ReFarm

A Year in the Fields

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THE/NUDGE INSTITUTE

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Executive summary

India's agricultural economy stands on the shoulders of its small and marginal farmers who constitute 86%[1] of all Indian farmers. A major part of our small and marginal farmers also are cultivating in rainfed regions. For them agriculture remains a fragile livelihood- highly dependent on erratic rainfall, with limited access to irrigation, fragmented landholdings, rising input costs, and poor market connectivity.

In order to make rainfed agriculture both climate-resilient and economically viable, The/Nudge launched ReFarm, a collective farming pilot for rainfed geographies. ReFarm was built on the thesis that all land types have untapped inherent economic value that can be realized by shifting agricultural practice to a high-value diversified multilayer regenerative cropping model, with water and market access taken care of. ReFarm was piloted with 41 smallholder farmers across five villages in Karnataka's Aland and Jewargi talukas of Gulbarga District. The model combined three key interventions: in-situ farm ponds for rainwater storage, regenerative multilayer cropping for year-round income, and farmgate market linkages with assured off-take. It also offered guaranteed working capital payouts, regular agronomic support, and farmer cluster meetings to enable peer learning and decentralized problem-solving.

The ReFarm pilot led to the construction of 41 farm ponds, enabling year-round irrigation on over 50 acres of previously rainfed land and harvesting 32 million liters of rainwater. This helped prevent an estimated 272 tonnes of topsoil erosion. Farmers adopted crop diversification through intercropping and border cropping, resulting in increased cropping intensity from one to two cycles annually. Guaranteed payouts reduced reliance on formal and informal credit by 50%, while over 70% of farmers engaged in compost-making and bio-input preparation, indicating a growing awareness of soil health.

The ReFarm pilot revealed critical insights for designing future interventions. Water solutions must be contextual and community-approved rather than standardized. Crop planning must prioritize market demand, as farmers are unlikely to adopt new or high-value crops unless they're assured of a buyer, regardless of the crop's agronomic benefits. Hybrid financial models that blend fixed and performance-based payouts are more effective in sustaining behavioral shifts. Investments in local processing and value addition can unlock significantly higher margins. Crucially, behavioral change is trust-driven- farmers follow peer success over external advice. While ReFarm validated the promise of collective regenerative approaches, it also exposed the limitations of isolated, plot-level interventions. The way forward lies in integrated, village/landscape-level models that combine water security, crop diversification, processing infrastructure, and community ownership in a systems approach.

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Acknowledgements

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Team:

The team that worked on this project includes Astha Arya, Nitish Bhagath, Naseem Banu, Sneha Deka, Naga Siva Sankar Reddy, Syed Layaq Ali, Arunkumar Manthale, Basavaraj Shankar, Sangamesh Dhannure and Gitanjali Rajamani.

Understanding the Problem: The Smallholder Farmers' Gamble

Across India, a vast proportion of farmland is held by small and marginal farmers, covering approximately 47.3% of India's total crop area[2]. These farmers navigate a landscape of uncertainty, where their incomes are dictated by the rains, their choices shaped by deep-rooted traditions, and their risks heightened by climate change, volatile markets, and shrinking profit margins. Many remain trapped in cycles of low-value monocropping, growing crops that bring modest returns but require minimal investment and risk. Without assured water, their options remain limited, forcing them to sow what survives, not what thrives.

Farming is inherently a business of risk and trade-offs – a calculation that smallholder farmers make each season as they decide what to sow, where to invest, and how to manage their land. But for rainfed farmers across India and in the area we worked in North Karnataka, the equation is often stacked against them.

Their incomes are dictated by rainfall, their options constrained by land and labor availability, and their decisions shaped by deep-rooted survival strategies rather than profit maximization. Most farmers in this region rely on low-investment, low-risk cropping systems and growing drought-tolerant staples that fetch modest but predictable returns. They make these choices not because they don't want to earn more, but because they can't afford to gamble on uncertainty.

While the challenges of rainfed farming are well-documented, we wanted to understand: Why weren't farmers already adopting solutions that could increase their income? Through field interactions, secondary research, and behavioral insights, we identified key barriers that prevented farmers from making the transition to high value agriculture.

Water: The First Barrier to High-Value Agriculture

For rainfed farmers, the lack of reliable irrigation is the single biggest constraint to transitioning to more profitable farming. Without water security, they stick to drought-tolerant crops that offer low returns, limit cultivation to the monsoon (Kharif) season, and avoid intensive cropping models that require irrigation at critical growth stages. While irrigation could unlock higher incomes, most farmers lacked the means to invest in water infrastructure. The upfront costs of wells or borewells were prohibitive, credit was inaccessible, and without guaranteed returns, the financial risk felt too high.

Farming Is a High-Risk, Low-Margin Business

For most smallholder farmers, agriculture is not just a livelihood—it is their safety net against uncertainty. Unlike wealthier farmers who can invest in better irrigation, high-value crops, or riskier but more profitable ventures, rainfed smallholders operate within razor-thin margins and limited financial flexibility. A single bad season can push them into debt, distress sales, or cutting back on essential household expenses. This risk aversion shapes every farming decision. Without assured financial security, farmers are unlikely to experiment with new practices, even if they hold long-term benefits.

Market Volatility Makes Farmers Distrustful of New Crops

Even when farmers know a crop is valuable, they hesitate to grow it if they don't know how and where to sell or don't trust the market will pay them fairly. Past experiences of price crashes or unfulfilled buyback agreements from traders have made them cautious.

Access to Credit Remains an Uphill Battle

Credit, for most small and marginal farmers, is not merely a financial tool - it is the difference between continuing cultivation and dropping out of farming altogether. Yet, accessing formal credit remains deeply challenging for this segment. Unlike large landholders who can offer collateral, build formal banking relationships, or leverage scale, smallholder farmers often rely on informal lenders, or input dealers for credit - sources that come with high interest rates, uncertain terms, and repayment pressure tied to harvest cycles.

Formal credit systems tend to favour predictability - fixed land titles, verifiable income histories, or repayment capacity - none of which are easily available to farmers working on fragmented, rainfed plots. Know Your Customer (KYC) issues, lack of awareness, and the sheer inaccessibility of rural banking infrastructure further exclude them from institutional finance. This pushes farmers toward conventional, low-margin choices that offer security but little room for innovation or income growth.

ReFarm: Designing for Farmer Behavior, Addressing Barriers

At its core, the ReFarm model was designed to test a hypothesis:

What if the barriers keeping farmers in low-margin, rain-dependent agriculture could be removed? Could their land be transformed into a source of stable, growing wealth?

We believed that if farmers had:

- Reliable water access through farm ponds, ensuring irrigation beyond the monsoon
- A structured transition to a multi-layer, high-value cropping system
- Guaranteed income to de-risk their shift to new practices

... then they could move beyond survival farming and begin farming for profitability. The inherent economic potential of their land, currently unrealized, could be unlocked, enabling them to optimize yields, improve profitability, and build resilience against climatic and market uncertainties.

ReFarm was designed not just as an intervention but as a behavioral shift experiment, ensuring that every component worked with farmer decision-making patterns rather than against them. Instead of expecting farmers to take risks on their own, the program removed key barriers that kept them in low-value agriculture, providing water security, reducing financial uncertainty, limiting exposure to risk, and ensuring market access.

The goal was simple: to help increase farmer income and enable them to unlock the economic potential of their land by shifting to high value agriculture. The program was designed to ensure that they had the water to grow, the financial security to experiment, the market assurance to sell, and the technical support to succeed.

Barrier	How It Keeps Farmers in Low-Value Agriculture	ReFarm's Approach
Lack of water access	Farmers rely on monsoon rains, limiting them to a single growing season.	Provided farm ponds, enabling an additional Rabi growing season and higher-value cropping.
Cash flow constraints	Without predictable income, farmers hesitate to invest in better inputs.	Introduced a fixed payout model, providing assured income regardless of yield.
Risk aversion	Farmers avoid experimenting with new crops due to fear of failure.	Limited intervention to one-acre plots, allowing experimentation without major financial risk.
Market distrust	Past experiences with price crashes or unfulfilled buyback agreements create hesitation.	Guaranteed offtake agreements, ensuring stable market access at predictable prices.
Labor & cost concerns	High-value farming requires additional effort and better management.	Provided agronomy support and training, optimizing labor use and improving productivity.

Table 1: Key Constraints for Smallholder Farmers and ReFarm's Mitigation Strategy

Piloting ReFarm: From Concept to Field

a. Mobilising a Village, One Farmer at a Time

We knew that the success of ReFarm depended on **getting farmers on board.** When we began piloting the ReFarm model, our objective was clear: Could farm ponds offer smallholder farmers a way out of the unpredictability of rainfed agriculture? Could this single intervention open the door to more diverse cropping choices, longer growing seasons, and ultimately, a more secure livelihood?

To answer these questions, we had to get three things right: the geography, the partners, and the farmers. The success of the model hinged not just on the concept, but on its relevance to local conditions and the commitment of those willing to test a new way forward.

Parameters for Geo Selection

Figure 1: Parameters considerations for selection of geography

b. Finding the Right Location and Partner

The first step was identifying where the ReFarm model could be most impactful. Unlike interventions like market linkages or multilayer cropping - both of which are geography-agnostic - the success of farm ponds is deeply tied to local ecological conditions. We needed regions where farm ponds would be technically feasible and agronomically beneficial.

Our search began with an analysis of soil type, rainfall patterns, and implementation capacity. Farm ponds are most effective in areas with deep black cotton soil and sufficient annual rainfall - conditions that support water retention and enable high-value horticulture. We overlaid this with a scan of states where experienced on-ground organizations were already working on farm pond construction. This led us to Maharashtra, Telangana, and Karnataka.

To scale pond construction effectively, we needed a partner with technical depth and on-ground presence. Among several potential collaborators, the Deshpande Foundation stood out. With over 12,000 ponds constructed - more than any other implementing agency - and an established presence across Karnataka and Telangana, they brought unmatched expertise. Following detailed discussions, we aligned on goals, operational processes, and expectations, formalizing a partnership.

Photo 1: Navalgund, Hubli- Near saturation of farm ponds due to Deshpande Foundation's efforts (Satellite Image)

With Deshpande Foundation's support, we zeroed in on districts that met four critical criteria:

- Presence of deep black cotton soil
- Active farming communities with viable landholdings
- Annual rainfall above 700mm
- Availability of skilled local contractors for pond construction

This led us to evaluate Gulbarga and Koppal in Karnataka, and select talukas in Adilabad, Telangana. Each location brought its own strengths and constraints.

