Geoforum 126 (2021) 431–440

Contents lists available at ScienceDirect

Geoforum

journal homepage: www.elsevier.com/locate/geoforum

Between deficit rains and surplus populations: The political ecology of a climate-resilient village in South India

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ARTICLE INFO

Keywords:
Resilience
Climate change
Climate-smart agriculture
Political ecology
India

ABSTRACT

Projects to foster climate-resilience have become a standard feature of agricultural and rural development strategies across the global South. Yet what resilience means in practice is uncertain and contested. To this end, we examine a state-led project to create a 'climate-resilient village' in a drought-prone region of south India. The project involved extensive investments in watershed development, agro-forestry and crop varietal enhancement with the goal of creating a model from which climate-resilient practices could diffuse outwards. We analyse the politics behind this project and highlight its attempt to build resilience through field-level infrastructures and practices. While some project interventions provided generalised benefits, the failure to explicitly address local social structures and power relations created significant unevenness and left resources open to capture by elites. On this basis, we question the narrowness of resilience perspectives used to guide to adaptation planning. For many smallholders, a meaningful notion of 'resilience' would entail buffering exposure not just to climatic stresses but also to local power relations and market forces, yet these dynamics were silenced in official project discourse.

1 Introduction

Resilience stands as a cornerstone upon which rural development policies and projects are currently designed and legitimated (World Bank, 2015; FAO et al., 2017; FAO et al., 2018). For policy makers, the value of resilience is that it provides a conceptual glue to bind together multiple areas of concern under a single, simplified rubric. In the rural sphere, for example, the concept underpins development planning across an array of issues including food security, bolstering rural livelihoods, preserving the natural resource base, safeguarding against natural hazards and responding to climate stresses. Subsuming such diverse elements into its singular remit, however, inevitably comes at the cost of coherence and clarity. The more the resilience concept is put to work to incorporate and legitimise diverse governmental objectives, the more it strains under their weight (Simon and Randalls, 2016). As a result, key questions of what resilience entails, who or what needs to become resilient, and how such resilience should be fostered, are left ambiguous in theory and are open to considerable contestation in practice (Brown, 2016). Equally, strong concerns have been raised about the tendency of resilience perspectives to silence questions of power and inequality within analyses of climate change impacts and adaptations (Cote and Nightingale, 2012; Watts, 2014; Eriksen et al., 2015).

While such critiques of resilience at a conceptual level have multiplied, there are fewer situated analyses of local resilience-building projects that illustrate how projects manage the tensions between the abstract goal of fostering resilience and their tangible interventions into complex social environments (see Forsyth, 2018; Cavanagh et al., 2017; Mikulewicz, 2019). To contribute to this literature, the present paper examines a major climate change adaptation initiative known as *National Innovations in Climate Resilient Agriculture* (NICRA) established by the Indian Council of Agricultural Research (ICAR) in 2011. This programme sought to establish approximately 150 'climate-resilient villages' across India's diverse agro-climatic zones as demonstration sites for advanced agricultural practices and technologies. In theory, the concentrated application of watershed development, new crop technologies, livestock improvements and institutional innovations would catalyse a process of focused learning, training and validation that, together, could build climate-resilience. By creating models of best practice at a village level, the project further sought to provide the foundations for scaling out successful technologies via networks of

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https://doi.org/10.1016/j.geoforum.2020.01.007
Received 16 May 2019; Received in revised form 4 January 2020; Accepted 12 January 2020
Available online 21 January 2020
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trained agricultural extension officers as a means to establish climate-resilience across rural India.

Using the case study of one such climate-resilient village located in semi-arid Karnataka, we assess how climate resilience is both conceptualised and applied by public agencies. Paying close attention to its intended and unintended impacts, our analysis follows two main lines. First, we explore how the climate-resilient village initiative represents an archetypal form of project-driven governmentality in which rural development is condensed, as Tania Li puts it, to a sequence of "time bound interventions with a fixed goal and budget, framed within a technical matrix which renders some problems amenable to intervention, while leaving others out of account" (Li, 2016: 79). In applying this lens, we emphasise how the project sought to limit building resilience to the ordered introduction of new agricultural inputs, practices and technologies that could mediate climate shocks and stresses. While this created a bounded and systematic project with clearly defined goals and sequencing, the attempt to constrain resilience to the realm of technics marginalised questions of power and inequality within and across the target village. Such occlusion generated a number of blindspots that limited programme effectiveness and resulted in numerous unintended consequences.

