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Community Water Budgeting for Drought-Prone Agriculture

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Abstract

Agricultural drought becomes particularly disruptive when seasonal crop-water demand is planned independently of the volume of water realistically available to a farming community. Individual farmers may respond rationally to crop prices, private wells, and short-term livelihood requirements while collectively creating irrigation demand that exceeds groundwater recharge, stored surface water, or expected seasonal supply. Community water budgeting offers a mechanism for converting hydrological information into shared cropping and irrigation decisions before scarcity becomes an emergency. This study develops a methodological framework for community water budgeting in drought-prone agriculture by integrating rainfall, groundwater storage, surface-water availability, essential domestic and livestock reserves, crop-water requirements, irrigation efficiency, uncertainty margins, and collectively negotiated demand adjustments. Because authenticated village water balances, groundwater observations, and farm-level crop records were not supplied, the quantitative component is explicitly simulation based. A synthetic portfolio of 160 farm households is evaluated under near-normal, moderate-drought, severe-drought, and extreme-drought scenarios.

A Community Agricultural Water Budget Index is proposed to assess monitoring quality, transparency of water availability, demand estimation, collective participation, equity protection, and implementation follow-through. Simulated analysis shows that community-adjusted crop plans reduce the average modeled seasonal irrigation deficit from 34.8% under uncoordinated individual planning to 19.5%, an absolute reduction of 15.2 percentage points. The benefit becomes more pronounced as drought severity increases, although community budgeting cannot eliminate scarcity under extreme water shortage. The study argues that water budgeting should not be treated merely as an accounting exercise. Its principal value lies in making the consequences of individual cropping decisions collectively visible before sowing and enabling negotiated adjustments in crop type, irrigated area, sowing sequence, supplemental irrigation, and groundwater reserves. Effective implementation requires reliable local monitoring, inclusion of farmers without wells, transparent assumptions, livelihood-sensitive rules, and institutional links with extension and water-management agencies.

Keywords: community water budgeting, drought-prone agriculture, groundwater governance, crop-water budgeting, participatory water management, drought resilience, irrigation planning, common-pool resources

1. Introduction

Water scarcity in agriculture is often experienced as a farm-level problem but generated at a hydrological scale larger than an individual holding. Farmers make decisions concerning crop choice, planted area, irrigation frequency, and groundwater pumping according to household needs, expected prices, available wells, credit, and climatic expectations. When many farmers depend on the same aquifer or small watershed, however, the consequences of those individual decisions accumulate. One farmer's additional groundwater abstraction can reduce the water available to others, increase pumping depth, or leave insufficient reserves for later crop stages. This characteristic makes groundwater a difficult common-pool resource: access can be decentralized and privately controlled even though the underlying resource is physically interconnected. Shah's analysis of groundwater governance in South Asia emphasizes how widespread private well development can generate major agricultural benefits while creating governance challenges that are poorly suited to conventional centralized irrigation-management approaches.

Drought intensifies this problem because uncertainty affects both water supply and agricultural demand. Rainfall may arrive late, terminate early, or be unevenly distributed within a season, while declining groundwater levels can constrain supplementary irrigation precisely when crops reach sensitive growth stages. Research on groundwater-dependent agriculture indicates that continued depletion can substantially reduce the capacity to sustain dry-season cropping and cropping intensity. Jain and colleagues showed that depletion of groundwater threatens the ability of agricultural systems to maintain current levels of irrigated production where alternative irrigation supplies are limited. Agronomic research also demonstrates that scarce irrigation water should be allocated according to crop sensitivity and water productivity rather than uniformly, since controlled deficit irrigation can conserve water in appropriate crops and growth stages while limiting yield penalties.

Community water budgeting attempts to move these decisions from isolated farm planning toward collective resource planning. Under participatory groundwater initiatives in drought-prone agricultural regions, farmers have been trained to measure rainfall, groundwater levels, well discharge, and other local hydrological variables and then use these observations to compare available water with proposed crop-water demand. The Andhra Pradesh Farmer-Managed Groundwater Systems experience is particularly relevant because its operational model combined participatory hydrological monitoring, Farmer Water Schools, crop-water budgeting, and demand-side groundwater management. FAO documentation describes the project's central premise as enabling groundwater users to understand the resource and manage agricultural demand through better-informed voluntary decisions.

