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Pakistan, Water Scarcity

Community-Based Water Cooperatives: A Scalable Solution for Punjab's Farmers

The Crisis: Pakistan Is Running Out of Water
"The abrupt increase in temperature this year in June caused severe water stress, and I was compelled to squeeze the irrigation interval to four days to combat the water stress" (Ashraf et al.). This cotton farmer from Punjab isn't alone in his struggle. Pakistan has dropped from 5,260 cubic meters of water per person in 1951 to just 1,032 cubic meters in 2016 (United Nations Development Program). That pushes Pakistan way past the line into serious water scarcity. Meanwhile, cotton farming—which uses up to 2,483 cubic meters of water per ton—consumes most of Pakistan's water but brings in little money compared to food crops that could feed people (Mekonnen and Hoekstra).

Punjab province grows about 70% of Pakistan's cotton, and farmers there face an impossible choice: grow cash crops like cotton or have enough water left to grow food that people actually eat (Ayub Agriculture Research Institute). Cotton requires the equivalent of 500 to 1,000 swimming pools of water just to grow one ton! Current flood irrigation wastes 40% to 50% of water, but individual farmers can't afford the $800 to $1,200 for drip irrigation systems that cut waste to under 10% ("Saving Water, One Drip at a Time"). The solution is community-based water co-ops in Punjab's cotton-growing areas. By learning from successful programs in Morocco, farmers can work together to reduce water use while improving crop yields (Sabir et al.). This approach works with Pakistani social structures instead of against them.

The Real Problem: Farmers Can't Work Together
The current water system, called *Warabandi*, gives farmers water on a rotating schedule based on land ownership (Bandaragoda and Rehman). But there's never enough water, and farmers are getting desperate. Individual farmers can't afford efficient irrigation and can't coordinate to buy equipment together. This coordination failure keeps everyone trapped in wasteful methods.

Big infrastructure projects get cancelled because they're too expensive. Policy reforms get blocked by powerful landowners. Water markets barely exist. This is exactly what co-ops can solve by giving farmers collective power they lack individually.

Why Co-ops Work Where Others Have Failed
Water co-ops build on Punjab's existing *baradari* system—family and community networks that already share resources and make decisions together. According to Baloch (2022), baradari networks have managed shared agricultural resources for generations through resource allocation, collective decision-making, and conflict resolution—exactly what water co-ops need (Baloch, 5-7).

The baradari leadership structure provides a template for co-op governance. These networks select leaders based on trust and competence rather than wealth, rotate responsibilities to prevent power concentration, and maintain transparency through public discussion (Baloch, 12). Islamic water law principles like "right of thirst" traditionally prioritize community access over individual profit, suggesting religious support for cooperative approaches.

Co-ops solve the coordination problem by pooling money so farmers can afford drip irrigation, negotiating as a group for better prices, and monitoring water use together to prevent over-pumping.

The governance structure shows how 25 farmers elect three key leaders who coordinate with outside partners. This simple structure prevents any single person from having too much control while ensuring clear responsibility for water management, finances, and conflict resolution.

How the Cooperatives Would Work

Each water cooperative would focus on four main areas:

1. **Buying Equipment Together**: 25 farmers could split the cost of expensive drip irrigation systems, making them affordable for everyone.

2. **Monitoring Water Use**: The group would track groundwater levels using simple methods like weighted rope measurements monthly, pump runtime logs, and shared record keeping. If water levels drop too fast, the group could reduce pumping or stagger schedules.

3. **Negotiating as a Team**: 25 farmers have much more power than one when dealing with equipment sellers or government officials.

4. **Teaching Each Other**: Farmers learn new techniques better from other farmers than from outside experts.