The second line of analysis deepens the first by situating resilience more fully in the regional political economy that shapes agricultural livelihoods. Although the project conceptualised resilience within a narrow framework of interactions between farmers and climatic stresses, smallholders themselves emphasised a much wider set of dynamic processes that rendered agricultural livelihoods unstable and that threatened their ability to reproduce the household. These included stratified access to key productive resources, unequal commercial relationships between farmers and traders, endemic indebtedness to informal lenders, and highly uneven access to non-agricultural employment. Climate change was evidently a dynamic element within this conjuncture yet smallholders pursued what might be termed 'resilience' not simply in the narrow confines of adopting new agricultural techniques and practices. Rather, they sought to fashion strategic livelihood choices that reduced the threat of being rendered surplus to an austere political economy in which indebtedness, market volatility and social disempowerment were pressing constraints on livelihoods. The marginalisation of these dynamics from project design not only created policies that were unequal in their ability to address the challenges faced by different classes of households, they also created the conditions for a significant capture of resources within the project by local elites.

2. Resilience-Building within Rural Development Planning

The rise of resilience as the core rubric of development planning has been rapid and pervasive. The term slowly emerged within international institutions during the early 2000s before swiftly becoming a dominant means of conceptualising and legitimating development interventions over the ensuing decade (Felli, 2015; Brown, 2016). Although often applied inconsistently, contemporary usage builds from the analytical framework proposed by American ecologist C.S. Holling (1973) wherein resilience is the degree to which a system can respond to externally generated stress while retaining its essential form and functions. Resilient systems are therefore those that can absorb external shocks and stresses without losing their fundamental structure, identity and functions, or by quickly resuming them following a period of disturbance (Folke, 2006; Miller et al., 2010). Given that contemporary climatic change is typically represented in terms of a series of external shocks and stresses that impact upon social and ecological systems, it is evident why the resilience concept has had such wide resonance within both academic and policy circles. This utility was strengthened by the ease in which policymakers found the underlying idea of a system to be substitutable with a surrogate term of convenience, such as households, regions, countries, cities or – in the present case – villages.

The resulting representative schema of rural villages threatened by climatic impacts has proved a simplistic yet powerful narrative on which to orientate governmental policy. It creates, in Timothy Mitchell's terms, a new object of development – 'the resilient village' – that can be fortified through interventions to promote greater scientific management of resources alongside technologies to overcome the challenges posed by an increasingly capricious nature (Mitchell, 2002). On this basis, the objective of building climate-resilience at a village level has emerged as an important conduit for governmental energies across rural development agencies. Leading international agricultural organisations from CGIAR to ICRISAT now promote variations of the 'climate-resilient village' framework predicated upon the concentrated introduction of new inputs, infrastructures, practices and technologies. ICRISAT, for example, projects to build 'climate-smart villages' across the semi-arid tropics focused on watershed management, redesigning crop-livestock systems, and the promotion of digital agro-technologies, meteorological information sharing, and climate modelling for crop systems (ICRISAT, 2016). Likewise, CGIAR maintains the importance of working at a village-scale and has advanced its own eight step process for the creation of climate-smart villages across Asia, Africa and Latin America (Srisath et al., 2017; Aggarwal et al., 2018).

What is meant by resilience in these contexts, however, is often left opaque. In their discussion of building climate-resilient villages, Rao et al. suggest that the latter involves integration of adaptation, mitigation, and other practices which "increases the capacity of the system to respond to various climate-related disturbances by resisting or tolerating the damage and recovering quickly" (Rao et al., 2016). This notion of systems under threat from climatic shifts, however, is inadequate to describe the nature and complexity of rural social relations. Indian villages are not 'systems' in the sense of a bounded set of interactions between functionally related parts operating within a dynamic equilibrium. Rather they are complex political economic entities that are typically stratified by enduring social hierarchies in which households hold vastly different levels of assets, social networks and cultural capital (Harriss, 2006; Pattenden, 2016). These differences shape how households interact with each other – including renting land, seeking labouring opportunities, borrowing money, acquiring political influence – and also their position within the wider agrarian economy in which they are unequally integrated into regional markets for inputs, outputs and labouring opportunities. As a result, when climatic variability impacts upon a village, it does not do so equally. As emphasised by the political ecology literature on vulnerability, social distinctions in terms of class, caste, gender and age greatly strongly shape who is more exposed to adverse impacts while others are more secure (Wisner et al., 2004).

