at 80% of rainfed farming, is especially vulnerable to changes in rainfall patterns. This results in delayed sowing, shortened growing season and reduced harvest as well as disrupting preparation for the next season. This major challenge calls for a wide array of solutions: weather forecasting, enhancing soil moisture conservation, efficient irrigation systems, and insurance mechanisms to reduce farmer risk.

Irrigation challenges are prominent as well. As electricity is commonly used for irrigation water pumps, combining "electricity" with "water source" would put this challenge to the top (28% of responses, against 25% in irregular rainfall). The challenge of timely access to water has been exacerbated by policies that promoted overproduction of water-intensive crops, resulting in depletion of water tables. Thus, 2007-2016 saw a 5% increase in dry wells and 3% increase in borehole construction in MP.2 This calls for solutions to improve water utilization, especially for water-intensive crops, and to adopt more resilient and climate-smart agriculture, including by moving to more water-efficient and high-value crops.

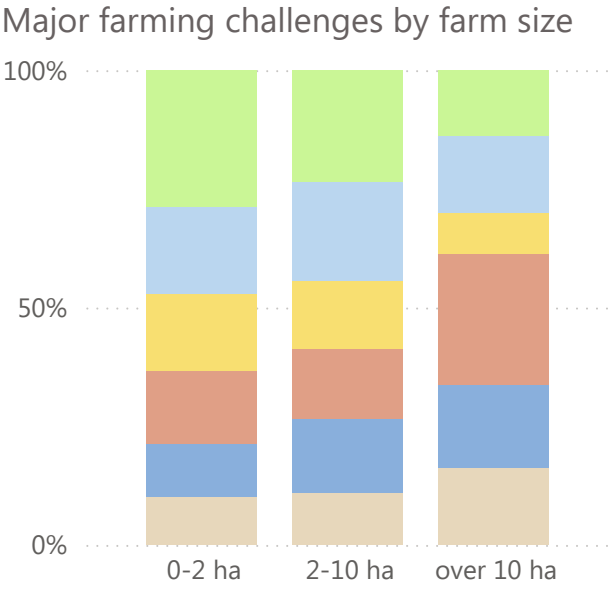
Here, as elsewhere, we see a great deal of geographical variation: in MP, which is less reliant on rainfed agriculture, for instance, irregular rainfall is overshadowed by water source issues (which also take priority among first-rank challenges for that state). Inputs take a major role there as well..



The AE survey, representing a different but complementary well-informed perspective, also lists irregular rainfall as a major challenge, but ranks lack of access to soil testing, diseases and pests, and low soil productivity significantly higher.



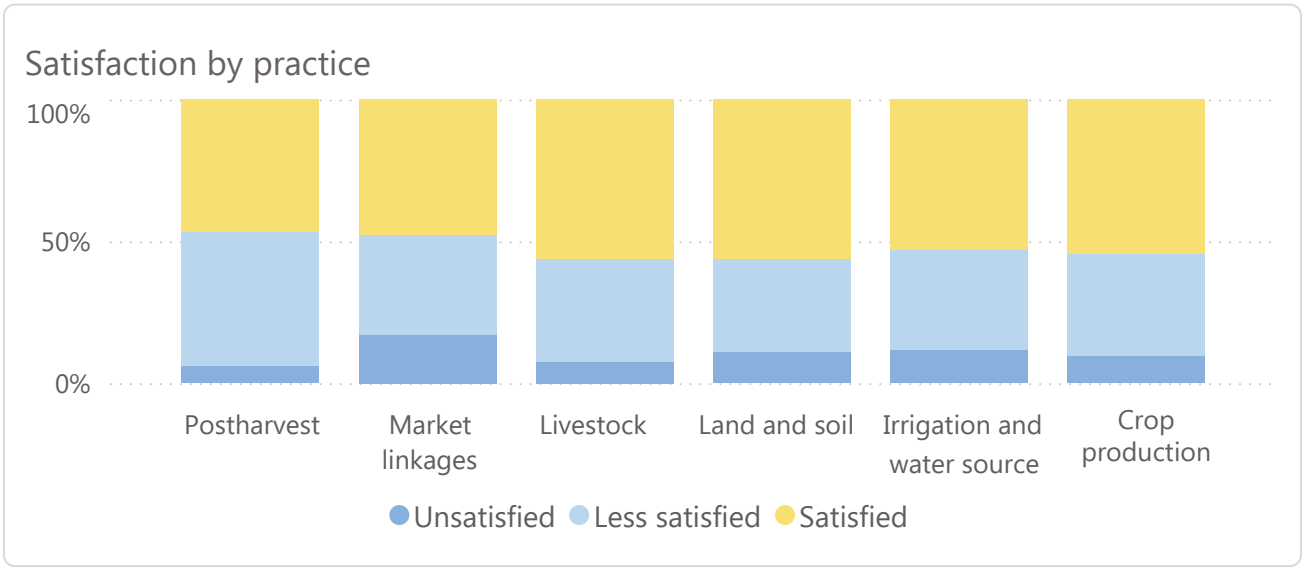
The general farming challenges vary in prominence depending on many other variables, with farm size and the crops grown being the most obvious ones. Granted, neither of these variables has nearly as strong an effect as geography. Keep in mind, however, that geography masks many other variations: not only physical geography and climatic zones, but also social and economic differences, which, in turn, also affect infrastructure, market access, farm size and specialization, and more. Geography may thus function less as a direct explanation than an indication of difference in farming challenges—but it is an important one with clear practical consequences.

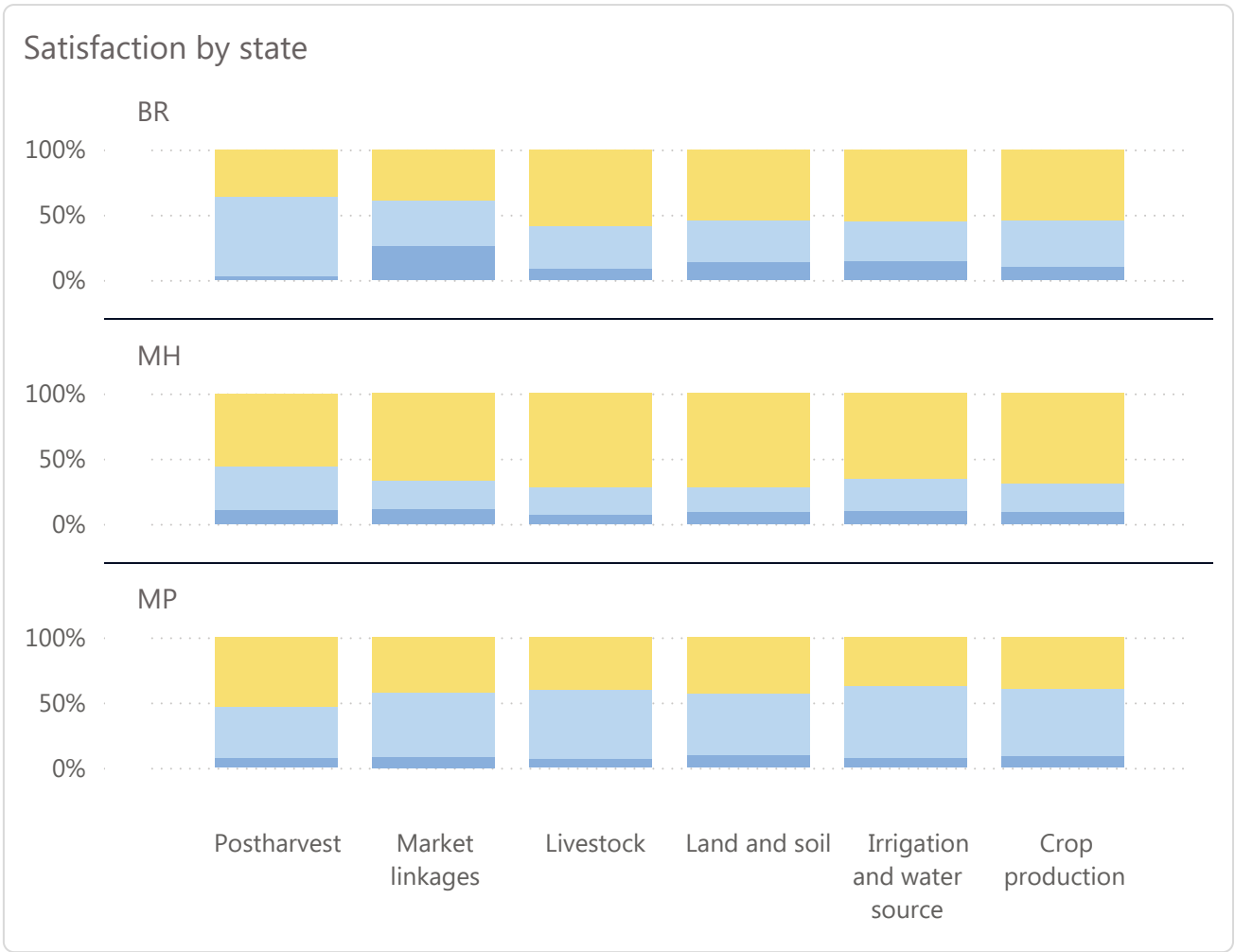


The farm size groupings shown are based on common definitions of smallholder farmers: under 2 hectares and under 10 hectares. Scale matters: in MP, for example, larger farms use three-phase pumping systems that only get a daily electricity supply of 6-8 hours. Irregular rainfall poses especial challenges for chili, potato, pulses, rice, sugarcane and tomato. Cotton and sugarcane stand out in especially struggling with labor and diseases and pests. Note, however, in reading this graph, that crops (and animals) are often grown in diverse combinations. In reality, there is significant overlap between the categories shown here. Our first report covers the distribution and combination of crops and animals, with brief summaries provided in the respective sections of this report.

Challenges by Agricultural Practice

Besides the general challenges to farming productivity, the survey covered a range of farming practices under the following categories: soil and land management, postharvest activity, market access and linkages, crop production and management, irrigation and water management, and livestock management. Farmers who expressed dissatisfaction were asked to provide three reasons for their answer. This effectively provides us with a ranked list of practice-specific challenges.





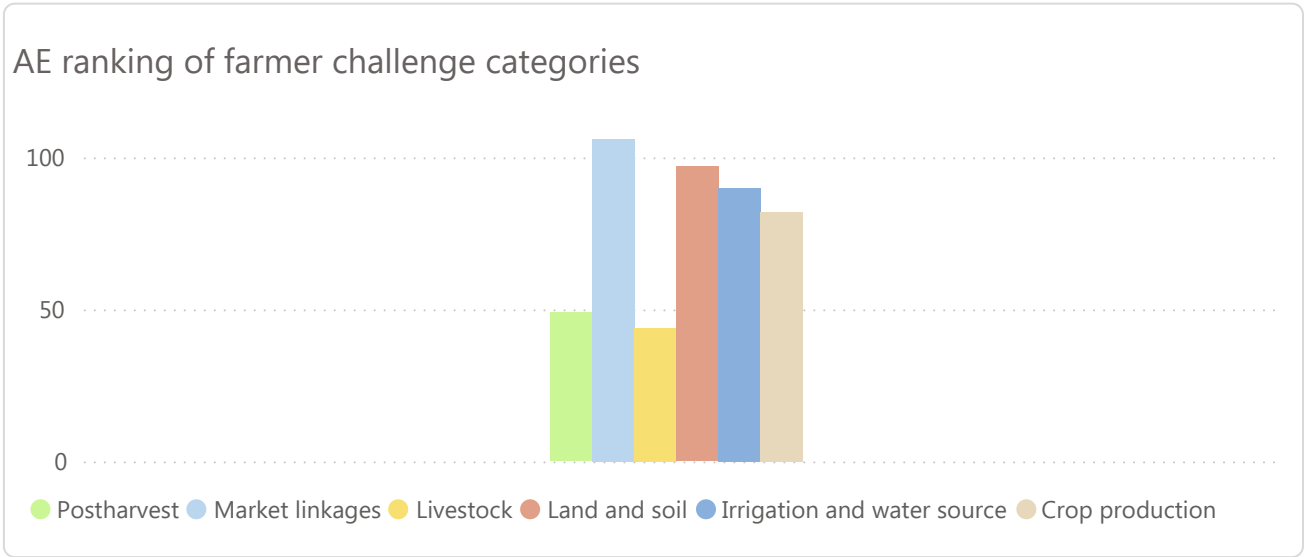
Overall level of dissatisfaction hovers at 47%. Postharvest and market linkages take a moderate lead at 53% and 52%, respectively, of dissatisfaction—though market linkages notably lead in the level of "unsatisfied" responses, 17% against 6% in postharvest and 11% overall average. These two categories are especially prominent in BR, which also provides the majority of "unsatisfied" responses in market linkages. BR, where the absolute majority of farms fall in the category of marginal holdings, does not benefit from economies of scale and suffers from inadequate road infrastructure and underdeveloped food processing and food storage facilities. Poor market access has been exacerbated by the abolition of the mandi (wholesale markets for agricultural produce), resulting in farmers having to sell their produce to private procurers at throwaway prices.[3]

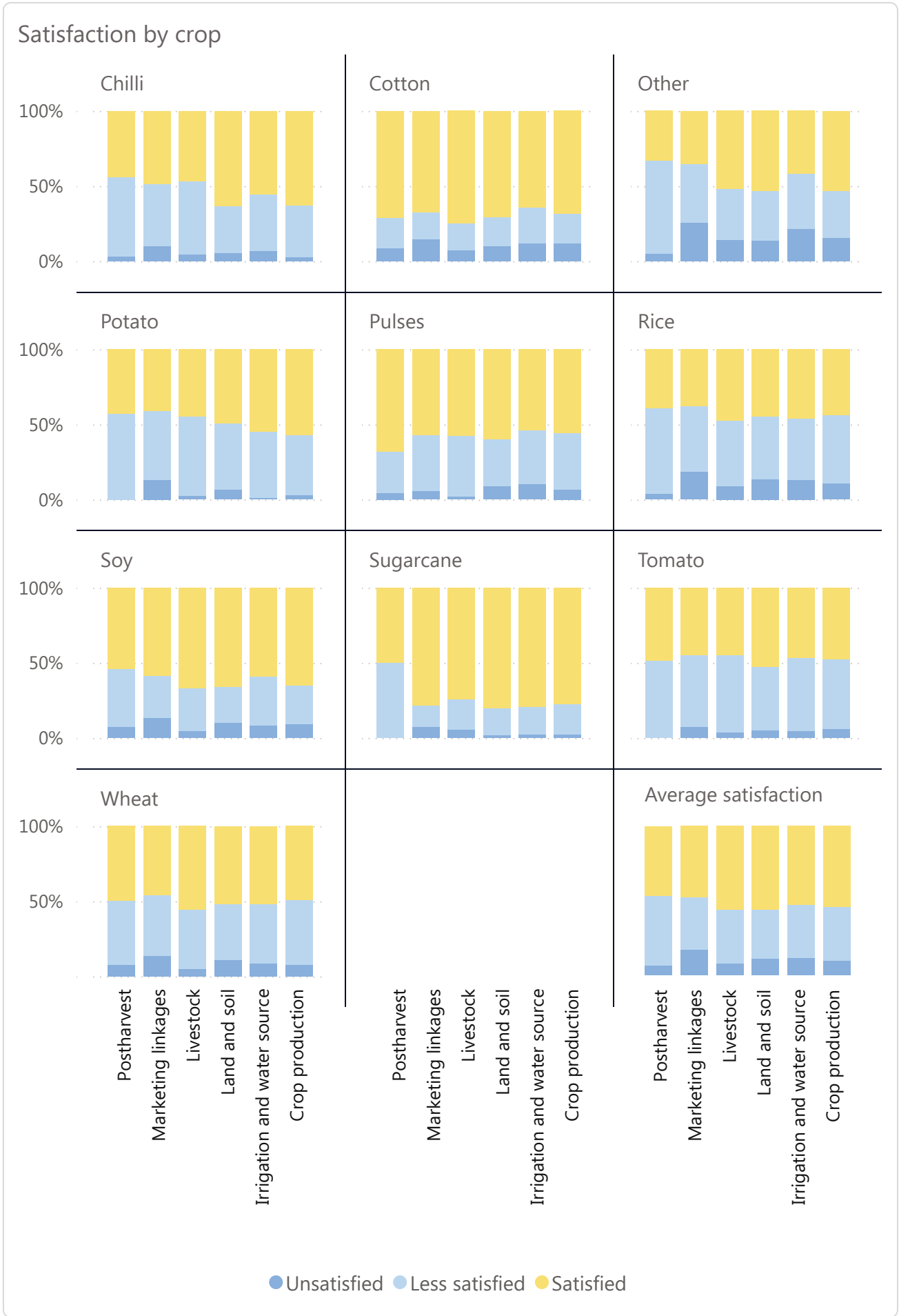
Crucially, satisfaction levels by practice are fairly similar on average, but vary significantly depending on other factors. There is a distinct pattern of satisfaction depending on state: MH farmers, who generally practice more advanced agricultural techniques and have better access to markets,[4] are significantly more satisfied, while MP farmers are the most dissatisfied. The latter is likely related to fact that several of the MP districts in our survey are populated by tribal communities with less developed farming systems, literacy rates, and access to infrastructure.

The AE survey, on the other hand, reports a more uneven ranking of challenges by practice, with market linkages taking a slight lead and postharvest and livestock lagging substantially behind the rest. Though conflicting with the overall farmers' satisfaction ratings, this matches more closely the pattern of farmers' "unsatisfied" responses. The difference, again, does not invalidate either source, but both perspectives are worth bearing in mind when making practical decisions.

Farmers' satisfaction levels and specific reasons for dissatisfaction further vary at the district, block, and village level. These details are crucial for making well-informed business decisions, and EIP uses this data in its validation and commercializing processes. There is a similarly strong pattern of variation by crop, with high levels of satisfaction for cotton, sugar cane (excepting sugarcane postharvest), and onion (summarized under "other"); moderately high levels for soy and pulses, about average levels for wheat, tomato potato, and maize (summarized under "other"), and notably lower than average satisfaction for rice—the top common crop.

The variation of satisfaction by crop, however, is at least partly explained by geographical variation. For example, the two high-satisfaction crops—cotton and sugarcane—are mostly found in MH, the state with the overall highest satisfaction levels. There are also specific local circumstances to consider that do not necessarily come down to agricultural technology. Thus, cotton is usually grown in arrangement with off-takers, bypassing much of the challenges associated with selling crops on the open market.




Satisfaction by crop
Chilli
Cotton
Other
Potato
Pulses
Rice
Soy
Sugarcane
Tomato
Wheat
Average satisfaction
100%
50%
0%
Postharvest
Marketing linkages
Livestock
Land and soil
Irrigation and water source
Crop production
Unsatisfied
Less satisfied
Satisfied

Reasons for Dissatisfaction by Agricultural Practice

The table below breaks down, within each practice, the proportion of reasons that respondents gave for rating their satisfaction with that practice below "satisfied." The breakdowns follow a relatively uniform distribution, with the top reason garnering around 25% responses, and the rest gradually declining in importance. In some cases, however, the top 2-3 reasons may be considered as subsets of a more general problem (e.g., under postharvest, "lack of adequate storage" and "lack of short-term storage facility" are both problems with storage). From this perspective, all practices except land and soil management and livestock management have a clear top area of concern.

Soil testing, although it does not stand out in this representation, deserves a special note. It is especially prominent in the ranked angle: 60% of farmers cite it as the first reason for dissatisfaction, the highest percentage allocated to a single reason across all practices. Further, in the AE survey, soil testing came out on top by a wide margin in a list of smallholder farmers' specific farming challenges.