- Gulbarga had deep black cotton soil across multiple taluks, but areas like Chittapur and Sedam had rocky terrain, making pond construction difficult.

- Koppal had very limited suitable geographies, raising concerns about future scale.

- Adilabad showed promise on soil and rainfall but had limited access to heavy machinery, which could delay execution timelines.

Technical feasibility alone wasn't enough. To truly understand the potential for farm ponds, we needed to hear directly from farmers - about their water-related challenges, current irrigation methods, and willingness to try new approaches. Our team visited Gulbarga, engaging with local non-profits and farmer groups across Afzalpur, Jewargi, and Chittapur talukas and conducted dipstick studies.
The conversations were revealing. Water scarcity was a central issue and while a few farmers had experimented with small farm ponds on their own, many remained cautious. There was genuine curiosity - but also skepticism about whether farm ponds would fit into their cropping systems, landholdings, or investment capacities.

After assessing ecological conditions, partner strength, and farmer receptivity, Gulbarga emerged as the most promising district for the pilot. Having identified Gulbarga as the pilot district, the next challenge was selecting the specific villages where we would begin operations. With input from agricultural officers and non-profit partners like Vrutti and MYRADA, we initially focused on Jewargi Taluk. Within Jewargi, Kalhangerga village panchayat stood out. The panchayat was receptive and highlighted that most farmers were smallholders, aligning with our eligibility criteria.

c. Identifying the Right Farmers

With the location finalized, the next critical step was selecting the right farmers to partner with.

Our eligibility criteria[3] were well-defined:

- Farmers with total landholdings of 5 acres or less (or under 10 acres per family)
- No existing source of irrigation, such as borewells or open wells

We wanted to ensure that the intervention reached those who needed it most - small & marginal rainfed farmers with limited access to water and capital.
Being new to the village, we understood that acceptance wouldn't come instantly. We understood that building meaningful relationships would take time, patience, and consistent presence. In the initial weeks, our team focused on simply being present - making regular visits to the panchayat office, walking through the fields, engaging in informal conversations, and observing the rhythms of daily life. We listened more than we spoke, taking time to understand the realities, routines, and reservations of the farmers.

To establish early goodwill, we organized a soil health testing camp, offering farmers support in collecting soil samples at a very nominal cost. These samples were sent to the Krishi Vigyan Kendra (KVK) in Gulbarga for professional analysis. For many, this was the first time they received reliable results - several shared that, in the past they had submitted samples through intermediaries but never heard back. This small but tangible act became an early marker of credibility.

By the third week, the farmers of Kalhangerga had become more familiar with ReFarm and our team. With a foundation of trust beginning to take shape, we introduced the farm pond model during small group meetings, deliberately inviting influential farmers in the hope that their endorsement would encourage wider participation.

The proposal was met with curiosity and polite interest - but initially no one signed up. A week went by with no registrations in Kalhangerga village. Conversations with farmers revealed three core concerns:

1. A History of Broken Promises

Previous encounters with external projects had left many disillusioned. They had seen outsiders arrive with bold claims, only to withdraw before any tangible benefit reached the community. This pattern had eroded trust, making farmers understandably cautious.

2. Doubts About Farm Pond Suitability

Some farmers questioned whether a pond would work on their land. Others were reluctant to allocate a portion of their cultivable land for a pond. A few, particularly those near canal-fed areas, simply didn't see the value in having a pond.

3. Need for the Farm Pond

As Kalhangerga village had extensive canal irrigation, the farmers there did not see a need for the farm pond as the water from the canals was sufficient for their cropping patterns.

As influential farmers backed away, smaller, more risk-averse farmers became even more hesitant. With the pilot timeline approaching and momentum stalling, it became clear: if we wanted to move forward, we needed a Plan B.

Photo 3: Farmer mobilization in Jewargi

To accelerate trust-building, we turned to a respected name that farmers already knew and trusted in another Taluk. We connected with Nisarga FPO, a well-regarded farmer producer organization in Aland Taluk known for its farmer-centric approach and openness to innovation. Nisarga had a track record of supporting progressive interventions, making them an ideal ally for introducing the ReFarm model. The FPO responded with interest to our model and offered to help mobilize their member farmers and formally endorse the initiative.

Over the next two weeks, we pitched the model to more than 150 farmers associated with Nisarga FPO. The response was overwhelmingly positive—over 100 farmers signed up to be part of the pilot. However, as the summer drew to a close and the monsoon approached, we decided to move ahead with a focused, manageable cohort of 41 farmers:

- 33 from Nisarga FPO in Aland
- 8 from Jewargi, mobilized independently during our earlier outreach

With that, the ReFarm pilot was officially underway, backed by the community and ready to be tested on the ground.

Photo 4: Introducing the ReFarm model to farmers

d. The Farmers of ReFarm: Their Land, Their Stories[4]

For the farmers of Jewargi and Aland, the monsoon is more than just a season - it dictates their survival. At Baseline, 61% of ReFarm's farmers relied solely on rainfed agriculture. Their lands were productive only for a few months before their fields dried up and lay barren for the rest of the year. Without water security, they grew only what could withstand minimal moisture, limiting both income and productivity. Irrigation was rare-most had never practiced it as their farms were completely rainfed, and those who did - depended on small borewells or shared water sources, both unreliable. Some of those who did have access to reliable irrigation were able to cultivate a second crop in Rabi, but even they struggled to make farming profitable.

Most farmers in the program were small and marginal landholders, with 62% owning less than 5 acres. The average landholding per farmer was 3.43 acres, higher than the national average for smallholder farmers, yet the semi-arid conditions and lack of water access offset this advantage. Given the unpredictability of rainfed farming, agriculture alone was rarely sufficient to sustain households. One in five farmers engaged in land leasing or sharecropping, while many supplemented their income through daily wage labor or livestock rearing.

Soil health was another growing concern. Years of reliance on chemical fertilizers and pesticides had depleted soil fertility, forcing farmers to increase input use just to maintain yields. With each passing season, their cost of production was rising, while their profits stagnated. Market access was equally challenging. With no direct links to buyers or storage facilities, farmers had little bargaining power and were often forced to sell to local traders at lower prices, simply because they could not afford to wait. Many depended on high-interest loans from traders and informal lenders to cover input costs, trapping them in cycles of debt. It was clear that water, soil health, and market access were interconnected barriers - solving one

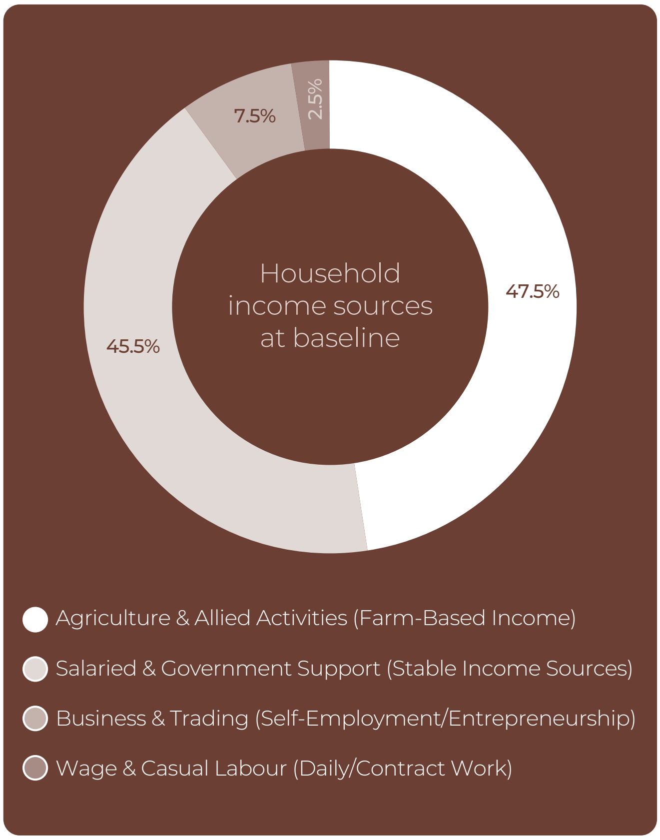
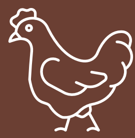


Figure 2: Breakdown of Household Income Sources: Agriculture and Beyond

without addressing the others would yield limited results.

While agriculture remained the primary occupation, many farmers in Jewargi and Aland sought additional income streams to navigate the uncertainties of rainfed farming. Nearly half **(47.5%) supplemented their earnings through allied farm-based activities**[5], providing crucial financial buffers during lean agricultural months. Another **42.5% relied on stable, salaried jobs**[6], ensuring a level of financial security that farming alone could not offer. A smaller group, **7.5%, engaged in business and trading**[7], leveraging local markets for additional income, while **2.5% took up daily or contract labor** as an alternative livelihood. These diverse livelihood strategies played a crucial role in sustaining households beyond the monsoon months, offering resilience in an otherwise unpredictable agrarian landscape.



47.5%

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42.5%

relied on stable, salaried jobs

7.5%

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Farm Ponds for Rainfed Resilience

The farm pond was at the heart of ReFarm's approach. In theory, it was a **simple yet powerful solution** - capture rainwater, extend the cropping season, and give farmers a reliable water source.

In rainfed regions like Gulbarga, where annual rainfall hovers around 700 mm, farming is shaped as much by uncertainty as it is by effort. Short, intense bursts of rain are common, often doing more harm than good - stripping away topsoil and leaving behind fields prone to both erosion and waterlogging. Without reliable rainwater management, farmers remain at the mercy of erratic weather patterns, with limited means to improve water productivity or safeguard their land.

Most farmers here rely solely on rainfall to irrigate their crops, which keeps productivity low and incomes unstable. Our field study pointed to farm ponds as a practical and impactful solution. By capturing rainwater when it falls, these ponds offer farmers a buffer against dry spells - a reliable source of water for both crops and livestock. The ability to store and control water opens up new possibilities: better yields, improved food security, and the chance to shift from subsistence-driven cropping patterns to ones focused on income generation.

The purpose of the farm ponds was even more relevant in regions where rainfall is sufficient in volume but poorly harvested due to lack of infrastructure. Once collected, this water could be used for bridging dry spells during the kharif season and for irrigating rabi crops, which otherwise relied on sparse rainfall. Farmers also used this water for other needs - livestock, pesticide sprays, and even basic domestic chores. By preventing waterlogging in the fields, the ponds also reduced the risk of crop damage due to standing water.