The value of such budgeting is not exclusively technical. Groundwater is difficult to govern partly because individual users may not perceive how their crop choices influence the shared aquifer. Meinzen-Dick and colleagues demonstrated through collective-action games that discussion of groundwater interdependence and crop choice can alter community understanding and strengthen the likelihood that communities develop groundwater rules and monitoring practices. Evidence from long-running participatory groundwater programs likewise suggests that community monitoring and water planning can improve groundwater literacy and adaptive awareness, although impacts on aquifer decline can remain localized and equity problems may persist when governance structures do not adequately represent all users.

The present study develops a structured framework for Community Water Budgeting for Drought-Prone Agriculture. Its central proposition is that an effective water budget should combine hydrological accounting with participatory agricultural planning. The community first estimates water that can reasonably be used without compromising essential household, livestock, and future-season requirements; proposed crop plans are then translated into expected water demand; and any deficit is discussed before planting decisions become costly to reverse. Because no verified community dataset has been provided, the study uses transparent synthetic scenarios rather than fabricated field results. The proposed framework is intended to support future empirical evaluation of whether community budgeting can improve drought preparedness, crop-plan feasibility, irrigation equity, groundwater stewardship, and livelihood resilience.

2. Objectives of the Study

2.1 To Develop a Community-Level Agricultural Water Budgeting Framework

The first objective is to develop a transparent budgeting structure through which communities can compare expected seasonal water availability with anticipated agricultural demand. The framework incorporates rainfall-derived recharge, accessible groundwater, surface storage, expected inflows, and usable water carried forward from previous periods while reserving appropriate quantities for domestic consumption, livestock, ecological requirements where applicable, and drought contingency.

The framework is intentionally designed at a community or hydrological-unit level rather than at the individual-well level. This is necessary because separate household calculations cannot reveal cumulative demand on a shared aquifer. The budget therefore translates individual crop plans into collective irrigation demand so that the community can identify potential deficit before the cropping season is fully committed.

2.2 To Evaluate Drought-Responsive Crop and Irrigation Adjustments

The second objective is to examine how water-budget information can support practical adaptation under different drought conditions. The framework does not prescribe one universal low-water crop. Instead, it creates a decision space in which farmers can compare alternatives such as reducing irrigated area, changing the crop mix, shifting sowing dates, reserving irrigation for critical growth stages, sharing wells, increasing protective irrigation, or adopting more efficient application methods.

This approach recognizes that water-saving strategies must remain agronomically and economically credible. Deficit-irrigation research indicates that water can sometimes be strategically reduced without proportional yield loss, but crop and growth-stage responses differ substantially. Community budgeting should therefore integrate local agronomic knowledge and extension advice rather than using water demand as the sole criterion for crop selection.

2.3 To Assess Governance and Equity Conditions for Community Water Budgeting

The third objective is to evaluate water budgeting as a governance process rather than a purely technical calculation. Communities contain farmers with different land sizes, access to wells, irrigation technologies, financial capacity, crop preferences, and livelihood dependence on agriculture. A budget that accurately measures water but systematically privileges well owners or larger landholders would remain institutionally weak.

The proposed model therefore incorporates participation, transparency, protection of basic water requirements, inclusion of rainfed and non-well-owning farmers, public review of assumptions, and follow-up monitoring. These governance dimensions determine whether collective information becomes a credible community commitment rather than an advisory calculation that individual farmers may disregard.

3. Review of Literature

3.1 Groundwater Scarcity, Agricultural Demand, and Drought Risk

Groundwater has played a major role in expanding irrigation and reducing agricultural dependence on unreliable rainfall, particularly in regions where decentralized wells allow farmers to irrigate when canal or surface supplies are insufficient. This flexibility has contributed substantially to agricultural production, but it has also created a governance structure in which millions of separate pumping decisions act upon shared aquifers. Shah describes this condition as a distinctive groundwater economy characterized by atomized private extraction and weak correspondence between private pumping incentives and long-term aquifer sustainability.