Reasons for dissatisfaction by practice

Postharvest	
Lack of adequate storage	26%
Lack of short-term storage facility	20%
Diseases and pests	18%
Lack of relevant information	18%
Lack of long-term storage facility	9%
Labour	8%

Market linkages	
Fluctuation in market price	26%
Low selling price	19%
Distance from markets	18%
Transportation facility	14%
Lack of relevant information	13%
Storage facility	11%

Irrigation & water source	
Electricity - supply	26%
Water source	21%
Low groundwater	18%
Cost of rented irrigation or labour	14%
Flood irrigation management	11%
Electricity - low voltage	10%

Crop production	
Damage from irregular rainfall	28%
Wild animals	21%
Diseases and pests	18%
Quality seeds	14%
Labour	10%
Fertilizer	9%

Livestock	
Distance from markets	23%
Veterinary services and medicine	22%
Lack of relevant information	20%
Low milk production	18%
Distance from milk collection centers	17%

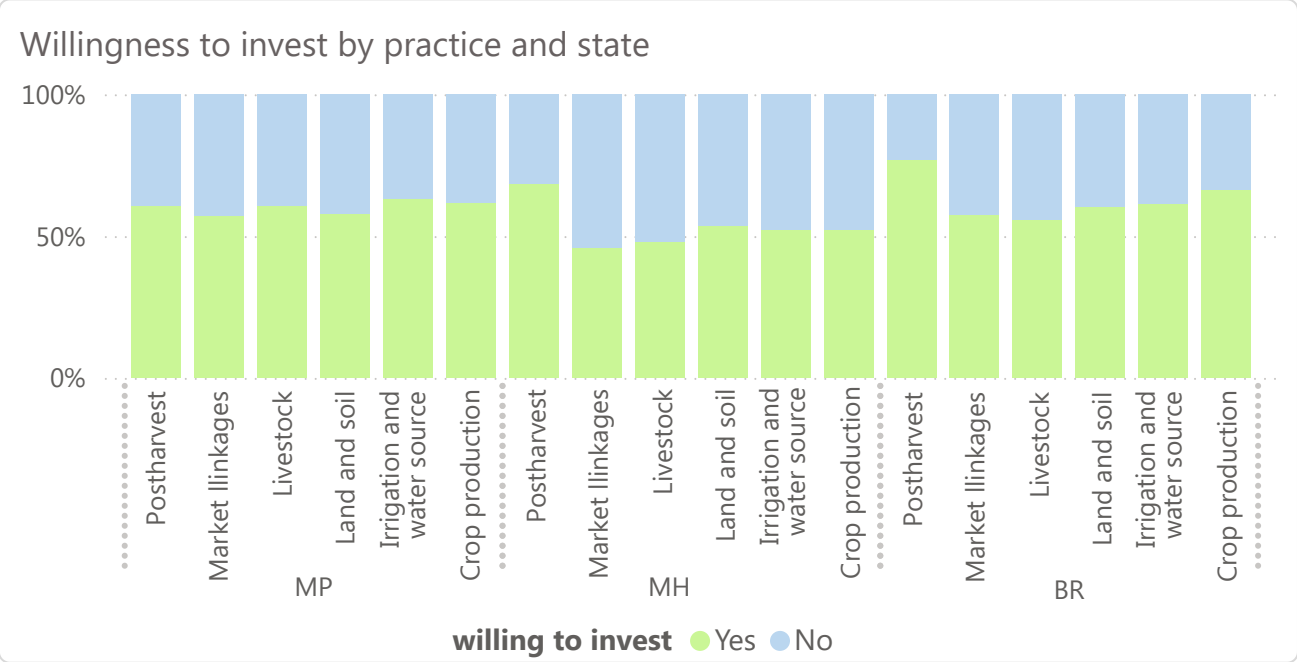
Land & soil	
Soil testing - lack of information or unavailability	26%
Soil health - low productivity	25%
Nutrient management or haphazard use of fertilizers	20%
Lack of relevant information	20%
Soil moisture or pH	7%
Soil erosion	4%

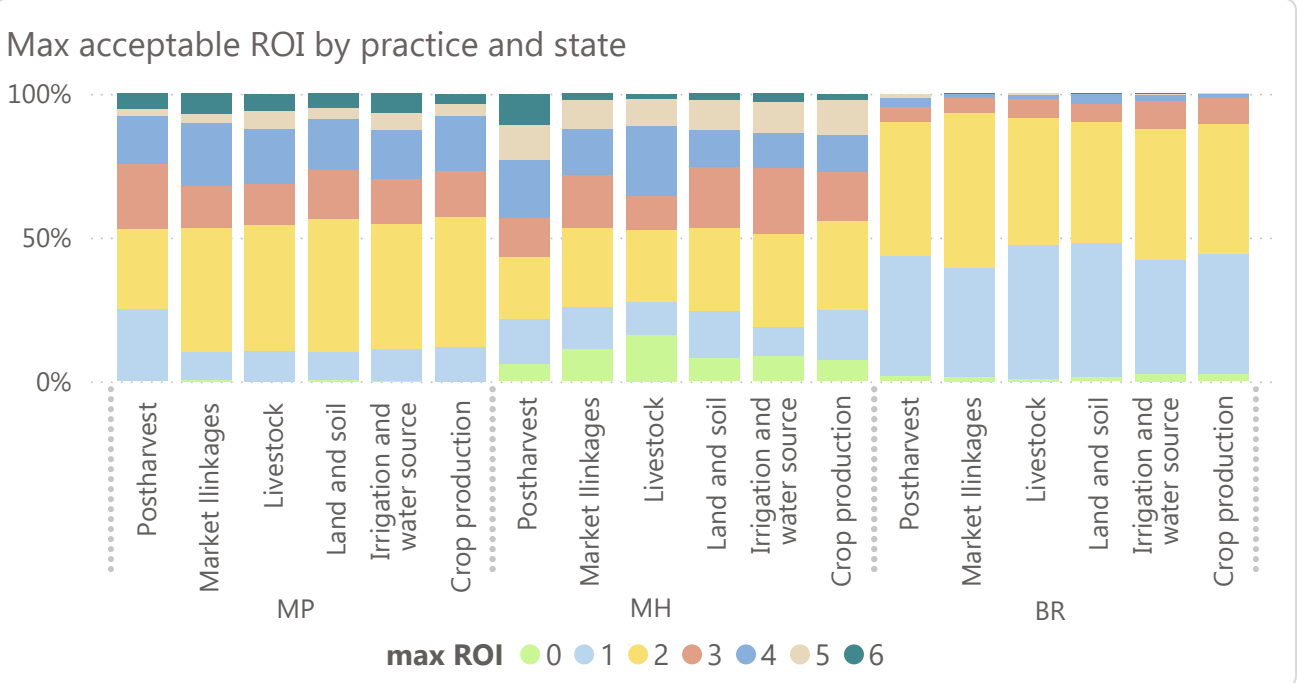
Willingness to Invest by Agricultural Practice

Farmers were also asked if they would be willing to invest in technological solution to their challenges in each practice, and if so, how long they would be willing to wait (in number of agricultural seasons, that is, twice a year) for the solution to pay for itself.

Postharvest has the highest will to invest at 69%, highest yet in BR at 77%. Market linkages score the lowest at 54%. The moderate rate of variation on the state level breaks down at a higher resolution: for example, two BR districts score 70%-90% willingness to invest, while another rates under 40% across all practices.

Maximum acceptable return on investment (ROI) timeframe typically stands at 2 or 1 seasons, but the picture changes dramatically based on state: while just about 10% of BR farmers are willing to wait more than two seasons, nearly 50% of MH and MP farmers are willing to do so.





Soil and Land Management: Soil Testing

Overview

Soil and land management includes practices that aim to maintain or improve soil health, prevent erosion and nutrient loss, ensure sustainable agricultural productivity, and optimize water use. Having found a pressing need for soil testing, EIP has begun working with several innovative companies in this sector, and we are devoting a special section of our report to this topic.

Soil testing, especially when paired with expert advice, allows farmers to optimize fertilizer use, promoting crop yield and quality, soil health, climate resilience, and cutting costs. Studies show as much as 20% average yield increases and 15% reduction in fertilizer use.[i] All of these are especially important for resource-strapped smallholders operating in regions prone to climate extremes. India is known for overall excess use of fertilizers, especially nitrogen.[6] The Indian government currently spends $21 billion per year on fertilizer subsidies, amounting to about Rs. 5,100 ($61) per farmer.[7] Soil testing can thus help not only farmers and the environment but the government as well.

Government Soil Testing Effort

The Indian government's Soil Health Card (SHC) scheme, introduced in 2014, has made substantial progress in providing farmers with soil analysis cards, reaching 230 million cards across the country. Soil tests, collected at the farm level, provide farmers with figures for 12 soil parameters[ii] along with recommendations for fertilizer use and soil amendment; the government spends Rs. 190 on a single card[8]. The scheme established soil test labs, reaching more than 12,100 labs by 2023. Of these, 70% are mini static labs, 20% are at the village level, and only 1% are mobile labs[9].

This is an impressive operation: in 2023, 4.4 million samples were collected, and 3.8 million tests were completed[10]. However, the demand is larger yet: just the three states included in EIP's survey are home to over 27 million smallholders; only 2%-8% of them benefited from an SHC. Soil testing laboratories are often overloaded with SHC samples, causing delays. The government plans to roll out 7,500 village-level labs from 2023-2026,[11] but given India's 150 million smallholders spread across over 600,000 villages, there is a clear need for faster, more cost-effective and scalable solutions to complement the government's efforts. These solutions will need to address the core challenges of logistics, accessibility, awareness, and cost.

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[i] An SFI & AEGF soil health initiative showed yield increases of 5-10% for wheat, mustard, and chickpea, and cost savings of 150 INR ($1.8) on average per smallholder for each macronutrient (UREA, DAP, MOP). An evaluation of the SHC scheme found cost reductions ranging from 20-50%, with fertilizer use decreasing from 50kg/acre to 40 kg/acre in the case of paddy, and yield improvements of 20-50% in paddy and coconut due to secondary-nutrient application. A study conducted by the National Productivity Council (NPC) found that applying Soil Health Card recommendations led to a decline of 8-10% in chemical fertilizer use and raised productivity by 5-6%.[5]

[ii] Macronutrients (N, P, K); secondary nutrient (S); micronutrients (Zn, Fe, Cu, Mn, Bo); and physical parameters(pH, EC,OC).

Logistics and Accessibility

Many farmers, especially those in isolated or rural locations, lack basic access to soil testing services. Service providers struggle to locate and communicate with interested farmers in addition to the technical challenges of performing soil testing. Increasing the number of testing facilities and introducing mobile testing services could make soil analysis more convenient and accessible, moving towards a more decentralized model with increased local access.

The sheer size of the Indian agricultural market as well as its diversity, however, mean that a "one size fits all" solution for soil testing highly unlikely. Different technological innovations as well as commercialization approaches are needed. This is where EIP can assist with its ability to study farmer needs, validate and commercialize solutions, and access a network of more than 1 million smallholders across different Indian states through AEs as last-mile and point-of-sale channels.

Awareness, Trust, and Costs

While the demand for soil testing already outstrips the government's SHC supply, there is still limited awareness of the issue: many farmers don't understand how soil tests can boost crop yields. Of the farmers surveyed, less than 30% reported inspecting their soil before applying fertilizers, and of those that did, more than half used visual observation rather than soil testing. Awareness-building, local validation and demonstration of success are crucial for building trust with farmers, which is essential for the success of soil testing solutions among smallholder farmers in India. The expense of soil analysis, often reaching Rs. 200-1000 outside of the SHC scheme, is an additional obstacle. Many farmers consider it an extra cost rather than an investment with significant future payoff. In addition to technological advances, more closely tailoring soil testing packages to specific locations and crops could also help address this barrier.

Solutions Landscape

The solutions currently on the market include traditional soil testing laboratories, portable solutions (soil test kits or handheld devices), embedded soil sensors, and remote sensing solutions (satellites and drones).

The traditional solution is based on collecting soil samples and sending them to specialized laboratories utilizing mass spectrometry, spectroscopy, and chromatography. This solution provides highly accurate measurements and useful practical recommendations. However, they are hindered by the high laboratory setup and maintenance costs. The testing process is relatively slow, and the complex logistics of sample transportation further increase the delays and limit access in remote areas. Both the testing process and the interpretation require skill experts.

Portable solutions attempt to overcome the hurdles of laboratory testing. Soil test kits allow farmers to directly test their soil, usually through reagent-based chemical reactions. Handheld meters use near infrared (NIR) and X-ray fluorescence (XRF) spectroscopy soil analysis for the same purpose. These user-friendly solutions come with simple instructions. The logistical simplification and elimination of a central laboratory lower costs and delays. However, these solutions are less comprehensive and less precise than laboratory tests. Results are hard to translate into actionable insights without expert consultations, and equipment wear and tear undermine the logistical advantage of decentralized solutions.

In-situ soil sensors work similarly to portable solutions, but operate autonomously and allow for continuous monitoring through a software platform. They can support precision agriculture and aid in managing large farms or multiple fields. However, their technological complexity and high cost make them less suitable for smallholders.

Remote sensing solutions use satellite or drones to capture images through spectral reflectance analysis, thermal infrared imaging, and radar. Satellite-based solutions have the advantage of low cost, but remote sensing is not currently capable of indicating nutrient content, which is crucial for soil management. Drone solutions are especially limited, largely providing surface-level insights.

Call to Action

Government action as well as with local signals from our survey indicate strong growth opportunity for soil testing solutions. The potential market for soil testing for smallholders in just three surveyed states is worth more than $95 million,[iii] and for all of India, it could reach $500 million. Currently, the soil testing market in India (including construction and other sectors) is estimated at $100 million.[12]

Innovation is needed to make soil testing more accessible financially and geographically while maintaining accuracy, simplicity of use, and commercial scale. Such innovations could leverage a combination of portable testing kits, handheld meters, and remote sensing technologies, supported by user-friendly data interpretation tools and localized recommendations. This approach could address the challenges of limited awareness, accessibility, cost concerns, and standardization issues while providing comprehensive and actionable soil health information to farmers.

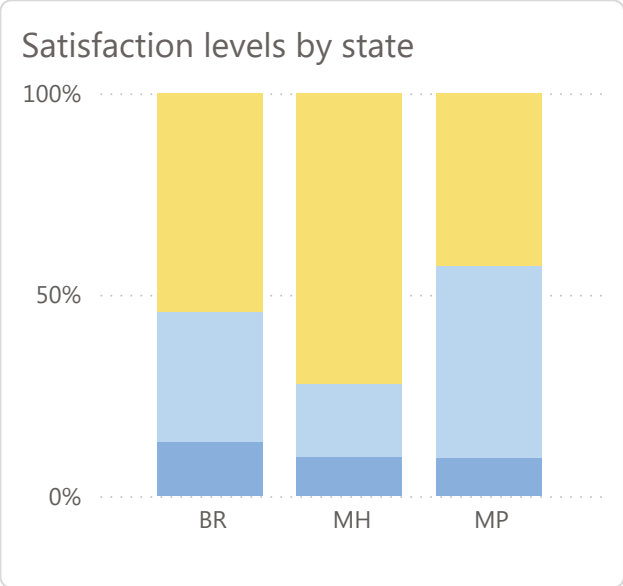
[iii] Based on cost of Rs. 300 per test and the 27.3 million farmers in three states.

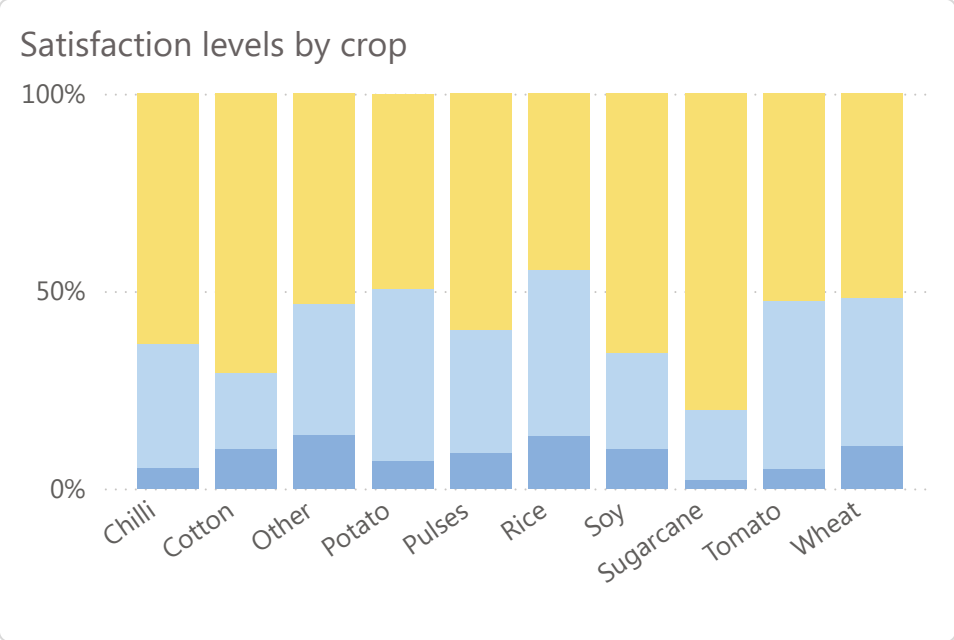
Soil and Land Management

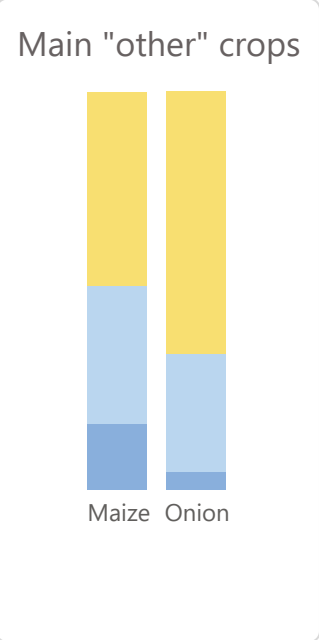
Soil and land management includes practices that aim to maintain or improve soil health, prevent erosion and nutrient loss, ensure sustainable agricultural productivity, and optimize water use. In addition to the prevalent use of inorganic fertilizers, these practices can include the use of organic fertilizers, crop rotation, cover cropping, and conservation tillage.

Farmer satisfaction with land and soil management practices generally varies by state and crop in tandem with the other practices: highest satisfaction in MH and lowest in MP; higher satisfaction with sugarcane and cotton, lower with rice, wheat, tomato, and moderate levels with potato, and soy, pulses, and chili.

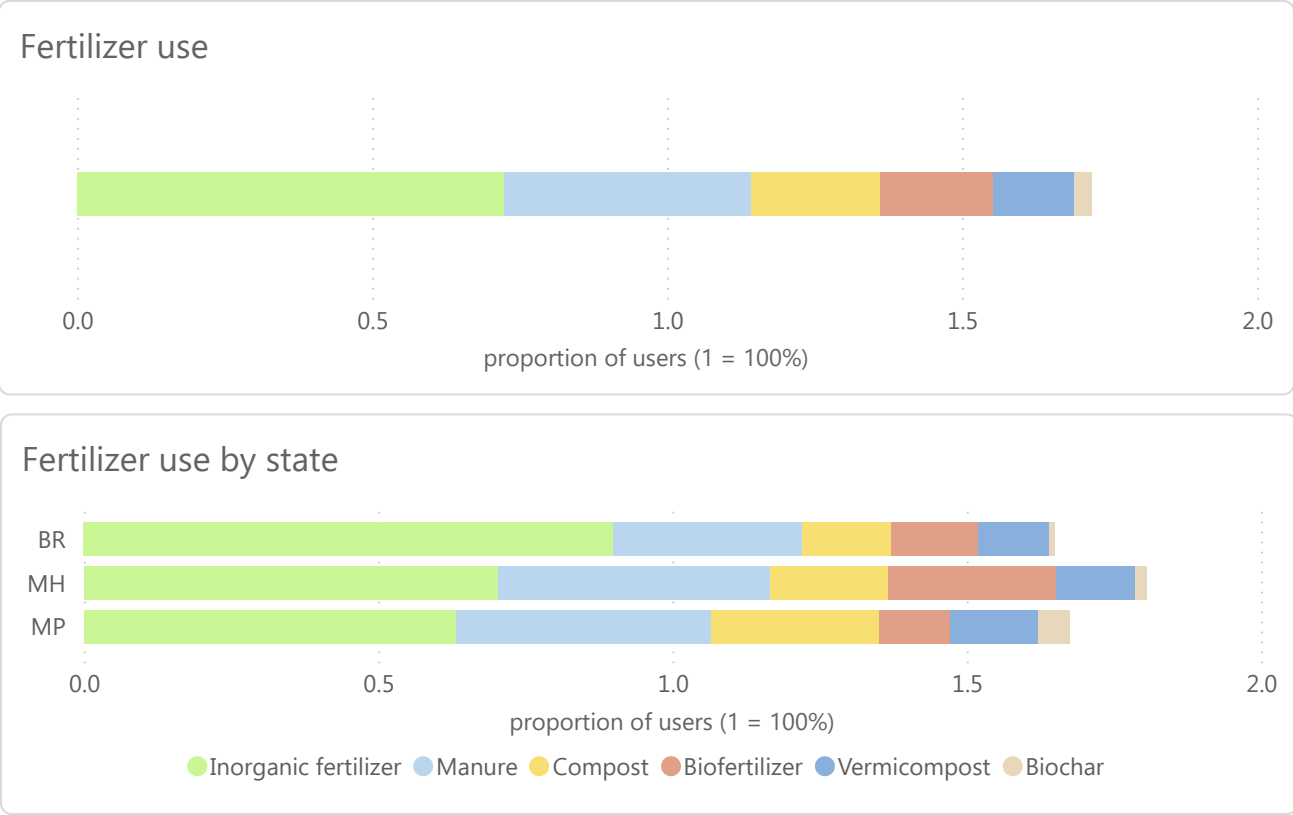
The AE survey has put land and soil management as the second-highest challenge, a little behind market linkages, and cited fertilizers as the top cited category of farmer expenditure, underlining the importance of potential savings, whether from soil testing or from a shift toward more organic fertilizer use.