Despite these benefits, not all farmers were convinced. During initial outreach, concerns ranged from practical to economic. Some worried about the space farm ponds would occupy, cutting into cultivable land. Others pointed out that ponds often dried up in the peak summer, making their utility questionable. In areas where rabi farming was minimal, the value of stored water seemed abstract. Rocky terrain posed another hurdle - the cost and effort of blasting through stone deterred many. And for some, deeper wells, though more expensive, seemed like a better long-term bet due to their larger storage capacity and durability. Without liners, there was also the risk of water seeping into the soil, rendering the effort futile.

Still, for many others, the idea of water security was persuasive. They saw the pond as an investment- not just in their land, but in their ability to plan ahead. The first step for those who signed up was pond construction, but timing was everything. Excavation could only happen in the lean summer months of March to May, when no standing crop would be damaged - either on the farmer's land or on neighboring fields through which machinery had to pass. This meant careful coordination: identifying contractors in advance, arranging tractors for soil movement, mapping routes for excavators, and negotiating right of passage with fellow farmers. It wasn't just a technical task; it was a logistical dance across villages, fields, and calendars.

Selecting the **right site for a farm pond** is as much about understanding the land as it is about understanding the farmer's needs. A farm pond is essentially a dugout with a defined shape and structure - complete with inlet and outlet points - to collect surface runoff. For maximum efficiency, it needs to sit at the lowest point on the farm, allowing water to flow naturally into it during rains. In our case, a standard design of 50 feet by 50 feet, with a depth of 12 feet, was followed.

Farmers were typically the first to point out where water accumulated on their land, and in most cases, their insights proved valuable. However, one key learning was the importance of complementing this local knowledge with Geographic Information System (GIS) data to map topography and confirm slope direction. Visualizing the average gradient helped pinpoint the true lowest point, making the pond more effective at capturing runoff. In some instances, what appeared to be the lowest point to the eye didn't align with the actual slope of the terrain.

Soil type also plays a critical role. Deep black soils, with their low infiltration rates, hold water well even without pond liners, making them ideal for harvesting rainwater into farm ponds. In contrast, sandy soils, or those with mixed textures, tend to lose water quickly through seepage - making lining essential if stored water was to last through the dry spells.

Soil depth was another factor that couldn't be ignored. Though not always measured at every site due to constraints, deeper soils, free of stones, made it possible to dig deeper ponds. Greater depth meant lower surface area exposure and therefore less water lost to evaporation. Where soil was shallow or rocky, pond depth had to be compromised, reducing both storage capacity and reliability. In some cases the rocks had to be blasted through to make way for deeper ponds.

There were also **practical considerations**. The ponds needed to be located away from canal systems to avoid any misuse of diverting canal water, which could lead to lesser water for other farmers and related conflicts within the village. Similarly, proximity to electrical poles posed a safety risk, particularly during excavation or when farmers accessed water from the pond.

a. Farm Pond Design

The farm pond's shape was crucial for stability. A trapezoidal design with side slopes helped prevent collapse and eased desilting. A 3-foot-wide berm acted as a buffer, while a compacted bund kept soil intact. The bund was just beyond the berm and was constructed using excavated soil, compacted into a low wall encircling the pond. The bund played a key role in holding the structure together, preventing soil from slipping in, especially during heavy rain. Its top was kept wide enough - typically between 1 to 2 meters - for farmers to inspect and maintain it without difficulty. Inlet and outlet pipes controlled water flow, and a silt trap reduced sediment buildup.

Water needed to enter and exit the pond in a controlled way. For this, two **inlet pipes**, each 6 feet in length and 2 feet in diameter, were laid at the base of the bund with a gentle slope to guide surface runoff from the field into the pond. To manage overflow, a single **outlet pipe** of the same dimensions was installed slightly below the top of the bund. This ensured water never exceeded the designed storage height. Where the water exited, lining the area with stones and plants helped soften the flow and prevent erosion - a small detail that made a big difference during intense rains.

To keep the pond from filling up with silt, a **silt trap** was added near the inlet - a 3x3x3 feet pit designed to slow incoming water and allow sediment to settle before it reached the pond. This made maintenance more manageable; instead of cleaning out the entire pond, farmers only needed to clear the silt trap periodically.

Photo 5: Inlet and outlet pipes laid in preparation for pond construction

b. Maintenance and Management

Building the pond is only half the work - keeping it functional over time requires regular attention. Without timely maintenance, even a well-constructed pond can lose its effectiveness. **Desilting** is one of the most important tasks. Over time, silt settles at the bottom of the pond and in the silt trap, gradually reducing its storage capacity. Clearing this out every couple of years helps restore volume. Interestingly, the removed silt isn't waste - it's top soil and often rich in nutrients and can be spread back onto fields to improve soil fertility.

The **bund** also needs close monitoring. Cracks, burrows made by rodents, or erosion gullies can weaken the structure. Even small breaches, if ignored, can grow into larger problems during the next heavy rain. A simple walk around the bund after each season is usually enough to catch issues early.

Water quality is another factor farmers need to watch. Allowing fertilizers or pesticides to drain directly into the pond can cause contamination. To manage algae and keep the water healthier, introducing floating vegetation - like duckweed or water lettuce or azolla - can help balance the ecosystem naturally.

Lastly, in areas where water is scarce, **regulated use** becomes essential. Having a basic plan for how and when water will be drawn (manually or through a electric/ diesel/ solar pump) - especially during critical crop stages - ensures that the pond serves its intended purpose across the season and benefits all parts of the farm it was meant to support.

Photo 6: Boundary demarcation completed for proposed farm pond site

c. The Dig: Turning Plans into Ponds

With 41 farmers across five villages in two taluks, coordinating excavation was a race against time. Once the monsoon began, digging would be impossible - fields would be under crop, machinery would compress and damage wet soil, and the opportunity would be lost. That left a narrow window: post-consent and pre-rain.

The digging followed a streamlined process, refined through on-ground learning:

- Farmer Consent: Work began only after written agreement, ensuring the farmer understood and committed to the pond process.
- Site Recce: The Agricultural Field Officer verified land ownership, topography (lowest point), absence of borewells, and safe distance from canals or electric poles.
- Clustering & Route Planning: To optimize fuel and time, farmers were grouped by geography so that excavators moved cluster by cluster.
- Marking Boundaries: Clear markings ensured the pond was dug to the correct dimensions, with slope considerations built in.
- Excavation: Earthmovers completed up to two ponds a day, depending on terrain. Rocky land slowed progress. Dug-out soil formed the bund; boulders were set aside.
- Measurement & Adjustment: Length, width, depth, and slope were measured post-dig. Deviations were corrected on the spot to ensure water retention.

Photo 7: Excavation in progress using JCBs during farm pond construction

- Inlet & Outlet Pipes: Pipes were installed at the base and just below the top of the bund - allowing water in, and letting excess drain without losing silt.
- Silt Trap: A 3-foot deep trap, stone-pitched at the inlet, prevented sediment from entering the pond - extending its life and reducing maintenance.
- The entire operation depended on tight coordination among farmers, contractors, operators, and tractor drivers. Farmers were encouraged to be present throughout - not just to supervise, but to build ownership of a structure designed to serve their land for years to come.

Early monsoon arrival forced faster operations, sometimes into the night, making supervision difficult. Misaligned pipes risked poor drainage or silt inflow, demanding extra care.

Despite the challenges faced, several key lessons emerged to improve future farm pond construction efforts. Planning excavation cluster-wise - village by village - helped optimize machine use and coordination. Starting construction early, ideally by March and finishing before the monsoon, is crucial to avoid incomplete ponds. Strict quality checks are essential to ensure proper pond dimensions, slope, bund strength, and pipe placement. Inlet and outlet pipes must be carefully positioned to balance effective water flow and prevent soil loss, while silt traps need stone reinforcement and regular maintenance to function well. Excavated subsoil should be used only for bunds - not on fields - as it's often nutrient-poor. Managing machine movement is vital to avoid soil compaction, and compacted areas can be naturally restored using deep-rooted crops. Finally, berms and bunds must be wide and firmly packed to prevent erosion during early rains and protect the pond's structure.

Photo 8: Farm pond construction completed with inlet and outlet pipe fixtures in place

d. Farm Ponds: Measuring Their Effectiveness

A total of 41 farm ponds were constructed each measuring 50 feet in length, 50 feet in width, and 12 feet in depth. These ponds were designed to harvest rainwater runoff from adjacent agricultural lands, and collectively harvested approximately **32.24 million liters** of rainwater and potentially prevented approximately **272.24 tonnes of topsoil** from being eroded in 2024[8]. Enhanced water availability, soil fertility preservation, reduced sedimentation in water bodies and improved climate-resilience all are downstream benefits of the farm ponds.

While the core promise of farm ponds was simple, to capture and store rainwater to enable Rabi cultivation, the implementation revealed a more complex picture —one shaped by water retention challenges, infrastructure gaps, and farmer behavior.

While nearly all ponds held water post-construction during Kharif, retention dropped as the dry months progressed. By the start of Rabi, 75% farm ponds contained water in November, but this steadily declined to 34% by February. Water retention varied by village, influenced by **location, soil type, and the availability of additional water sources.** In two cases, farmers even converted their ponds into open wells due to consistently poor retention.

There were early signs of **positive effects**, too. Some farmers observed improved soil moisture in surrounding fields during Kharif, suggesting **potential groundwater recharge benefits**. While these were promising insights, they remained inconsistent across locations.

Photo 9: Farm ponds filled with water during the Kharif season

- **Site selection proved to be critical.** In some instances, ponds were dug in less-than-ideal spots - either too shallow, too rocky, or too exposed - leading to high rates of seepage and evaporation. While many farmers had an instinct for where water tended to collect on their land, **those instincts didn't always match scientific assessments of topography and soil type.** Poor site selection often led to underuse, or even frustration.

- In four cases[9] construction **flaws - such as misaligned pipes, level mismatch - caused runoff issues or waterlogging**, rendering the ponds ineffective.