The implications become particularly serious in drought-prone agriculture. Jain and colleagues demonstrate that groundwater depletion can substantially reduce future cropping intensity when shallow groundwater is no longer accessible and alternative irrigation cannot fully compensate. This finding reinforces the need to treat groundwater reserves as an intertemporal resource. Using all available water during the first part of a dry period may increase short-term planted area while reducing the capacity to protect crops during later critical stages or to sustain subsequent seasons.

Agronomic water-management literature provides several strategies for operating under restricted supplies. Fereres and Soriano emphasize the importance of deficit irrigation where available water cannot satisfy full crop evapotranspiration, while Geerts and Raes demonstrate that appropriately designed deficit irrigation can improve water productivity in dry areas without necessarily producing severe yield losses. Chai and colleagues further show that deficit-irrigation performance depends upon physiological stage and crop response, meaning that water-saving plans require crop-specific knowledge rather than uniform reductions. These agronomic findings provide the technical foundation for community budgeting: once available water has been estimated, it must be allocated according to how different crops use and respond to that water.

3.2 Participatory Groundwater Monitoring and Crop-Water Budgeting

Participatory groundwater management emerged partly from the recognition that groundwater users cannot reasonably self-regulate a resource they do not understand. Hydrological science is frequently inaccessible to local users because aquifer boundaries are invisible, groundwater movement is difficult to observe, and public monitoring networks may be too sparse to represent village-level conditions. The FAO-supported Andhra Pradesh program responded by training farmers to measure rainfall, groundwater levels, well discharge, and related hydrological variables and by integrating these observations into recurring water-management discussions.

Crop-water budgeting was a central component of this participatory architecture. Communities estimated the quantity of water available and compared it with the demand implied by proposed cropping patterns. When demand exceeded supply, participants could reconsider high-water-demand crops, irrigated area, irrigation practices, or other management options. Contemporary implementations of crop-water budgeting similarly describe the approach as a way to reserve water for domestic and livestock requirements and then compare remaining resources with seasonal crop demand. The significance of the approach is that crop choice becomes linked explicitly with hydrological limits before water scarcity is expressed through well failure.

Evidence from participatory groundwater programs is nevertheless mixed and methodologically important. Reddy, Pavelic, and Reddy's review of the Andhra Pradesh experience concludes that participatory management improved groundwater knowledge and created some evidence of behavioral adjustment, yet effects on long-term groundwater decline were limited or difficult to attribute, and equity concerns affected institutional sustainability. A separate assessment of drought resilience similarly concludes that knowledge and adaptation improved but that voluntary participatory management alone may be insufficient where extraction incentives remain strong and institutional or regulatory support is weak. These findings caution against presenting community budgeting as a guaranteed solution to aquifer depletion.

3.3 Collective Action, Water Literacy, and Shared Cropping Decisions

Community water budgeting requires farmers to understand that groundwater extraction is interconnected. This is difficult because the resource itself is largely invisible. Collective-action research provides an important explanation for how shared understanding can be developed. Meinzen-Dick and colleagues used groundwater games in which crop choices generated different aquifer consequences. Communication and repeated experience strengthened collective understanding, and communities exposed to the intervention were more likely to adopt water registers and local groundwater rules.

Such findings indicate that water budgeting has a social-learning function in addition to its numerical output. When proposed crops are translated into liters or cubic meters of water demand and compared with a collectively observed supply, individual decisions become visible as components of a shared resource balance. The process can therefore shift discussion from abstract recommendations to an explicit trade-off between current cropping ambitions and future water security.

The literature also highlights the importance of institutional design. Participatory programs may improve awareness without changing behavior when farmers face strong economic incentives to cultivate water-intensive crops. Some evidence suggests that training and crop-water budgeting by themselves do not necessarily produce lower-water crop choices, reinforcing the need for complementary incentives, credible rules, market alternatives, and monitoring. Effective community water budgeting should therefore be understood as one component of a broader water-governance system rather than as a stand-alone awareness intervention.

