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A 'Drought-Free' Maharashtra? Politicising Water Conservation for Rain-Dependent Agriculture

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ABSTRACT: Soil moisture conservation ('green water') and runoff capture ('blue water') can reduce agricultural risks to rainfall variation. However, little is known about how such conjoined initiatives articulate with social inequity when up-scaled into formal government programmes. In 2014, the Government of Maharashtra institutionalised an integrative green-blue water conservation campaign to make 5000 new villages drought-free each year (2015-2019). This paper analyses the extent to which the campaign, Jalyukt Shivar Abhiyan, enhanced the capture, equity, and sustainability of water for agricultural risk reduction. We find government interests to demonstrate villages as 'drought-free' affected the character and implementation of this integrative campaign. First, drainage-line and waterbody initiatives were disproportionately implemented over land-based adaptations to redress water scarcity. Second, initiatives were concentrated on public land – and less so on agricultural plots – to achieve drought-free targets. Third, the campaign conflated raising overall village water availability with improvements in water access. These dynamics: 1) limited the potential impact of water conservation; 2) excluded residents, including members of historically disadvantaged groups, who did not possess the key endowments and entitlements needed to acquire the benefits associated with drought-relief initiatives; and 3) fuelled additional groundwater extraction, undermining water conservation efforts. Villages will not be drought-free unless water conservation benefits are widespread, accessible, and long-term.

KEYWORDS: Agriculture, drought, water conservation, inequity, Jalyukt Shivar Abhiyan, India

INTRODUCTION

Climate change and variation highly influence crop production and livelihood generation in rural areas (Dasgupta et al., 2014), and are of particular concern for agricultural systems that have limited irrigation potential (Jiménez-Cisneros et al., 2014). As such, improving water security for rain-dependent agriculture in contexts of heightened precipitation variability is a policy imperative (Falkenmark, 2016).

Despite projections of increased precipitation variability in certain rain-dependent agricultural areas (Jiménez-Cisneros et al., 2014), water security scholars often explain crop – and linked food and economic – risks as driven by "management-induced" scarcity (Rockström et al., 2010: 545). That is, production risks from variable rainfall patterns are more problematic in contexts where management practices have not adapted land and crop systems to capture, and more efficiently use, the dynamic availabilities of water (Agarwal, 1999; Lundqvist and Falkenmark, 2010; Rockström et al., 2010). The potential for socio-ecological adaptations to mitigate the effects of precipitation variability has increased calls to 1) improve water availability (e.g. moisture conservation, supplemental irrigation) and 2) enhance water productivity (e.g. drip irrigation, drought-tolerant variants, shifted planting dates) (Wani et al., 2009; Rockström et al., 2010; Agarwal, 1999). Increasing the amount of water available to agriculturists can involve enhancing rainfall infiltration and conserving soil moisture (green water) for the crop root zone, as well as capturing runoff and baseflow (blue water) for supplemental irrigation (Rockström et al., 2007, 2010). Soil moisture can be enhanced through in-situ (on-farm) interventions, such as farm bunding, terracing, and mulching (Kahlon and Lal, 2011) – important given a large percentage of precipitation (≥ 70% in semi-arid contexts) is often lost from farmers' fields via evaporation and runoff (Rockström et al., 2007: 326). Land-based management activities across the watershed can slow runoff, which in turn increases percolation and baseflow contribution. Last, water can be captured in small dams or ponds on farmers' fields, communal land, or in drainage courses. As one example, Sreedevi and Wani (2009) found in-situ adaptations for rainfall infiltration, and runoff collection contributed to yield increases in maize (72%), castor (60%), and groundnut (28%) in drought-prone areas of Andhra Pradesh (India). Such successful field experiments underpin current calls from the scientific community urging governments to fund and up-scale integrative green-blue water conservation in order to protect and even enhance crop production in contexts of precipitation variability (Rockström and Falkenmark, 2015).

Since the 1970s in India, a number of government-led water security interventions in rainfed areas have been implemented, including the Drought Prone Area Program (DPAP) and the Desert Development Programme (DDP) (Kerr, 2002; Kumar et al., 2018). These high-profile Central Government programmes – spending the equivalent of US$253 million between the mid 1970s and 1993 (MoRD, 1994) – focused on "soil and moisture conservation, water resources development, afforestation and pasture development" to restore ecologies, reduce desertification, and enhance crop yields (MoRD, 1994: 10).

In 2014, the Government of Maharashtra launched a decentralised green-blue water conservation campaign, the Jalyukt Shivar Abhiyan, with the objective of making 5000 additional villages drought-free each year between 2015 and 2019 (GoM, 2014). While the campaign aspired to reduce the impacts of intra- and inter-annual precipitation variability on both crop production and drinking water, we focus on the agricultural dimension. In this context, drought-free refers to eliminating agricultural drought – seasons where village crop yield is < 50% of what it averaged over the last decade, due to shortfalls or variabilities in precipitation.[1] Described below, Jalyukt Shivar was an umbrella campaign wherein several government schemes and public donations were coordinated to fund drought-relief initiatives in villages. With support from local officials, selected villages prepared implementation plans using 14 general types of conservation initiatives funded by schemes under the campaign, with the objective of becoming 'water neutral' – a state where village water supply met demand to eliminate agricultural drought (GoM, 2014).

Earlier programmes (e.g. DPAP, DDP) failed to reduce water scarcity, in part because water conservation initiatives were implemented in piecemeal ways without strategic concern for how they could mitigate drought impacts (MoRD, 1994: 11). In contrast, Jalyukt Shivar touted a "ridge-to-valley" planning approach (Water Conservation Department, 2018), widely considered, in India, as a scientific method for watershed development. This approach, prioritising systematic land-management interventions across the micro-watershed ahead of drainage-line works 'in the valley', intends to: 1)

[1] 19,059 villages (48.3% of Maharashtrian villages) were declared drought-hit based on < 50% crop yield in December 2014 (GoM, 2014: 18). This formed a key basis for the campaign (GoM, 2014).

reduce the velocity of runoff and thus increase the proportion of water percolated and conserved as baseflow, and available for wells; 2) increase soil moisture captured on agricultural land through in-situ activities (e.g. farm bunding); and 3) increase the volume of water harvested in drainage-lines or waterbodies through the installation of new or restored physical structures. A ridge-to-valley approach positions land-management interventions across the entire catchment area as vital to both blue (runoff, baseflow, groundwater stocks) and green water (moisture) conservation.

From 2015 until 2019, the campaign spent INR 96.3 billion (nearly US$1.3 billion) on 630,000 completed water conservation interventions in 22,586 villages (CAG, 2020). The aim was to protect wet season agriculture (June to October) from "uneven, unpredictable, and intermittent rainfall" (GoM, 2014: 1) and to support dry season cultivation using water conserved in the wet season. Overall, the campaign resembled an integrative green-blue water conservation approach that is called for by agricultural water security scholars to mitigate crop losses from precipitation variability (Rockström and Falkenmark, 2015).

Analysing interview data from key informants, government officials, and households in three villages, we explore the extent to which the Jalyukt Shivar programme enhanced the capture (availability of multiple forms of water), equity (distribution of water conservation benefits, including for socio-economically disadvantaged residents), and sustainability (non-depletion) of water for agricultural risk reduction in drought-prone villages.