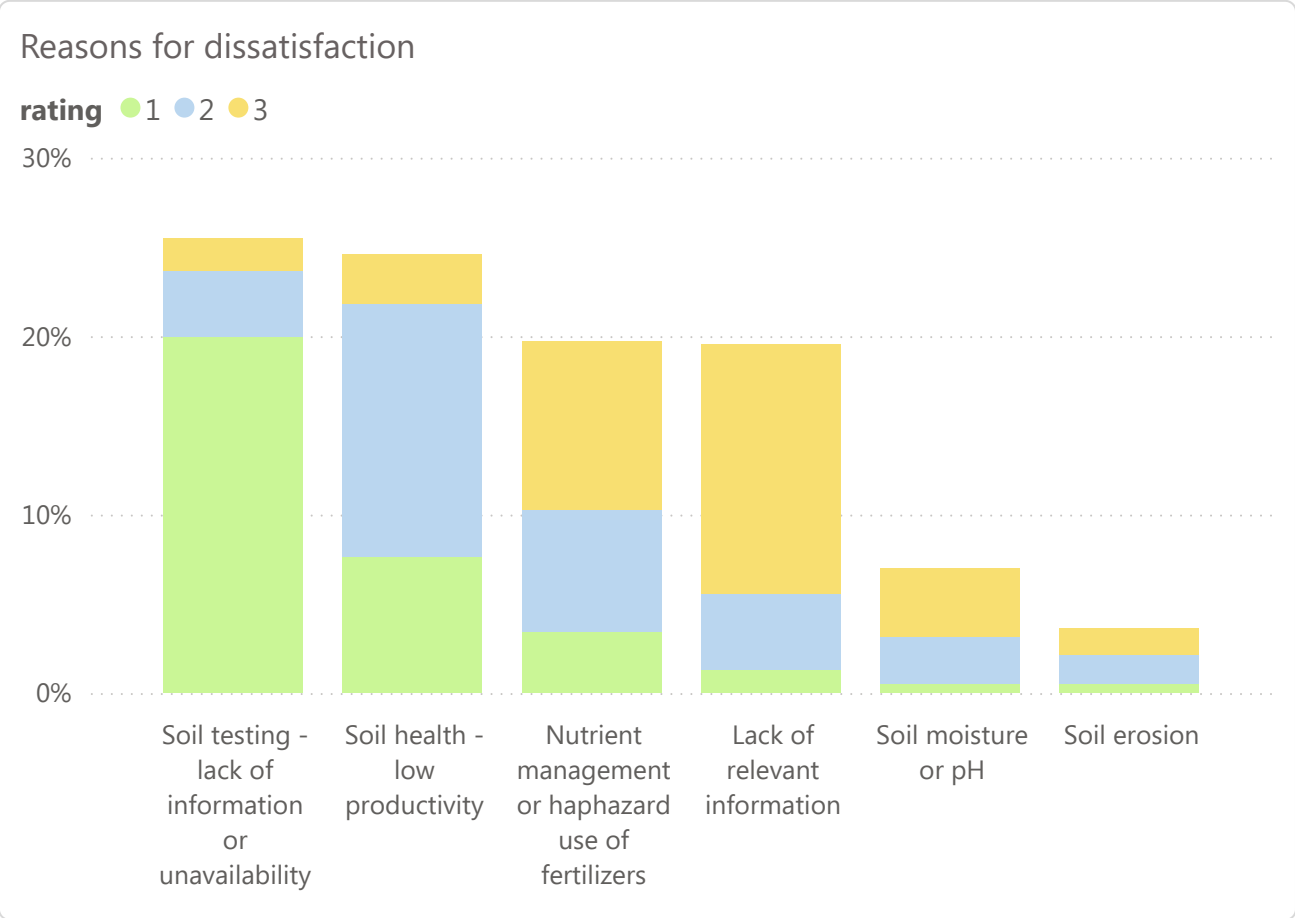
Biofertilizers Opportunity



Although inorganic fertilizer is the most common fertilizer used, we see substantial use of various biological-based fertilizers, especially in MP and MH (since farmers commonly combine multiple types of fertilizers, total use sums to more than 100%). While it is true that government subsidies drive up inorganic fertilizer use, the Indian government is also supporting the use of biofertilizers and the practice of organic farming (MP and MH lead in organic agriculture in India with 1.5 million and 1.3 million hectares of organic farms respectively).[13] There are subsidies for biofertilizer use, efforts to set up biofertilizer production units[14], and demonstration and awareness programs.[15] Biofertilizer production in 2019-20 was 110,000 tons, up from 20,000 tons a decade prior, a compound annual growth rate of 18.6%.[16]

India's biofertilizer market presents a significant opportunity for startups. While the total rate of biofertilizer use in our sample stands at 20%, three districts ranked above 30%, two more—near 50%, and another stood at 96% biofertilizer use. As of 2023, organic farming covers 10.1 million hectares across India. The biofertilizer market is rapidly growing. Given differences in price, familiarity, ease of use, and shelf life, to be competitive against inorganic fertilizers, biofertilizers should aim to provide 10-25% yield increase, a 20-25% reduction in inorganic fertilizer use, and aim for a longer shelf life. With government support and a growing market, India offers a fertile ground for biofertilizer innovation.

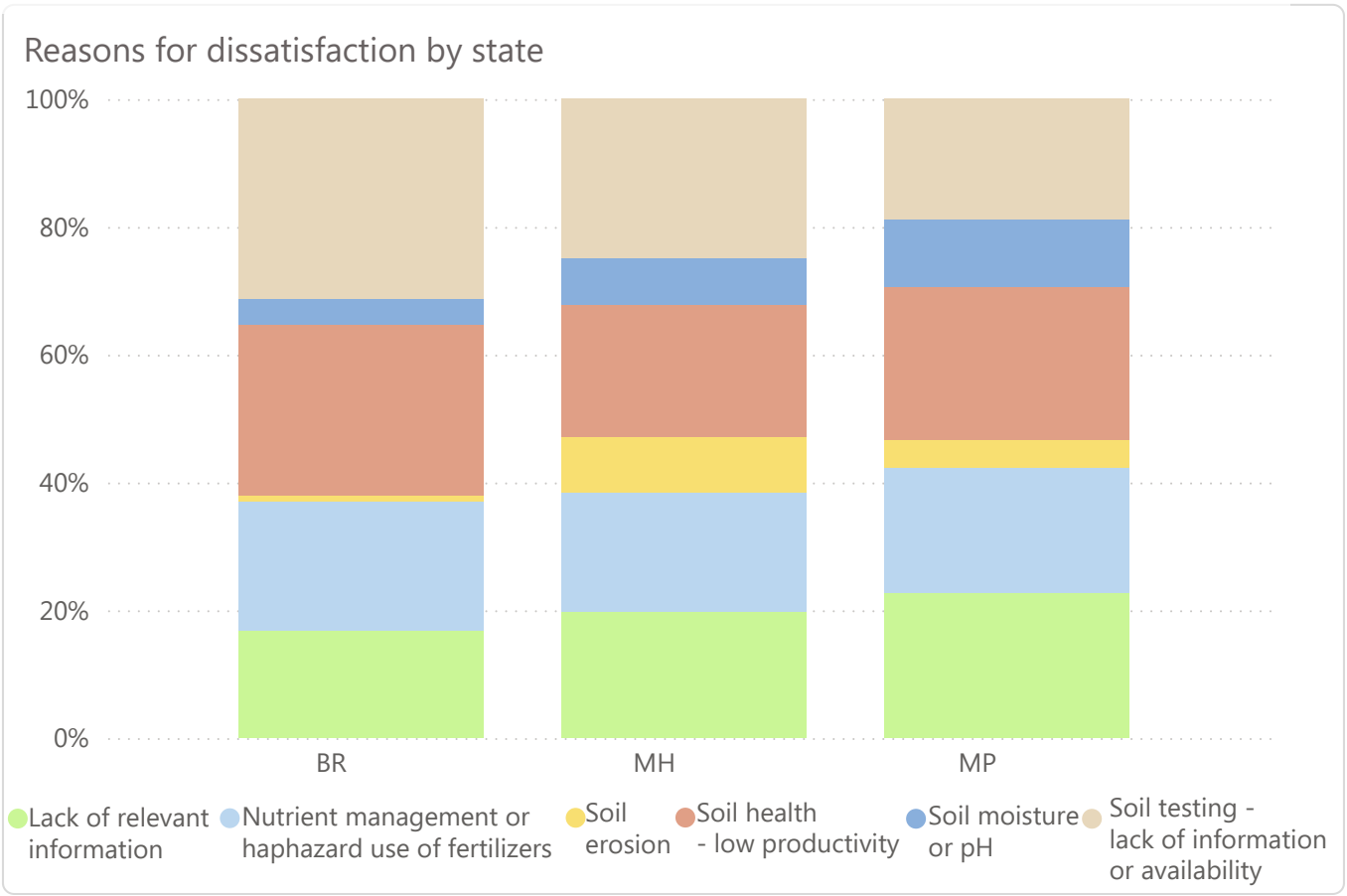
Reasons for Dissatisfaction

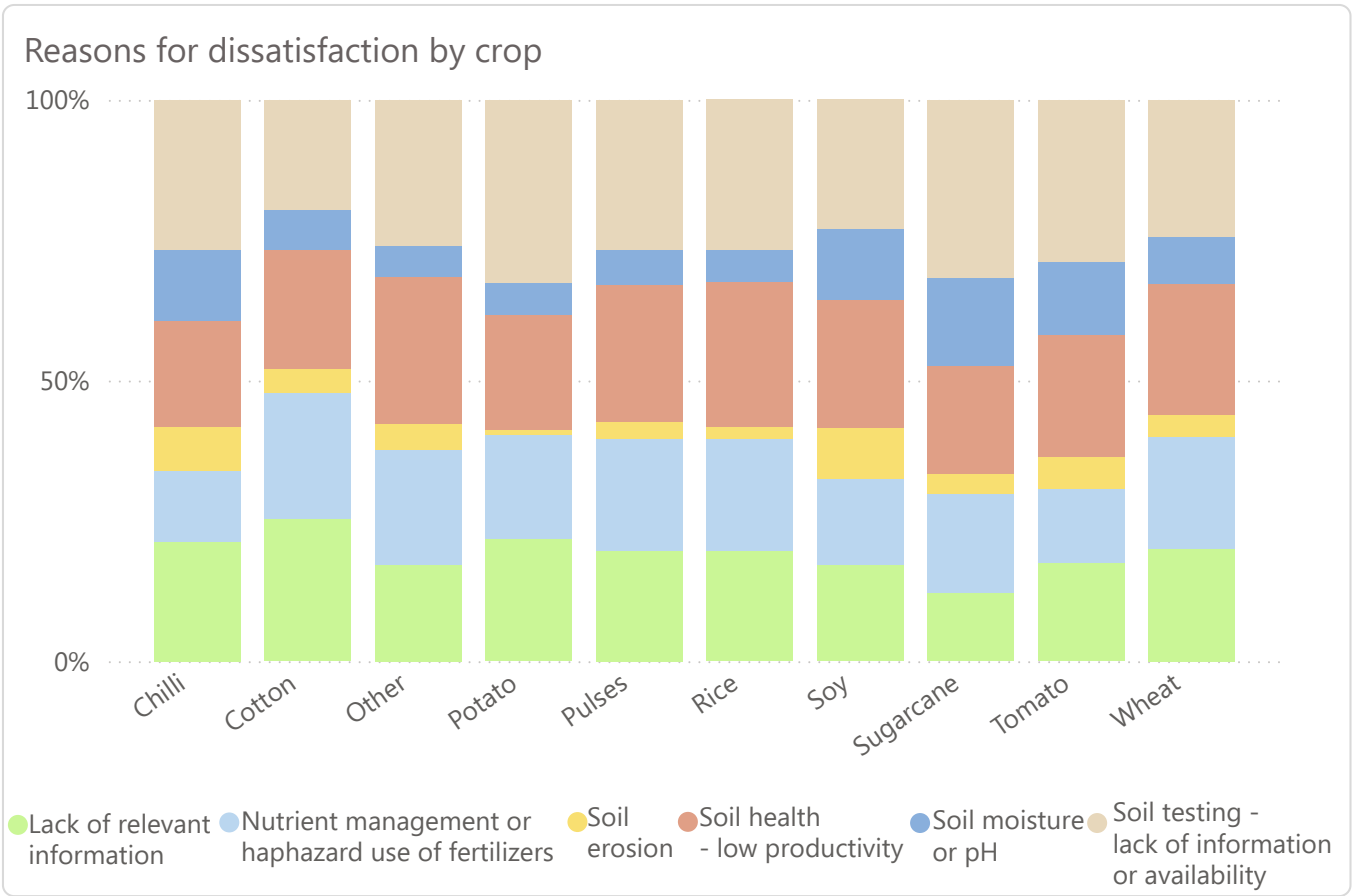


Soil testing stands out not only as the top overall cited reason for dissatisfaction in this category, but also as by far the top reason ranked the first in importance. Soil testing as well as the related issues of soil health and nutrient management are especially prominent in BR. There is a clear commercial opportunity for suitable technologies.

Lack of relevant information is also ranked quite high, though mostly ranked third in importance. Still, this indicates an opportunity, especially since information is easier to replicate and disseminate than physical products or services.

Reasons for Dissatisfaction by State and Crop



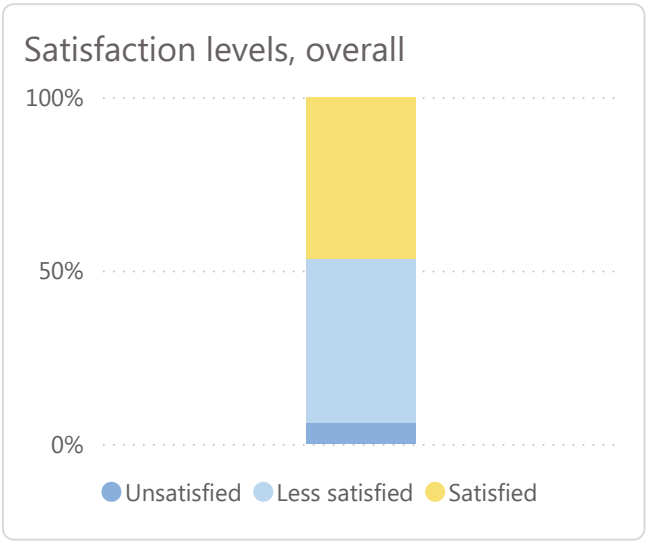


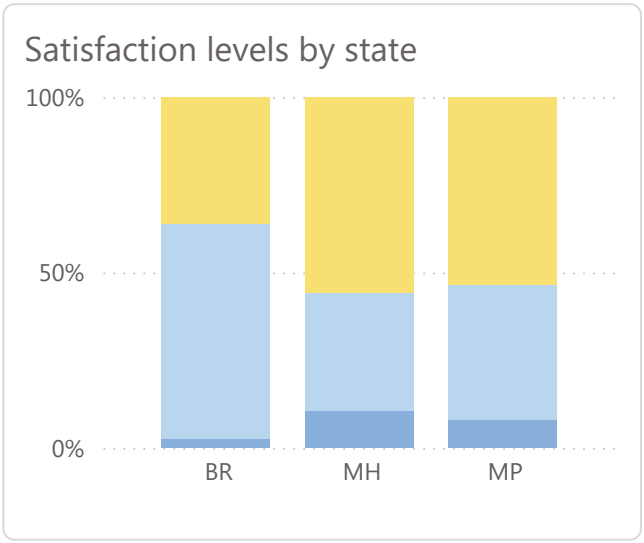
Postharvest Activity

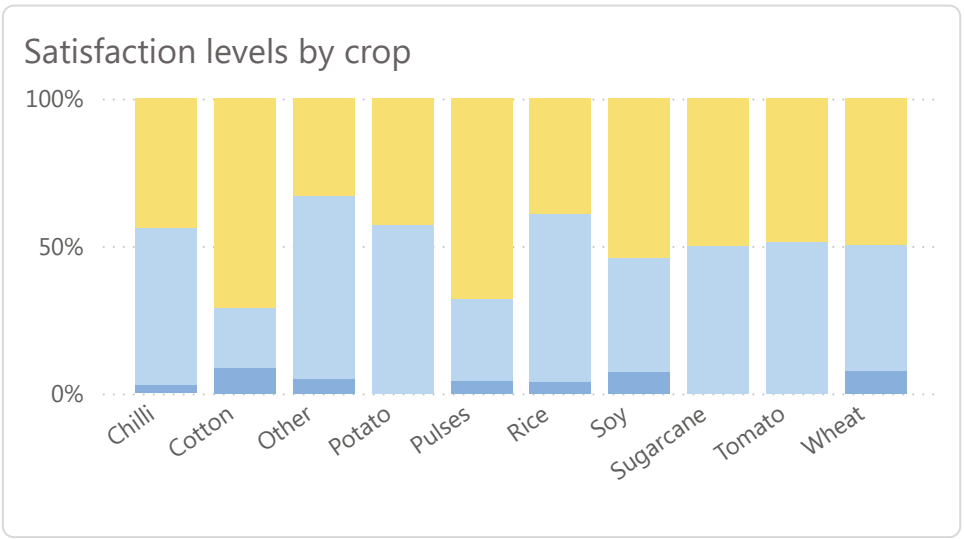
Postharvest activity concerns the processing and storage of farm produce. Postharvest is overall the category with the lowest satisfaction rates, though the AE survey puts postharvest (along with livestock) far behind the other categories in their challenge rating. Farmer satisfaction in the category breaks the typical patterns. Though MH remains the state with the highest satisfaction rates, it is nearly tied with MP, which usually has the lowest satisfaction rate by far. BR, usually between MH and MP, here is 20 percentage points lower than the other two. In crops, postharvest is the one category where sugarcane's typically high satisfaction drops to a moderate level. Pulses, on the other hand, attain higher satisfaction in postharvest than in any other category.

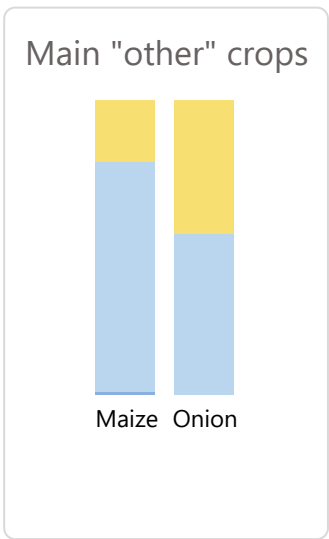
Lower satisfaction correlates with lack of access to storage (55% lacking access to storage for grains and 80% lacking access to storage for vegetables). Storage is critical for farmers' ability to cope with fluctuating prices and long distances from markets. Deficient access to storage contributes to post-harvest loss, which, at 5-10%, reaches $0.8 billion.[17]

In all this, it is crucial to remember that our data does not tie postharvest (or other categories) satisfaction to a specific crop, animal, or practice: farmers grow multiple crops and animals, but only express their per-category satisfaction once. Our data shows significant ties between, for example, growing sugarcane and expressing high levels of satisfaction, but it is not a strict one-to-one relationship.





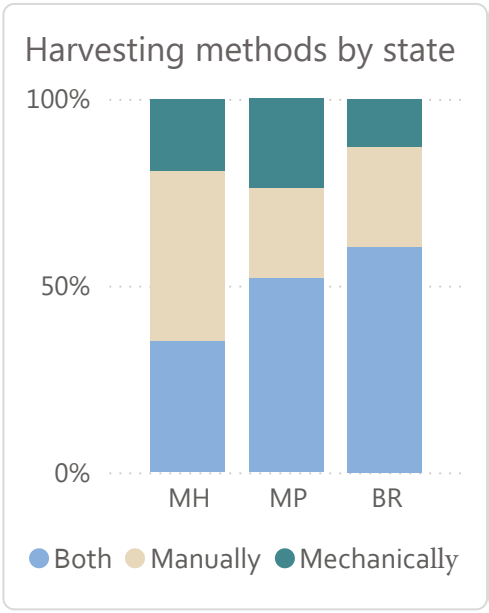


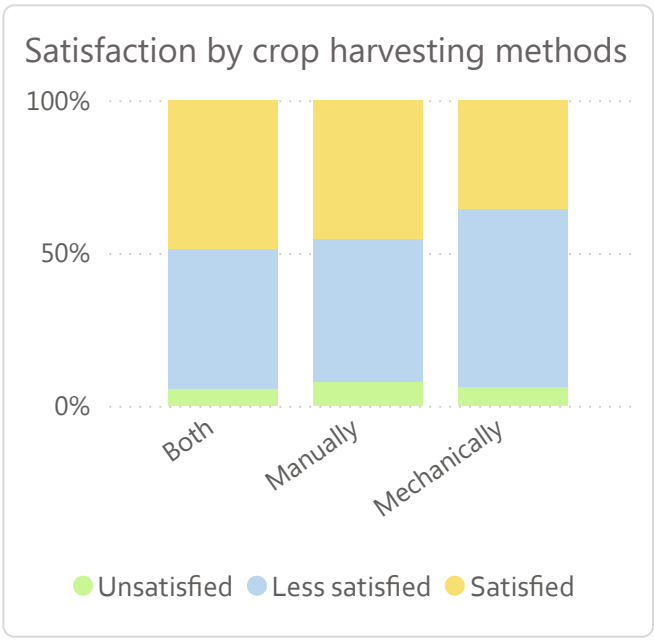


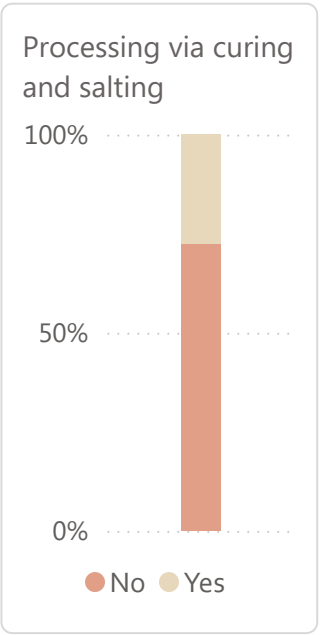
Solutions may include small-scale storage such as bags and drums as well as larger structures, depending on farm size, aggregation potential, and local value-chain characteristics. In addition to providing simple containment, storage solutions require technologies that can maintain produce quality and freshness across the value chain. The poor infrastructure in remote rural areas and long distances in India provide a significant opportunity for storage solutions that can do this in a cost-effective manner without requiring refrigeration. The increased demand for organic produce and the growth in the processing industry and export demand, supported by friendly government policies, further increase the commercial opportunities.