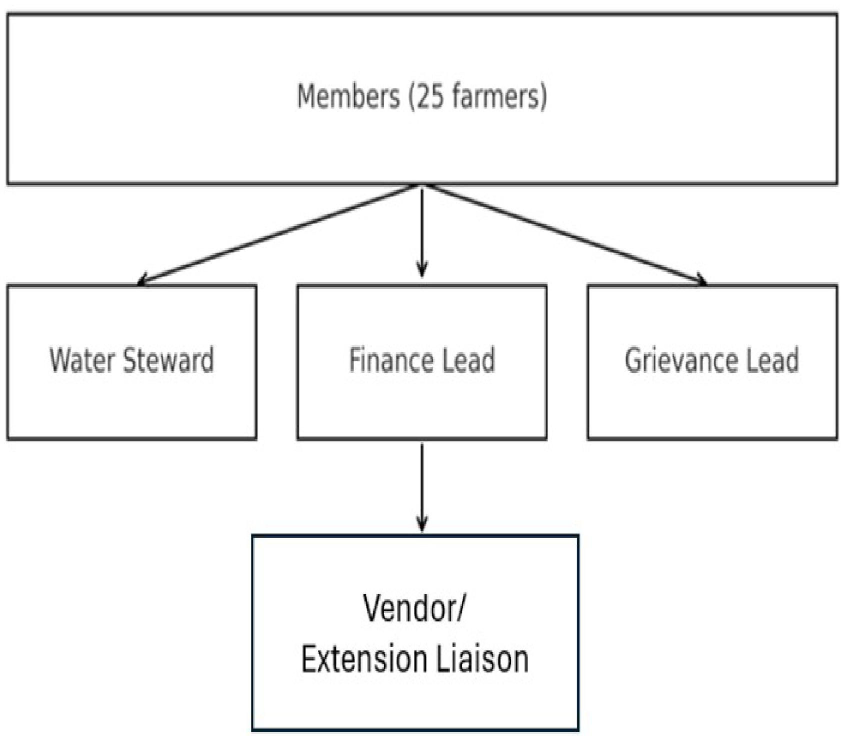

Figure 1. Co-Op Governance Diagram (members → elected leads → vendor/ extension liaison)

A Day in a Co-op (User Journey)

This short example shows how the co-op organizes turns, checks groundwater, and handles maintenance and disputes on a normal irrigation day:

6:30 a.m. – Water steward posts the day's schedule on a public board and WhatsApp group.

7:00–11:00 a.m. – Morning turns. Each farmer logs pump start/stop times on a shared sheet.

11:15 a.m. – Groundwater check. Two members lower the weighted rope and record the depth.

12:00 p.m. – Short huddle: if water is down >10 cm from last week, afternoon turns are shortened by 10 minutes each.

1:00–4:00 p.m. – Maintenance window. Vendor tech replaces one inline filter under the co-op's service agreement.

4:30–6:30 p.m. – Afternoon turns. Any disputes go to the elected grievance lead; minor violations trigger a warning; repeat violations pay a small fine that funds repairs.

7:00 p.m. – Finance lead posts daily summary: m^3 used, downtime, and issues for follow-up.

A simple routine illustrated in the example above would keep the system fair, transparent, and easy to run.