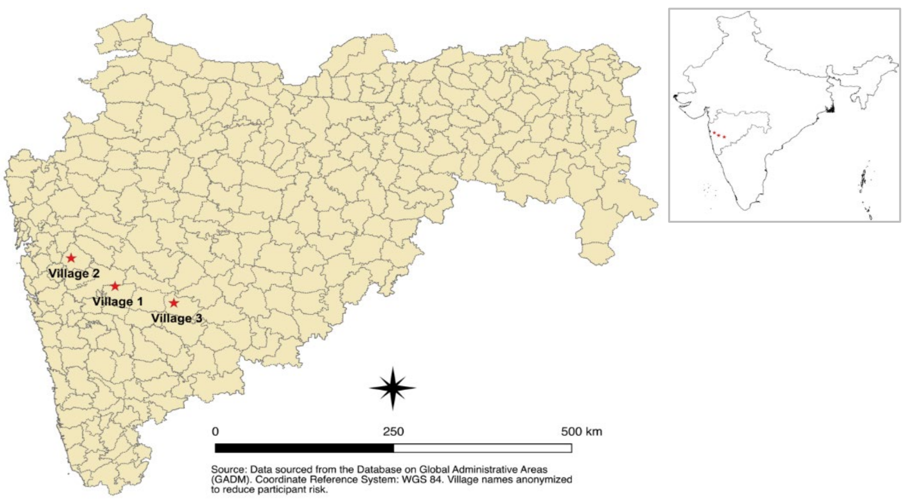
While motivated by the need to critically evaluate the state's drought-freeness[2] programme, the case context, objective, and analytical focus contributes a critical and novel analysis at the intersections of water conservation, agriculture, and environmental change. First, we examine how environmental governance systems conceptualise and aim to transform villages into 'drought-free' spaces. Where 'drought-proofing' or 'drought-resistance' are used to guide agricultural livelihood resilience in semi-arid and arid regions with high absolute water scarcity, we focus on interventions that are intended to mitigate the impacts of precipitation variability on agriculture across diverse socio-ecological and climatic contexts, including but not limited to semi-arid environments. Second, the promotion of integrative green-blue water initiatives must be complemented by studies that evaluate their socio-ecological outcomes as they increasingly become part of government programmes in India and abroad (for other critical studies see: Kerr, 2002; Samuel et al., 2007; Bharucha et al., 2014; Bharucha 2016; Taylor and Bhasme, 2020). In our case, the specific objective of transforming villages into a drought-free state distinguished Jalyukt Shivar Abhiyan from historical and conventional watershed development efforts in India, which are less explicit about the outcomes related to drought mitigation and adopt broader objectives related to natural resource protection, economic development, and sustainable livelihood generation (Reddy, 2006). Third, and relatedly, few studies have analysed the extent to which government-led livelihood adaptation programmes and wider system-scale transformations are equitable and sustainable in contexts of climate change and variation (Olsson et al., 2014). Research that pivots from analysing the technical efficacy of interventions (whether *something works*), towards interrogating *how* interventions were selected, *who* they serve, and under *what* conditions, can support more inclusive climate adaptation and transformation programmes. We advance these three contributions by examining the framing and implementation of the Jalyukt Shivar campaign, and by analysing how water conservation initiatives are re-configuring water access and use patterns in the production of 'drought-free' spaces. We find water inequities and extraction are increasing and argue that drought-freeness cannot be considered a reality unless the benefits of water conservation are widespread, accessible, and long-term.

[2] We use the terms drought-freeness and drought-relief interchangeably, unless otherwise noted.

METHODOLOGY

This study is primarily based on combined surveys and semi-structured interviews with households (n = 63) in three villages 'well-served' by the campaign in Pune District (Box 1). Government officials (n = 7), and key informants (n = 18) – including watershed experts, journalists, and historians – were interviewed on the subjects of drought, rural and watershed development, and the drought-free campaign. Of these 25 informants, 19 were knowledgeable about the campaign's objectives and outcomes in different areas of the state. Village 1 (Purandar sub-district), Village 2 (Mawal sub-district), and Village 3 (Indapur sub-district) are shown in Figure 1. Table 1 summarises their agro-ecological, climatic, and livelihood characteristics. To reduce participant risk, we anonymised each village. Tables 2 and 3 report the interventions in Pune District and in each sampled village. An 'intervention' reflects the government's classification of a single project, and can include 1) a singular activity in a focused area (e.g. a concrete dam) or a wider area (e.g. deepening of a stream-course); or 2) clustered components (e.g. handful of contour trenches) in a focused area that are recorded by the government as one intervention. The number of land- and drainage-course interventions is indicative of the weight given to them in producing drought-free plans. We draw on these tables in the results.

Figure 1. Study villages in Purandar (Village 1), Mawal (Village 2), and Indapur (Village 3) sub-districts (Pune District, Maharashtra).



Source: Vector data from the Database on Global Administrative Areas (GADM, 2017).

Note: Not all of the 358 sub-districts shown due to an outdated jurisdictional boundary layer.

After receiving the permission to conduct research from the elected head of each village, the lead author and two research assistants sampled households in different *vastis* (sub-communities of kinship) who could have benefited from the interventions. This included sampling households near verified and mapped works (using publicly available geo-coded data from secondary databases, GoM, 2015b), within and outside village centres, and near older, similar interventions to provide a sense of how such initiatives functioned in practice. Occasionally, village leaders and interviewed households would introduce us to participants. Across the three villages, we conducted household survey-interviews (n = 63) and focus groups (n = 6), collecting data on demographics, water uses, conditions of water access, knowledge of the campaign (including its implementation), who and what benefits from the completed interventions, and perspectives on how water could be better managed in the village. Household interviews were conducted in Marathi, Hindi or a mix of the two. Transcripts and notes were coded for each village and for the collective set of key informants using NVivo 12.0. We coded large portions of the text using 'structural coding' – content-based codes representing broad areas of inquiry that establish a foundation for more in-depth coding (Saldaña, 2009). Structural categories (e.g. 'concerns of Jalyukt Shivar', 'water access') were re-coded into more refined content-based codes. The results reflect a synthesis of the findings from the key informant interviews and the multiple sampled villages.

Table 1. Sub-district and village characteristics.

Sub-district	Village characteristics
Purandar • 731 mm of rainfall • Cereal/pulse/vegetable cultivation dominant	Village 1 • 461 households (2409 residents) • Fig, custard apple, cereal and vegetable cultivation; livestock production (e.g. buffalo, poultry, goats). • Multiple sources of water available for irrigation but differentiated access based on location and economic standing.
Mawal • 1547 mm of rainfall • Cereal/sugar cultivation dominant	Village 2 • 330 households (1880 residents) • Hillside and rural/peri-urban context • Rice and cereal cultivation; livestock production (e.g. buffalo, poultry); off-farm livelihoods (e.g. water park, restaurants). • Most of the area under cultivation is unirrigated; few wells.
Indapur • 582 mm of rainfall • Cereal/sugar/fruit cultivation dominant	Village 3 • 855 households (4141 residents) • Sugarcane, pomegranate, maize, and cereal cultivation; export-oriented agriculture (horticulture). Livestock production (e.g. poultry, buffalo, goat); grazing is declining due to land enclosure. • Borewells and wells; village served by the Khadakwasla canal (Pune) but irrigation is intermittent. Capital-intensive pipelines from Ujani Dam secured by well-to-do farmers.

Sources: Authors' interview data, Climate Hazards InfraRed Precipitation with Station data (Funk et al., 2015; Climate Hazards Group, 2017), Agricultural census (GoI, 2011a) and Population Enumeration census (GoI, 2011b).

Box 1. Village selection process

Of the 36 districts in Maharashtra, primary data collection occurred in Pune District because of its varied climatic and socio-ecological contexts and its access to a large number of non-governmental organisations and informants who were familiar with the programme. Primary data collection occurred with the support of two local field assistants from January until end-April 2018 (dry season) in three villages, each with unique climatological, livelihood, and agro-ecological characteristics. To select villages, we used the state's publicly available Jalyukt Shivar database (GoM, 2015a), which lists the approved initiatives and maps the completed works for villages selected in each intervention year. We used the database to identify projects that were completed and mapped in villages within Pune District for the intervention years prior to fieldwork (i.e. 2015-2016 and 2016-2017). Villages in these cohorts (n = 241 in Pune District), particularly those in 2015-2016, were prioritised by the government for creating drought-free plans based on their level of water scarcity[3] and the effect of that scarcity on agricultural production and drinking

[3] Villages were selected by district committees if they were: 1) included in prior or on-going watershed programmes; 2) declared scarcity (crop yield < 50%) for the last five years; 3) continuously 'tanker-fed' for the last five years; iv) in a watershed where groundwater is semi-critical/critical/over-exploited; and v) part of watershed programmes but experienced drought for the last five years (Government official interview No. 2, January 2018; Government of Purandar, 2014; CTARA, 2018).

water requirements. A three-tiered selection strategy was used to identify the three villages suitable for sampling. First, we selected villages considered to be 'well served' under the campaign. We defined a 'well served' village as one where the diversity of completed and mapped initiatives (e.g. canal digging, cement dams, contour trenching, sediment removal, etc.) listed within a village was higher than nearly 90% of the villages served between 2015 and 2017. Villages with a higher number of different water conservation initiatives were likely to have a higher number of absolute interventions (corr: 0.76). Second, within this subset of 'well served' villages (n = 45), we selected three sub-districts (Purandar, Mawal, and Indapur) surrounding Pune city on the basis of their different climate and agricultural features as identified by secondary data sources (e.g. agricultural and population census records; precipitation data). Third, one village was selected from each sub-district based on the demographic representativeness and the travel cost considerations of the research team.

Table 2. Number of approved interventions in Pune District (2015-2016). Source: GoM (2015a).