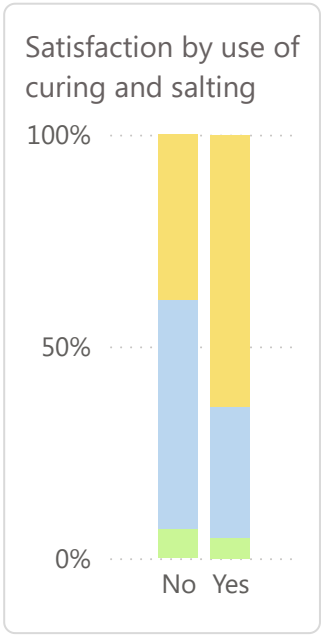
The EIP validation and commercialization process benefits from detailed data on storage solutions in use by locale and a mapping of relevant stakeholders.

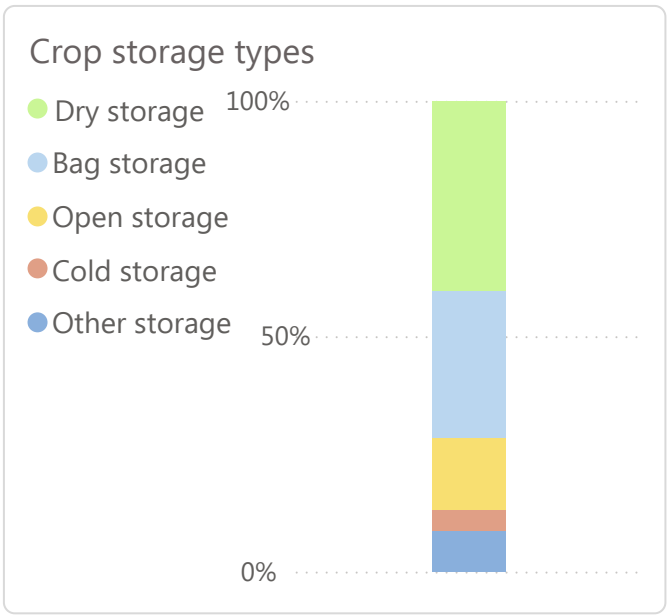
Naturally, farmers with access to storage report far higher satisfaction than those lacking access, by as much as 30 percentage points—and there is a great deal of farmers lacking access. The use of curing and salting is associated with nearly as large a gap. The effect of other factors on satisfaction, however, appears moderate or small—perhaps due to data noise from overlapping crops, animals, and practices.

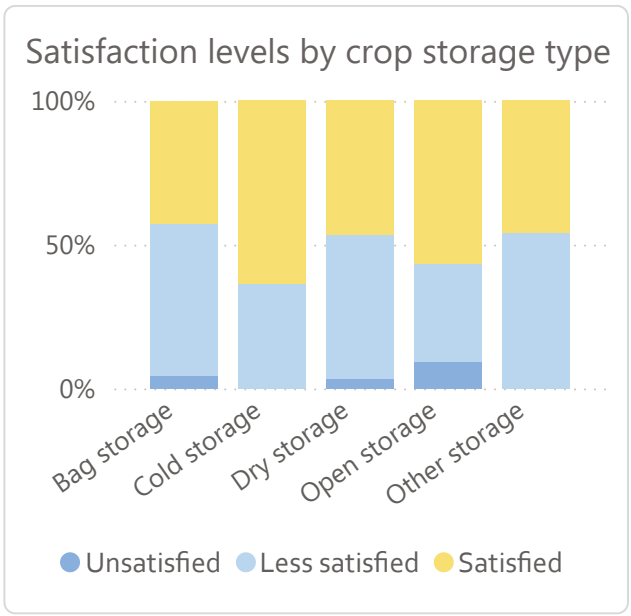


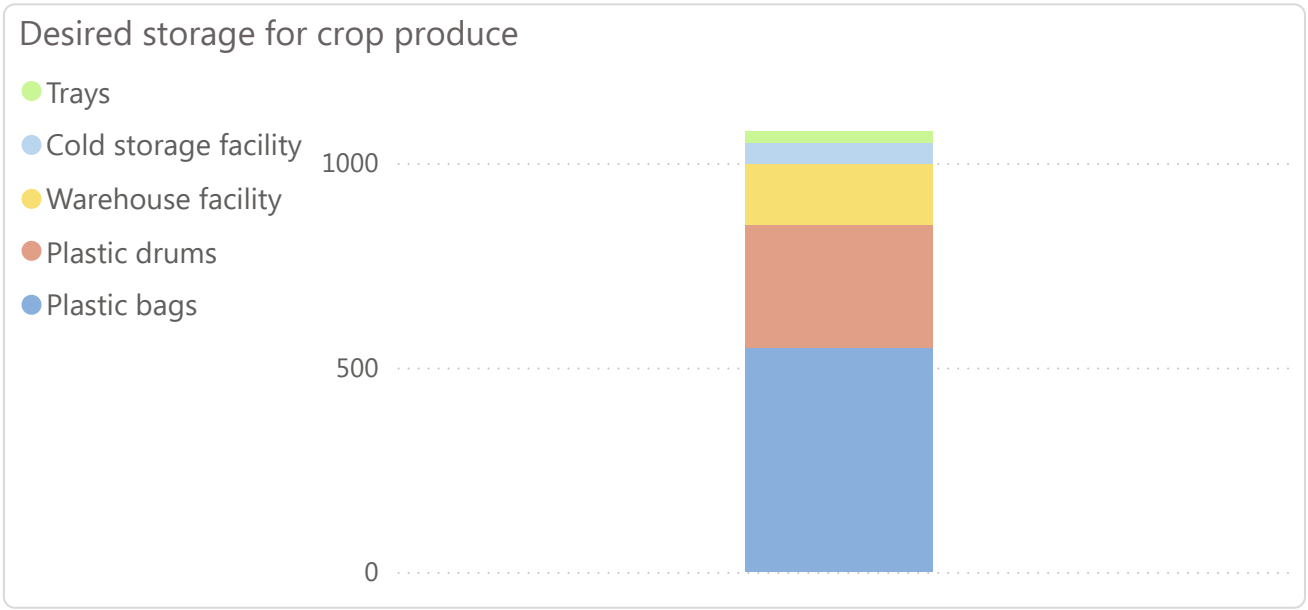




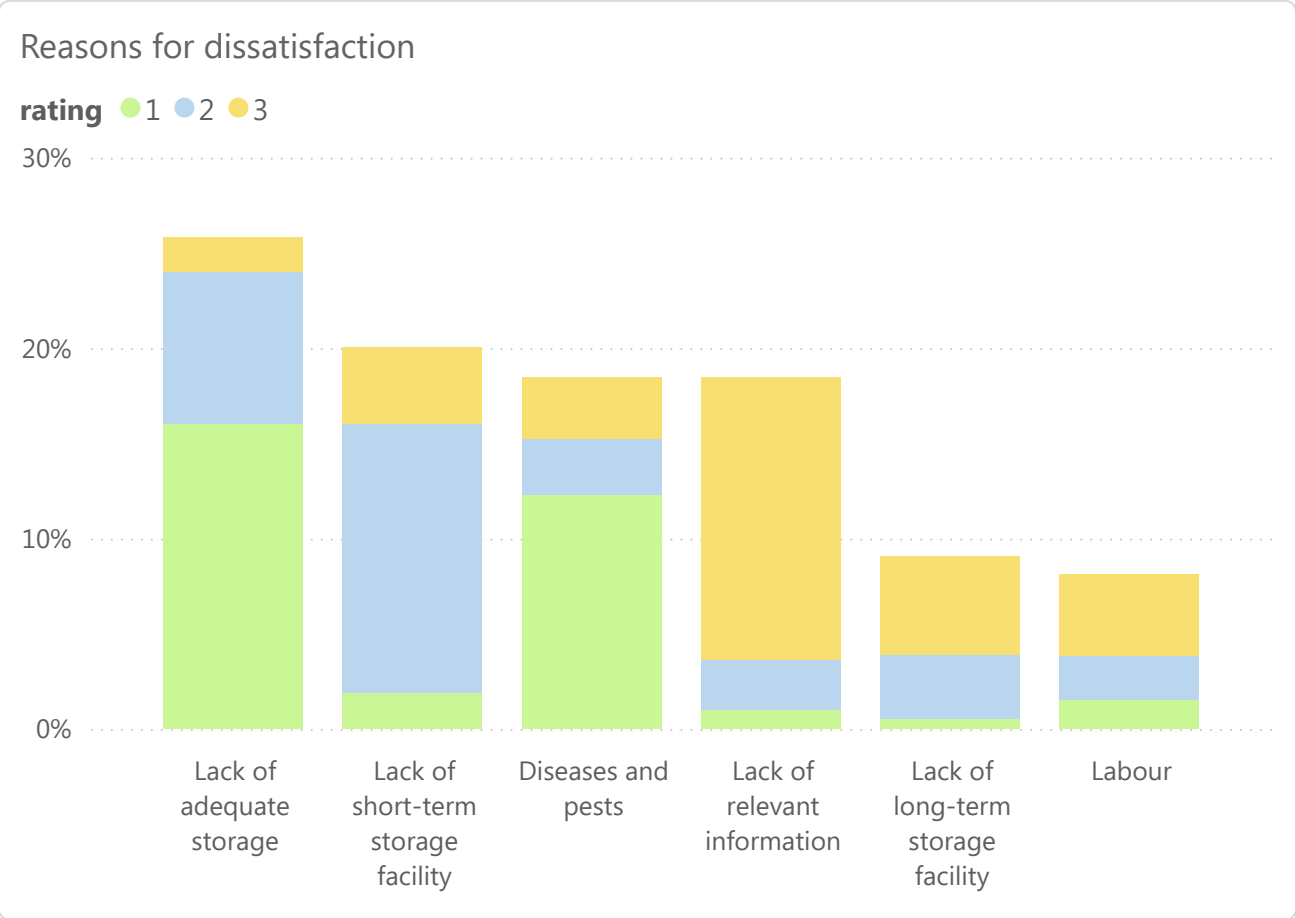



Crop storage types
Dry storage
Bag storage
Open storage
Cold storage
Other storage
100%
50%
0%


Satisfaction levels by crop storage type
100%
50%
0%
Bag storage
Cold storage
Dry storage
Open storage
Other storage
Unsatisfied
Less satisfied
Satisfied


Desired storage for crop produce
Trays
Cold storage facility
Warehouse facility
Plastic drums
Plastic bags
1000
500
0

Reasons for Dissatisfaction



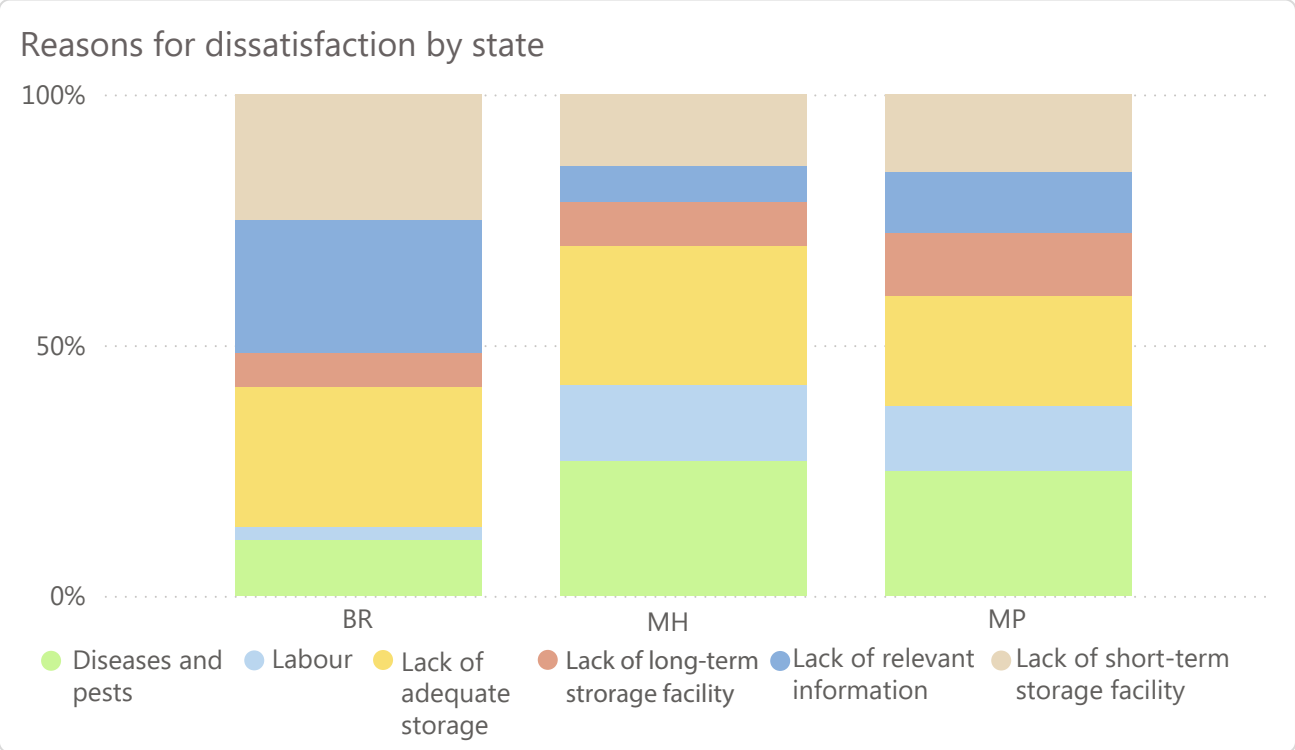
Lack of adequate storage and damage to stored produce from diseases and pests are clearly at the top of the farmers' concerns. Short-term storage seems to be a more relevant issue than long-term storage, but both highlight the importance of the essential challenge of storing harvested produce.

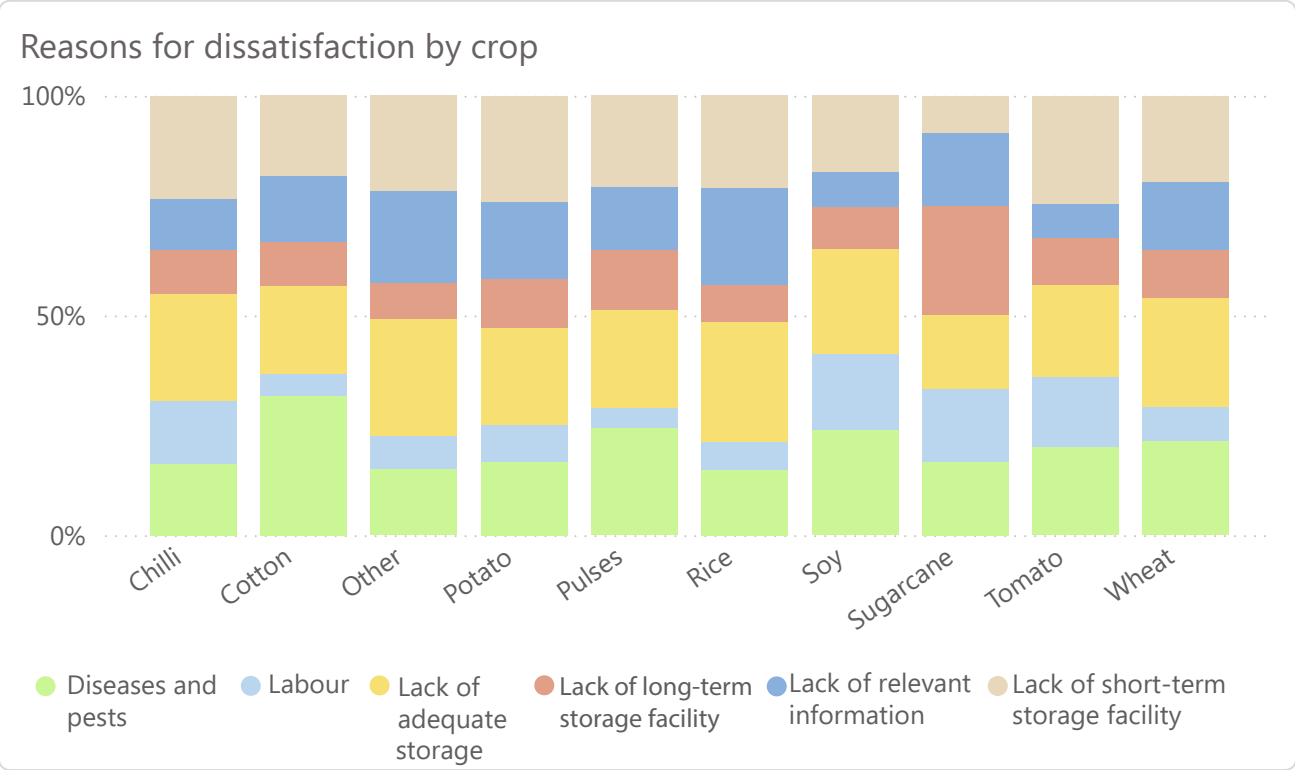
Lack of relevant information has a significant presence, but mostly ranked in the third level of priority.

Reasons for Dissatisfaction by State and Crop

Lack of adequate storage retains its primacy in BR and MH, but is slightly edged out by diseases and pests in MP. Pests seem to be a lower priority in BR, which is also far less concerned with labor; instead, relevant information and short-term storage expand in importance compared to the other two states.

Different crop types show substantial variability in reasons for dissatisfaction. While the overall priorities remain the same, specific crops may be more heavily influenced by some factors than the rest.

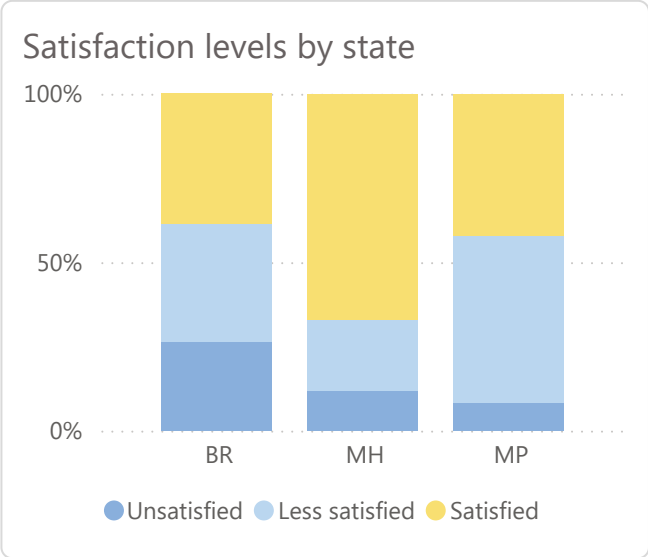


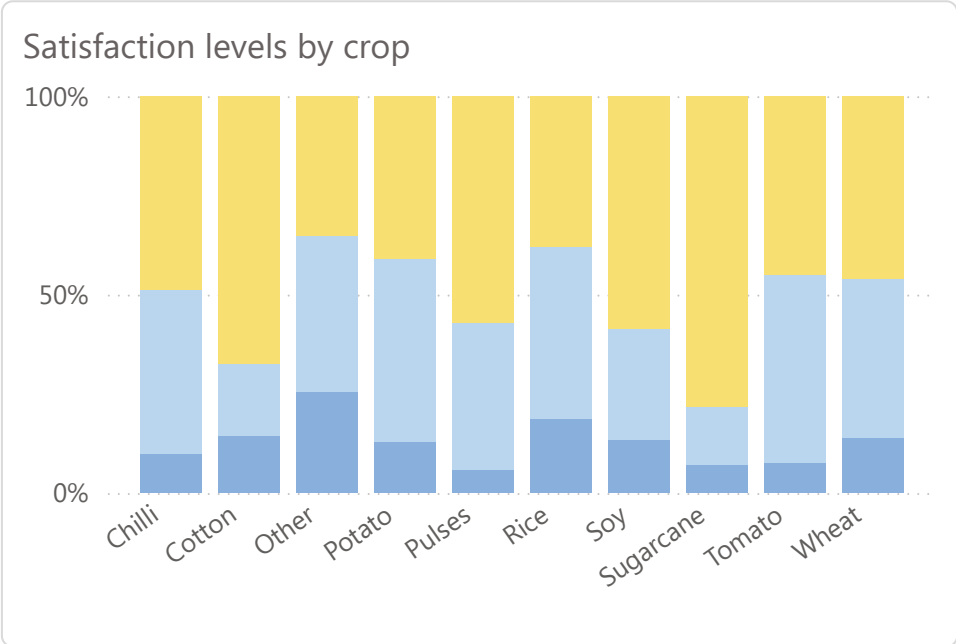


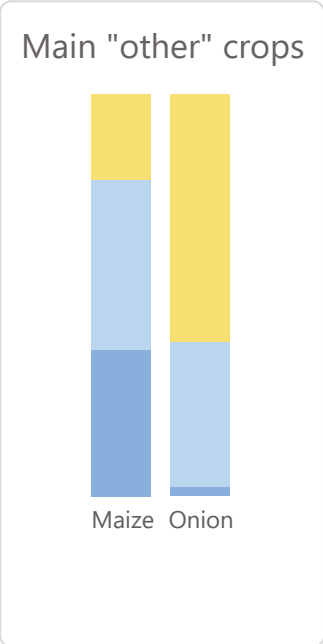
Market Access and Linkages

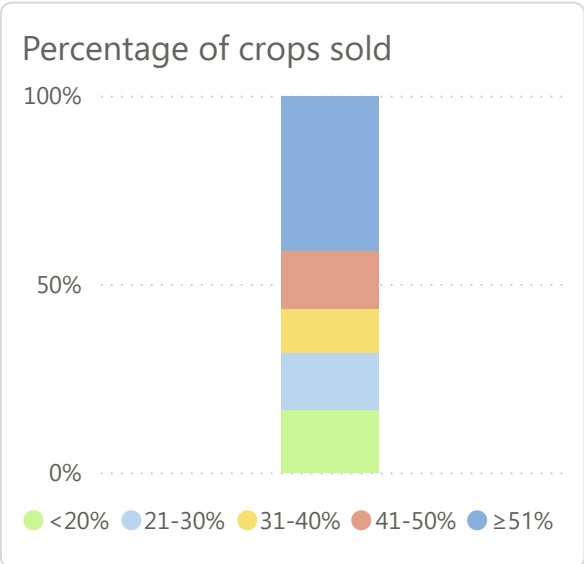
Though market linkages is second behind postharvest in average dissatisfaction, it has a significantly higher level of "unsatisfied" (rather than "neutral") responses of any category. It is also the top challenge category in the AE survey.