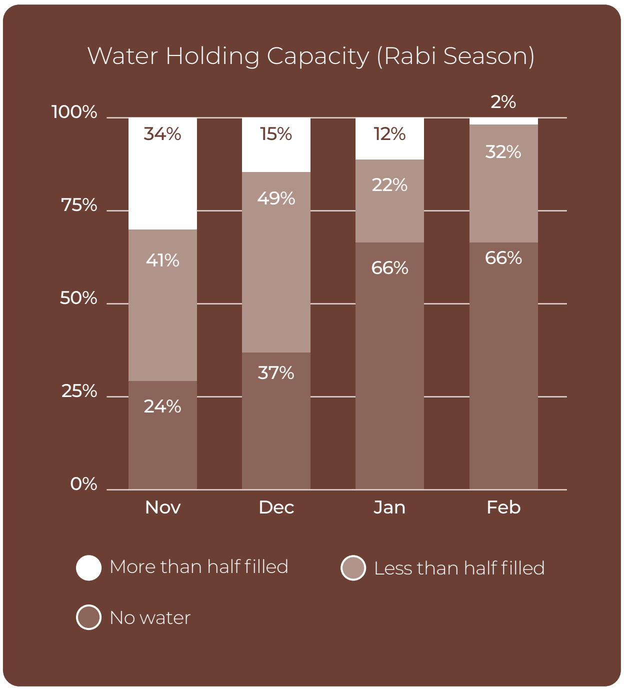


Figure 3: Water Holding Capacity of Farm Ponds in the Rabi Season[10]

Despite both taluks being just 80 km apart, Aland and Jewargi saw stark differences in farm pond performance.

Jewargi

Despite starting with moderate water levels - with around **two-thirds** of ponds holding some water in November and December - Jewargi's retention dropped sharply as the season progressed. By February, **only 25%** of ponds retained any water at all, and just a small fraction had more than half their capacity. The early-season promise did not translate into meaningful irrigation support when it was most needed, limiting its effectiveness through Rabi.

Aland

Aland's ponds showed relatively better mid-season resilience. In December, **over 60%** of ponds still held some water, even as Jewargi began to dry up. Although Aland too saw a steep drop by February - with **none** of the ponds retaining more than half capacity - the slower rate of decline allowed for more sustained irrigation in the middle of the season. This reflects a comparatively stronger retention profile and slightly better prospects for late-stage cropping.

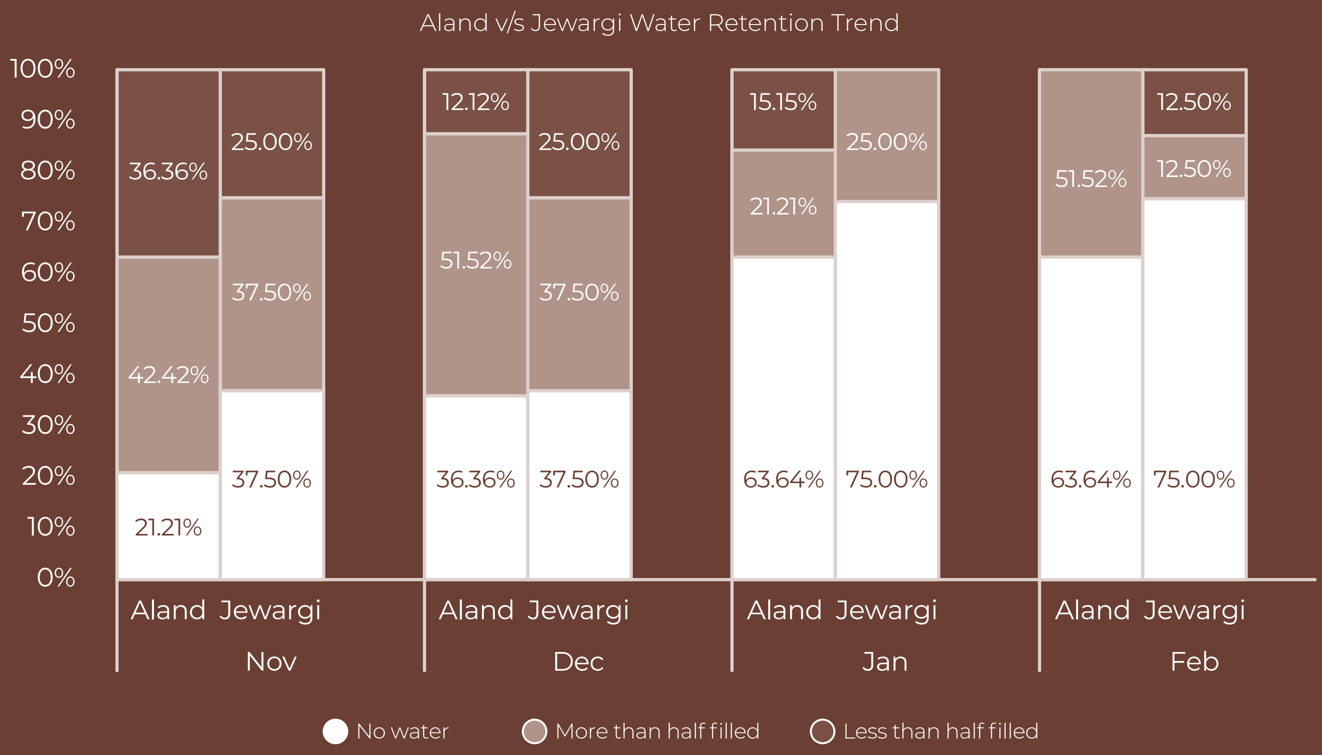


Figure 4: Water Retention Trend in Aland and Jewargi[11]

These disparities were shaped by **soil composition, topography, pre-existing water sources, and rainfall patterns.**

- **Soil Type Shaped Water Retention:** Aland's black cotton soil had high clay content, allowing better moisture retention in ponds. Jewargi also had black cotton soil, but patches of sandy and loamy soil in some areas led to faster drainage, making water retention more difficult.

- **Topography Influenced Water Accumulation:** Aland's flatter terrain helped water collect in ponds more effectively, reducing runoff losses. Jewargi's uneven landscape, with depressions and riverbeds, led to uneven water distribution, causing some ponds to drain faster.

- **Existing Farm Ponds Provided an Advantage in Aland:** Before ReFarm's intervention, Aland had a greater number of existing farm ponds, which contributed to better water availability by enhancing groundwater recharge and reducing runoff losses. The presence of established water catchment areas in Aland might have further improved retention by reinforcing the surrounding soil's capacity to hold moisture, as well as more stable groundwater levels, a factor that was less pronounced in Jewargi.[12]

With minimal rainfall and high temperatures, water retention in farm ponds across both Taluks was challenging. November saw 8.89mm of rain (2 rainy days), December 11.17mm (0 rainy days), and January–February had no rainfall. With temperatures averaging 30°C[13], evaporation accelerated, further depleting water

Photo 10: Jewargi, Gulbarga- Low Farm Pond Adoption Prior to ReFarm

Photo 11 : Aland, Gulbarga- Higher Farm Pond Adoption; Visible as Water-Filled Squares

levels. Without sustained precipitation, preventing seepage and evaporation became critical for ensuring water availability through the dry months.

While **67% of ponds were filled by rainfall**, reinforcing their dependence on monsoon patterns, many farmers sought alternative ways to replenish them. Around **10% of ponds were refilled by canal water (not recommended)**, highlighting how farmers actively used their ponds as storage units when rainfall alone was insufficient. Another **21% drew from underground sources**, including wells and borewells. While these sources provided a more **consistent water supply**, they also contributed to **groundwater depletion**, raising concerns about long-term sustainability. While rainfall alone was often inadequate for sustained water storage, farmers adapted by utilizing available water sources to maximize the utility of their ponds.

Water availability, however, did not guarantee usage.

- Only 63.83% of farmers used pond water for spraying fertilizers or pesticides;
- 10.64% used it for livestock or labor needs; and
- 25.53% did not use their ponds at all, either because they had dried up or because farmers relied on alternative sources.

For many, the challenge was access: without pumps or tools to lift and distribute the water, the stored resource often remained unusable. In some cases, ponds were seen as underutilized assets; in others, as lost productive land. A few farmers found alternative uses- converting farmponds into open wells or exploring fish farming which pointed to the need for contextualized support and complementary infrastructure.

The biggest insight from the pilot was this: a well-constructed pond is only part of the solution. And that water availability alone does not lead to improved agricultural outcomes unless supported by usability, distribution mechanisms, and farmer intent. While some farmers saw the pond as an asset, others viewed it as lost productive space - a patch of land that once yielded crops, now occupied by a structure they weren't sure how to utilize. Ultimately, their impact was shaped as much by local conditions and implementation quality as by farmer engagement and access to complementary tools.

Despite mixed agronomic outcomes, farm ponds played a significant role in trust-building. In villages where community skepticism was initially high, the visible delivery of promised infrastructure helped shift perceptions. Even where water retention fell short, the presence of a tangible, constructed asset reinforced belief in the program and contributed to increased participation in other interventions. As such, the ponds served not just as a tool for water conservation, but also as a foundation for deeper community engagement and long-term institutional trust.

Transforming Cropping Practices and Farmer Mindsets

Gulbarga, often called the Toor Bowl of India, has long been synonymous with pigeon pea cultivation. In the villages where ReFarm was active, **Toor (pigeon pea)** dominated the landscape during the baseline. Most farmers were growing it as a monocrop, while a few others cultivated other crops such as **cotton and jowar**. Crops like **groundnut, sesame, black gram, sunflower, and safflower** made occasional appearances, but only in scattered plots. Intercropping - a practice that could bring both ecological and economic benefits - was observed in just one of the two blocks we worked in. **Border cropping was rare**, adopted by fewer than one in four farmers, despite its benefits for soil conservation and pest control. **Horticulture** remained **small-scale**, with crops like coriander, fenugreek, and okra grown primarily for household use rather than commercial sale.

Farming in this region is mostly **low-intensity and seasonal**, with cultivation centered around the kharif months (June to January/February). Very few farmers practiced distinct kharif[14] and rabi[15] cropping cycles. For most, **March through May was a fallow period**, spent preparing the soil or waiting out the heat. The system remained heavily skewed toward **monocropping** - particularly of toor or cotton - year after year.

Crops	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Red gram	Harvest						Sow					
Green gram						Sow						Harvest
Cotton				Harvest		Sow						
Black gram						Sow					Harvest	
Soybean							Sow				Harvest	
Jowar			Harvest							Sow		

Rabi Season

Kharif Season

Figure 5[16]: Pre-Program Crop Cycles: Sowing and Harvesting Calendar of ReFarm Farmers

The long-standing reliance on monocropping, however, had serious consequences for the land. Baseline soil testing of the plots revealed a worrying picture: soils were biologically tired and low in fertility. Nearly all farmer plots showed deficient levels of organic carbon and nitrogen, key indicators of soil vitality, reflecting the toll of years of chemical-intensive farming. Soil pH was also a concern, with most plots testing highly alkaline (pH >8.5), which can impair nutrient uptake. These results confirmed what farmers were already experiencing on the ground- depleting soil health, stagnant yields, and rising input dependency. Monocropping also makes crops more susceptible to pests and diseases. A single outbreak can wipe out an entire field. Farmers in the region had already experienced this first hand with **Nete (root rot)**, and newer threats like **Macrophomina phaseolina (dry root rot)** and **Phytophthora (blight)** were beginning to spread - raising concerns of widespread damage.