4. Research Methodology

4.1 Research Design and Synthetic Community Water System

The study adopts a quantitative simulation-based methodological design. No authenticated village rainfall series, observation-well measurements, pump-discharge data, household irrigation schedules, crop-yield observations, or water-user records were supplied. Accordingly, the quantitative findings should not be represented as observations from an actual drought-prone farming community.

A synthetic population of 160 farm households is constructed within a hypothetical shared hydrological unit. Farms differ in land size, well access, crop preference, irrigation technology, and livelihood dependence. Four seasonal water scenarios are modeled: near-normal conditions, moderate drought, severe drought, and extreme drought. Each scenario modifies rainfall contribution, groundwater recharge, accessible groundwater storage, and expected surface-water availability.

Water demand is estimated from the proposed irrigated area of each crop and a standardized seasonal irrigation requirement. The exercise is conducted twice. Under the uncoordinated condition, households prepare crop plans independently. Under the community budgeting condition, total demand is compared with the common water budget and collectively adjusted before finalization.

Table 1: Components of the Community Agricultural Water Budget

Water-Budget Component	Illustrative Measurement	Function in the Budget	Governance Safeguard
Seasonal rainfall and recharge	Local rain gauges and estimated recharge relationship	Establishes expected natural water contribution	Assumptions reviewed publicly
Accessible groundwater	Observation-well trends and sustainable abstraction estimate	Identifies usable groundwater reserve	Avoids equating total aquifer storage with available pumping
Surface and harvested water	Tanks, ponds, check dams, canals, farm ponds	Adds locally accessible supplementary water	Prevents double counting between structures
Essential noncrop reserve	Domestic, livestock, and basic community needs	Protects priority requirements before irrigation allocation	Basic needs cannot be displaced by profitable crops
Crop-water demand	Irrigated area × crop-specific seasonal requirement	Converts crop plans into comparable water demand	Calculations visible by crop and farmer category
Drought uncertainty buffer	Percentage of estimated available supply	Protects against forecast and recharge error	Buffer cannot be allocated without collective review

Source: Author-developed simulation framework informed by participatory groundwater management, water accounting, and crop-water budgeting practices.

4.2 Community Agricultural Water Budget Index

The Community Agricultural Water Budget Index (CAWBI) evaluates how effectively communities plan, discuss, allocate, and monitor agricultural water. It combines monitoring, transparency, demand estimation, participation, equity protection, and compliance into one standardized measure ranging from 0 to 1.

Equal weights are assigned to all six dimensions for methodological demonstration, ensuring that no single governance component dominates the index. A higher CAWBI indicates stronger budgeting quality and governance, rather than greater physical water availability within the community.

This distinction is important during drought conditions. A community may achieve a high CAWBI despite severe water scarcity if its budgeting process is transparent, participatory, equitable, and consistently monitored. Conversely, abundant seasonal water may temporarily hide weaknesses in governance and allocation practices.

4.3 Water-Balance Equations and Simulation Procedure

The usable agricultural water budget is estimated by combining accessible groundwater, surface-water storage, effective rainfall, and reliably available harvested water, while reserving amounts for domestic needs, livestock, drought uncertainty, and required carryover reserves.

Aggregate crop-water demand is calculated according to irrigated area, crop-specific water requirements, and effective water-saving practices. This approach allows the simulation to represent differences in crop composition, irrigation efficiency, and seasonal agricultural requirements across participating households.

The resulting seasonal deficit is identified when crop-water demand exceeds usable agricultural water. Communities can reduce this deficit through crop diversification, adjusted irrigated areas, supplemental irrigation, revised sowing sequences, shared wells, and improved application efficiency, while maintaining minimum livelihood and food-security thresholds.