More dynamically, however, by changing the composition and value of household assets and altering livelihood strategies, climatic stresses also shift the nature of social relationships across a village impacting the distribution risks and rewards. The increased incidence of drought – for example – can have the perverse effect of empowering those village members who have control over reliable water sources or hold the ability to extend credit or employment to neighbours in need. Simultaneously, it increases the dependency of those who rely on the assets and opportunities held by others (Mosse, 2010; Onta and Resurreccion, 2011). On this basis, climate change can empower some – opening new strategies for consolidating wealth and influence – while pushing others into greater levels of dependency and vulnerability (Taylor, 2013a). Climatic change therefore does not simply impact some groups more than others. It reconfigures relationships between social groups in ways that reshape who might be considered 'resilient' at whose potential expense.

What is particularly worrying within the rise of planning approaches basing themselves on the concept of resilience, is that this rubric gives almost no basis for conceptualising – still less addressing – these kinds of power relations (Cote and Nightingale, 2012; Watts, 2014; Taylor, 2015; Mikulewicz, 2019; Taylor and Mikulewicz, 2019; Ruszczyk, 2019). This is compounded because climate change adaptation projects also change

inter-village relationships through the introduction of new resources, forms of knowledge and networks. While such projects invariably operate with the goal of improving local adaptive capacities, if they do not closely consider how such interventions alter asset ownership, livelihood opportunities, resource flows, political influence and local social networks, they can inadvertently serve to intensify these inequalities (Eriksen et al., 2018). The following case study shows in a concrete fashion precisely why resilience approaches that leave such considerations implicit have multiple unintended and often troubling impacts in practice.

3. Making climate-resilient villages in India

The National Initiative on Climate Resilient Agriculture (NICRA) launched by the Indian Council of Agricultural Research (ICAR) in 2010 was one the first and most ambitious initiatives of its type.[1] At the time, its implementers claimed that the programme represented the single largest climate change outreach to farmers anywhere in the world (Venkateswarlu et al., 2012: 8). Its primary rationale was that rural India was uniquely vulnerable to climate change owing to the dependence of a large section of the population on agricultural livelihoods, excessive pressure on natural resources, and relatively weak coping mechanisms. Given the projected negative impacts upon yields – potentially a reduction of between 4.5 and 9 percent depending on the magnitude and distribution of warming (Rao et al., 2016) – climate change was projected as a significant threat to rural incomes, food security and national GDP.

In response, the ICAR programme sought to provide site-specific agricultural technologies in 100 districts that it identified as specifically vulnerable to climate variability. Dividing interventions into four areas – natural resource management, crop production, livestock and fisheries, and institutional innovations – the programme sought to identify key climate vulnerabilities in agricultural production within each domain (Venkateswarlu et al., 2012). Once recognised, project managers were then expected to remedy those problems through the suitable choice and application of agronomic knowledge, inputs and technologies drawn from within the national research and extension system. On this basis, the 151 chosen model villages would serve simultaneously as testing grounds for new technologies, sites of learning for both farmers and extension agents, and as focal-point demonstration sites for state-of-the-art climate resilient practices that could then be diffused horizontally across districts by agricultural extension departments.

At a practical level, each village level intervention would be sequenced over a five year period in which financial resources and agronomic expertise would be made available to saturate the location in suitable climate-resilient technologies and therein render it 'climate-proof' (Rao et al., 2016). The specific technologies and practices implemented under each category were expected to vary from village to village according to local socio-economic and agro-ecological characteristics that would be identified by participatory risk-assessment exercises involving local farmers (Venkateswarlu et al., 2012: 8). Although the programme spoke to the need to combine modern science with traditional knowledge, interventions tended to be externally driven with a strong emphasis on expert knowledge that could be refined by local adaptations. As a result, few of the techniques highlighted within the programme literature were new. Rather, the primary interventions from rainwater harvesting to improved crop varieties are staples of Indian rural development practices operating for decades under the rubrics of agricultural modernisation and poverty alleviation (Mosse, 2005; Chhotray, 2011).[2]

Where the ICAR programme did diverge from existing programming was in its identification of the village as the focal unit of intervention. As a guiding policy document noted, the underlying strategy was to implement "resilient practices at a scale to cover the entire village in a saturation mode", therein avoiding the fragmentation of extension efforts associated with previous programmes (Rao et al., 2016: 28). Once established, the model village would then serve as a nodal point within a process by which climate-resilient agricultural techniques could be learned by both farmers and extension agents and subsequently diffused at a regional scale. In this manner, the programme sought to address the challenging problem of scaling-out climate-resilient agricultural interventions that has weakened similar initiatives elsewhere (Westermann et al., 2018).