Green water / Blue water / Unknown	Projects approved in Pune District (2015-2016)
Afforestation	28 (0.45%)
Land bunding or terracing	653 (10.45%)
Deep continuous contour trenching (CCT)*	849 (13.59%)
Deepening, widening, de-silting or linking streams (nallahs)	325 (5.20%)
Diversion structure	30 (0.48%)
Concrete / cement check dam	534 (8.55%)
Stone check dam	42 (0.67%)
Loose boulder structure / blockage	324 (5.18%)
Earthen dam	669 (10.71%)
Desilting tanks and lakes	81 (1.30%)
Desilting cement and earthen dams	453 (7.25%)
Farm or forest ponds	380 (6.08%)
Repair of weir, dam structure, or water retention areas	162 (2.59%)
Repair and strengthening of percolation tank	57 (0.91%)
Bore and well recharge	23 (0.37%)
Recharge shaft	1203 (19.25%)
Efficient irrigation (e.g. sprinkler, drip irrigation)	66 (1.06%)
Hydro-fracturing	52 (0.83%)
Unknown or not available	318 (5.09%)
Number of approved projects in Pune District (2015-16)	6249
Green water	1530 (24.48%)
Blue water	4401 (70.43%)
Unknown or not available	318 (5.09%)

Note: Work types re-grouped from the original data and coded as green or blue water based on the Government of Maharashtra (2019) classification. Asterisk (*) indicates green water initiatives that could contribute to blue water (baseflow) conservation. Data for additional years requires de-duplication.

Table 3. Planned, and completed and mapped projects in each sampled village.

Green water / Blue water	Village 1		Village 2		Village 3	
	Planned	Completed & mapped	Planned	Completed & mapped	Planned	Completed & mapped
Concrete check dam or storage weir	13 (21.7%)	10 (21.3%)	0 (0%)	0 (0%)	8 (13.8%)	5 (12.8%)
Loose boulder or earthen dam	9 (15%)	2 (4.3%)	10 (27%)	10 (38.5%)	0 (0%)	0 (0%)
Diversion structure for irrigation	0 (0%)	0 (0%)	1 (2.7%)	1 (3.8%)	0 (0%)	0 (0%)
Repair of water storage or dam	0 (0%)	0 (0%)	1 (2.7%)	1 (3.8%)	7 (12.1%)	4 (10.3%)
De-silting and deepening nallahs	1 (1.7%)	0 (0%)	0 (0%)	0 (0%)	11 (19%)	6 (15.4%)
Deepening of dams, ponds, or tanks	7 (11.7)	7 (14.9%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Well recharge	0 (0%)	0 (0%)	2 (5.4%)	2 (7.7%)	0 (0%)	0 (0%)
Recharge shaft	20 (33.3%)	20 (42.6%)	0 (0%)	0 (0%)	11 (19%)	11 (28.2%)
Continuous contour trenching*	10 (16.7%)	8 (17%)	13 (35.1%)	10 (38.5%)	21 (36.2%)	13 (33.3%)
Agricultural terrace	0 (0%)	0 (0%)	2 (5.4%)	1 (3.8%)	0 (0%)	0 (0%)
Agricultural field improvement (farm bunding)	0 (0%)	0 (0%)	8 (21.6%)	1 (3.8%)	0 (0%)	0 (0%)
Total	60	47	37	26	58	39

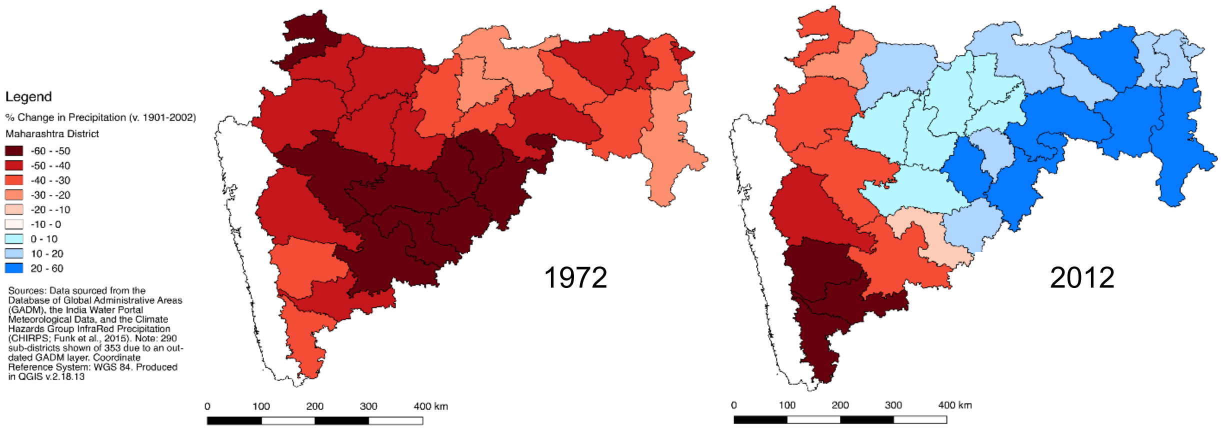
Source: Government of Maharashtra (2015a).

Note: Work types re-grouped from the original data and coded as green or blue water based on the Government of Maharashtra (2019) classification. Asterisk (*) indicates green water initiatives that could contribute to blue water (baseflow) conservation. There were a handful of completed but unmapped initiatives. These were not included in the 'completed and mapped' column because they were unverifiable. In Village 1: one (1) stream-course deepening, one (1) contour trench, and four (4) additional boulder / earthen dams were built. In Village 3: one (1) additional deepening project of a stream-course was completed.

JALYUKT SHIVAR ABHIYAN: THE MAKING OF 'DROUGHT-FREE' VILLAGES

Jalyukt Shivar Abhiyan was formalised in 2014 but has its origins in the 2012 state drought – popularly referenced as the worst drought since 1972 (Dandekar and Thakkar, 2013). According to one study, households lost, on average, 86% of their major crop in 2012 (Udmale et al., 2015). Where the 1972 drought is understood as a natural calamity, the effects felt in 2012 were blamed on a systemic "disaster [in] water management" (Dandekar and Thakkar, 2013). In fact, the amount of rainfall in 2012 for certain districts exceeded the long-term annual average (1901-2002) (Figure 2). Sugarcane cultivation (4% of the net sown area in Maharashtra), using over 70% of the irrigation water in the state (GoM, 2011), received blame. However, what intensified the public's resentment was the discovery of the 'irrigation scam' where an equivalent of nearly US$10 billion of public money spent on state irrigation projects from 2000-2010 was not reflected in the water services constructed. During this period (2000-2010), the state's gross irrigated area increased by only 3% (GoM, 2011).[4] The political fallout was enormous, and forced the still in-power Congress-NCP government (2010-2014) to promote decentralized interventions as a form of water governance distinct from large dams (Jitendra, 2019). This focus was later formalised as the Jalyukt Shivar Abhiyan by the new Bharatiya Janata Party (BJP) government in 2014. This section describes the evolution of Jalyukt Shivar and traces how the types, spatiality, and extent of drought-relief interventions were shaped by government interests to demonstrate a 'drought-free' Maharashtra under the prevailing context of drought, irrigation sector corruption, and public resentment.

Figure 2. District-wise annual precipitation anomaly for 1972 (left) and 2012 (right) relative to the long-term annual average precipitation (1901-2002).



Source: Data sourced from the Database on Global Administrative Areas (GADM, 2017), India Water Portal (2020), and the Climate Hazards InfraRed Precipitation with Station data (Funk et al., 2015; Climate Hazards Group, 2017).

Note: No statistics were produced for multiple districts (shown as undivided) shaded in white because of the absence of baseline data.

In the immediate aftermath of the 2012 drought and the irrigation scam, a retired groundwater scientist in northern Maharashtra named Suresh Khanapurkar gained celebrity-status for a proposed fix to water scarcity (Jitendra, 2019; Key informant interview No. 11, 23 March, 2018). The deposition of sediment in streams, Khanapurkar proffered, reduced their ability to retain runoff and recharge local aquifers – a problem that widening and deepening could solve if replicated across the entire state (Key informant interview No. 9, 03 March, 2018). He pointed to the water-filled streams in Shirpur sub-district as an

[4] The average decadal increase in gross irrigated area was 34% from 1960-2000 (GoM, 2011).

encouraging sign of the impacts of deepening, widening, and damming. A government committee was later appointed by the state to review the scientific merits of deepening and widening and found, according to Joy (2015), negative environmental impacts, cost ambiguities, and replicability issues, concluding that Khanapurkar's claims of recharge were "rather exaggerated". Despite the tenuous scientific and environmental basis of stream modification, the easily visible nature of water in restored streams and canals explained the political attention Khanapurkar's idea received.[5] This was clarified by a leading expert on watershed development in Maharashtra:

> I don't think any serious effort to understand its [stream deepening and widening] sustainability, what is the type of interchangeability with the surface and groundwater which takes place, and type of like interaction that you have and things [was made]. …[T]he other context was, there was already a drought [for] a continuous, two-three years. So, when people saw, physically, water stored [they said], 'okay this is the answer to long-term drought' (Key informant interview No. 16, 05 April, 2018).