5. Analysis

5.1 Water Demand Under Uncoordinated and Collective Crop Planning

The synthetic analysis shows that the gap between desired agricultural water use and available water is limited under near-normal conditions but expands sharply under drought. When households prepare crop plans independently, individual decisions are based primarily on expected profitability and private irrigation access. Farmers with operational wells continue planning relatively water-demanding crops even where cumulative community demand exceeds the water budget.

The community-budget condition changes the information available during planning. Proposed crop areas are displayed collectively and translated into expected seasonal water requirements. Farmers can therefore observe the effect of each crop category on the remaining community water balance. Adjustments occur first through reduced irrigation to lower-priority areas and substitution of crops with high water demand where viable livelihood alternatives exist.

Under severe scenarios, the community does not attempt to eliminate water stress completely. Instead, the model prioritizes protection of critical crop stages, avoids excessive early-season abstraction, and preserves part of the groundwater reserve for later irrigation. This approach is consistent with deficit-irrigation literature, which emphasizes strategic rather than uniform water reduction when supplies are constrained.

5.2 Simulated Water-Budget Outcomes Across Drought Scenarios

Table 2: Community Water Budgeting Under Contrasting Drought Conditions

Seasonal Condition	Uncoordinated Irrigation Deficit	Community-Budgeted Deficit	Absolute Reduction	Main Simulated Adjustment
Near-normal season	11%	5%	6 percentage points	Minor area adjustment and improved irrigation scheduling
Moderate drought	27%	13%	14 percentage points	Reduced high-water crop area and supplemental irrigation
Severe drought	43%	24%	19 percentage points	Crop substitution, protected critical irrigation, groundwater reserve
Extreme drought	58%	36%	22 percentage points	Major irrigated-area reduction, protective irrigation and emergency reserve
Mean	34.8%	19.5%	15.2 percentage points	Progressive demand adjustment

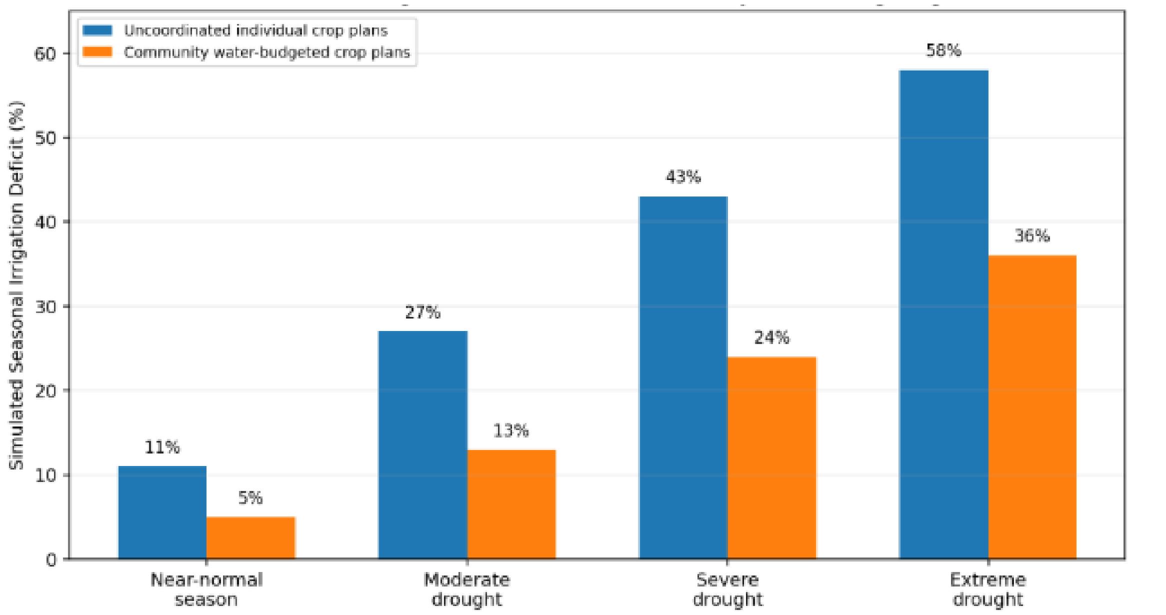
Note: The percentages are simulated methodological values and do not represent measured impacts of any actual community water-budgeting program.