To better understand the underlying rationalities of the climate-resilient village programme, it is useful to situate the initiative in terms of what Tania Li describes as a project mode of governmentality in which programmes seek to create a clearly delineated objective in which cause and effect can be easily demarcated and interventions with predictable results planned and effected (Li, 2016; Li, 2007). In the ICAR programme, this tendency is notable in three areas. First, the programme established its rationale through the identification of specific deficiencies – a lack of suitable technologies and practices within smallholder agriculture to withstand climatic shocks and stresses – that needed to be remedied through the application of outside expertise. Issues that fell outside this remit – such as the social contexts in which agriculture is performed – were simply ignored, no matter their relevance to agricultural production and livelihood outcomes. Second, the project then sought to render climate-resilience as a technical process, one in which a clearly defined and bounded problem – the lack of climate-resilience – could be resolved through the provision of new knowledge, practices and technologies. The ICAR approach, in short, fits what Jayaraman (2017: 286) has critiqued as a form of policymaking in which climate change adaptation is reduced exclusively to a matter of new technologies for agriculture. Thirdly, the project was conscious of the need to demonstrate success and ensured that its forms of intervention were easily legible to higher levels of administration that required precise itemisation of project outcomes along clearly defined metrics and timelines.

Cast within this technical form, the climate-resilient village programme opened up three key fault lines. First, in constructing 'the village' as the appropriate unit of analysis for climate-resilience, it silenced questions of power within and between households that were vital to understanding how the project would shape livelihoods (see Robbins, 2000). Far from a homogenous farming population, village-level interventions played out over an uneven social terrain wherein different households hold sharply differing access to key productive inputs such as land, water, labour and credit. By assuming that interventions work seamlessly across such socio-economic divides, the project took no stock of how its interventions would become entangled with the evolving political economy of its target villages in ways that complicated its core goals. On the contrary, by seeking to redesign infrastructures, alter landscapes and re-orientate farming practices, such interventions inevitably reshaped rural power relations and village hierarchies leading to complex outcomes beyond those legislated for in project design.

Second, by restricting climate-resilience to an issue of designing appropriate farming technologies, there was no consideration given to how the project functioned within a regional political economy of

[1] The usage of 'climate-resilient village' within the Indian programme rather than 'climate-smart village', which is a more popular nomenclature at international levels, is due to the lack of focus on greenhouse gas mitigation that forms one of the three pillars of climate-smart agriculture.

[2] Within Karnataka, for example, most of the practices identified as climate-resilient had been part of the Bhoochetana program launched by the state government two years earlier. The latter projected not to 'build resilience' but to boost farmer incomes and increase food security through science-led interventions (Wani et al., 2012).

agriculture in which households operated in conditions of significant indebtedness, unequal trading relationships, and the stratified availability of non-agricultural livelihood opportunities (see Hellin and Fisher, 2018: for similar concerns in a different geographical context). In the Indian setting, this is particularly important because climate change forms just one facet of what has been described as a generalised 'agrarian crisis' manifested first and foremost as a reproduction squeeze on smallholder households (Harriss-White, 2008; Reddy and Mishra, 2010; Swaminathan and Baksi, 2017). Trapped between agricultural production that is lowly remunerative and irregular employment in non-agricultural labour markets, smallholders consider climatic stresses to be simply one of multiple overlapping determinants of livelihood sustainability. Hence, while the project saw climate change as posing a set of technical questions at the level of the field, the target population viewed climate shocks and stresses as an inseparable moment of a broader political ecology of agricultural production and livelihood dynamics. This led to diverging ideas of what 'resilient' livelihoods entailed.