Khanapurkar's proposal received considerable state patronage as a "miracle cure" (Joy, 2015) for drought by the incumbent Congress-NCP party in what some critics saw as an effort to divert attention from the "irrigation scam" (Jitendra, 2019; Key informant interview No. 11, 23 March, 2018). What followed, in the lead-up to the 2014 state election, were similar initiatives led by notable 'watermen' of various political parties at local levels (Pallavi, 2015). Further, the Divisional Commissioner of Pune led the Jalyukt Gaav program ('waterful village') (Jitendra, 2019) – a pilot programme removing sediment from stream-courses, constructing small dams, repairing weirs, and interlinking canals – claimed, by the state government, to have created 8.40 TMC (thousand million cubic feet) of storage, and to have raised groundwater levels by between one and three metres (GoM, 2014: 2).

The capacity of drainage-course initiatives to render water visible and available for transforming villages into 'drought-free' spaces enabled these interventions to form an integral and well-funded component of the state's flagship drought-free programme, Jalyukt Shivar. More specifically, the "main sources of the fund[ing]" came from the District Planning Development Committee funds, and Central and State Government funds (Department of Land Resources, n.d.). District level funds alone, available for cement concrete dams, canal deepening, and old water structure repair (GoM, 2014: 7-8), comprised over 40% (US$5.3 million) of the anticipated expenditure in Pune District in the initial year of the campaign (*Indian Express*, 2015). Central and State funds, even while distributed for a broader set of interventions, allocated substantial funding[6] for drainage-course and waterbody interventions (GoM, 2014). Last, corporate social responsibility donations emerged as a major source of drainage-course funding (Key informant No. 16, 22 June, 2020). By March 2016, only one and a half years after the campaign's initiation, INR 900 million (US$12 million) had been donated by public and corporate social responsibility actors (*Press Trust of India*, 2016), and made available for funding concrete dams, canal deepening, and water infrastructure repair (GoM, 2014: 7).

Drainage-course and waterbody bias

In practice, drainage-line and waterbody infrastructure (blue water) became overrepresented in relation to the wider set of interventions expected under the state's purported ridge-to-valley approach, whereby systematic land-area treatments occur across the micro-watershed both to conserve moisture and to increase the contribution of runoff as baseflow. Four established watershed development experts confirmed this, with one stating:

[5] Water storage has long been positioned by government as the solution for overcoming water scarcity in drought-prone areas (Mehta, 2001; Bharucha, 2018).

[6] For example, the Mahatma Phule Scheme allocated INR 250 million (US$3.3 million) for water structure repair, de-silting, recharge, and awareness initiatives in 2015-2016 (GoM, 2014).

> [The campaign and its implementers] don't follow [a] ridge-to-valley approach. ...The bulk of expenditures is happening on river-courses or stream-courses. ...[W]hen we do watershed development, we take [a] ridge-to-valley [approach]. *We emphasise area treatments as opposed to drainage line treatments.* Area treatments are largely soil and water conservation – in-situ – and then last, we go to the drainage line treatments (Key informant interview No. 8, 02 March, 2018; our emphasis).

Another leading watershed development expert asserted that a focus on comprehensive land or area treatment could have increased the impact and scale of water conservation under the campaign:

> If they [implementers of the campaign] had done a ridge-to-valley approach… the overall water velocity [from upper lands to the lower areas] would have been much less… and much more would have been converted into baseflow. …[T]he benefit of interventions would have been much more widespread from an equity point of view. When you have much more of a ridge-to-valley or area treatment-based [approach] then the water gets percolated and access to water would have been much better for people in the entire watershed to some extent. [The water will] finally [drain] to the valley, but at least people who have wells would have got recharge a little more. Now, what has happened is the benefit has been for people who are close to the riverbeds (Key informant interview No. 16, 22 June, 2020).

The narrow focus on drainage-course and waterbodies was so apparent that it was challenged as "unscientific" in a public interest litigation (PIL) filed in the Bombay High Court ("Desarda v. The State of Maharashtra", 2016).

In Pune District (2015-2016), at least 48% of the total approved projects were situated on waterbodies and drainage-courses (Table 2). This percentage is likely substantially higher given recharge shafts constituted a large proportion of the interventions (19.25%) and can be located on stream-courses and waterbodies. In Village 1, Village 2, and Village 3, 40.5%, 46.1% and 38.5% of completed and mapped interventions, respectively, involved constructing or repairing small dams (earthen and cement) and de-silting watercourses or waterbodies (Table 3). Apart from these structures, recharge shafts were implanted into the ground to increase recharge in Village 1 and Village 3 (Table 3). The geo-coded secondary data revealed most shafts were located on stream-courses and waterbodies. Thus, the collective drainage-course and waterbody works are closer to 83% (Village 1), 46% (Village 2), and 59% (Village 3) of the completed and mapped interventions. Land area treatments (non-drainage) accounted for under one-third of the completed and mapped interventions in the three villages – and were largely comprised of scattered deep-contour trenches, much of them now re-filled with sediment.[7] Soil moisture conservation (green water) on farmers' fields – critical for mitigating the impacts of precipitation variability – was virtually absent across the three villages (1.78% of completed and mapped projects) and comprised only 10.45% of the approved projects in 2015-16 across Pune District (also see Bhadbhade et al., 2019).

Last, the drainage-course and waterbody emphasis was reinforced through large private farm ponds (commonly 30 x 30 x 3m, 2196 m^3), built in many villages by farmers as a drought-relief initiative. Ponds further proliferated after 2016 following the introduction of the Magel Tyala Shettale (MTS) or "Farm Pond on Demand" subsidy (Kale, 2017) – and are hence conspicuously absent in the village-level initiatives in Table 3. After village plans were implemented, individual farmers continued building ponds subsidised under MTS and other schemes. Public media and even government officers in their interviews erroneously characterised MTS as entirely unrelated to Jalyukt Shivar, when in fact, the campaign is a convergence of MTS and other schemes used to finance drought-relief initiatives[8] (Key informant No. 7, pers. comm.; 15 March, 2018; GoM, 2014). Although new pond storage is not retroactively counted in Village 1, Village 2, and Village 3's Jalyukt Shivar plans (approved before May 2015), their proliferation

[7] Geo-coded data from the campaign revealed deep contour trenches were scattered, not systematically developed in sampled villages, and sometimes not located on sloped areas where runoff rate is highest.

[8] This was validated by identifying MTS as a funding source for farm ponds approved for construction in the public Jalyukt Shivar database (GoM, 2015a).

constitutes an important drought-relief intervention made possible through schemes nested under the campaign. At the time of fieldwork (January 2018), one agricultural officer stated Village 1 had a 'record' 225 farm ponds (Government official interview No. 2, January 2018). In Village 3, a local agricultural officer estimated that from 2016 to 2017, an additional 400 farm ponds had been built (Government official interview No. 5, March 2018). Across the state, 161,000 ponds were completed as of June 2019 under Jalyukt Shivar – reinforcing the emphasis on waterbody storage (blue water) for drought-relief.

While not explored in-depth, it is worth noting that the water storage bias was further reinforced at the village-scale – even as villages were explicitly selected on the diversity of water conservation interventions (see Box 1). Villages selected by district-level committees were required to hold a *shivar pheri* or a transect walk where relevant officials (e.g. *Talathi* [Revenue Officer], Agricultural Supervisor, Agricultural Assistant at the sub-district level) and residents interactively planned drought-relief initiatives for the village (Government official interview No. 1, January, 2018; GoM, 2014: 9). However, participation was gendered, and limited to 'big' people and members within core institutions of the village (e.g. *sarpanch* [village head], *gram panchayat* members [village council], *pani samiti* [water committee]). Nevertheless, well-constructed blue water storage projects and more efficient use of existing water were perceived by interview respondents as most effective for redressing local water crises. Taken together, the government's promotion of drainage-level and waterbody work as the needed interventions for drought-relief, combined with respondents' perceptions of these as the most effective water security strategies, contributed to the disproportionate focus on such initiatives, relative to what is otherwise expected under the state's touted ridge-to-valley focus. These dynamics crowded-out the potential value of a catchment-wide focus, including the role of green water in mitigating precipitation variability.