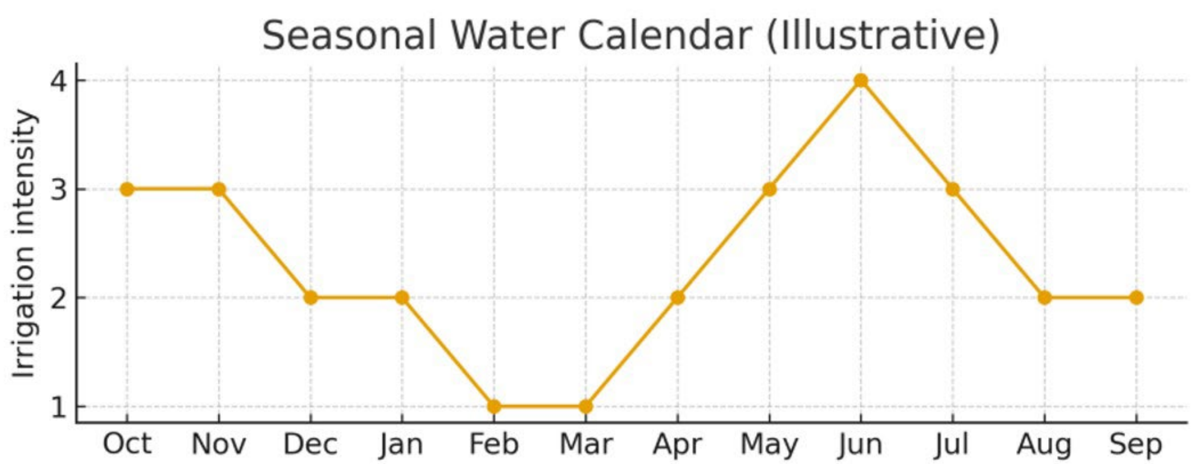

Figure 2. Seasonal Water Calendar (illustrative irrigation intensity across months).

Figure 2 above depicts how water demand rises and falls throughout the year, guiding our co-op's turn lengths, repair timing, and groundwater monitoring so the system stays fair and reliable when farmers need it most.

Water demand changes dramatically throughout the year, with peak irrigation during hot summer months (June-July) when farmers like the one quoted earlier had to water every four days. The seasonal calendar helps co-ops plan turn lengths, schedule repairs during low-demand periods, and monitor groundwater more carefully when demand is highest.

Government Support and Partnerships

Co-ops can plug into programs Punjab already runs:

- **District Agriculture Extension** provides training and a contact person for help and monthly check-ins (Agriculture Department, Government of the Punjab)
- **High-Efficiency Irrigation Systems (HEIS) vendors** install systems and provide quick repairs within 72 hours (Government of the Punjab, PIPIP/HEIS; World Bank)
- **Microfinance institutions** give group loans with payments timed to harvest (State Bank of Pakistan)
- **Local mosques or community centers** post water-turn schedules and groundwater readings publicly to reduce conflicts (Shah, Bell, and Anwar)

The Numbers: Water Savings and Costs

Pakistani field studies show that optimized irrigation scheduling alone can reduce water consumption by 14-18% while maintaining yields (Sajid et al.). When combined with drip irrigation technology, co-ops could achieve even greater savings.

Water Savings Calculation: Based on cotton's water requirement of 1,476-2,483 cubic meters per ton (Mekonnen and Hoekstra) and typical Punjab farm sizes, a 25-farmer co-op covering approximately 58 acres could save an estimated 96,000 cubic meters annually through 30% efficiency improvements from combined scheduling and drip irrigation.

Cost Breakdown for 25-Farmer Pilot Co-op:

- Drip irrigation systems: $13,750 ($550/acre × 25 acres)
- Filters/mainline/valves: $5,500 ($220/acre × 25 acres)
- Installation and training: $1,875 ($75/acre × 25 acres)
- **Total upfront cost: $21,125 (about $845 per farmer)**

With Punjab's 60% subsidy for high-efficiency irrigation, farmers pay only $338 each upfront (Government of the Punjab; World Bank). Annual maintenance costs about $450 total—just $18 per farmer.

Morocco's MOURAFAKA program provides the best comparison. They have water shortages, they're a Muslim country, and they grow cotton on small farms just like Pakistan. Research on hundreds of cooperatives shows that supported ones had much higher success rates and lower costs compared to farmers working alone (Sabir et al.). What made them successful: starting slowly, hands-on training, financial transparency, and ongoing technical support.