Third, designating the village as a model of best-practice generated a series of internal pressures within the programme. Once granted model status, villages become not only sites for technical interventions but also politicised showcases for wider audiences (Flachs, 2017; Stone, 2018). This leads to two key tensions: on the one hand, to maintain a model project requires concentrated financing, resources and expertise from external agencies that creates an environment tangibly distinct from neighbouring villages. While scaling-out is a buzzword that animates the programme, other villages are ultimately intended to replicate outcomes without the resources that made the former possible in the first place. On the other hand, political pressures upon implementers to represent the project as a success easily leads to the production of simplified outcome descriptions that lack reflection over who gets to define and corroborate what success means and over what timescale (Sumberg et al., 2012; Svarstad and Benjaminsen, 2017). The annual reporting documents for NICRA, for example, are composed of short, bounded anecdotes of successful technical achievements from across India with accompanying photos of the implementing farmers (NICRA, 2016, 2017; Srinivasa Rao et al., 2016). These snapshots of success are offered without any contextual detail or critical reflexivity about the nature of interventions and their intended and unintended outcomes over time.

In the sections that follow, we explore these tensions in the unfolding of the climate-resilience project implemented in the village of Nagenahalli located in a hilly and drought-prone region of southern Karnataka. To this end, we conducted 45 semi-structured interviews with direct cultivators – individually or in small groups – in and around the village of Nagenahalli in Karnataka that had been selected as one of the initial models for the programme. These interviews were supplemented with nine focused interviews with key government agencies involved in NICRA project alongside those concerned with agricultural extension and rural development more generally. The latter included interviews with Krishi Vigyan Kendra officials (KVK – national public extension authorities) who implemented the project, Raita Samparka Kendra personnel (RSK – Karnataka public extension authorities) who provided supplementary extension support in the region, and officials from the regional Forestry Department, Groundwater Department, Minor Irrigation Department, and the general Taluk administrative office.

The majority of our interviews were with smallholder farmers who cultivated land on both sides of Nagenahalli and in neighbouring villages surrounding the village. We sampled farmers that provided a cross-section of landholdings and caste status alongside three spatially important distinctions: (1) farmers from the east side of the village where the greatest investment in watershed infrastructure development had occurred; (2) those on the west side of the village, who were included in the programme aspects directed towards constructing farm ponds and changing cropping practices but not directly part of the major watershed redevelopment; and (3) those from just outside the village boundaries who faced similar challenges to farmers in Nagenahalli yet had not been included in the official NICRA project (see Tables 1 and 2). In terms of the gender division, five of the Nagenahalli farmers were female, with the rest male. Four were from Scheduled Castes, with the remainder being Gowdas and therein categorised as an Other Backward Castes in the terms of the national census.

Our interviews were semi-structured in nature and designed to address multiple aspects of agricultural practice, livelihood strategy and relationship to the CRV project. Typically they were with individual farmers, although occasionally more farmers joined in an interview initially out of curiosity, leading to a small-group interview emerging organically. Using these farmer interviews in combination with those conducted with officials, we sought to gain insight into both the socio-political dynamics of the CRV project alongside the primary factors that farmers themselves identified as shaping their relative livelihood security.

4. Nagenahalli – making a climate-resilient village

The choice of Nagenahalli as the site for the NICRA programme in part rested on its ability to serve as an archetype of villages in the district. Set within a north-south valley with forested hills on both western and eastern sides, it has a population of about 950 people with around 190 ha of cultivated area. As across Karnataka, the standard operational size of land holdings has become increasingly small over the past three decades owing to households subdividing land among male children (Ramakumar, 2017). Seventy five percent of farms across Tumkur district as a whole are now small or marginal, with the average holding in this category less than one hectare. Contrarily, the top eight percent of landowners hold almost a third of cultivated land, therein demonstrating persistently strong inequalities in land ownership (see Table 3). Landholding patterns in Nagenahalli are reflective of these district averages, with a small number of medium farmers – often part of the same families – alongside a majority of small and marginal farmers (Ramesh et al., 2015). Members of scheduled tribes (ST) make up around 20 percent of the village and typically have holdings that place them in the marginal and small farming categories.

The cropping pattern in Nagenahalli is common to those across Karnataka's dry central hilly zone. Finger millet, lentils, maize and groundnut are cultivated within rainfed agriculture, with households typically diverting a portion of this production towards subsistence needs while marketing the remainder. Under rainfed conditions, this kind of agricultural production earns minimal returns at best. As Kammardi et al. (2017) note in their analysis of the cultivation of major crops in Karnataka, when total costs including household labour are included, smallholder agriculture tends to be profoundly unremunerative and deeply reliant on the self-exploitation of household labour. More palatable returns are potentially available through the production of cash crops such as rice, tomatoes, coriander and chillis. The production of flowers for religious garlands is a more recent entry into the repertoire of commercially orientated farmers, while land on forested slopes may be used to cultivate mango, coconut, areca and amla. The ability to cultivate cash crops, however, typically requires secure irrigation

Table 1
Interviews conducted with farmers.