Planning and implementation

The ambitious objective of freeing 5000 additional villages from drought each year imposed fast-paced village planning and specific metrics that enabled villages to be documented as 'drought-free'. The selection of villages by district-level committees, development of local irrigation plans, subsequent approvals for funding, and expenditure for construction activities had to be completed within the fiscal year, and ideally within a span of months before the first rains arrived in June (GoM, 2014). After that, the campaign selects and allocates budget for a new round of villages. In contrast, one leading watershed development expert said effective watershed development requires between 24 and 36 months (Key informant interview No. 8, 02 March, 2018). Rapid implementation, in part, limited interventions to public land areas, such as drainage courses, grazing areas or Forest Department land. This was confirmed by an NGO researcher familiar with the campaign's effects in western Maharashtra:

> This government wants to say we are doing something for the farmers, something for water conservation. They came up with the flagship program and they have to show you the results. They [don't have] that much time to discuss with the farmers [about] the whole thing so, they use the common land. The whole [of the] common land, like rivers, lakes, and ponds – and they dredge it like anything… very unscientific works they were doing (Key informant interview No. 6, 19 February, 2018).

This informant is suggesting that private land development – and the required processes, particularly landowner consent and planning – were traded-off given the limited time period to plan, build, and advance a 'drought-free' status. This further limited the potential focus on in-situ initiatives, namely soil moisture conservation on farmers' fields, discussed above.

Last, the interventions were aimed at making villages 'water neutral' – a state where village water availability met demand. In Village 1, for example, the drinking and crop water requirement was estimated at 538.72 TCM (thousand cubic meters), of which existing watershed works store 360.79 TCM of water (Government of Purandar, 2014). The initiatives proposed under the campaign were estimated to store 118.66 TCM, thus closing the annual supply-demand gap (Government of Purandar, 2014). In theory, runoff otherwise lost from villages in a normal year, is captured during the monsoon and protects farmers from rainfall variability (Government official interview No. 7, 12 April, 2018). This storage further supports dry season cultivation, which may either not be possible for some or be risky for others if water was unavailable. By raising the aggregated volume of water, the government was able to formally count thousands of villages as water neutral and allege their 'drought-freeness' despite questions of improved access being unresolved for village residents. The inadequacy of existing metrics for evaluating the campaign were made clear by one frustrated expert:

> So, two metres in groundwater level was increased. …[But] two metres where? In which well? So, a well near your *bandhara* [check dam], so how many farmers are getting benefited by that two metres of increase? …[Y]ou have to bring metrics -good metrics: How much of new land was brought under rabi [dry season] crop? How many farmers who were initially doing only kharif [wet season crop] are now able to do rabi also? (Key informant interview No. 7, 24 February, 2018).

The pace and limited scope of implementation enabled the government to declare, in 2019, that over 16,000 villages had been made water neutral. This figure is disconnected, however, from the everyday lived experiences of water access in villages. The data above indicates that the types of projects, their locations, and the overall scope of the campaign were directly and indirectly shaped by government interests to demonstrate a 'drought-free' Maharashtra – particularly under the context of irrigation sector corruption, repeated drought, and public resentment towards the state. This had implications for the capture, equity, and sustainability of water, which we now turn to.

HOW EFFECTIVE, EQUITABLE, AND SUSTAINABLE WERE JALYUKT SHIVAR INTERVENTIONS?

The findings below examine the effects of water security initiatives in drought-prone villages and emerge from the coded interview data. They hold across the majority of sampled villages and are described in key informants' experiences in other areas of Maharashtra; however, in limited cases, individual villages break from these general patterns. Where this occurs, it is noted.

Capture and regeneration

Participants stated that key blue water initiatives were unable to consistently capture water due to local variations in precipitation, topography, and geology. Although the purpose of the campaign was to reduce the effects of precipitation variability, participants in Village 1 stated changes over the last seven or eight years in rainfall intensity affected the capacity of drainage course works and farm ponds to capture water. One agricultural officer problematised changing rainfall dynamics as the reason why check-dams – a core intervention in the village – were unable to store water:

> In [Village 1], also there are CNB [cement nallah bunds] works, but the problem in [Village 1] is that ever since the work has been done, there has been no rain for two years now (Government official interview No. 2, January 2018).

This reference to 'no rain' was echoed by other respondents and is a referral to shortcomings in the amount, duration, and intensity of precipitation. Reflective of other sampled respondents, one indicated similar parallels to the officer above:

> Earlier there was more rain because all these streams would fill up a lot. The *bandharas*[9] would be full. Now it doesn't even fill up to half. …Not even half. There is only a light drizzle and then the rains are over (Village 1 interview No. 20, 26 March, 2018).

These drainage-course works exist alongside large private farm ponds, which store water from precipitation, canals, and most commonly, groundwater pumped from wells, for high-value and water-

[9] Some check-dams were built earlier in the village by the Rotary Club.

intensive crop production. While ponds function to reduce farmers' dependence on capital-intensive water access, such as private tanker trucks, farmers rely on these sources if shortcomings in precipitation – and consequently, groundwater – occur. This was made clear in one focus group with Village 1 farmers, some of whom owned ponds:

> Respondent (No. 6): Some people have made farm ponds, but there has been less rain… That is the condition now. There is lots of land, but such less rain. That's why the tanker water is used to fill them.
>
> Respondent (No. 2): …The water is not enough. So, when that finishes, we can buy water [from a private water tanker]. With that you can store it in the farm pond and then later, it can be used. Or, we can even release the water directly in the farm. Otherwise, now there is the Purandar upsa[10] [project], from there we can buy the water and store in the farm pond (Focus Group No. 1, Village 1, January 2018).

In Village 1, and in the context of fig farming, costs vary depending on the amount of water needed and the size of the fig farm; however, at least one water tanker (INR 1200 [US$17]) may be needed every twelve days for a relatively smaller-sized cultivation (e.g. 20 fig trees) during the mid-late dry season if water runs out. For those that use the Purandar upsa – a lift irrigation scheme transporting polluted water from Pune's Mula Mutha river to the surrounding area – a contribution of INR 5000 (US$70) is needed. In absolute terms, these are sizeable fees, given that the average income for rural households in Maharashtra is INR 8938 per month (US$117) (NABARD, 2018). Noted earlier, a ridge-to-valley focus could have increased the proportion of surface runoff conserved as baseflow and available for agricultural water use.

A second example comes from Village 2 – an area that can receive high rainfall during the monsoon (Table 1). Aside from two farm bunding initiatives, several land contour interventions (10) and small dam projects (12) were intended to reduce erosion, store water for animal use, and increase groundwater recharge. Unfortunately, the land contours were not systematically constructed across the sloped valley and the small dams were located far from the main village. Further, any potential benefits were not easily accessible because the sloped and impervious geology was not conducive to recharge. This was illustrated by one resident:

> [T]he forest officials had dug them [*bandhara* structures] for the jungle animals to drink water, and for the cattle from the village to drink from. But that was not a success. It all flowed away. We get tremendous amount of rainfall for four months but every bit of the water flows off and does not get stored. Because of the rocky terrain it all washes away. It doesn't stay much. Even if we put in bore wells, it doesn't go into the bore and the bore wells stay dry (Village 2 interview No. 19, 07 March, 2018).

Made clear by respondents, the poor quality of works and the geological conditions result in sub-optimal outcomes. A final example comes from Village 3. The benefits from stream-course development were not uniform, as captured in a conversation with one household:

> [W]ater seeps inside [the ground because of the *bandhara* or checkdam] and this allows groundwater levels to improve. And the seepage doesn't happen as per our wish. It is a natural process, so it can happen wherever it is possible in whatever quantity depending on the geography and landscape (Village 3 interview No. 20, 22 March, 2018).

This respondent is highlighting that increasing the storage volume through stream-course development, and where and when that seepage occurs, are different matters, which affect the distribution of benefits. The central point is that the narrow focus on drainage-course and waterbodies was insufficient to match local biophysical and hydrological variability. A broader focus on conserving water at multiple sites and levels could have increased the impact and distribution of water conservation benefits. Missed

[10] A pipeline transporting polluted water from Pune. This water is released into a local stream where pond owners can appropriate a portion of it.

opportunities included a systematic focus on contour trenching to enhance the surface runoff conserved as baseflow for wells in Village 1; and in-situ efforts to maximise rainfall harvesting and infiltration, and soil moisture conservation for rainfed rice cultivation in Village 2 where sub-surface drainage is not capturable.