Three-Phase Rollout Plan

Years 1-2: 25 pilot co-ops in five districts (Multan, Vehari, Khanewal, Sahiwal, Lodhran) to prove the concept

Years 3-4: Expand across all five districts for better negotiating power with officials and suppliers

Years 5+: Successful co-ops mentor new ones, creating self-sustaining expansion

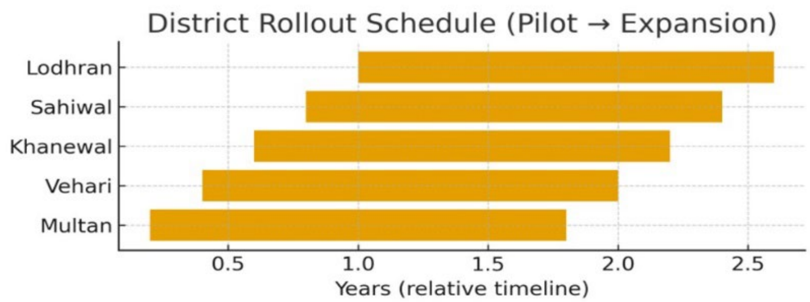

Figure 3. District Rollout Schedule (pilot to expansion).

Figure 3. District Rollout Schedule

The rollout starts with Multan and gradually expands to all five districts over 2.5 years. This staggered approach allows early co-ops to work out problems and train later ones, while building the political and economic support needed for province-wide expansion.

Managing the Risks

Challenge: Farmers don't know drip irrigation maintenance
Solution: Pair each new co-op with experienced farmers who already use this technology

Challenge: Many farmers can't get loans
Solution: Let farmers start with labor and local materials, then buy full membership once they profit

Challenge: Some areas are losing groundwater fast
Solution: Start co-ops where water situation is bad but not hopeless

Challenge: Politicians might try to take control
Solution: Keep transparent records, post schedules publicly, use secret ballot voting, and rotate leadership every 6-12 months

Expected Impact

Phase 1 (Years 1-2): Pilot Results

- 25 co-ops × 25 farmers = 625 farmers
- Water savings calculation: Each co-op covering ~58 acres saves 96,000 cubic meters annually (based on 30% efficiency improvement from baseline cotton water use of 1,600-2,400 cubic meters per acre)
- Total water savings: 25 co-ops × 96,000 cubic meters = 2.4 million cubic meters annually

Phase 2 (Years 3-4): District Expansion

- 200 co-ops across 5 districts = 5,000 farmers
- Total water savings: 200 co-ops × 96,000 cubic meters = 19.2 million cubic meters annually

Phase 3 (Years 5+): Provincial Scale

- Target: 2,000 co-ops = 50,000 farmers (approximately 8% of Punjab cotton farmers)
- Total water savings: 2,000 co-ops × 96,000 cubic meters = 192 million cubic meters annually

Note: These projections assume 30% efficiency improvements through combined drip irrigation and better scheduling, based on Sajid et al.'s documented 14-18% savings from scheduling alone. Adoption rates assume 30% participation among eligible farmers—conservative compared to Morocco's 65% adoption rate (Sabir et al.).

Conclusion: Time is Running Out

Pakistan's water crisis isn't just about resources but also about farmers not being able to work together. Water co-ops offer a realistic solution because they work within Pakistan's culture and economy while addressing the root causes of waste.

The international evidence is clear: well-designed agricultural co-ops achieve strong results when adapted to local conditions. Pakistan has advantages: strong family networks, Islamic values supporting cooperation, good infrastructure in Punjab, and farmers ready for change.

Every year of delay means more groundwater being depleted, more farmers abandoning their land, and more families going hungry. Water co-ops can turn Pakistan's greatest challenge—coordinating millions of individual farmers—into its greatest strength by working with existing social bonds.

The evidence is overwhelming. The tools are ready. The farmers are willing. But Pakistan must act now. Tomorrow, another thousand wells will pump closer to empty. Tomorrow, another hundred families will consider abandoning farming. The question isn't whether co-ops work because Morocco proved they do. The question is whether Pakistan will use them before it's too late.

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