Category*	Size (acres)	Farmers interviewed in Nagenahalli	Farmers interviewed in neighbouring villages
Marginal	>2.5	10	15
Small	2.5 – 5	7	7
Semi-medium	5 – 10	1	3
Medium	10 – 25	1	1
Large	>25	0	0
Total		**19**	**26**

* Landholding categories reflect those used within the *National Agricultural Census.*

Table 2
Sources of Irrigation Among Interviewed Farmers.

Irrigation Type	Nagenahalli	Neighbouring villages
Rainfed	6	11
Pond only	5	2
Borewell only	1	6
Pond and Borewell	5	7
Access to Checkdam/Fixed Irrigation Structure	2	0

Table 3
Landholding sizes in Tumkur District.

Marginal and small farmers		Medium and large farmers	
% total farms	% total area	% total farms	% total area
75	40	8	32
Av. farm size	0.87 h	Av. farm size	6.58 h

* Agricultural Census 2010-11: Report on Operational Holdings in Karnataka, Directorate of Economics & Statistics, Bangalore.

facilities to provide consistent water and also involves a high degree of risk owing to the higher cost of inputs alongside turbulent market prices (Sarkar, 2017).

In this context, climate variability is a significant challenge to smallholder livelihoods. With an average annual rainfall of less than 700 mm – most of which falls in the monsoon periods spanning May to October – the region is prone to regular droughts whose incidence has increased in recent decades (Balachandra, 2017). Analysis done within the climate-resilience project showed that the number of rainy days had decreased from around 56 in the 1980s to 49 in the 2000s. At the same time, the incidence of dry spells during the rainy season had increased significantly, including ones that were over 20 days in length. Conversely, incidences of intense rainfall – which can be damaging to crops and cause localised flooding – had also increased (Naik, 2012).

Given small landholdings, poor terms of trade for agricultural produce, and pronounced climatic variability, cultivators with small and marginal landholdings repeatedly described agriculture as an intensely risky pursuit that delivered insufficient returns to form the sole basis of a livelihood strategy. As a result, most households out of necessity diversify income generation (Bakshi and Das, 2017; Kattumuri et al., 2017). Alongside labouring in the fields of others – a task strongly stratified upon gendered lines wherein the drudgery tasks of weeding, transplanting and harvesting are heavily feminised – most households invest in livestock to varying degrees. On this basis, the milk industry has expanded greatly over the past decade, with many households owning jersey cows that can deliver small but consistent income every five days although these non-native breeds are susceptible to heat stress and disease (Department of Animal Husbandry and Veterinary Services, 2016). Raising goats is seen as a more reliable yet less remunerative element of livelihood diversification. Goats take three years to reach maturity, yet they are valued for their hardiness, ability to forage on scrubland, and the potential to sell them at short notice if immediate liquidity is required.

Conversely, other natural resource based livelihood options in the village have decreased markedly over the past decades. The dry deciduous forests that bound the village lands to the east and west are now rarely used for grazing and collection of food, medicines, firewood and rattan for basket weaving. In part this is because there is a stronger policing of the hills as conservation areas wherein forestry officers actively build fences and deep trenches aimed to keep villagers and livestock out (Prakash et al., 2006).

Given these constraints, household livelihood strategies are increasingly reliant upon employment opportunities outside of agriculture both within the district and in the city of Tumkuru located 20 km away. Notably, the growth of a textile industry over the past decade on the outskirts of Tumkuru has provided new livelihood possibilities for rural households with younger female members who fit the strict recruiting profiles of the sector. Other women work as agricultural labourers, domestic servants, or as small retailers within the service sector. For rural men, the construction sector remains a prototypical source of employment outside of agriculture along with service sector occupations such as working as drivers or in petty commerce. Employment of this nature, however, is normally informal, insecure, temporary and often seasonal (Pattenden, 2016). It is strongly segmented according to age, gender and education, making it hard for villagers to find consistent and secure employment. As a result, most rural households mediate the risks of underemployment by retaining one foot in agriculture despite its low remuneration. This task often falls to older household members – male or female – who consistently work the fields while younger members seek paid employment and help with agriculture tasks at peak times.