Equity

The implementation of drainage-course works and farm ponds concentrated benefits for subsets of the population within villages and excluded residents, including members of historically disadvantaged groups, who did not possess endowments (e.g. capital, sufficient land size, land location) needed to access the potential benefits of drainage-course works or to construct farm ponds. We attend to these considerations for stream-course development, before returning to the case of farm ponds.

Land location

Drainage-related works (i.e. weirs, dams, stream deepening, recharge pipes) constituted a substantial share of the completed and mapped interventions in Village 1 (83%), Village 2 (46%), and Village 3 (59%). Numerous respondents and informants made clear that such projects concentrate the distribution of benefits to those farming, often in low-lying areas, near the installation. This can be illustrated by one higher-earning (> INR 10,000 [US$130] per month) household who farmed a medium-sized plot (2 ha [5 acres]) near a small dam:

> I feel there should be some improvements in terms of water supply to the villagers. … Right now, those who live close to the *bandharas*, they get water supply but the ones living on the higher plains, they suffer from lack of water supply. This should change. And every year post Diwali, that is, November and months after that until the next rain our village starts facing dropping water levels. This should change (Village 3 interview No. 11, 20 March, 2018).

What this respondent makes clear is how the benefits of lowland stream-course work are not reachable for those who live in upland spaces because water, conserved at lower spatial points, cannot travel up the hydraulic gradient. This has meant that certain households, without direct access to water storage initiatives, undertake significant costs to acquire water for agriculture – such as farm ponds or water pipelines. One household interviewed, who reported giving up half an acre of their land without compensation for the construction of a new *bandhara*, said:

> Our well is far from the *bandharas*. Hence, we didn't see any change happening in the water levels in our well. …It doesn't help us. It is maybe helping some, but not us. …We gave some land to them too [0.2 ha or 0.5 acre]. …[W]e gave [it] away thinking we might also benefit from [the *bandhara*]. We thought it will help us solve water problems. And nothing really happened in our favour (Village 3 interview No. 10, 20 March, 2018).

Due to the inaccessibility of water, the same household, albeit in a relatively privileged position financially, spent a substantial amount[11] to construct a pipeline for agriculture to secure water:

> We need to grow seasonal vegetables along with other bi-monthly and yearly crops, and if [we] don't farm other vegetables [and other produce], how can we survive? None of us have ever been to school. We are not educated [such that] we could think of finding a job or something elsewhere (Village 3 interview No. 10, 20 March, 2018).

The consequences of water inaccessibility are much more severe for poorer households, who may be unable to invest in pipelines, farm ponds or other water-related adaptations. This was made evident by

[11] Some spend the equivalent of US$39,200-$52,300 to connect water pipelines to nearby reservoirs.

one household in the same village farming a smaller parcel (1-1.2 ha [2.5-3 acres]) on a hillside, who when asked if the small dams helped them, said:

> No, unfortunately not. It depends where do you have your well. …[T]hese projects are not for upper level lands. It is useless for upper reaches. …[The people farming the hillside] depend upon [the] rainy season. Whatever water becomes available naturally. Those few months. …[B]ecause we face water scarcity, we plough [our] maize early and feed our cattle with it. We can't really do much on our land. If we were well-off then we would have arranged water. With that extra water we could have done many things in our farm – grown better crops too. Not like now, we plough them early (Village 3 interview No. 6, 19 March, 2018).

In recognising the varied capacities of households to adapt to water shortage, and the potential consequences of water inaccessibility, it is essential to recognise that the distribution of stream-course benefits are not random. Villages are socio-spatial assemblages where land acquisition, settlement, and capital accumulation have often occurred in fertile and lowland areas. It is not uncommon, as we observed, to see marginalised socio-economic communities of Scheduled Castes, Scheduled Tribes, and Denotified Tribes living 'outside' the village or be landless, and for these groups and households within lower strata of upper castes to farm drier and marginal upland farming areas. This understanding is well-reflected in how key informants characterised the distribution of benefits in villages, exemplified by one watershed expert who referred to himself as a 'close observer' of the campaign:

> [E]verywhere you find that the better off lands are owned by the rich farmer and… are always located along the nallah courses [or] the stream courses. And the poor farmers' land, the Scheduled Caste and Scheduled Tribe farmers' land, are always located away from the nallah courses. You can say, the upper reaches land. …[T]he focus of the programme is on nallah deepening and widening, [and] creating waterbodies along the nallah courses. The immediate results and beneficiaries are the better off farmer[s]. …Also, for the small farmers and poor farmers, they do not have a major say in the planning process in terms of identifying the structures [and] location [of] the structures. …[The programme] is not really addressing the needs of the small and marginal farmers, needs of the landless people, [and] needs of the upland farmers (Key informant interview No. 5, 19 February, 2018).

This quotation should not be interpreted as implying a deterministic pattern of settlement in each village but an acknowledgement that the location of farmland is historically produced through social exclusion. While the central point of this section relates to the narrow distribution of benefits associated with the implemented initiatives of the drought-relief programme, the study results from Village 1, below, provide a clear indication of how stream-course works acted indirectly to exclude members from historically disadvantaged groups and to deepen entrenched inequities in water access.

In the mid-1900s, the state Tenancy Act provided the foundation for agricultural tenants and tillers to purchase land from the landowners at a price set by the government (Focus Group No. 1, Village 1, January 2018). In Village 1, the Marathas were historically agricultural workers, whereas members from Scheduled Tribe, Scheduled Caste (e.g. Mahar, Matang) and Denotified Tribe groups (e.g. Ramoshi) were involved in non-agricultural occupations (Focus Group No. 1, Village 1, January 2018). This legislation enabled Maratha tenants to purchase land from the landowning Brahmin community (Focus Group No. 1, Village 1, January 2018). Over time, marginalised socio-economic groups either purchased smaller pieces of land, were recipients of parcels from the government, or remained landless (Focus Group No. 1, Village 1, January 2018). Today, while the Maratha caste is internally stratified on socio-economic axes – as a broader collective, they hold larger and geographically favourable farming areas. For example, of the Maratha households interviewed in Village 1, 58% of them held above average size plots (> 1.6 ha [> 4 acres])[12], with the Kale clan (a strata of the Maratha caste) holding the largest sized plots. In comparison, 85% of the Scheduled Caste and Denotified Tribe members interviewed were either landless

[12] The average landholding size in the sub-district is 1.43 ha (3.53 acres) (GoI, 2011a). Approximately one-quarter of all landholdings in Maharashtra are < 0.5 ha (1.25 acres) (GoI, 2011a).

or held marginal or smaller plots (< 1.6 ha [< 4 acres]). We return to the benefits of larger land sizes, immediately below. We identified in interviews and through field observation that Tribe and Scheduled Caste households often had their farmland far from nine of the ten cement *bandharas* under the campaign, which were constructed on two streams near to the village – one of which was an outlet for imported wastewater irrigation that could be stored, appropriated and used by farmers nearby. One such household (Ramoshi) said, of water inaccessibility:

> Not everyone [gets water for farming]. There are 'big people' belonging to the Maratha caste. …They bring water from the Purandar Upsa [a lift irrigation system on a stream near the village with new *bandharas*]. …They have their borewells for drinking. [They] also have wells. What does our lower community have? …[N]obody thinks about our people. Now, our people have land there [upland at the foothills of the Fort]. But because there is no water, there are no crops. If it rains, then the crops grow (Village 1 interview No. 20, 26 March, 2018).

Where the examples above for Village 3 demonstrated the central point – that is, the distribution of benefits were limited with consequences for households without access – the empirics in Village 1 extend this finding, concretising how a narrow drainage-course bias indirectly concentrated the benefits not *spatially* but *socio-spatially* in ways that deepened entrenched inequities in water access. We carry forward this point below in relation to land size.

Capital and land size

The second point concerning the distribution of benefits relates to who constructs private farm ponds, which range from a minimum of about 15 x 15 x 3m to the standard 30 x 30 x 3m (Government official interview No. 2, January 2018). Consistent with others' field research (e.g. Kale, 2017; Yadav, 2019), we rarely observed minimum-sized ponds. Ponds often met, and sometimes even exceeded, the standard-size and were developed almost exclusively by medium and large farmers. Two reasons underlie this pattern.