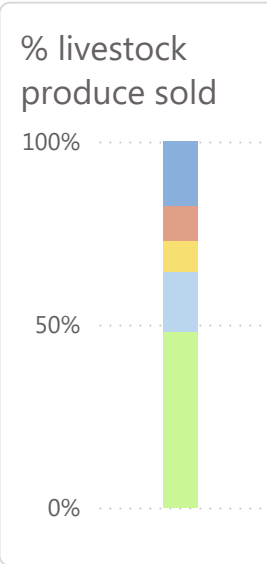
In states, MH retains the highest satisfaction as usual, but BR satisfaction is nearly as low as MP, and moreover reports a great deal more "unsatisfied" responses. Satisfaction by crops follows the typical pattern.

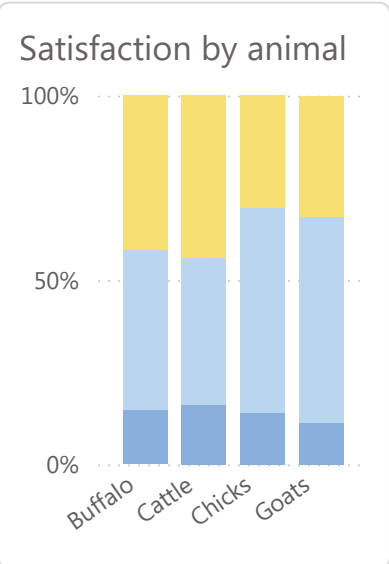


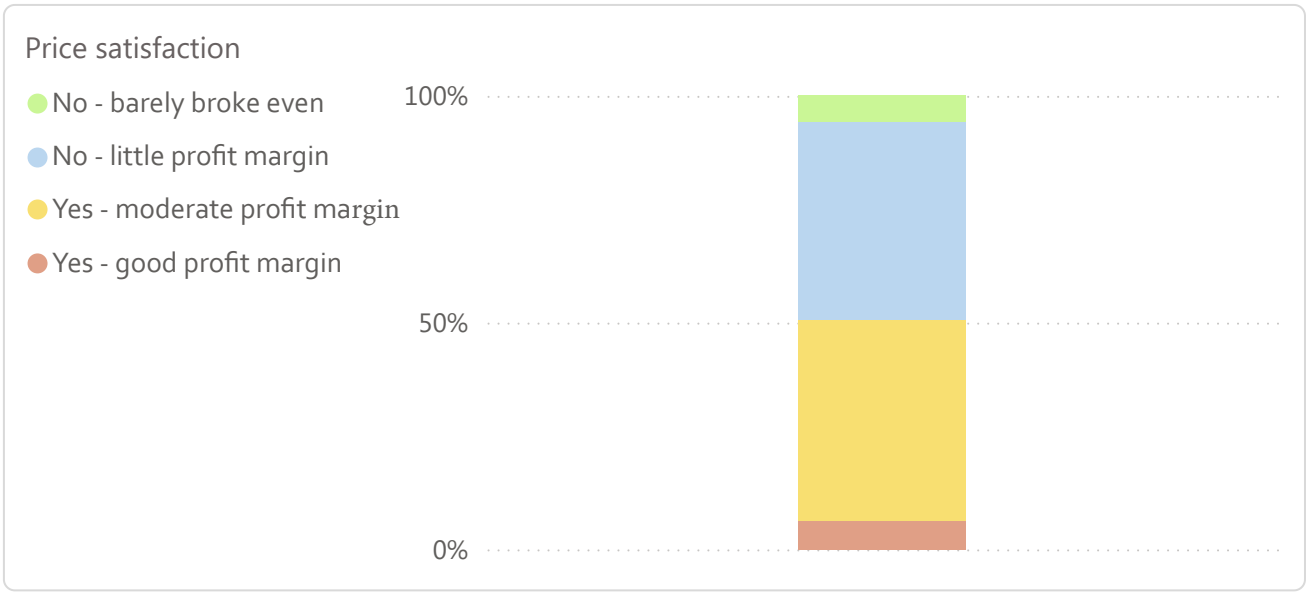


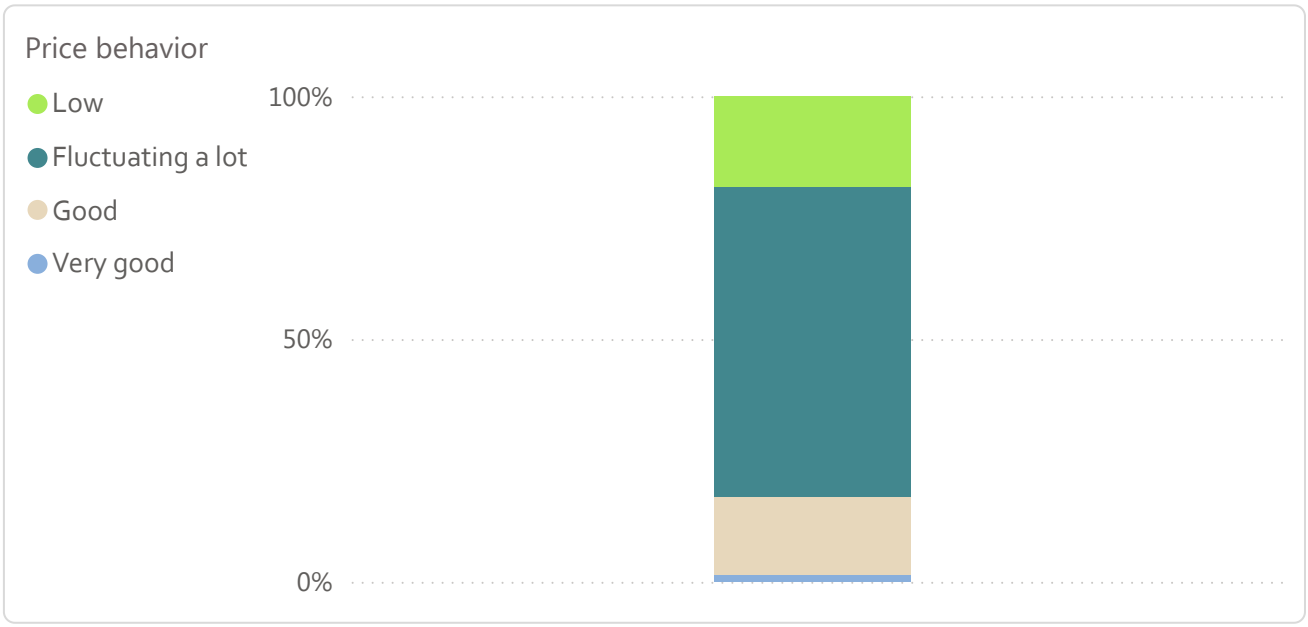












Indian smallholders suffer from poor market linkages, exemplified by low access, especially in BR:

Access to insurance

State	No	Yes
BR	91%	9%
MH	45%	55%
MP	75%	25%
Total	**67%**	**33%**

Access to credit

State	No	Yes
BR	90%	10%
MH	55%	45%
MP	60%	40%
Total	**72%**	**28%**

Access to subsidy

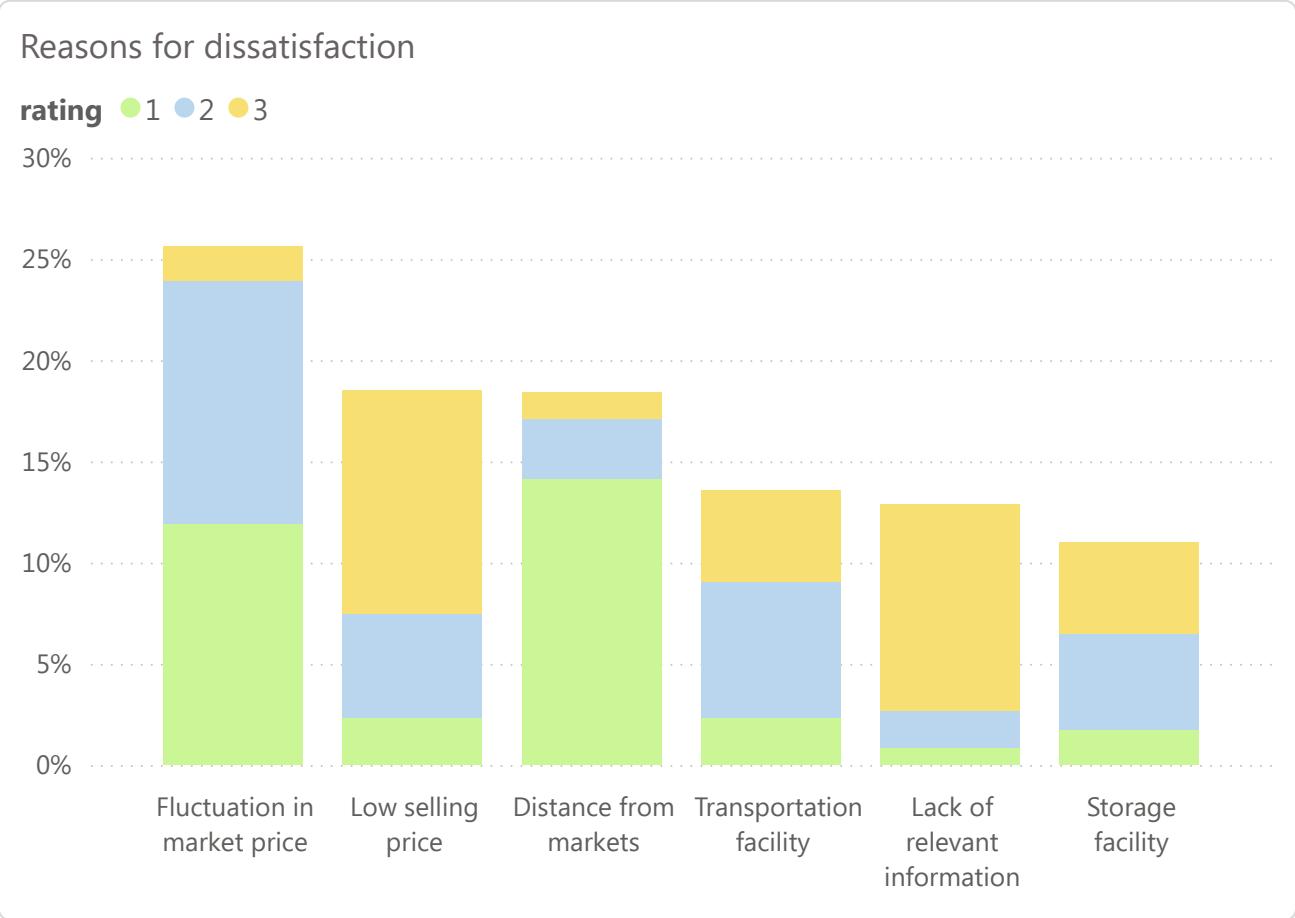
State	No	Yes
BR	93%	7%
MH	65%	35%
MP	67%	33%
Total	**78%**	**22%**

Farmers struggle to even find a market for the quantity of produce desired to sell (in the last 12 months):

0.57
market availability crops

0.43
market availability livestock

Reasons for Dissatisfaction

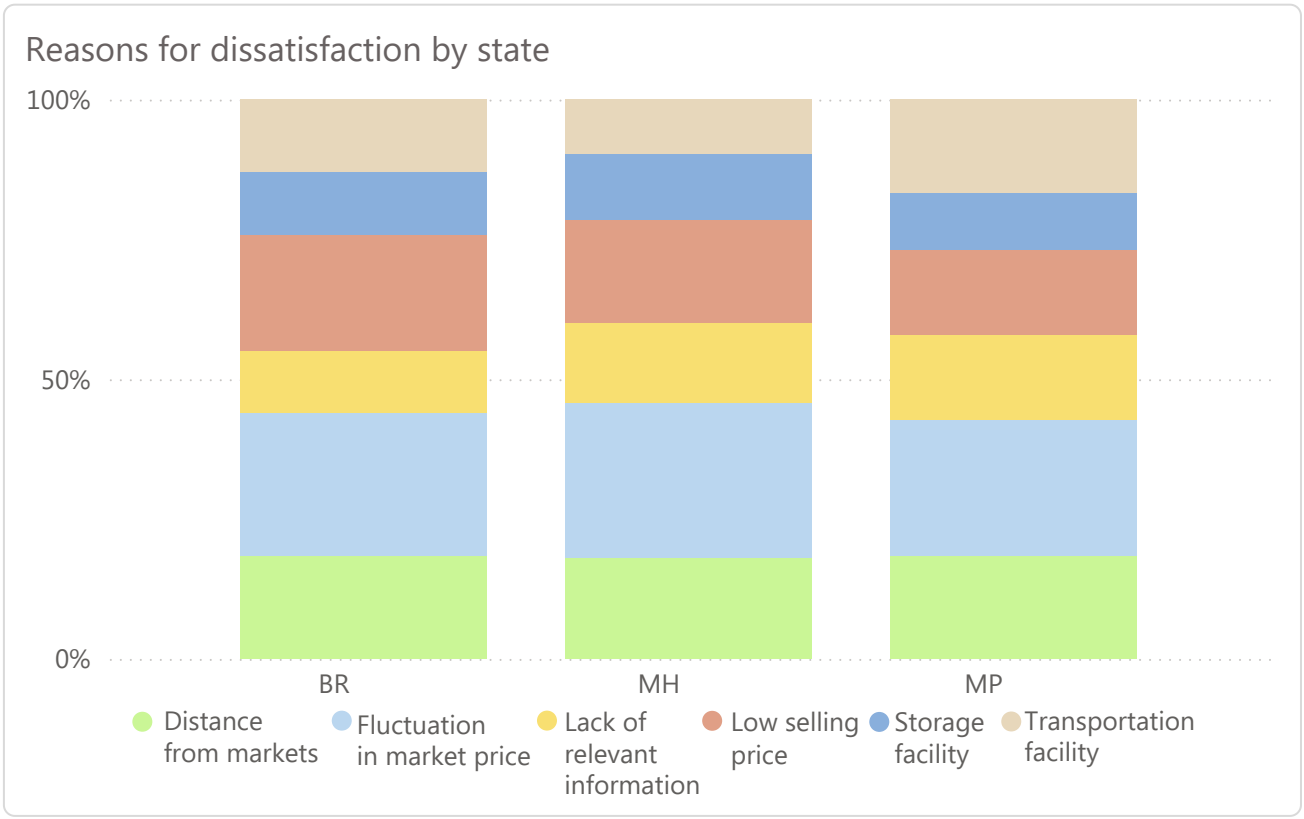


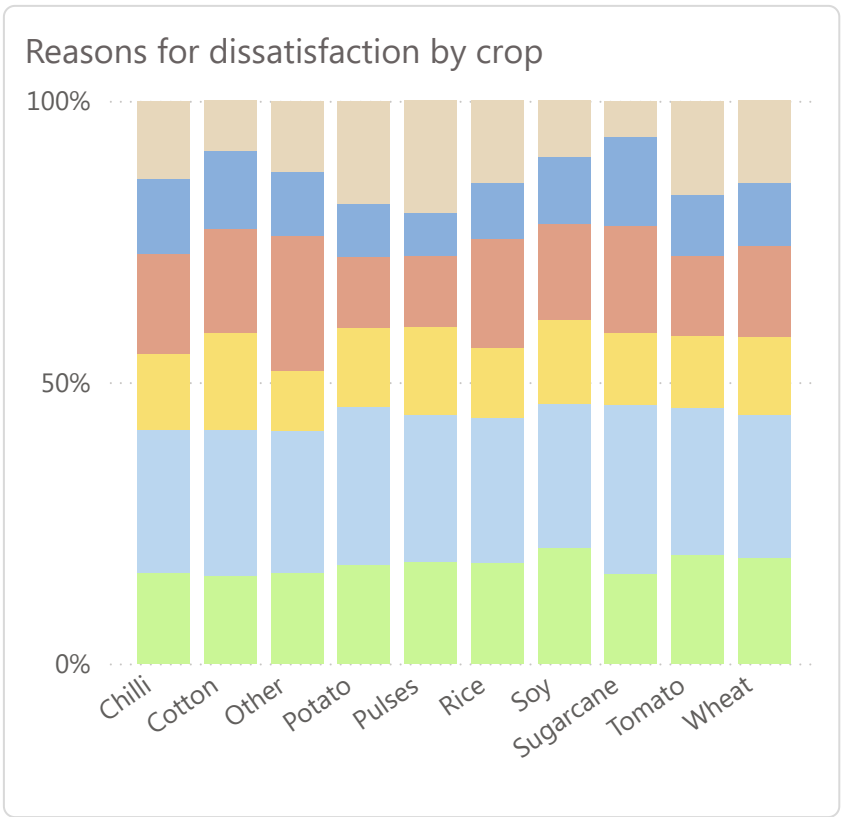
Selling price and distance from markets are clearly at the top of the farmers' concerns. Price fluctuation is the clear leader in total reasons for dissatisfaction, with low selling price being second (if only a fraction of percentage point ahead of distance from markets). The first ranked reason for dissatisfaction, however, is distance from markets, which, along with the price of transportation can force farmers to sell to dealers under the going market rate or MSP prices. Price fluctuation ranked second, while low selling price, like the other reasons, scores quite low. Lack of relevant information, as usual, mostly makes an appearance in the third priority.

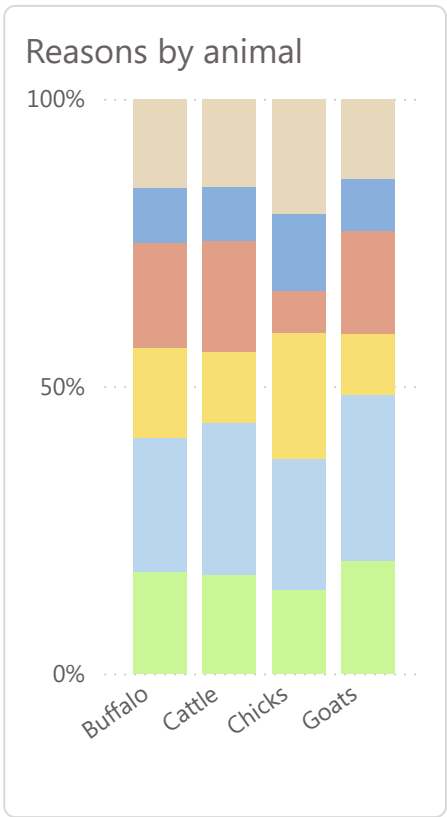
Additional notable challenges in this category include farmers' overall quality of produce or their inability to correctly grade them due to insufficient communication with potential buyers, and generally poor connections to off-takers and retailers. Helpful solutions in this category include transportation technologies, value-adding processing solutions, and aggregation platforms.

Reasons for Dissatisfaction by State, Crop, and Animal

Reasons for dissatisfaction in market linkages appear fairly constant across states. In crops, the main variations are in the priority of storage and transportation issues, with only occasional movements on other issues.