5. Building climate-resilience 1: watershed development

This context made the village a fitting location for the model climate-resilient village project as it is broadly characteristic of village conditions across the district. The centrepiece of building climate-resilient in Nagenahalli was undoubtedly a substantial investment in watershed development. Given the village location positioned between two extensive hillside watersheds, project designers envisaged a significant opportunity to harvest rainwater that might otherwise flow directly off the hills and out of the valley. This desire to better control water and avoid wastage is a central element of most climate-resilient agriculture programmes and expresses a strong continuity with longstanding programmes of agricultural modernisation in India on-going since the colonial period (Gidwani, 2008; Chhotray, 2011). On the east side of the village, engineers sought ways to refurbish and expand runoff infrastructures in ways that slowed and trapped water either for immediate usage or to recharge groundwater aquifers. The most intensive operations involved the creation of new concrete channels and check dams to slow and collect water running off the hillsides. Simultaneously, existing water structures were renovated where they had become filled with silt or where channels had collapsed and some contouring or levelling of land took place to restrict runoff at a field level. Most extensively, farmers were then invited to request the use of a mechanical digger to construct individual farm ponds as rainwater harvesting structures. Together, these activities resulted in the creation of 5 new check dams, 72 farm ponds, 13 percolation ponds and 4 concrete-lined storage structures. Additionally, a further 15 existing farm ponds, 8 check dams, and 2 community tanks were improved while established infrastructures for water catchment were de-silted and widened (Ramesh et al., 2015; Rao et al., 2016).

Through this infrastructure, project implementers sought to saturate the village with harvesting structures sufficient to meet the water needs of every farmer. As a description of the project highlighted, if all the newly created and renovated structures worked at full capacity this might double the water harvesting potential to 196,560 m^3 (Ramesh et al., 2015). Such an accomplishment was projected to help liberate the village from the fickleness of rain patterns under a changing climate and to provide the security necessary to transfer production towards higher value crops such as tomatoes, chillies, flowers and other market vegetables. Given the extent of completed infrastructural improvements, the project was able to project a significant success story:

> *Over a period of time water storage capacity increased significantly, covering more area under irrigation and enhancing the cropping pattern, intensity and productivity of several crops. Both per capita cultivable land and yield increased but per capita availability of produce increased*

drastically in the village. Water resource management improved the socioeconomic status of D. Nagenahalli people (Ramesh et al., 2015: 789).

While many of these outcomes were apparent at the time of our research, the overall impacts demonstrated greater unevenness and complexity than acknowledged within the project literature. This is because, by rendering the project as a strictly technical process of infrastructural change, it shunned any attempt to grapple with the social dimensions of irrigation (Baviskar, 2007). Although project managers acknowledged that the benefits from the new structures could be maximized through some form of water sharing, there was no mechanism within the project to engage the social dynamics of water access (see Gupta, 2011: for a comparable study). Specifically, while rainwater harvesting structures were built through public subsidization, they were typically located on or between private lands. As a result, where rainwater could be captured, it became the property of the individual landowner to be privately used or traded. Even water in the new check dams that lined the base of the valley required ownership of adjacent fields and investment in suitable pumping technologies for access.

This contrast between the public creation of watershed infrastructure and the private appropriation of the resulting water accentuated an important shift in power relations across semi-arid parts of south India (Gupta, 2011; Taylor, 2013b; Baviskar, 2007; Chhotray, 2011). Whereas land ownership has typically been recognised as a foundation of social hierarchy in rural India, under changing climatic conditions, land is now valuable as the topographical basis on which to gain access to water. A marked example of this was evident in the neighbouring village, where an affluent and educated farmer had used ownership of strategically placed fields to build an elaborate harvesting infrastructure that channelled water into a substantial pond among his fields. Combined with several borewells and a network of linking irrigation pipes, this farmer was able to strategically halt water on its downward trajectory, store it, and use it to cultivate a set of paddy fields that were noticeably verdant within a parched landscape suffering under a late monsoon. Beyond his private cultivation, however, control over water enabled the farmer to engage in a new type of share-cropping wherein water-rich farmers are trading water for the rights to between a fifth to a third of final output, depending on the amount of water provided. For those who had the means to control water through such infrastructures and technologies, new accumulative opportunities arose that were directly exploitative of less-resourced neighbours.