The region's **semi-arid climate** adds to the pressure. Irregular rainfall and high temperatures worsen **soil moisture stress**, and without diversified root systems or protective ground cover from intercropping, the land struggles to retain moisture. The result? **Lower yields, rising input costs**, and increased economic vulnerability. To maintain productivity, farmers often had to rely more on chemical fertilizers and pesticides - solutions that may work in the short term but strain the land and pocket over time.

Toor, despite being the mainstay, is not a crop without risks. Its **yields are highly sensitive to monsoon variability.** A timely rain during flowering can make all the difference, while even a small delay can severely affect pod development. Over the years, production in the region has **fluctuated sharply**, driven by unpredictable weather and changing farming practices - like shifts in acreage or occasional use of improved seed varieties. Baseline surveys also revealed that farmers were producing significantly below the district's average yield estimates, highlighting the combined impact of poor soil health, monocropping, and low-input farming systems.

Crop Name	ReFarm Baseline Data- Average harvest / acre (in kgs)	Gulbarga Estimates[17] - Average harvest / acre (in kgs)	Difference in Harvest (in kgs)
Red gram	317	350	-64
Soybean	380	662	-417
Jowar	327	478	-169
Green gram	114	268	-143
Black gram	167	265	-118

Table 2: Baseline data of crop varieties grown in the region last year by ReFarm farmers

Market dynamics only compound the volatility. A good price in one year for one crop often triggers a rush to plant more of the same in the next, sometimes resulting in oversupply and a subsequent price crash. When prices fall, farmers are quick to pull back, switching to other crops or reducing their planted area—leading to cyclical highs and lows. While **government procurement and Minimum Support Prices (MSPs)** offer some level of cushioning, they're not enough to fully protect farmers from market swings.

a. Bringing in Crop Diversity and Regenerative Techniques

ReFarm sought to introduce a **multi-cropping approach**, built around **intercropping** and **border cropping**, as a strategy for risk diversification. The goal was simple: spread the risk, improve soil health, and reduce dependence on a single crop. By working with farmers in both kharif and rabi cycles, we encouraged the adoption of mixed cropping patterns that could offer better resilience - against pests, weather, and markets alike.

Photo 12: Kharif training with farmers on the benefits of crop diversity and spacing

Alongside farm ponds, we introduced new cropping models to shift farmers away from low-margin monocropping toward diverse, high-value agriculture. The idea was to build resilience - not just through water access, but by ensuring farmers grew crops that fetched better returns.

In Aland, where multi-cropping was already common, farmers were open to experimenting. But elsewhere, layered cropping and regenerative practices met hesitation and resistance. Many were accustomed to growing a single crop, and the introduction of border crops, intercropping, and bio-inputs required significant hand-holding and behavioral shifts.

During **Kharif**, the new cropping plan included **Moringa, Castor, and Sesbania** as border crops, while **Quinoa and Sunflower** were introduced as the main high-value crops. **Pest trap crops** were also experimented with - **Coriander**, to attract beneficial insects like ladybugs, and **Cowpea**, to lure aphids away from the main crop. **Castor**, aside from being a border crop, also served as a trap for specific pests. Importantly, **all of this was done without the use of chemical inputs** - no synthetic fertilizers, pesticides, or herbicides.

During **Rabi**, the cropping plan included discussions with the farmers to introduce crops that they were slightly familiar with. Mustard, Safflower and Flax seeds were introduced as main high value crops in Rabi and farmers were given the choice to grow either of these.

Photo 13: Sunflower field in full bloom in Kharif season

b. Training Farmers to Farm Differently

Spacing, sowing methods, and crop planning were discussed in group training, and farmers were introduced to techniques rooted in **natural and organic farming**. They learned about **seed treatment** using microbial solutions like Trichoderma and Pseudomonas, how to prepare and apply **Gokrupa-Amruta** (a fermented soil conditioner), natural pest management, and the principles behind intercropping systems. But the shift wasn't easy. **Accessing ingredients** for organic formulations proved a challenge - most farmers did not own cattle, and indigenous breeds, which are key to many traditional bio-inputs, were hard to find.

Farmer training became a critical enabler to support the transition to organic farming. ReFarm introduced **a two-tiered training model**[18] to build both technical knowledge and community capacity. **Expert-led monthly sessions** by award-winning organic farmer Laxmi Lokur provided in-depth guidance on practices like composting, pest control, and soil health, while her farm visits offered personalized feedback on Package of Practices (PoP) adherence. Complementing this, s**maller peer-led cluster meetings** created space for hands-on learning, problem-solving, and behavior change through trusted local facilitators. Trainings were delivered in local languages and adjusted to seasonal timelines, focusing not just on knowledge transfer, but on simplifying complex practices and linking them to economic outcomes. This mix of technical depth and peer support helped farmers gradually build confidence in adopting organic methods, despite initial resistance and resource constraints.

Photo 14: Expert-led monthly agronomy training session in progress

c. Key Learnings from the Cropping and Training Pilots

Transforming how farmers farm isn't just about introducing new crops—it's about changing habits, expectations, and the deep relationship between land, labor, and livelihood. Over the course of two cropping cycles, we saw first-hand what enables or hinders this transition. Here are our key learnings:

- **Trust is built on early success:** When introducing a new model of farming, the first season matters immensely. In Kharif, we introduced quinoa as a high-value, drought-tolerant crop, but it didn't perform well in most fields. This early failure affected farmers' confidence - not just in the crop, but in the broader idea of ReFarm. Where sunflower did better, there was more openness to continuing with new practices. The takeaway: if the first bet doesn't land, the entire game is at risk.

- **Following the PoP pays off:** Across Rabi crops - especially mustard and safflower - we saw a clear correlation between adherence to PoP and crop health. Farmers who prepared their land on time, used recommended bio-inputs, and followed irrigation and pest control schedules were better able to manage aphid outbreaks and retain pod development. On the other hand, delayed sowing, skipped sprays, or low soil preparation translated into visibly weaker crops. We began classifying fields as Green (high adherence), Amber, and Red to track outcomes more clearly.

- **Water is everything:** Even the best practices fall flat without water security. The availability of farm ponds, borewells, or nearby irrigation was the single biggest determinant of success in the Rabi season. In Aland, where water was more accessible, crop performance was significantly better. In Jewargi, water stress during critical phases like flowering and seed setting led to widespread yield loss, especially in mustard and flaxseed.

- **Labor shapes what's possible:** While farmers appreciated the logic of multi-cropping and bio-input-based systems, the ground reality of labor shortage quickly surfaced. Many ReFarm plots were not adjacent to their main farm areas, making them harder to monitor or prioritize. With limited family labor and high opportunity costs during peak season, farmers often focused on their monocropped Pigeon Pea plots and left the new model plots under-attended - sometimes skipping irrigation or weeding altogether.

- **Each crop brought its own lesson:** Mustard showed early promise with strong germination, but couldn't sustain it - aphid and pod borer attacks, along with water stress during flowering, led to poor pod formation in over half the fields. Safflower proved resilient, with steady early growth and better tolerance to drought, but weed pressure and irrigation gaps dragged down its performance by harvest. Flaxseed was the most delicate - it struggled with germination, nutrient deficits, and drought stress, and without precise pest and water management, it quickly faltered. These outcomes reaffirm that agroecological suitability varies sharply, and every new crop demands deep local trialing and care.

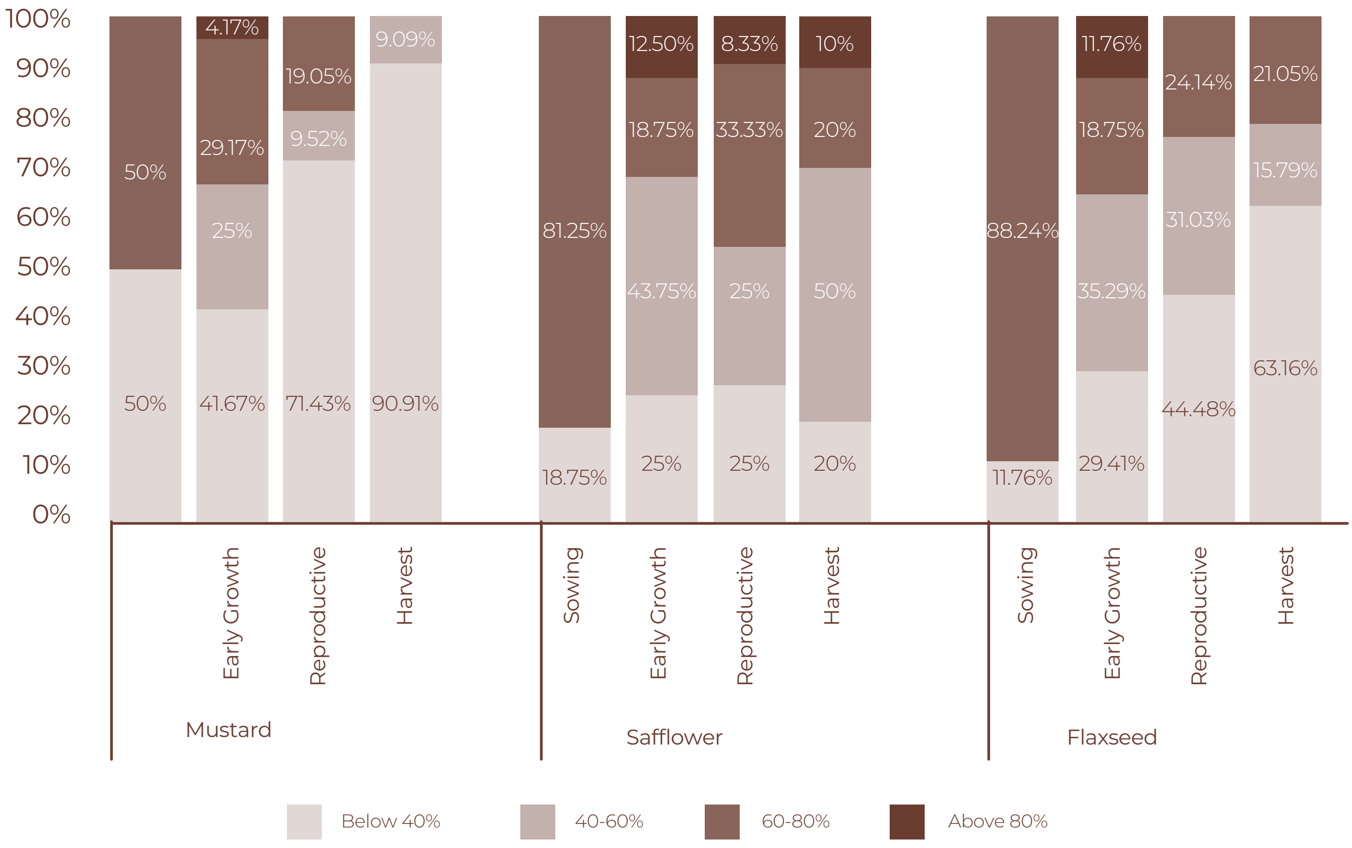


Figure 6: Crop survival trends in Rabi season[19]

- **Root training in local realities and social structures:** Effective adoption of organic practices hinges on trust in local facilitators, alignment with farming cycles, and visible economic incentives[20]. Investing in community-based facilitators, timing sessions with agricultural activities, and framing trainings around cost savings and yield gains can significantly boost participation and impact.