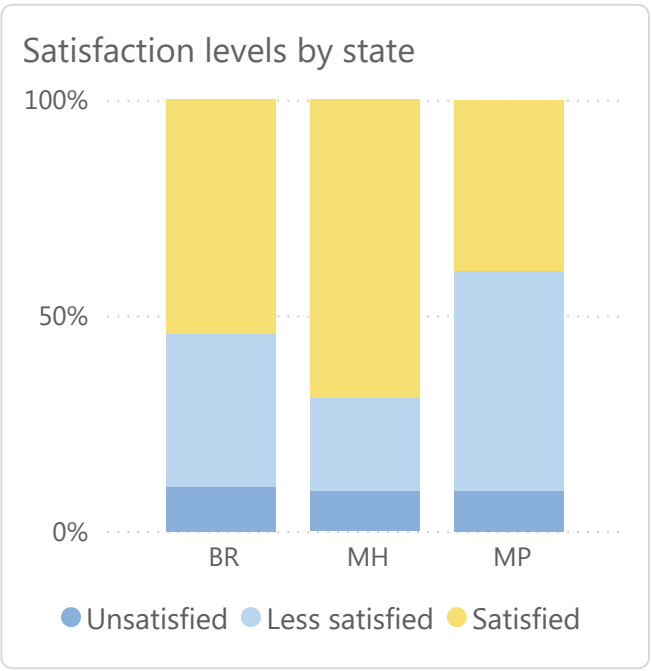


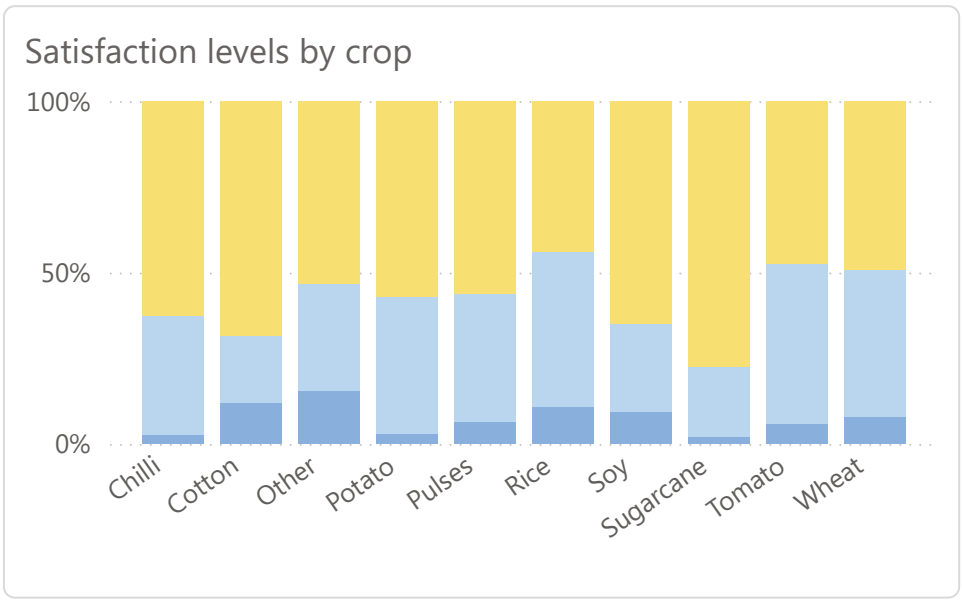
Crop Production and Management

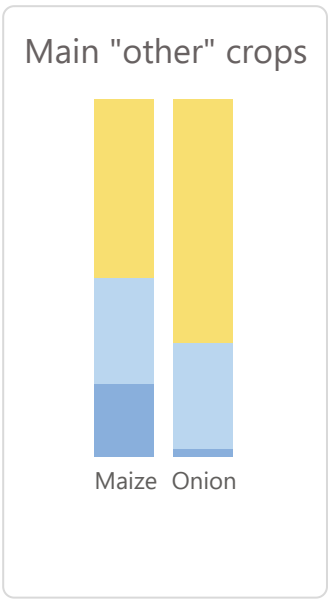
Crop production and management refers to the selection of crops and the activities directly involved in growing them, touching on seed varieties, fertilization, and factors affecting the final yield quality and quantity.

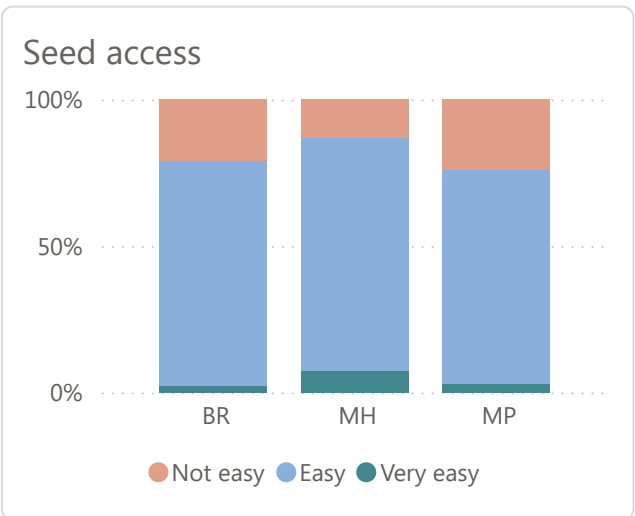
Farmer satisfaction with crop production and management practices generally varies by state and crop in along the usual patterns.

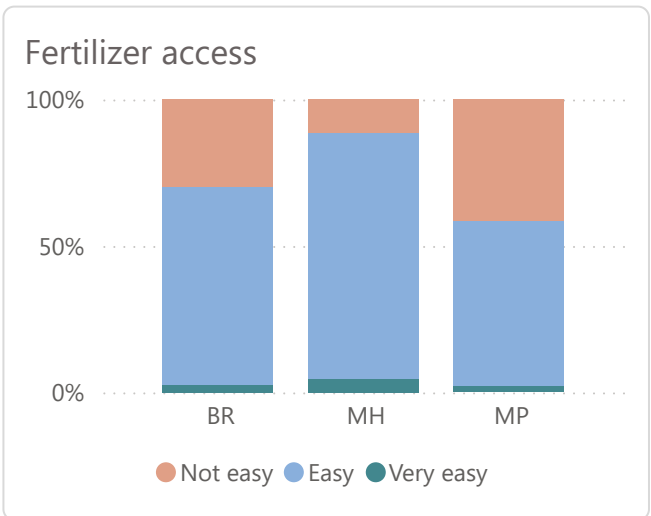
Access to seeds and fertilizers—the most crucial farm inputs—varies by state (and further differentiates by crop and other factors), but the share of farmers reporting difficulty in access represent a significant opportunity, especially with regard to fertilizer.



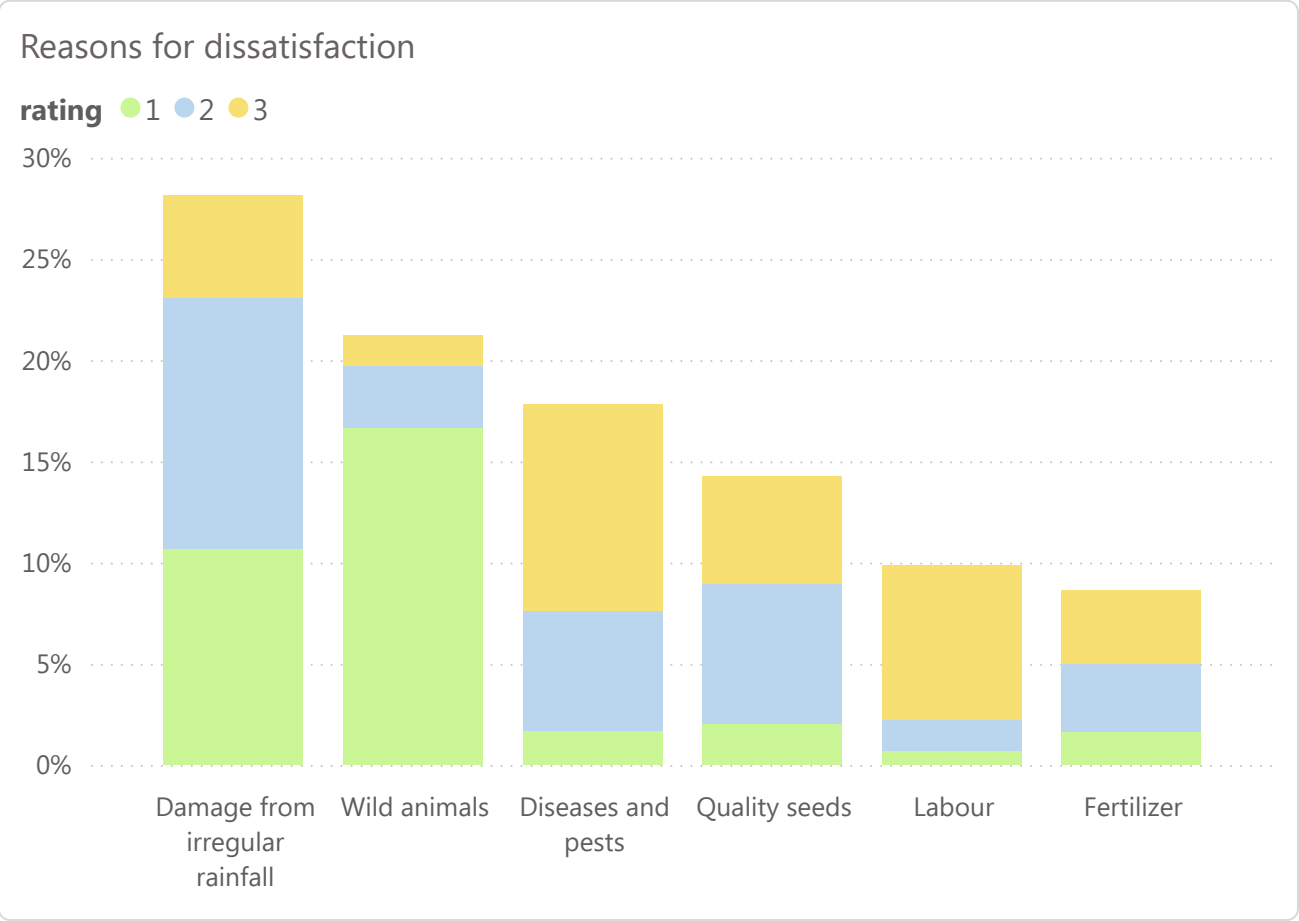








Reasons for Dissatisfaction



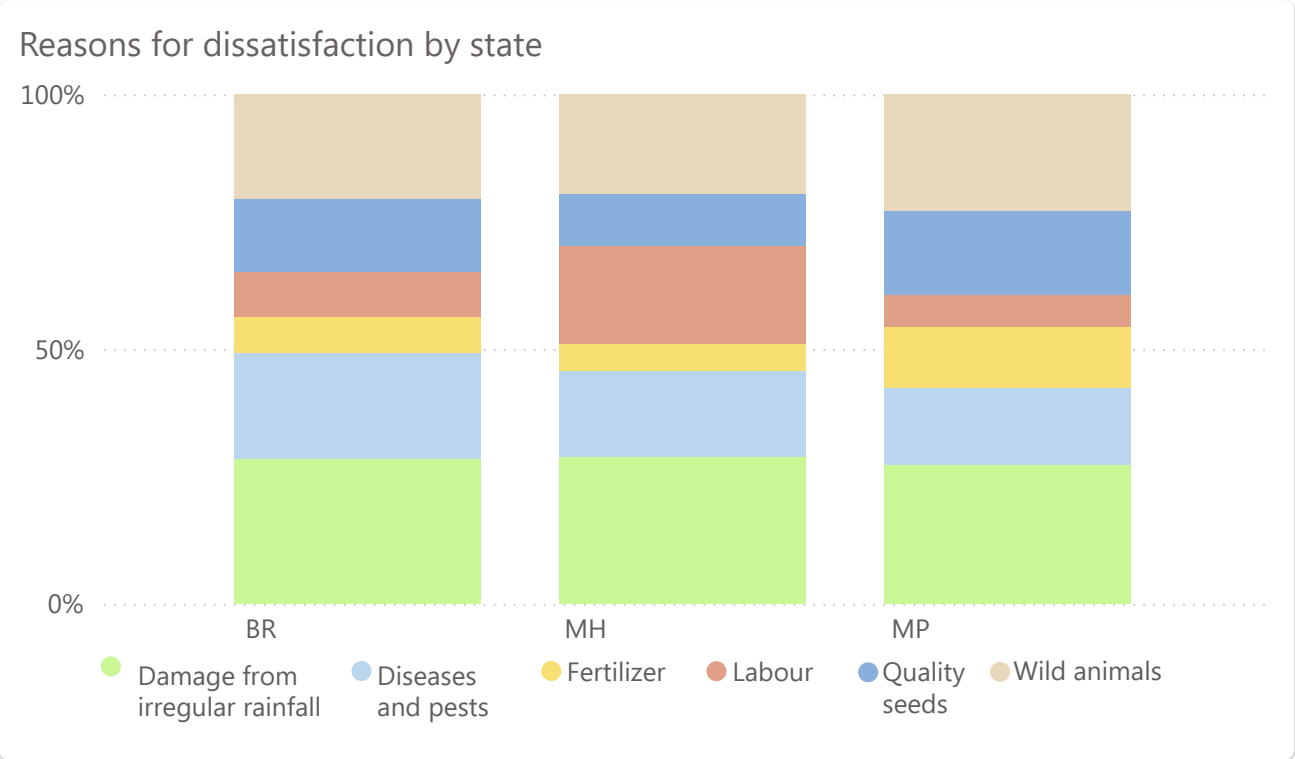
Damage from irregular rainfall (which we already discussed under general challenges) shows at the top, with wild animals following. Diseases and pests, which, like the top two challenges, relates to crop damage, is close to wild animals in the overall ranking of reasons for dissatisfaction. However, rainfall damage and wild animals clearly dominate the first reason for dissatisfaction in a breakdown by rank, suggesting that these problems are significantly more acute than diseases and pests.

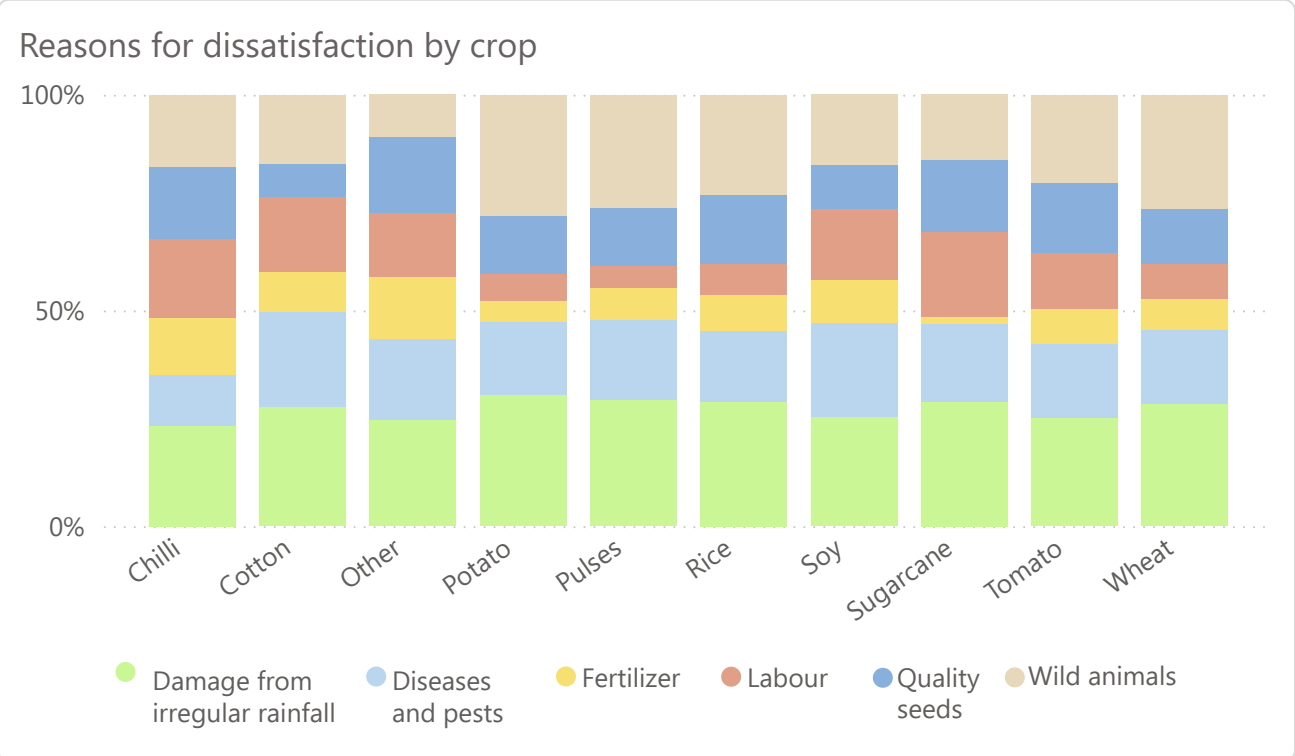
Wildlife such as elephants, wild boars, and deer intrude into agricultural fields in search of food, damaging crops both by eating and trampling underfoot. As much as 50-60% of crops are damaged in some cases, and income losses of 12-32% are common.[18] Moreover, animals may attack farmers, resulting in injury and psychological damage.[19] This is a particularly acute problem in states like MP and MH where forests and reservoirs border many farms. Solutions, of course, must not themselves damage crops or disrupt farming operations, and should also be environmentally friendly and avoid harming the animals. Existing technologies include highly effective visual and acoustic repellents as well as deterrents based on smell and taste.

Reasons for Dissatisfaction by State and Crop

The overall shape of the distribution is preserved across states and crops, with important variations. The dominance of the top two reasons is very clear in BR and MP, while in MH, labor takes a slight lead over diseases and pests. The labor challenge in MH is in part conditioned by a proliferation of urban centers that offer more attractive employment opportunities.

Solutions may include small, maneuverable and cost-effective tractors and robots that assist in labor-intensive tasks such as sowing, weeding, spraying, harvesting and picking while also enabling cost savings in inputs due to improved precision.





Given the financial constraints of small-scale farming, high-value machinery is more commonly rented than sold in India, requiring robust distribution and service networks (see, for example, the operations set up by Mahindra).

Access to inputs (seeds and fertilizers) in MP is also confirmed in direct questions about access to inputs, where 45% of farmers said they could not easily access fertilizer for most crops. This challenge relates to both financial constraints and inefficient distribution systems, and may be met through improved linkages to input suppliers, micro-credit financing, and solutions that improve the efficiency of fertilizer use, including soil testing and advisory services.

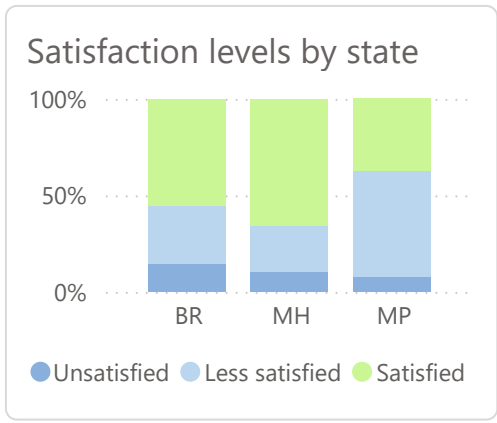
Similarly, in crops, the overall shape of the distribution is consistent with the other challenges, but significant specific differences show up. Soy, "other" (mainly maize), cotton, and chili have a more even distribution of challenges. Sugarcane, on the other hand, stands out in the near absence of fertilizer as a reason for dissatisfaction.

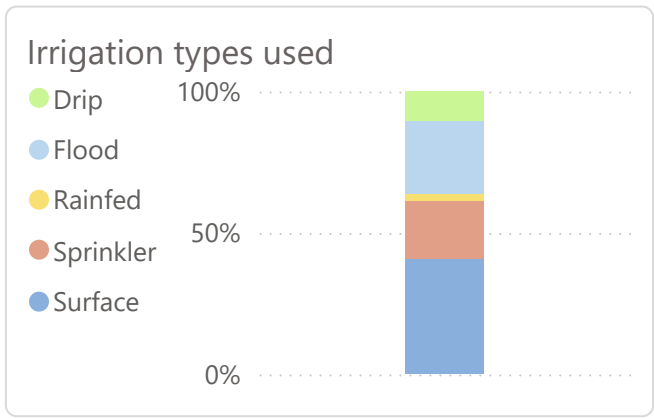
Irrigation and Water Management

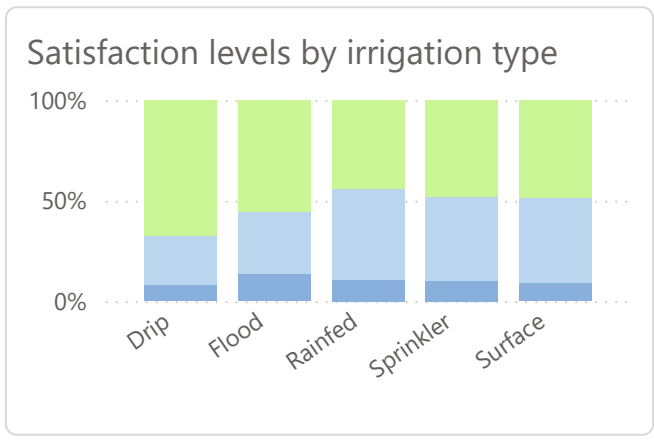
The distribution of farmer satisfaction with irrigation and water management practices follows the usual patterns when broken down by state and crop.

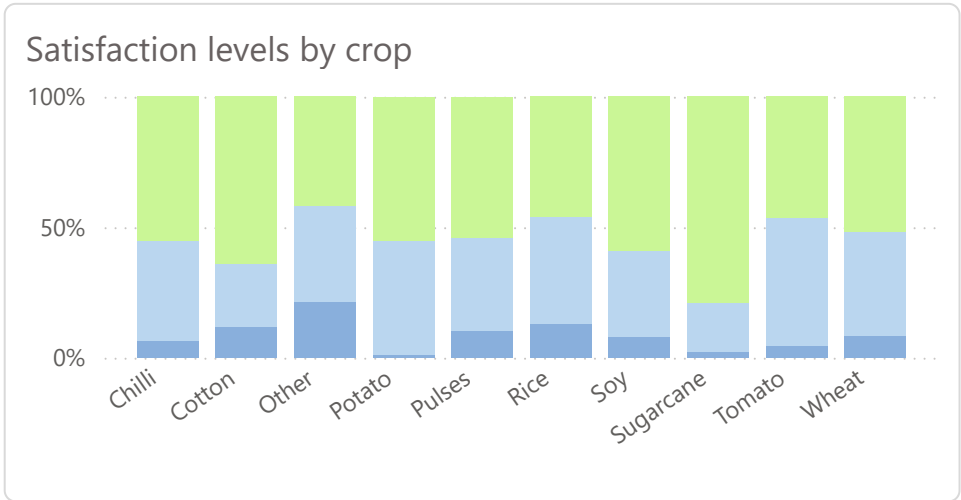
A breakdown of satisfaction by irrigation types shows a correlation between drip irrigation and significantly higher satisfaction, suggesting a potential for expanding its use beyond the current 10%. First, however, one would need to study the barriers to its adoption, including high initial investment costs and the potential for clogging due to high water salinity. The same is true with regard to power sources and solar. In BR, for example, 55% farmers rely on diesel to drive their water pumps, and as many as 22% are not connected to the electric grid. Recent increases in fuel prices drove the cost of diesel-based irrigation, even after subsidies, to 4 times that of electric pumping.[20] This opens obvious opportunities for solutions like solar irrigation systems, which also benefit from subsidies.