First, we were told by government officials and household respondents that farmers ought to hold at least 0.6 ha [1.5 acres] to consider constructing a farm pond, given the high opportunity cost of losing land in the pond's construction (Focus Group No. 1, Village 1, January 2018). The cultivatable land lost in the construction of smaller-sized ponds is sizeable for small and marginal farmers, and likely accounts for the bias observed in pond ownership (Phadke et al., 2018). Of the household respondents who owned a pond, only two farmed smaller plots (<1.6 ha [1-4 acres]); most other pond-owners held between 1.6 and 8.1 ha [4 and 20 acres].[13] Second, even where farmers may hold $\geq$ 0.6 ha [1.5 acres], the cost of a pond further exacerbates the ownership bias against small and marginal farmers (Phadke et al., 2018). A standard sized pond (30 x 30 x 3m) can cost INR 75,000-150,000 (US$1060 to $2111) for the excavation and another INR 150,000-200,000 (US$2111 to $2646) for an optional plastic lining used to prevent water percolation (Prasad, 2018). Schemes converging under Jalyukt Shivar offer farmers a maximum subsidy of INR 50,000 (US$704) for excavation and a 50% subsidy for the cost of a plastic lining, limited to INR 75,000 (US$1060) (Government official interview No. 2, January 2018; Prasad, 2018). The capital costs depend on the size, geological profile, lining material, and service providers (SANDRP, 2017; Prasad, 2018). Notably, the rockier terrain in Village 2 prevented the proliferation of farm ponds because the excavation cost can be over double the normal cost (Government official interview No. 3, February 2018). Capital is needed for building farm ponds, even after subsidies have been accounted for.

Overall, farm ponds are largely inaccessible to village residents who own smaller land sizes and who cannot afford the capital and operating costs. This was made clear in one conversation with a smallholder farmer (< 0.4 ha [< 1 acre]), who cut down their 100 fig trees because of water scarcity and the high cost of purchasing tanker water, and instead planted 50 less water-intensive *sitafal* trees (custard apple):

[13] One farmer, included in this tally, did not report their land-size. It was estimated at 40.5 ha (100 acres).

> [The *sarpanch* has] plenty of water. …They are towards the hilly side. So, when it rains, [the water] immediately goes into their well. They also built a big farm pond. …That's why they're able to manage, and because they have such a large farm, they didn't mind building a farm pond. Now, what can we make on 1 acre of land?... [I]f we make a farm pond on half the land, what can be done on our other half? (Interview No. 23, Village 1, 27 March, 2018).

This respondent makes a clear linkage not merely between land-size and pond acquisition – but, as described in the previous subsection, between biophysically favourable farming locations and the ability to benefit from drought-relief initiatives. In sum, the empirical evidence on drainage-course works and farm ponds demonstrates that privileged groups have benefited disproportionately from the drought-relief programme. Some members of the more privileged groups have access to hydrologically advantageous spaces (e.g. in lowlands; by streams and irrigation outlets which the *bandharas* serve; at the base of hillsides where water drains) and own larger plots of land. These advantages mediate their ability to benefit from the nature of the programme when compared to members from historically disadvantaged groups.

Groundwater extraction

Widespread farm pond development has heightened groundwater extraction in drought-prone villages, particularly in the absence of enforced regulation over their size, number, and function (Kale, 2017). A standard-sized farm pond (30 x 30 x 3m) can hold a volume of 2,196 m^3, nearing that of an Olympic-sized swimming pool (2500 m^3)[14] (Prasad, 2018; cf. GoI, 2016). Despite different experiences in Village 2 (absence of ponds limited by cost), Village 3 (filled with groundwater / canal water), and Village 1 (largely groundwater-fed), key informants familiar with farm pond use across Maharashtra, as well as household respondents in the sampled villages, indicated that large volumes of groundwater are pumped out during the end of the wet season (Sept-Oct) to fill farm ponds, which support existing, new, or expanded cultivation of water-intensive crops in the dry season (Key informant interviews No. 7 [24 February, 2018], No. 11 [23 March, 2018], No. 18 [20 April, 2018]). Their proliferation has been found to accelerate groundwater depletion across the state (Key informant interview No. 18, 20 April, 2018; Kale, 2017; SANDRP, 2017). This is because farm ponds improve the certainty in the volume of water that a now pond-owner can access by converting a common pool resource into a private good (Prasad and Sohoni, 2018). This encourages a shift from traditional crops to water-intensive fruits or vegetables, "increas[ing] the monthly irrigation requirement which is fulfilled by increased ground water extraction" (Prasad and Sohoni, 2018: 5-6). Using secondary data from Village 1 – a typical semi-arid village – our estimates indicate ponds undermine the drought-relief programme.

Village 1 (1283 hectares) receives about 679 mm of rainfall each year contributing to an estimated runoff of 538.94 TCM (thousand cubic meters) (Government of Purandar, 2014). At the time of the campaign (2014-2015), the estimated village water requirement inclusive of human, agricultural, and livestock requirements, was estimated at 538.72 TCM (Government of Purandar, 2014). Notwithstanding farm ponds – which we now understand as sites of water extraction for intensifying or expanding water-intensive cultivation instead of mechanisms for enhancing water conservation – the pre-existing water conservation works and proposed initiatives under Jalyukt Shivar were estimated to capture 421.5 TCM of water in the village during a normal year – about 78% of the expected runoff (Government of Purandar, 2014).[15] Thus, the proposed water stored by soil and water conservation structures reduced the supply-

[14] Farm ponds are trapezoidal in shape. Volume can be estimated as: $Volume = \left(\frac{a+4B+C}{6}\right) * d$, where *a* is surface area, *b* is mid-range surface area, *c* is pond bottom surface area and *d* is depth. For a standard pond, *a* is 900m^2 (30 x 30m), *b* is 729m^2 (27 x 27m), *c* is 576m^2 (24 x 24m), and *d* is 3m.

[15] This figure excludes the contribution of farm ponds to water conservation. If ponds functioned as sites of recharge, the water conserved by existing and proposed works is 90% of the total village water requirement, nearing a 'water neutral' state (Government of Purandar, 2014).

demand gap, but did not capture enough water to meet the aggregated village needs (cf. CAG, 2020). From 2014-2018, Village 1 saw a 400% increase in the number of farm ponds, from 45 to 225 (Government of Purandar, 2014; Government official interview No. 2, January 2018). One official confirmed the horticultural (fruit) area increased dramatically as a result (Government official No. 6, March 2018). Some ponds are smaller (e.g. 20 x 20 x 3m) and others are significantly larger than the standard sized pond. Assuming each pond had the standard dimensions and only 50% of their capacity (1,098 m^3) was filled using groundwater, about 247 TCM would be extracted (equivalent to 59% of runoff captured by the other existing and proposed initiatives).[16] This figure (247 TCM) does not include other agricultural water uses for non-pond owners or drinking water needs of the village, which were already substantial.[17] In normal rainfall years, therefore, the addition of farm ponds and the corresponding increases in water demand should exacerbate the existing water deficit. Farm ponds here, which continue to be developed, are therefore a major threat to long-term groundwater sustainability. Moreover, large appropriations of groundwater, used for cultivating or expanding existing horticultural crops, undermine drought-relief efforts to conserve water for villages as a whole (Figure 3). This was indicated by an official who viewed appropriation as a positive outcome:

> Because of the farm ponds, lots of land has come into cultivation. …And when was [a] farm pond possible? When water is possible, only then. The farm ponds, the water conservation work that have happened, through that the farm ponds are filled. And from that, even the small areas, even up to half [an] acre, that also can be cultivated (Government official interview No. 6, March 2018).

Figure 3. Left: A farm pond with a plastic lining to prevent seepage. Right: A farm pond, built in 2017, next to a stream-course where multiple recharge pipes and one concrete dam were implemented under the Jalyukt Shivar Abhiyan (2015-2016)

Source: Authors' photographs.

[16] The exact village crop water requirement with the current 225 farm ponds is not available; however, the volume pumped into the ponds is considerable and likely more than was used previously by now pond-adopters because farm ponds intensify or expand cultivation of water-intensive crops, like figs.

[17] According to the Government of Purandar (2014), the crop water requirement with only 45 farm ponds was estimated at 415.6 TCM and the livestock and human drinking needs were 123.2 TCM. Given the significant increase in farm ponds for horticultural intensification and expansion (Government official interview No. 2, January 2018), the 2014 agricultural water requirement (415.6 TCM) can only have increased.