- **Move from one-time instruction to continuous, practical support:** Organic farming demands behavior change, labor, and experimentation. To overcome barriers, training must go beyond knowledge transfer - emphasizing hands-on learning, peer-driven reinforcement, simplified techniques, and long-term contextual support tailored to farmers' lived experiences.

- **Context matters more than any one intervention:** The same crops, sown using the same PoP, performed very differently across the two taluks. Factors like soil type, water access, household labor, and even farmer mindset led to wide variation. A farmer in Aland with a pond and good soil saw healthy safflower, while a peer in Jewargi on dry land with poor germination saw crop failure. These differences caution against assuming uniformity even within a 50-kilometer radius.

- **Transitioning to natural farming is a long game:** For many farmers, the biggest shift wasn't in what they planted—but in what they didn't use. Moving away from chemical fertilizers and pesticides toward bio-inputs required not just materials and training, but a mindset shift. Some lacked livestock to prepare inputs like jeevamrut; others weren't convinced that microbial sprays would work as well as chemical ones. These hesitations, coupled with unfamiliarity and risk-aversion, underscored that transitioning to natural farming isn't a one-season effort - it's a multi-year journey of change.

The experience reinforced a core lesson: **new ideas must earn trust gradually, not demand it upfront.** Shifting a cropping system is not just a technical decision - it's a social one, shaped by risk, habit, and history.

FARMER STORY

Shantappa Pujari

A Steward of Soil and Change

At 45, Shantappa Pujari doesn't own land - but that has never stopped him from thinking like a farmer and acting like a steward of the soil. As the trusted farm manager for Shailaja Kulkarni and her husband Narsing Rao Kulkarni's family, who collectively own over 40 acres in Munnahalli, Shantappa became one of the most engaged and curious participants in the ReFarm pilot. From the outset, Shantappa and his landowner Narsing Rao embraced the model wholeheartedly. He meticulously followed every POP suggested by the ReFarm team - planting all the recommended crops, preparing compost, and adopting new soil fertility techniques. He also consulted the ReFarm agronomists to make advanced bio-inputs like fish amino acid, Dashaparni Kashayam, and Jeevamrut, applying them across Shailaja's fields. He was one of the first to set up vermicomposting beds, recycling crop residue and cow dung to regenerate the soil. His initiative made him a model farmer in the village - and a quiet innovator in the field.

Shantappa also decided to run his own comparative experiment. On a small piece of land under his personal management, he grew toor dal (pigeon pea) using entirely organic methods he had learned through ReFarm. He compared it with five acres of conventionally grown toor dal in the other part of his farm, managed using chemical inputs.

Farming Method	Total Cost/Acre	Yield (quintals/acre)	Total Revenue per acre	Profit per acre
Organic	₹13,000	6.2	₹62,000	₹49,000
Chemical	₹19,000	5.8	₹58,000	₹39,000

Table 3: Shantappa's Toor Dal Trial: Organic Farming Outperforms in Cost, Yield & Profit

In the organic plot the input costs were only ₹3,000 whereas in the chemical plot it cost ₹9,000, significantly higher. These outcomes not only validated Shantappa's instincts but gave him the confidence to commit fully to regenerative farming. In his own words:

"The land gave me more when I gave it care, not chemicals."

He now plans to convert all 40+ acres under his care to organic methods, ensuring a healthier farm and lower costs for the family he works with. Not stopping at soil health, Narsing Rao and Shantappa also turned their attention to water. They took the initiative to deepen the farm pond constructed under ReFarm, converting it into an open well to increase water storage capacity. This intervention ensures that water is available year-round, reducing dependence on erratic rainfall and enabling off-season cultivation.

Income, Costs, and the Economics of Smallholding

At baseline, farming for ReFarm's smallholder participants was a **high-risk, low-return activity**, marked by dependence on rainfall and volatile markets. The **cost of cultivating one acre** stood at ₹13,238, covering land preparation, labor, and inputs. However, annual earnings were a modest ₹28,094per acre for rainfed farmers, compared to ₹43,436 for those with irrigation access. Without irrigation, farmers had limited flexibility- **no second crop, higher risk exposure, and fewer ways to recover from a failed season.**

Out of every ₹100 spent[21] on farming:

₹54 went to land preparation (tilling, weeding), the largest cost driver

₹19 to labor

₹16 to fertilizers and pesticides

₹11 to seeds

These numbers reflect a **heavy dependence on labor-intensive methods and chemical inputs**, particularly among farmers without access to family labor. Hired labor alone cost ₹2,518 per acre or more[22]. With **limited liquidity**, many farmers relied on credit, often from traders or informal sources, trapping them in a **cycle of**

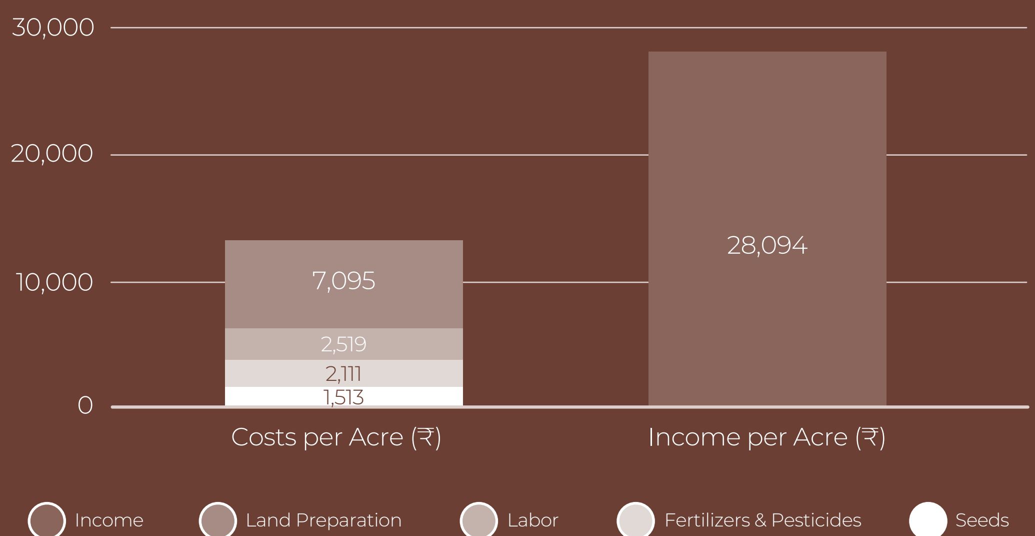


Figure 7: A typical Rainfed Smallholder Farmer's Cost Breakdown and Income per Acre[23]

debt that made long-term investments in soil health, irrigation, or diversification increasingly out of reach.

The thin margin of ₹14,856 per acre explains why stability remained out of reach. A single bad season could wipe out profits, deepen debt, and leave farmers with little to reinvest. ReFarm's guaranteed payout model sought to mitigate this by ensuring predictable income, but the baseline economics reveal the steep challenge of overcoming these cost drivers without structural shifts like reducing weeding expenses or improving access to affordable labor and inputs.

a. The Debt Trap: Who Did Farmers Borrow From?[24]

Despite receiving some government subsidies, rainfed smallholders remained financially vulnerable. Government support did reach about 70% of farmers in the form of free electricity and water, crop insurance (Pradhan Mantri Fasal Bima Yojana; PMFBY), and seed subsidies. However, the benefits were uneven. Free power and water primarily aided those with irrigation facilities, offering little relief to the rainfed majority. Crop insurance often failed to fully cover actual losses, and seed subsidies reduced only a fraction of overall input costs. These measures acted more as short-term buffers than long-term stabilizers, propping up an inherently fragile system without resolving underlying vulnerabilities.

The economic strain stretched beyond the farm. A typical ReFarm household had six members, with only two earning and four dependents. With average earnings of ₹27,873 per acre and many farmers cultivating under five acres, per capita income remained critically low. In years of poor yields or unexpected expenses, this income-dependency mismatch left families teetering on the edge, often forced to turn to credit just to manage daily needs.

With limited savings and unpredictable income, borrowing became a financial necessity rather than a choice. Nearly 45% of farmers accessed loans from banks, and another 31% turned to cooperatives. However, for those shut out of formal credit systems, informal borrowing filled the gap, albeit at higher risk. Around 18% relied on friends, family, or local moneylenders, often facing steep interest rates or ambiguous repayment terms. Only a small fraction accessed Self-Help Groups (4.48%) or microfinance institutions (1.59%), underscoring the limited reach of formal financial inclusion. In the absence of stable cash flows, farmers prioritized immediacy over affordability, deepening the cycle of debt and dependency.

b. ReFarm's Payout Model: Power and Limits of Guaranteed Payouts

One of ReFarm's boldest features was its **guaranteed payout structure**, a fixed income for farmers, independent of market returns. This was designed to:

- Remove financial fear, enabling experimentation with better practices
- Reduce dependency on informal lenders and break debt cycles
- Provide working capital for timely input and labor investments

At its peak, 50% of farmers relied on ReFarm payouts as their primary source of working capital. However, shifting long-standing financial habits took time with 35% still drawing from personal savings, and 15% continuing borrowing informally. While payouts brought greater stability, they didn't always cover all farming costs. Before ReFarm, 100% of credit needs were met through external borrowing with 82.09% from formal channels[25] and 17.91% from informal lenders. This marked a clear move toward internal financial resilience, but also highlighted the continued need for accessible, affordable credit in rainfed farming systems.