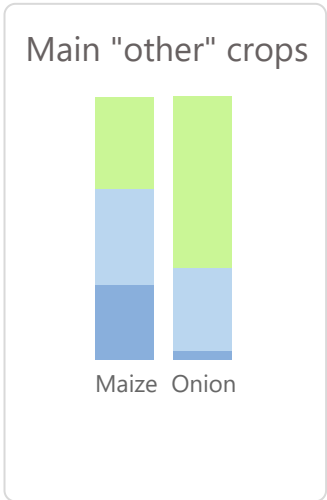
A breakdown by water sources seems less helpful: borewell, dug well, and groundwater, used by most farmers, all have moderate satisfaction rates; only canals stand out in high satisfaction, but are rarely used.

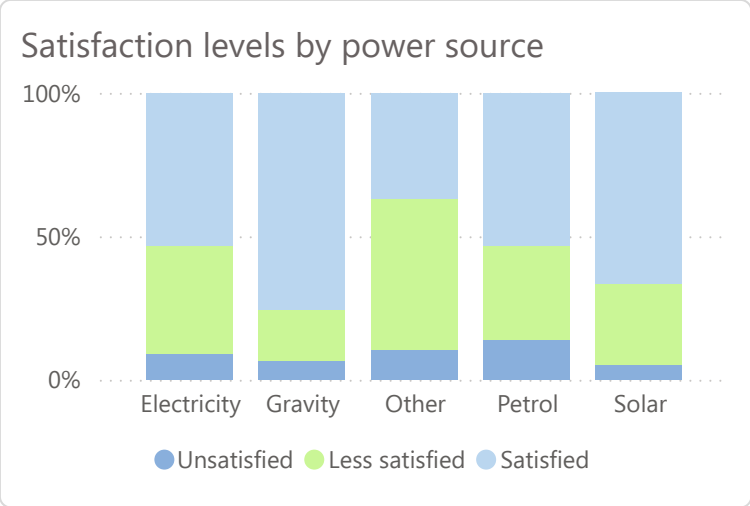


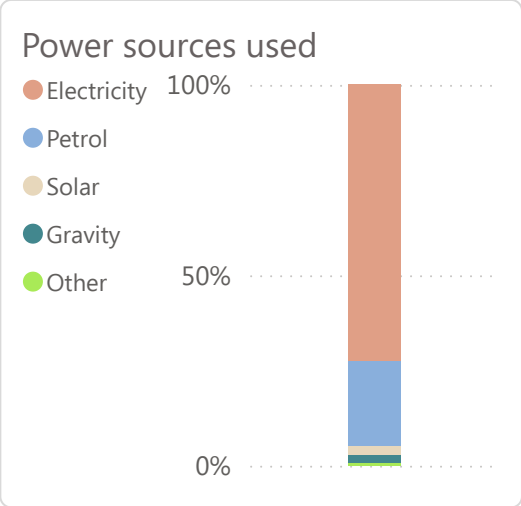




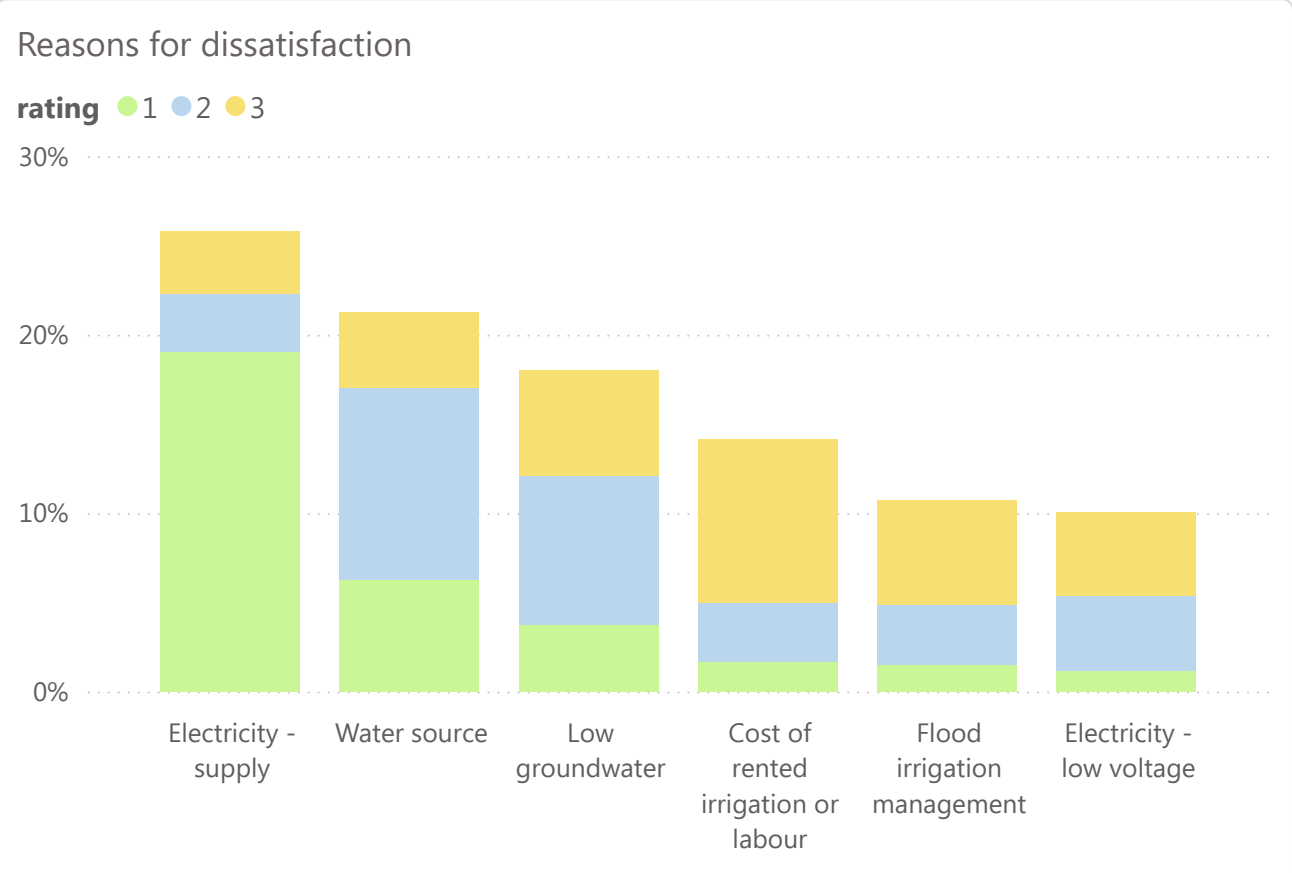








Reasons for Dissatisfaction



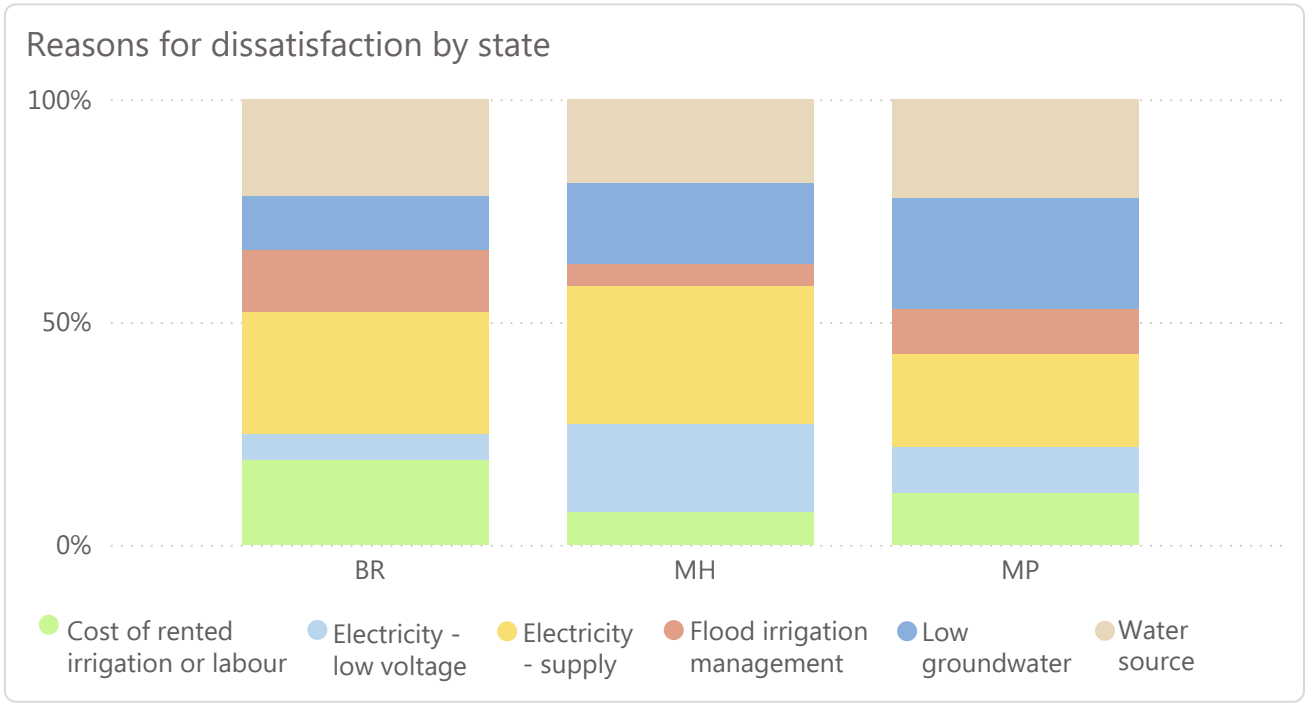
Electricity, the major power source used for irrigation, stands both as the top overall cited reason for dissatisfaction and as by far the top reason ranked the first in importance. Problems with low voltage are far less prominent than overall supply, but they still underline the general problem (and the associated opportunities).

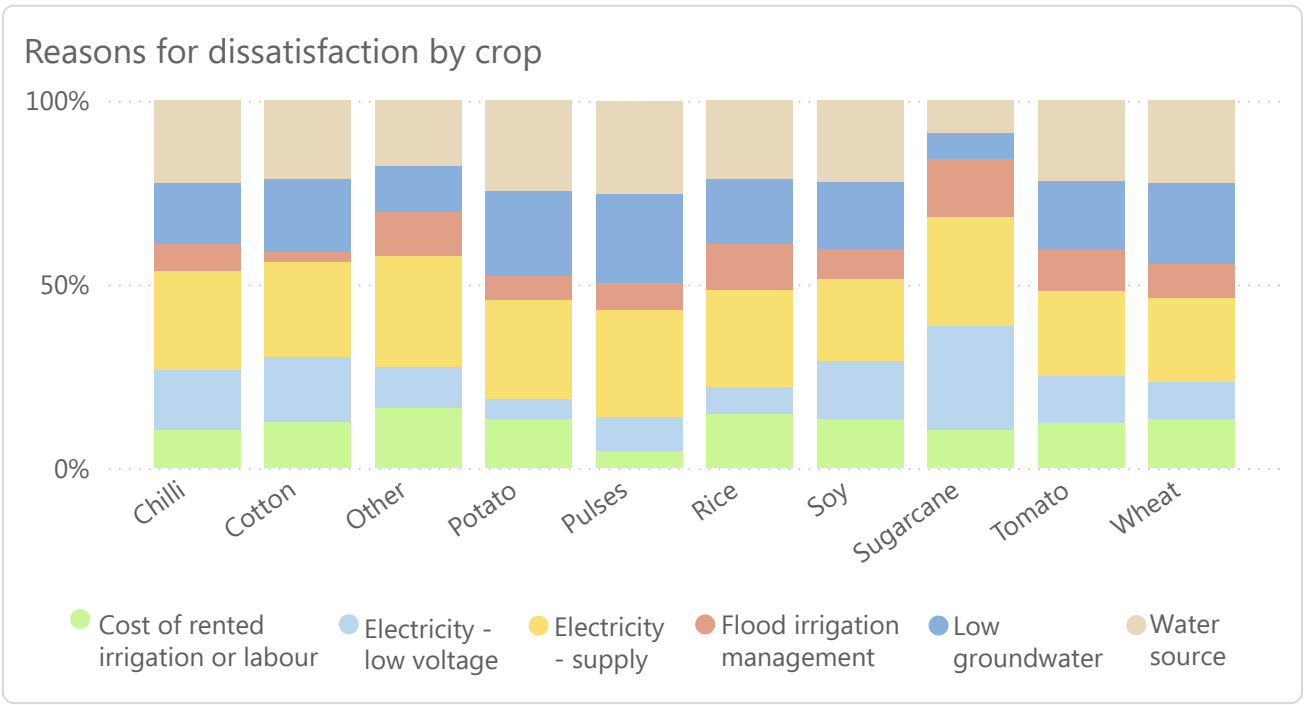
Water supply problems—water source, low groundwater, and at least in part the cost of irrigation—are quite expected in this category. The low water prices in India (in some cases, water is provided to farmers free of charge) only incentivize technological investment in the context of water deficiency or for intensive or high-value farming. Potential relevant solutions may be water capture and storage systems or small and cost-effective water treatment systems.

Reasons for Dissatisfaction by State and Crop

The breakdowns below especially show significant variation in the relative prominence of electricity versus water supply problems: electricity stands out in MH while water is especially critical in MP. MP suffers from groundwater over-exploitation in 48 out of its 313 blocks, and some of its available water is of degraded quality or highly saline.[21] BR, while still concerned with both electricity and water, shows higher sensitivity to cost of rented irrigation or labor and to flood irrigation.

In crops, sugarcane stands out in especially low concern with water source, while pulses see especially little concern with cost of rented irrigation or labor. While flood irrigation is most commonly associated with rice, it shows throughout the graph—though that may be in part explained by an overlap between rice and other crops on the same farms.

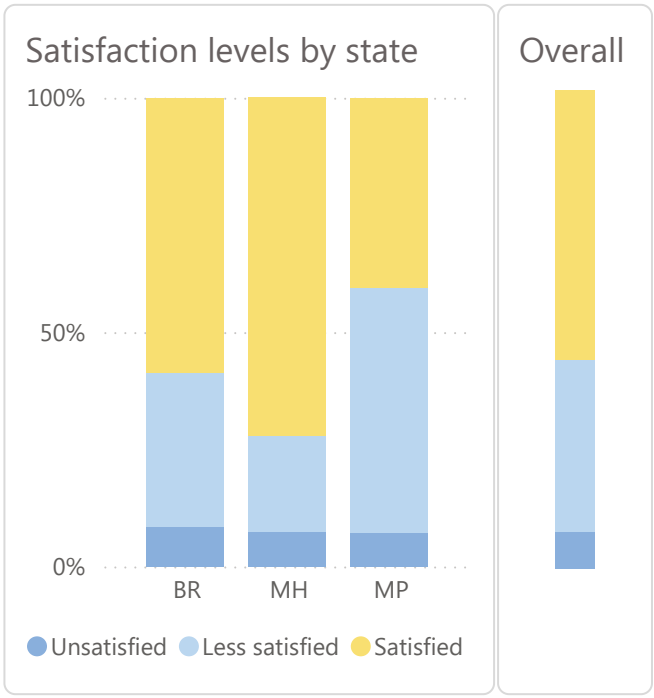


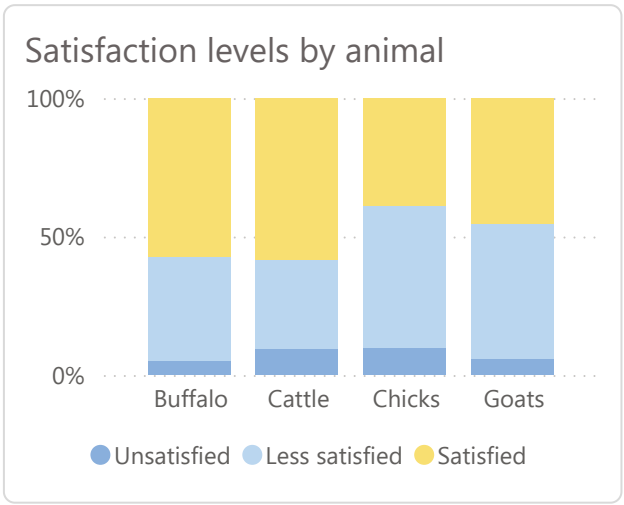


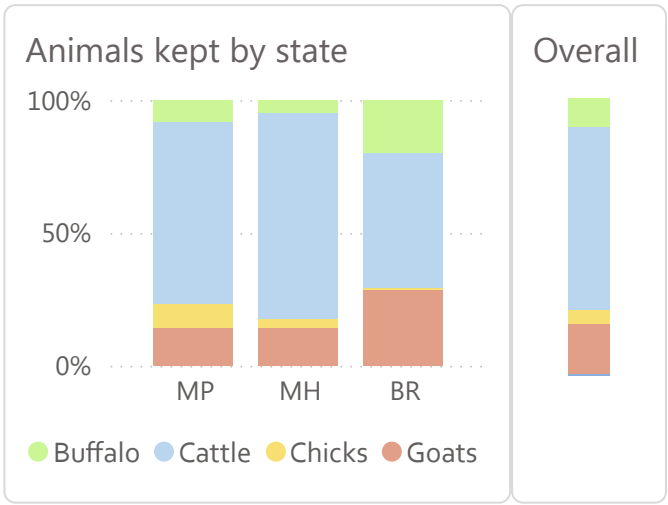
Livestock

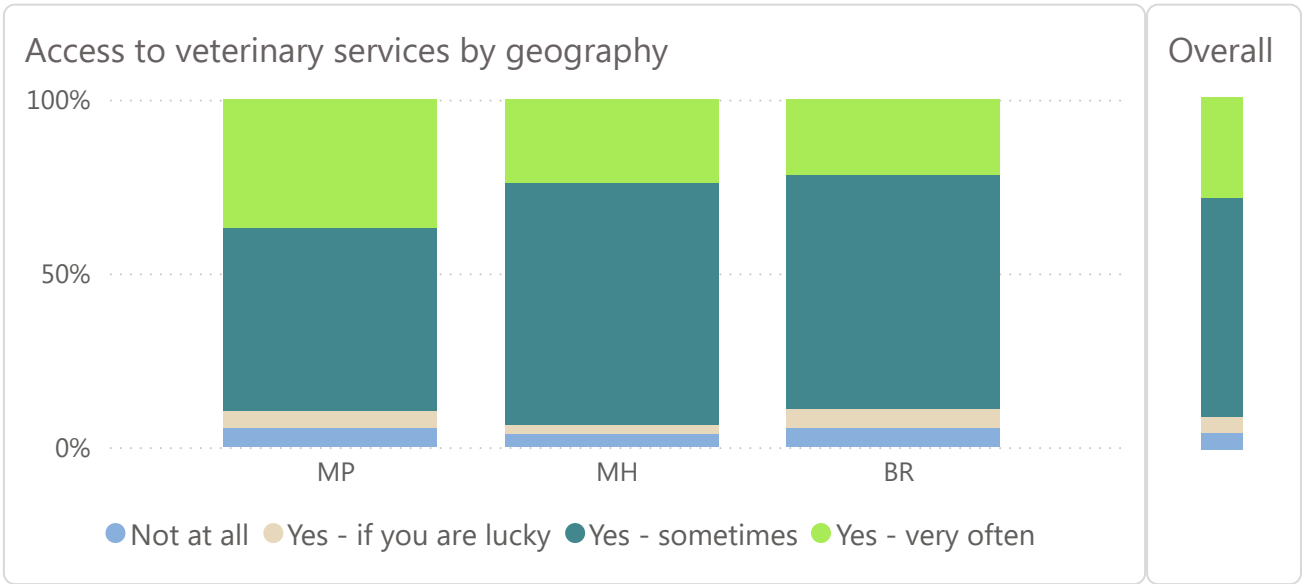
A little over half the farmers surveyed keep livestock in addition to growing crops, most commonly just one or two heads of cattle. Farmer satisfaction with livestock follows the usual pattern of satisfaction by state. Cattle, by far the most common animal, is associated with the highest satisfaction (though also with a relatively high rate of "unsatisfied" responses). Poultry shows the lowest satisfaction; poultry keeping is also highly concentrated in just a few districts and, as seen on the next page, shows distinct patterns from other animals.

Ready access to veterinary services is reported by less than a third of the farmers—clearly a critical gap, especially in BR and MP.