The central point is that the proliferation of farm ponds has increased the pressure on groundwater resources and undermined the objective of the drought-relief campaign. Further, as ponds are invariably owned by larger-landed farmers, their role in extraction re-distributes the benefits associated with water conservation within a narrow subset of the village population (Key informant interviews No. 11 [23 March, 2018], No. 18 [20 April, 2018]).

DISCUSSION

To date, the limited critical research on Jalyukt Shivar criticises the quality of completed works, the contractor-driven nature of development, the supply-dominated approach, and the lack of groundwater conservation and management (Bhadbhade et al., 2019; Kale et al., 2019). In 2020, the Comptroller and Auditor General (CAG) of India released a scathing report of the campaign after auditing completed works in 120 randomly selected villages (CAG, 2020). The report found that: the planned water storage works were insufficient to capture runoff (63% of 120 villages); the completed initiatives were inadequate for meeting village water requirements (69% of 120 villages); the cultivation of water-intensive cash crops had *increased* (58% of 112 villages); the groundwater levels after the Abhiyan had *decreased* in 60% of the villages where groundwater audits were completed (35 of 58 villages); and an absence of funding for project maintenance existed in every single sampled village (CAG, 2020). Despite spending INR 96.3 billion (US$1.3 billion) on the campaign, the report concluded that Jalyukt Shivar "had little impact in achieving water neutrality and increasing groundwater level[s]" (CAG, 2020: 17). Our findings on capture and regeneration and groundwater extraction above corroborate these findings. Additionally, we provide three insights at the intersection of water, agriculture, and climate-related risk reduction.

First, we linked the disproportionate focus on drainage-course and waterbody initiatives to widening inequities in water access. Certain residents, including historically disadvantaged peoples, did not hold key endowments (e.g. capital, sufficient land size or beneficial land location) or entitlements (e.g. decision-making influence, collective water rights) that may have otherwise enabled them to acquire benefits associated with the narrow character of the campaign. Moreover, the development and use of farm ponds have increased the pressure on groundwater, and have further skewed the distribution of benefits in favour of pond owners by enabling them to appropriate water intended for villages as a whole.[18] The nature of drought-relief is inadequate because it does not explicitly ensure that benefits are widely distributed and that water-use is safeguarded in the long-term. Future integrative water conservation programmes should avoid a narrow focus on a subset of water conservation initiatives, which are unlikely to yield broadly-distributed gains. Discussed earlier, a ridge-to-valley approach could have yielded – as one, partial approach for drought-relief – a wider distribution of benefits, in part through conserving water at multiple levels and locations using a diversity of strategies. Further, increasing aggregated village-scale water availability is not synonymous with increasing household-scale water access. A targeted, farmer-centric approach to public-private land interventions could have improved access and benefits through different forms of water conservation. Future efforts should prioritise disadvantaged households, who may be excluded from both the efforts to build aggregated water endowments and the benefits of such interventions, and as a result may face disproportionately larger impacts from precipitation variability (e.g. food insecurity, debt bondage, dangerous work). In-situ interventions (e.g. soil moisture conservation, small-size ponds, evaporation management) that raise hydrological endowments, even by marginal absolute levels, can reduce instances of crop failure in the wet season for many farmers without a reliable irrigation source. Moreover, our case demonstrates the need for local governance institutions to manage the collective interests of residents for how water is distributed and used. Such institutional arrangements have a rich history in Maharashtra, including in Pune District with the advent of *pani panchayat* – a community-based governance system and set of rules

[18] See Kerr (2002), MoRD (2006), Samuel et al., (2007), Bharucha et al., (2014), and Taylor and Bhasme (2020) for further documentation of the equity effects of watershed development in India.

for re-distributing and sustainably using the common-pool resource of groundwater (Thakur and Pattnaik, 2002). While technical interventions that incrementally raise green and blue water endowments can reduce the potential for unacceptable outcomes (e.g. crop failure), local institutions that regulate water use and enact sharing arrangements can preserve and re-distribute large stocks and flows of water to further protect livelihoods from precipitation variability, meet basic needs, and support livelihood aspirations for a large number of people. This is critical because the initiatives benefited only some (often privileged) residents and constituted absences or even risks to others.

Second, proponents of integrative blue-green water management may suggest the undesirable outcomes in sampled villages arose because of unscientific, standardised, and biased planning and implementation. We do not refute these claims but re-frame them. Rather than placing the burden of responsibility on local actors to 'correctly' plan and construct infrastructure, the case of Maharashtra suggests we understand these uneven socio-ecological dynamics as *outcomes* of broader governance structures and political contexts through which the purposes and objectives of drought-relief infrastructure were established and later implemented.

Third, researchers ought to be less concerned with particular interventions and more devoted to understanding and promoting particular design and implementation principles. In calls for up-scaling and intensifying water conservation programmes, scholars have sometimes assumed that these solutions will be used, adopted, and planned in rational and scientific ways coherent with the researcher's intention or expectation. Our paper confronts this slippage, inviting careful attention to how water scarcity risks can remain tangential amongst a wider set of other government interests that affect how infrastructure becomes planned and implemented. If water scarcity and insecurity are, as Zwarteveen et al. (2017: 2) remind us, crises of how water is governed, who is served and underserved, and how flows of water actively become re-configured, it is critical that governance systems and implementation dynamics receive much greater attention in the context of drought-relief and agricultural risk reduction. Here, researchers could develop an explicit set of normative equity and sustainability guidelines for creating resilient agricultural systems. The development and use of strategic criteria can direct focus to *what*, *how*, and *whom* environmental governance systems serve in climate resilience projects, and can de-centre the promotion of specific technological options abstracted from the political contexts of implementation.

CONCLUSIONS

Improving water security for food production and livelihood generation in drought-prone areas is a public policy imperative. Considerable research on water resilience, often based on field experiments, has shown interventions to control erosion, conserve soil moisture (green water), and capture runoff (blue water) can protect rain-dependent agriculture from precipitation variability. We explored how such an integrative water conservation programme in Maharashtra functioned in practice, and whether and to what extent it enhanced the *capture*, *equity*, and *sustainability* of water and water use for agricultural risk reduction in drought-prone villages.

Even with considerable investments, drought remains a recurrent seasonal risk for thousands of villages (Bhadbhade et al., 2019). In the 2017 wet season, 37% (14,679) of the state's villages produced < 50% of their standard crop yield meeting the formal definition of 'drought-affected' (Jamwal, 2018). The next wet season saw nearly one-third of the state's sub-districts experience severe drought (Malik, 2018). Our results suggest the reason why many villages served by the campaign report significant seasonal crop declines, and are thus designated as 'drought-affected', is because political impulsions to demonstrate 'drought-freeness' limited the nature and scope of initiatives, animating a conditional, unequal, and highly extractive set of outcomes around water availability and use that have not served all agricultural livelihoods.[19] Even where villages may meet aggregated thresholds of crop production, we argue villages on the whole should not be simplistically characterised as 'drought-free' if water conservation is not widespread and long-term.

We limited the scope of this paper to synthesising the broader conceptualisation, implementation, and effects of the campaign. Of particular importance is ethnographic research on how drought-relief plans were developed and implemented through village bodies, grassroots officials, and the contractor-lobby. These micro-level processes were likely to impinge on who was made water secure, and who was not, and will complement the broader focus here on government interests that shaped the natures and outcomes of the campaign. Further, we recognise the possibility that villages in other areas of the state may reveal different outcomes, or enrich those reported here. Nevertheless, we maintain that our findings are not an artefact of a single village context because villages were selected with different climatic and agro-ecological contexts. Moreover, we contend that these findings are not limited to Pune District because key informants' experiences with the campaign in Eastern and Western Maharashtra, and the recent CAG Report (2020), corroborate several of our findings. Last, the association between ponds, and spatial indicators of environmental stress and socio-economic privilege was recently 'scaled' across Maharashtra (Shah, 2021), complementing certain indicators (e.g. landholding size) that explain the uneven adoption of farm ponds at the household-scale.

Overall, the case of Maharashtra demonstrates that without an overlapping focus on social difference and entitlement structure, policy programmes designed to protect communities from the risks associated with environmental variation can deepen existing inequities. In conclusion, the likelihood of agricultural drought will not be reduced for all people, and villages as a whole, if water access and use is not widespread and safeguarded for the long-term.

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[19] Opposing parties ridiculed the scheme as a "Jholyukt Shivar Abhiyan" ("scam-ridden campaign" instead of Jalyukt Shivar Abhiyan ["waterful or water-plentiful campaign"]), claiming it served the contractor-lobby and failed to eliminate drought for vulnerable villages (*Hindustan Times*, 2020).

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