The question remained: Did financial security translate into better farming decisions? With a guaranteed payout in place, farmers had more freedom to choose but their choices varied widely. Some reinvested in their farms, buying bio-inputs or hiring labor during peak periods. Others treated the payout as a safety net, sticking to old practices rather than adopting new ones. A few prioritized immediate household needs over long-term investments in soil health. The key insight was: **security alone doesn't drive change, structure does.** Because payouts were tied to practices, not outcomes, many focused on compliance over productivity. Financial stability helped reduce risk but wasn't enough to shift ingrained behaviors shaped by generations of farming in a semi-arid, uncertain climate.

ReFarm's PoP marked a significant departure from traditional methods, moving from chemical inputs to regenerative farming. The PoP provided crop-specific guidance for Kharif and Rabi seasons, including seed treatments (like Trichoderma), soil conditioners (Gokrupa Amrut), and natural pest repellents. It also emphasized timely de-weeding, irrigation planning, and activity tracking through a Farm Calendar. However, adoption wasn't easy. Bio-input preparation was time-consuming, benefits were not immediately visible, and structured routines clashed with the demands of farmers' other lands. This highlighted a deeper challenge: aligning short-term realities with long-term behavioral shifts.

To track compliance[26], ReFarm used a Red-Amber-Green (RAG) compliance framework:

- **Green (High Compliance):** ≥90% of sprays applied on time[27] (Weighted Score: 0.668–1)
- **Amber (Partial Compliance):** 45–89% compliance, often with minor delays[28] due to labor or logistics (Weighted Score: 0.334–0.667)
- **Red (Low Compliance):** <45% compliance, with many applications skipped due to skepticism or time constraints (Weighted Score: <0.333)

This structure helped identify adoption trends and where support or course correction was needed. Across both seasons, 17.07% of farmers achieved Green, 60.98% were Amber, and 21.95% remained Red.

While a majority were partially compliant, and a growing minority adopted fully, several challenges slowed progress:

- **Time & Labor Constraints:** Aligning PoP activities with existing farm responsibilities proved difficult.
- **Skepticism & Short-Term Thinking:** Bio-inputs build soil health gradually, unlike fast-acting chemicals. Many farmers, seeking immediate results, lost motivation.
- **Future Market Uncertainty:** Though the program guaranteed a market for organic produce during its tenure, farmers were unsure about demand post-program especially given the relatively lower short-term yields of organic methods.

c. The Big Learning: A Hybrid Model Works Best

Our findings underscored a key insight: non-compliance wasn't driven by resistance alone, it reflected rational concerns, competing demands, and uncertainty about long-term viability.

Several trends emerged in how farmers responded to financial structures and agronomic expectations:

1. **Compliance vs. Incentives:** Some farmers did not fully adhere to the recommended PoP but still expected full payouts. Without a market-linked incentive, the focus for some shifted from improving production to merely collecting payouts, raising accountability challenges.
2. **Preference for Frequent Payments:** Farmers had the choice[29] of receiving payouts in 3 larger installments or 5 smaller, more frequent installments to align with different farming expenses. A clear village-level trend emerged - once lead farmers picked a certain payout model, others in the village followed the same. Farmers in Aland opted for 3 installments, while those in Jewargi preferred 5 installments. Though not explicitly stated, a possible reason is that Aland farmers, being relatively better off, could afford to wait for bigger sums, whereas Jewargi farmers needed regular cash flow to cover immediate expenses like labor and inputs. This highlights how financial conditions at a community level influence individual decisions, even when flexibility is provided.

The most effective financial model, we found, was a hybrid one that balanced:

1. A fixed base payout to reduce risk and build confidence.
2. Harvest linked payouts to maintain output motivation.
3. Performance-based incentives to encourage adherence to agronomic best practices.

This layered structure balanced security with accountability and reinforced a core lesson: behavior change requires more than money - it needs smart incentives that reward effort, build ownership, and nudge sustainable choices.

Equally important was the realization that **community-led change matters most.** Sustainable adoption wasn't driven by top-down mandates, but by peer influence. When farmers saw local champions succeed and co-designed the journey, change became both credible and replicable. Social proof, not pressure, made the shift stick.

The Market Challenge: Stability vs Reality

For most ReFarm farmers, traditionally market access was dictated by necessity rather than strategy. **With no storage facilities and immediate financial needs, 70% of farmers sold to local traders, prioritizing quick payments over higher prices.** While larger buyers or Agricultural Produce Market (APMC) markets could offer better rates, logistical barriers and delayed payments made them less viable options. Limited awareness of alternative market channels further reduced bargaining power, reinforcing dependence on middlemen and keeping farmers locked in short-term survival cycles rather than long-term profitability.

ReFarm sought to change this equation. By guaranteeing a fixed payout and taking responsibility for market linkages[30], we aimed to de-risk farming while securing better prices for crops. The reality, however, proved more complex. Some crops had strong demand, while others suffered from price fluctuations that made guaranteed pricing difficult to sustain.

a. Case Study: Market Fit Lessons from Sunflower and Safflower

Sunflower, despite being a known crop in Gulbarga, posed unexpected marketing challenges. While de-shelled sunflower seeds of a different confectionery variety sell for four times the price of raw seeds, the region lacked de-shelling infrastructure, limiting how the crop could be sold.

Markets around Gulbarga favor crops traditionally grown within a 50-100 km radius. While sunflower had once been popular, falling prices and high labor requirements had led to reduced cultivation. As a result, selling options were limited to

1. Selling unprocessed sunflower seeds at the mandi at prevailing prices.
2. Processing it into oil for direct sale

To maximize returns, ReFarm facilitated a collective processing arrangement. A local ghana (oil mill) agreed to extract oil for free in exchange for the leftover seed

Photo 15: Kharif yield of Sunflower seeds

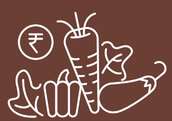
cake, which it purchased at ₹4 per kilo. This partnership made oil extraction viable, but also revealed the importance of processing infrastructure in ensuring fair prices for farmers.

Coriander and mustard faced similar hurdles. Neither were staple commercial crops in the region, meaning local buyers were hesitant to purchase in bulk. Without a pre-established market, these crops had to be transported to city markets, adding logistical costs and uncertainty. The lesson was clear: new crops require not just agronomic success, but also a well-established buyer network.

Unlike sunflower, safflower fit seamlessly into the region's market ecosystem. Already grown in large quantities in Rabi, it had dedicated oil mills eager to purchase in bulk. Buyers approached ReFarm directly, and even local farmers were willing to purchase the safflower harvest at market rates.

This contrast between sunflower and safflower underscored a crucial insight - market demand must drive crop selection. Without a ready buyer or processing support, high-value crops remain unsustainable beyond an intervention like ReFarm. The challenges we faced in marketing certain crops would likely persist for farmers post-exit, reinforcing the need for stronger market linkages before introducing new crops at scale.

The biggest lesson from the pilot was clear- market access isn't just an enabler, it's a prerequisite.



New crops, no matter how promising, must have a direct market connection.

Smallholder farmers don't have the luxury to experiment if they can't be certain of a sale.

Market access isn't just about selling. It's about ensuring the right buyers, infrastructure, and demand exist before farmers take the risk of growing something new or one that local markets don't have a need for.

The Road Ahead: From ReFarm to Resilient Villages

ReFarm set out to answer an ambitious question: Can smallholder rainfed farming be made more secure, profitable, and climate-resilient, at scale through structured water interventions, financial support and market access? While the model did not scale as intended, it provided invaluable on-ground experience that continues to shape our thinking and has left behind a rich body of insights for anyone working to improve the resilience and incomes of small and marginal farmers.

We learned that technical feasibility alone isn't enough, what matters is how deeply an intervention aligns with farmers' economic realities, social dynamics, and local ecosystems. The cost of farm ponds, the need for ongoing compliance, and the volatility of markets posed significant barriers. Even the most well-intentioned models face friction when operating at an individual plot level, without embedded systems of support or scale.

Yet ReFarm also demonstrated that when the conditions are right, when water security, trust, and economic incentives align, farmers are ready to adapt. We saw glimpses of transformation: increased soil health awareness, better adoption of composting, and early shifts toward diversification. These shifts, however, were fragile, dependent on continuous external support, and difficult to sustain in isolation.

a. Pilot Takeaways: What We're Taking Forward

Key insights from ReFarm now inform a broader, more integrated vision of rural transformation:

- Water security must be contextual and community-driven, with a pre-intervention assessment of water needs, understanding of groundwater availability, and cropping intensity.
- New crops need a trust curve. Gradual introduction with strong hand-holding builds farmer confidence and adoption.
- Market-driven crop selection is essential. Without real, accessible demand and buyers, even high-value crops are unsustainable.
- Local processing unlocks value helping farmers move beyond raw produce to higher-margin products.
- Incentive structures must evolve combining fixed payouts with performance-linked rewards to balance security and accountability.

And most importantly: farming change cannot be top-down. It must be a pull-driven process, built on farmer demand, trust in peers, and collective ownership.

b. From Plots to Panchayats: The Next Chapter

The ReFarm experience also reaffirmed a broader insight: interventions that operate at the level of the individual farmer, especially in fragmented, rainfed ecosystems, face natural limitations. Impact dissipates when the approach is too atomized.

We are now seeing that landscape or village-level models, which layer together multiple interventions across water, soil, livelihoods, and markets, have a far better chance of delivering resilient outcomes. These models allow for:

- Geography-wide water management (including ponds, recharge, and cropping patterns)
- Community ownership of water assets
- Community-level cropping and market strategies
- Cluster-based market linkages and aggregation
- Peer learning and social norming around new practices
- Social mobilization that centers farmer voice and leadership
- And better convergence with public schemes

The road ahead lies in moving from plot-level interventions to integrated village ecosystems where climate-resilience, livelihood security, and farmer agency are not treated as separate silos, but as interconnected levers of change.

Poverty and exclusion are rooted in complex, interlinked, and systemic challenges that affect the entire village ecosystem. Addressing these requires a holistic, village-wide approach, one that goes beyond individual livelihoods to include natural resource management, climate-resilience, and other local barriers to progress. By layering interventions such as improving access to clean water, enhancing nutrition, and strengthening market linkages, we unlock powerful synergies. Healthier families are better able to participate in income-generating activities, while increased household income leads to better education outcomes and overall well-being. Evidence shows that such integrated efforts create a compounding effect, laying the groundwork for inclusive and sustained growth. By shifting the focus from piecemeal solutions to whole-community transformation, we aim to address the root causes of poverty and enable long-term socio-economic mobility.