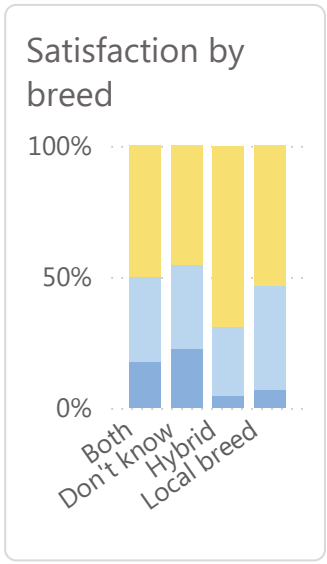


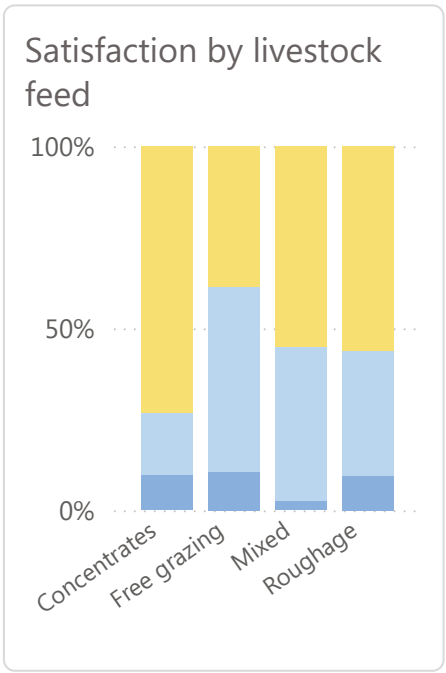


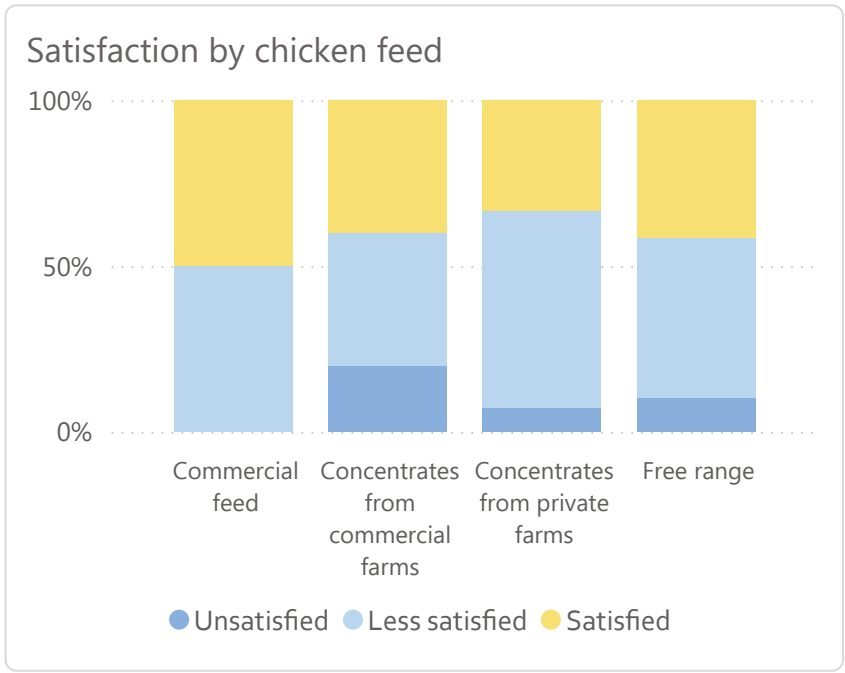
Local breeds are prevalent across the board at 80% or more, while hybrid—just 12% of the animals—are associated with the highest satisfaction levels.

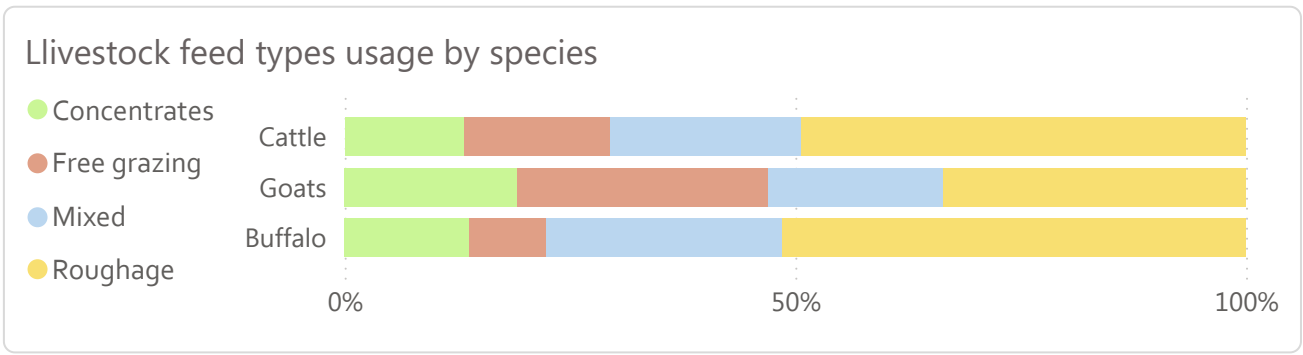
Feed types get somewhat complicated due to the fact that poultry consumes different types of feed from cattle, buffalo, and goats. Concentrates for cattle and the like show high satisfaction, followed by mixed feed and roughages. For poultry, commercial feed shows the highest satisfaction, while concentrates and free range feeding (the most common option) are lowest.

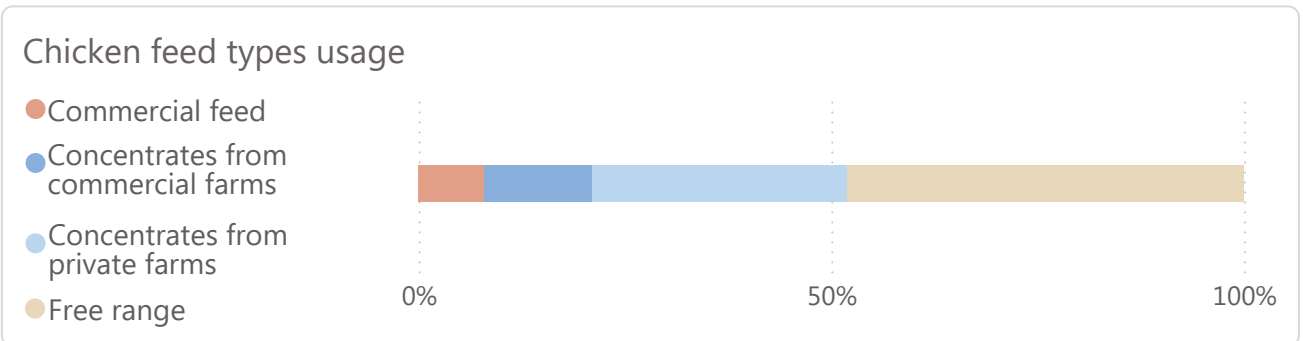
Storage for livestock produce is most often dry storage or bags, accounting for over 50% responses when combined. Cold storage, correlated with the highest satisfaction rates, is only present on 15% of the farms, presenting an opportunity—while we had low response rates on desired livestock storage (n=20), 95% requested cold storage.

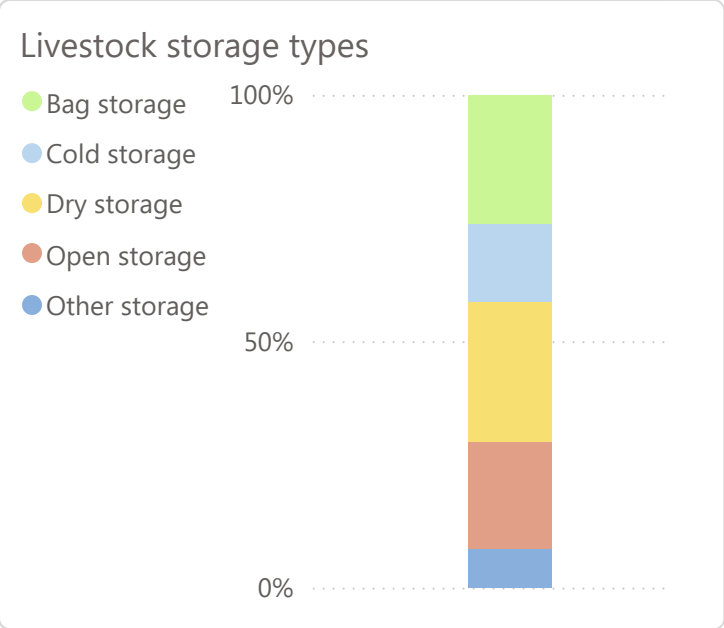


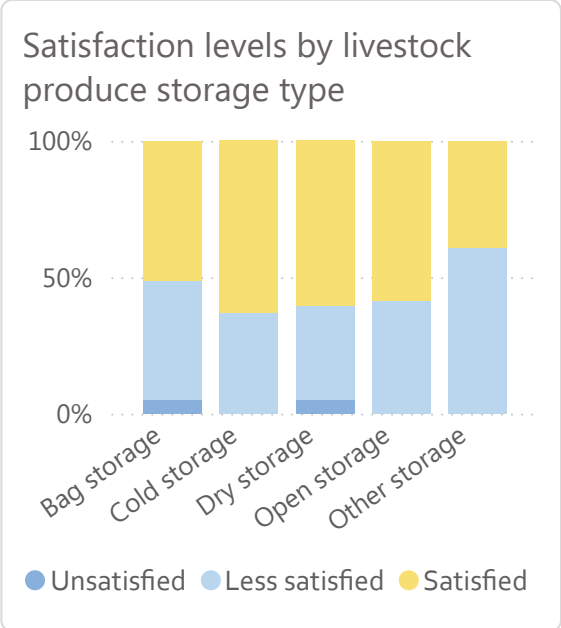




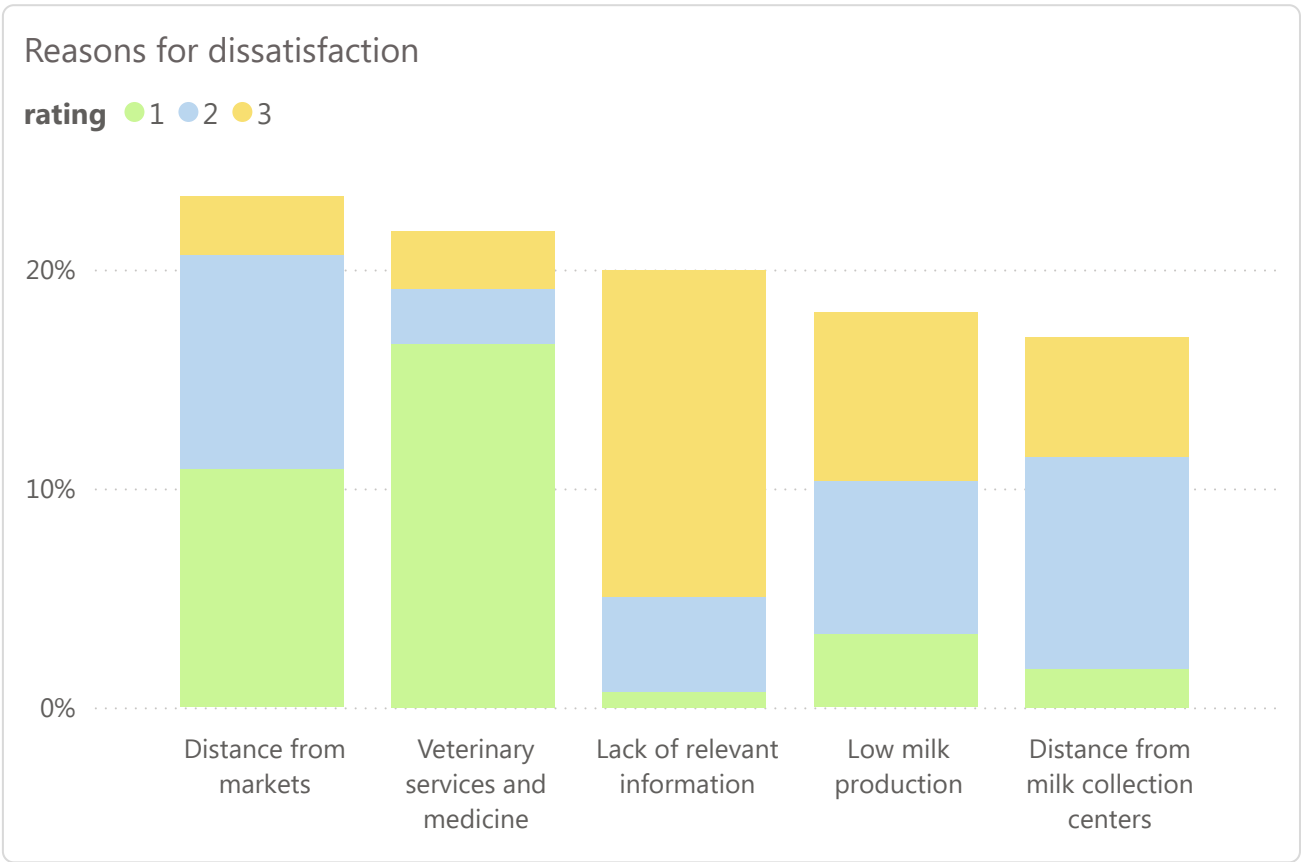








Reasons for Dissatisfaction

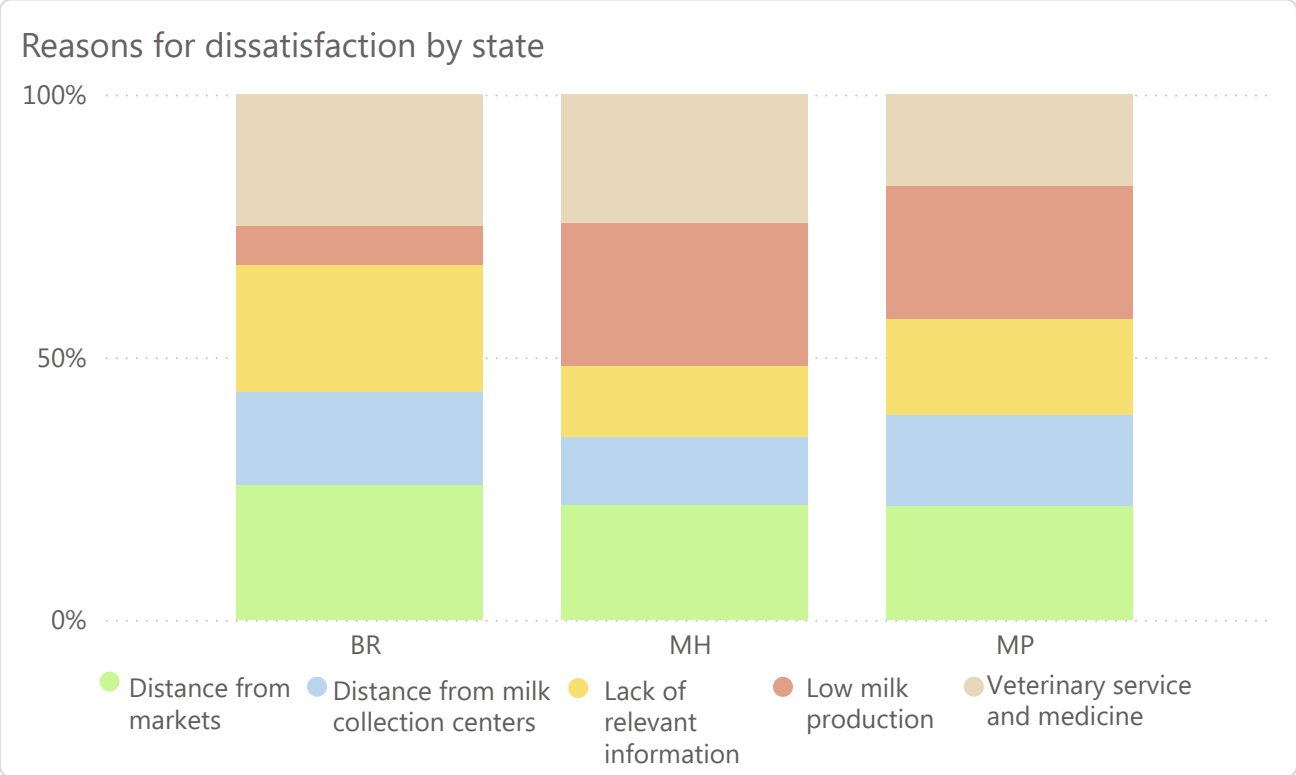


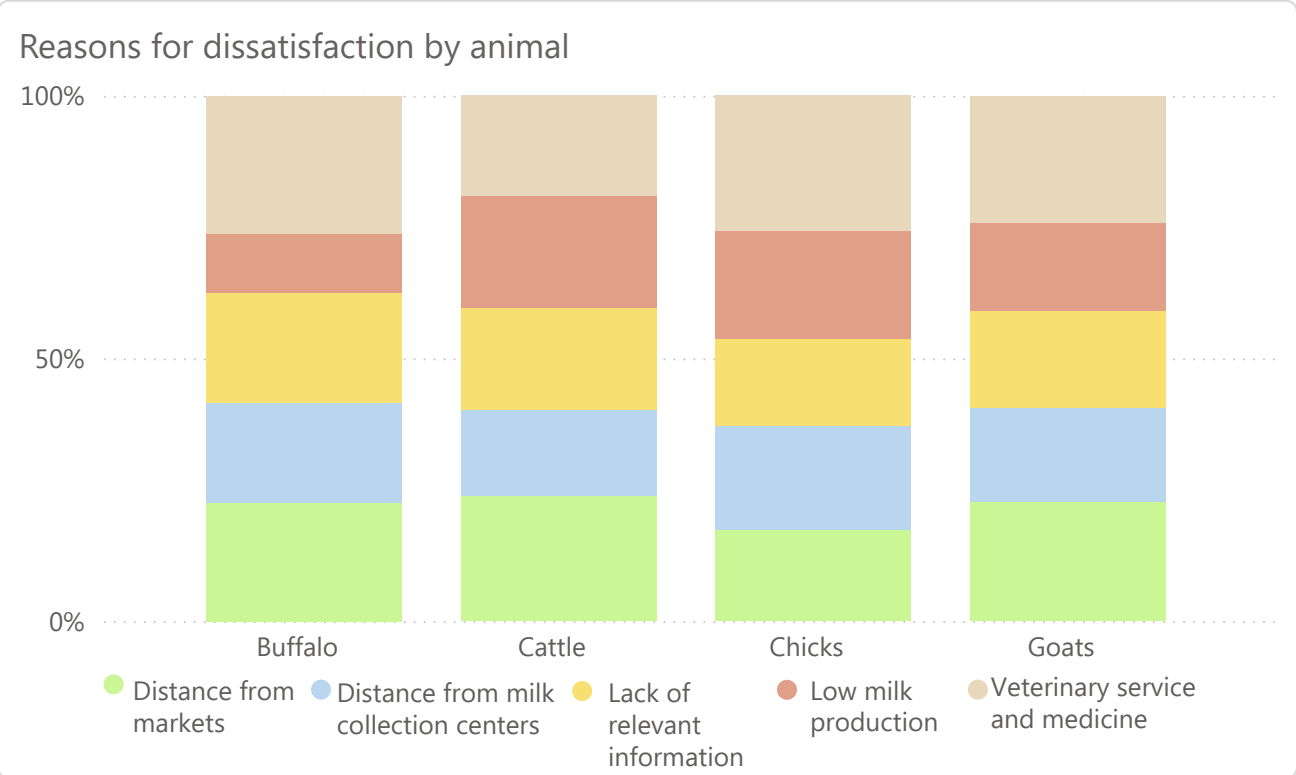
While the graph of overall reasons for dissatisfaction shows a fairly even distribution, the first-ranked reasons put veterinary services and distance from markets far ahead of the rest. This suggests that the farmers affected, though only a slight majority over the rest, are much more acutely concerned by these issues. Lack of information, on the other hand, is most often listed as third in importance. These challenges are likely to be addressed by solutions within the general spectrum of market linkages.

Reasons for Dissatisfaction by State and Animal

The most dramatic shift by state seems to be the switch from BR's higher concern with lack of information, coupled with lesser concern for low milk production, to the reverse in MH and MP.

Low milk production seems a lesser concern for buffalo than other animals (the intersection of milk production and poultry results from farmers keeping both poultry and milk-producing livestock). On the other hand, buffalo seems associated with a higher concern for veterinary services.





Conclusion

Indian smallholder farmers are facing significant challenges compounded by poor infrastructure and limited resources. The climate crisis is already introducing new pressures which will only grow with time—the challenge of irregular rainfall is a particularly poignant example.

A range of different approaches may be applicable. Technological solutions to specific problems come to mind first—ethylene inhibitors to extend storage duration for fruits and vegetables or resilient plant strains to improve yields under environmental stressors. But organizational or logistical solutions may be just as impactful. An aggregation platform could help farmers sell more of their produce and receive better prices, while forecasting and advisory services could empower farmers to make better decisions, improve yields, and prepare in advance against coming disruptions. Some solutions, especially those that approach infrastructural challenges, have a strong potential for spillovers into further applications. Thus, solar panels for irrigation pumps could power additional farming technologies. Innovation can span a broad range of domains, and the Indian smallholder market has many needs to address.

Seen from a business perspective, however, these needs provide tremendous opportunity. Pooled together, 150 million smallholders producing nearly half of India's food command huge resources. Accessing these resources, of course, requires coming up with the right technologies and the right business models to address the smallholders' challenges in a relevant fashion. A thorough understanding of these challenges is a necessary first step to developing solutions, and EIP is committed to extending our data grounding in this area to use during our cycle of sourcing, validating, and commercializing relevant technologies. We are eager to partner with a wide array of stakeholders and would be happy to share more granular data from our surveys where relevant.

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