The table illustrates two important patterns. First, community budgeting produces relatively modest benefits when water is abundant because individual and collective crop plans are already close to hydrological feasibility. Second, the absolute difference increases as drought becomes more severe. This occurs because collective planning identifies water-intensive commitments that become progressively less feasible as available supply falls.

However, even the community-budgeted condition records a 36% irrigation deficit under the extreme-drought scenario. The result is intentionally conservative. Community governance can redistribute and ration scarcity, but it cannot create water where hydrological supply is insufficient.

5.3 Irrigation Deficit and Drought Severity

Graph 1: Simulated Irrigation Deficit Under Community Water Budgeting



The graph demonstrates the widening difference between uncoordinated and community-budgeted crop planning as drought intensifies. Under near-normal conditions, the modeled irrigation deficit falls from 11% to 5%. During moderate drought it falls from 27% to 13%, while severe-drought deficit decreases from 43% to 24%.

Under extreme drought, the corresponding values are 58% and 36%. This result demonstrates a limitation as well as a benefit. Community water budgeting can substantially improve the compatibility between crop demand and available water, but it cannot fully compensate for exceptional hydrological scarcity.

The mean simulated reduction of 15.2 percentage points therefore represents improved preparedness and allocation rather than elimination of drought risk.

Key Finding: Community water budgeting becomes most valuable when it shifts agricultural planning from "How much can each farmer pump?" to "What cropping plan can the shared water system realistically support through the entire season?"

6. Discussion

6.1 Water Budgeting as a Preseason Drought-Governance Mechanism

The principal contribution of community water budgeting is temporal. Many drought interventions occur after water scarcity becomes visible through crop stress, well failure, tanker demand, or emergency irrigation restrictions. By that point, farmers have already invested in seed, land preparation, labor, fertilizer, and crop establishment. Changing the crop plan can therefore impose high losses.

Community budgeting moves the decision earlier. Rainfall, groundwater levels, reservoir storage, and proposed cropping patterns are discussed before or during the initial sowing period. This enables farmers to identify whether the community is collectively committing to more irrigation demand than the hydrological system can support.

The Andhra Pradesh participatory groundwater experience illustrates the practical logic of this approach. Farmers collected hydrological information and used crop-water budgeting within Farmer Water Schools to understand the consequences of agricultural demand. Reviews of the program conclude that the strongest contributions involved groundwater literacy, community capacity, and drought adaptation rather than uniformly demonstrable aquifer recovery. This distinction is important because unrealistic expectations can undermine good governance programs. The appropriate question is not whether budgeting "solves drought," but whether it improves the quality and timing of decisions made under scarcity.

6.2 Collective Budgets Require Equity and Credible Rules

The second implication concerns the distribution of scarcity. Groundwater access is rarely equal. Some farmers own deep borewells, others depend on shallow wells, some purchase irrigation water, and others remain primarily rainfed. If community water budgeting simply reports total groundwater and allows existing ownership patterns to determine allocation, it may reproduce or intensify inequality.

Equity should therefore be incorporated before crop planning begins. Domestic water and essential livestock requirements should be protected, while agricultural allocations should consider farmers without direct access to wells and households with limited capacity to absorb crop failure. Water-sharing agreements can be especially relevant where pipelines or coordinated pumping allow unused well capacity to provide protective irrigation to neighboring farms.

Evidence from participatory groundwater management also cautions that knowledge alone may not be sufficient. Farmers can understand aquifer depletion yet continue extracting water when the private economic return from a water-intensive crop is high. Community budgets therefore require credible rules, social legitimacy, monitoring, and where necessary supportive incentives or regulatory mechanisms.

Collective-action research suggests that communication and repeated interaction can strengthen this legitimacy. Meinzen-Dick and colleagues found that groundwater games and community discussion helped participants understand resource interdependence and were associated with greater adoption of local groundwater rules. A water budget should therefore be presented as a deliberative process rather than an external technical instruction.