ReFarm has laid a strong foundation offering grounded learnings, hard-won insights, and a deeper understanding of what it takes to build resilient, dignified, and future-ready villages. These experiences continue to inform and inspire the way forward. By sharing what we've learned, we aim to contribute meaningfully to the growing dialogue on transforming rainfed farming- not just into a viable livelihood, but into a vibrant and enduring one.

Appendix

1. Calculation of Harvested Rainwater and Conserved Topsoil from 41 Farm Ponds.

Annual Rainfall in Gulbarga (2024): Approximately 777 mm[31] (0.777 meters)

Runoff Coefficient for Agricultural Land: Typically ranges from 0.2 to 0.3 and is more for areas with black cotton soil; for this calculation, we use an average value of 0.25

Surface Area Contributing to Runoff per Pond: 1 acre = 4,046.86 square meters. In many farms, the total surface area contributing to the rainwater harvested was a lot more than 1 acre.

Volume of Rainfall on 1 Acre:
0.777 meters (rainfall) × 4,046.86 m^2 = 3,145.4 cubic meters

Volume of Runoff Collected per Pond:
3,145.4 m^3 × 0.25 (runoff coefficient) = 786.35 cubic meters

Total Runoff Collected by 41 Ponds:
786.35 m^3 × 41 = 32,238.35 cubic meters

Conversion to Liters:
32,238.35 m^3 × 1,000 = 32,238,350 liters

Thus, the 41 farm ponds collectively harvested approximately **32.24 million liters** of rainwater in 2024.

Soil erosion is a significant concern in Indian agriculture. The average soil erosion rate in India is estimated at 16.4 tonnes[32] per hectare per year.

Soil Erosion per Acre:
16.4 tonnes/ha × 0.404686 ha/acre = 6.64 tonnes per acre

Total Soil Erosion Prevented by 41 Ponds:
6.64 tonnes/acre × 41 acres = 272.24 tonnes

By capturing runoff, the farm ponds potentially prevented approximately 272.24 tonnes of topsoil from being eroded in 2024. Enhanced water availability, soil fertility preservation, reduced sedimentation in water bodies and improved climate-resilience all are downstream benefits of the farm ponds.

2. Farmer Training in ReFarm

Training was designed in two key formats:

a. Expert-led Monthly Agronomy Training: Conducted by Laxmi Lokur, a National Award-winning farmer, these sessions combined group meetings and on-farm visits. The focus was on farm health, soil and crop assessment, PoP adherence, and technical guidance on pest and nutrient management.

b. Cluster-Based Training Sessions: Smaller sessions with 5–6 geographically grouped farmers, led by field staff fortnightly. Designed to build peer learning, reinforce PoPs, and support organic practice adoption.

Farmers were also introduced to a new tracking tool - A Farm Calendar- to systematically track daily farm activities and PoP compliance. However, adoption was low due to:

- Low perceived value: Farmers did not see a direct benefit in maintaining records and it added to their existing farm based effort.
- Lack of habit formation: Regular farm activity tracking was not a standard practice, and this behavior change required more incentive.
- Limited accountability mechanisms: No direct incentives were linked to calendar usage.

Given these gaps, the monitoring PoP adherence was done by field officers and agronomists through direct farm inspections. Some practices like weeding were more tangible and easier to verify; others like spraying bio inputs relied on self-reporting.

The training effectiveness was tracked through attendance and engagement[33] levels.

Training Type	Attendance Rate	Engagement Pattern	Key Observations
Expert-Led Monthly Training	85%	High	Farmers valued technical depth and saw direct benefits.
Peer Led Cluster based Trainings	60% (Aland), 45% (Jewargi)	Variable	Peer-driven learning was effective where trust existed.

Table 4: Training Model comparison (Expert-led vs Peer-led learning)

Farmer engagement between November and January revealed that combining expert-led sessions with peer-based clusters created a balanced learning model. Training linked to income-generating practices (e.g., composting, border cropping with Subabul) saw higher participation. Organic pest control had low uptake, and most farmers waited for early adopter results. Aligning training with farmer priorities and simplifying delivery improved engagement.

3. Abbreviations

Abbreviation	Full Form	Description
APMC	Agricultural Produce Market Committee	A state-level marketing board in India that regulates the sale of agricultural produce, often through designated market yards.
FPO	Farmer Producer Organization	A collective of farmers, typically registered as a company or cooperative, aimed at improving market access and bargaining power.
GIS	Geographic Information System	A system for capturing, storing, analyzing, and displaying geospatial data, used here for mapping topography in farm pond site selection.
KYC	Know Your Customer	A process used by financial institutions to verify client identity, often a barrier for smallholder farmers accessing formal credit.
KVK	Krishi Vigyan Kendra	Agricultural Science Centers in India that provide extension services, training, and technology transfer to farmers.
MSP	Minimum Support Price	A government-set price at which certain crops are procured to protect farmers from market price fluctuations.
PMFBY	Pradhan Mantri Fasal Bima Yojana	A government-sponsored crop insurance scheme in India to provide financial support to farmers in case of crop loss.
PoP	Package of Practices	A set of recommended agronomic practices tailored to specific crops and seasons to optimize yield and sustainability.
RAG	Red-Amber-Green	A compliance framework used to assess adherence to recommended practices, with color coded levels indicating high, partial, or low compliance.

References

1. As per India's Agriculture Census 2015-16, 86.1 percent of Indian farmers are small and marginal (SMF)
2. 10th agriculture census 2015-16
3. Exceptions were made to the stated eligibility criteria to include influential progressive farmers who could serve as early adopters and local champions for broader adoption.
4. A baseline study was conducted with all 41 farmers of the cohort to understand their landholdings, their agricultural practices prior to joining ReFarm through a survey questionnaire consisting of 100+ questions. The insights in this section capture the results of the baseline study to represent the demographics of the farmers we worked with.
5. Allied farm-based activities: Horticulture, animal husbandry, sericulture, tractor lending, agricultural wage labor.
6. Stable, salaried income: Government jobs, private sector employment, pensions.
7. Business and trading: Cotton brokerage, goldsmithing, independent enterprises.
8. Calculations of rainwater harvested and topsoil prevented are detailed in Appendix 1.
9. Four farm ponds did not hold water at all post construction.
10. Source: ReFarm Farm Pond Survey.
11. Source: ReFarm Farm Pond Survey.
12. Source: GOI, Ministry of Jal Shakti, Ministry of Water Resources, RD & GR, Central Ground Water Board, Aquifer Management Plan of Jewargi Taluk, Kalaburagi District, Karnataka State, by Dr. J. Davithuraj (Belagavi: State Unit Office, October 2020); Bharath Kumar L, "Water Table Characteristics and Mapping of Gulbarga Taluk, Gulbarga District, Karnataka using ArcScene Software," in Innovative Energy Technology Systems and Environmental Concerns: A Sustainable Approach, ISBN: 978-93-84144-81-4 (Kadaganchi: Central University of Karnataka, Department of Geology, n.d.); Seedari Ujwala Rani et al., "Impact of Krishi Bhagya Yojana (KBY) Farm Pond Technology on Semi-Arid Farmers in North Eastern Transition Zone of Karnataka State in India," International Journal of Environment and Climate Change 13, no. 11 (2023): 2697–2706
(Kalaburagi district, formerly known as Gulbarga, is one of the 31 districts of Karnataka. Renamed in 2014, Kalaburagi translates to "Stony Land" in Kannada.)
13. Source: Indian Meteorological Department (https://mausam.imd.gov.in/)
14. The Kharif season varies by crop and region, starting at the earliest in May and ending at the latest in January. In India, the season is popularly considered to start in June and end in October. Kharif crops are usually sown at the beginning of the first rains during the advent of the south-west monsoon season, and they are harvested at the end of monsoon season (October–November).
15. Rabi crops are sown around mid-November, preferably after the monsoon rains are over, and harvesting begins in April / May. The crops are grown either with rainwater that has percolated into the ground or using irrigation.
16. This figure represents a snapshot of regional cropping patterns, not individual farmer-level diversification. (Source: ReFarm Baseline Survey)
17. Source of Gulbarga yield estimates:
https://des.karnataka.gov.in/storage/pdf-files/AGS/2019-20%20FRE.pdf
18. Appendix 2 details out the two tiered training models at ReFarm.
19. Below 40%: Severe health decline (Indicates major crop loss—pests, water shortages, or poor management often strike, leaving yields minimal. Most fields struggle to recover.)
40–60%: Moderate health, limited potential (Reflects partial survival—growth is uneven,

often due to weed pressure or nutrient gaps. Yields are compromised but salvageable.)
60–80%: Good health, steady progress (Shows resilient crops - pest control and irrigation are typically in place, supporting decent yields with room for improvement.)
Above 80%: Optimal health (Marks thriving fields - timely inputs and water align, driving high survival and strong harvests. Rare without consistent care.)

20. Training sessions linked to income generation like composting or border cropping with Subabul saw notably higher participation and interest.
21. Note: Harvest costs (e.g., transport and storage) are not included in the cost per acre.
22. Source: ReFarm Baseline Survey
23. Source: ReFarm Baseline Survey
24. Source: ReFarm Baseline Survey
25. Formal credit sources before ReFarm: banks, cooperative societies, self-help groups (SHGs), and microfinance institutions. (Source: Baseline Survey)
26. Adherence was tracked through a structured system that measured farmer compliance across four key growth stages - Sowing, Early Growth, Reproductive, and Harvest. Farmers were ranked based on whether they applied the sprays on time, late, or not at all. Each action was assigned a score, with timely applications receiving the highest weightage.
27. A delay by up to two days was accepted.
28. Minor delays were a delay of 2-5 days after prescribed time
29. This choice was given so that farmers could decide what suited their financial needs better.
30. ReFarm collected harvests directly from farmers, taking on the responsibility of securing market connections and negotiating with buyers, ensuring farmers did not have to sell individually.
31. Source: OpenCity Karnataka State Annual Report https://data.opencity.in/datase
32. Source: Soil Erosion: Causes, Extent and Management in India Dr. Jitender Saroha, Associate Professor https://ijcrt.org/papers/IJCRT1704172.pdf
33. Engagement was defined by how many times the farmers spoke / asked questions in the meetings.

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