6.3 Linking Water Budgets With Agronomy, Markets, and Institutional Support

The third implication is that hydrological feasibility cannot be separated from agricultural livelihoods. Advising farmers to abandon water-intensive crops may be technically logical but economically unrealistic where alternative crops have weak markets, poor seed availability, higher production uncertainty, or lower household value. Water budgeting therefore needs to be connected with agricultural extension, market information, crop insurance, input availability, and local livelihood priorities.

Agronomic options can expand the set of feasible responses. Deficit irrigation, improved irrigation scheduling, mulching, soil-moisture conservation, crop diversification, drought-tolerant varieties, and strategic supplemental irrigation can reduce agricultural water demand without necessarily requiring complete abandonment of profitable crops. Research on crop-water productivity emphasizes that the appropriate objective in water-limited settings is frequently to maximize useful production per unit of scarce water while retaining acceptable yield.

Digital tools can also support the process by simplifying crop-water calculations and making alternative scenarios visible. However, the quality of the underlying data remains more important than application sophistication. A mobile dashboard cannot compensate for unmeasured wells, unrealistic recharge assumptions, outdated crop-water coefficients, or exclusion of marginalized farmers from the planning meeting.

The strongest institutional model is therefore likely to combine local monitoring with technical support. Community volunteers can maintain rainfall and groundwater records; agricultural specialists can update crop-water requirements; water-resource agencies can contribute aquifer information; and village institutions can negotiate crop and irrigation adjustments. This architecture retains community ownership while reducing the risk that local water budgets become isolated from scientific and policy support.

7. Conclusion

Community water budgeting provides a practical framework for converting water scarcity from an individual pumping problem into a shared agricultural planning problem. Its principal contribution is not the production of a water-balance number but the creation of a transparent connection between available water, proposed crops, irrigation demand, and the consequences of collective extraction. In drought-prone agricultural systems, this connection allows farmers to recognize water deficits before the season becomes fully committed.

The Community Agricultural Water Budget Index developed in this study integrates monitoring quality, transparency, demand estimation, participation, equity protection, and follow-through. The associated simulation shows that uncoordinated crop planning generates a mean seasonal irrigation deficit of 34.8%, whereas community-budgeted planning reduces the corresponding value to 19.5%. The absolute modeled difference is 15.2 percentage points, with larger reductions appearing under severe drought. These values are illustrative rather than empirical and should not be represented as measured water savings.

The analysis also shows that water budgeting cannot eliminate hydrological scarcity. Under the extreme-drought scenario, the community continues to face a substantial deficit despite major changes in irrigated area and crop-water demand. This is an important governance finding. A credible budgeting system should make severe scarcity visible rather than artificially producing a balanced plan through unrealistic assumptions. In some years, responsible water management will require accepting reduced irrigated production while protecting drinking water, livestock, critical crops, and future groundwater reserves.

The framework further emphasizes that agricultural water budgeting must remain equitable and livelihood aware. Farmers without wells, smaller landholders, and households lacking financial reserves can experience disproportionate losses when irrigation is rationed. Collective planning should therefore include transparent rules for basic needs, protective irrigation, water sharing, and participation in crop-plan decisions. Water-intensive crops should not be prohibited mechanically when market and livelihood conditions provide no viable substitute; instead, communities require agricultural and institutional support that expands the range of economically feasible water-saving options.

Future empirical research should test the framework using repeated groundwater measurements, rainfall records, crop-area mapping, farmer irrigation diaries, pump-discharge measurements, crop-water requirements, yield outcomes, and household livelihood indicators. Multi-season studies could determine whether water budgeting reduces emergency crop failure, improves groundwater carryover, alters crop selection, strengthens water-sharing arrangements, or improves drought recovery. Research should also examine compliance, gender participation, unequal well ownership, local political power, and the interaction between community rules and formal groundwater regulation. Community water budgeting has the greatest potential when it functions as a recurring cycle of measurement, shared interpretation, collective planning, monitoring, and revision, enabling drought-prone farming communities to align agricultural ambition more closely with the water that their landscapes can actually sustain.

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