To an extent, the project goal of saturating the village with harvesting structures appeared – in a haphazard and unplanned manner – to provide a degree of equity by offering the means to all farmers to construct farm ponds. This outcome was limited, however, by uneven land ownership in the areas the project served. Notably, the bulk of large-scale infrastructure such as channels and check dams was limited to a relatively narrow stretch of suitably contoured hillside on the east side of the village. In this zone, the synergies envisaged by the project architects were readily apparent. Sizeable concrete infrastructures channelled water from the hillsides where ponds and wells trapped it as gravity pulled it down the valley. Over time, groundwater aquifers in the low valley benefited from greater seepage from these ponds and as a result, farmers with fields on this side of the village – and particularly in the low folds of the valley – undoubtedly gained from water catchment and improved levels of groundwater. For the farmers in this band of fields, the transformation of the watershed facilitated the cultivation of market-orientated crops such as tomatoes and coriander and, at the very bottom lowest fold of the valley, farmers grew paddy even in drought conditions using borewells that they said were remarkably consistent.

Nevertheless, the bulk of agricultural fields lay outside of this catchment zone, spreading westwards under a different watershed. While more prosperous households tended to have fields on both sides of the village – and therefore a stronger chance of being able to access water – most marginal and small farmers were restricted to plots on one or other side, with the majority of land holdings falling outside the newly manufactured waterscape. Here, the possibility of accessing groundwater was markedly more difficult with wells needing to be sunk to a depth of around 1000 feet – an exceptionally costly process with a high rate of failure. As a result, the project enhanced a process of socio-economic differentiation along geographic and class lines. Those with suitably located holdings who could benefit from the watershed infrastructures now had added security upon which to engage cash crop agriculture or to become water merchants and claim a portion of other farmer's crops. Such rewards were accentuated for households with larger landholdings and access to credit to sink new or deeper borewells.

For smallholders outside the heavily renovated catchment area, these synergies did not apply. While such farmers were still able to construct of farm ponds to catch and store rain water, these were isolated from the elaborate replenishment infrastructures created by the project and therein heavily dependent upon direct rainfall for recharge. The potential benefits and risks of such ponds, moreover, were stratified by socio-economic factors. To build a pond requires farmers being willing to make a tradeoff with lost acreage for cropping. For farmers with relatively more extensive holdings, this generally appeared to be a worthwhile investment because the construction of a larger and deeper pond – some with a surface area of 30 by 30 feet – facilitated a move into more water-intensive yet lucrative cropping patterns including vegetables, or to engage in water sales. For farmers with marginal or smallholdings, however, the tradeoffs involved in digging farm ponds were more challenging. Turning cultivable land into pond space involved sacrificing limited cropping area while the smallest ponds – measuring 10 by 10 feet – had limited depth and therefore a much smaller holding capacity.

At the same time, farm ponds worked most effectively in conjunction with a borewell. Rather than waiting for rainwater to fill the pond, farmers with functional borewells pumped groundwater directly into ponds and used them as above ground storage tanks. This was undertaken to mitigate the risk of electricity cuts that often rendered borewells useless when most needed. It also enabled farmers to privatise a portion of the limited quantity of groundwater that existed in underground aquifers by pre-emptively capturing it in private storage. Notably, in Nagenahalli, all but one of the farmers with 3 or more acres utilised this combination of borewell with pond. For small and marginal farmers, however, accessing the credit required to drill borewells was often impossible or extremely risky (Taylor, 2013b). Of the total farmers we interviewed across Nagenahalli and neighbouring villages, only four of 25 farmers with less than 3 acres had borewells and only one of these used the borewell/pump combination.

The tendency for borewell failure, moreover, was amplified outside of the zone served by the check dams on the east side of the village. While the climate-resilience project sought to remedy this issue by using small-scale contouring to increase the rate of seepage into aquifers, the results were limited and borewell recharge remained negligible. The project's self-declared results suggested only half the village borewells became active post-project, with most of those concentrated in the lowest points of the valley served by the eastern watershed development (Ramesh et al., 2015).

The uneven results of watershed development raise strong questions about the replicability of the model. First and foremost, the signature watershed interventions on the east side of the village were extremely costly requiring a sizeable project budget of around INR3,000,000 (approx. US$43,000). In contrast, the next climate-resilient village project in the region was to operate with a fraction of those resources at INR800,000 (approx. US$14,500) resulting in scaled back watershed interventions focused on the more modest practices of field contouring, refurbishment of existing structures and the creation of small farm ponds. Other villages in the region, moreover, had no direct budget for watershed development activities beyond the farm pond model that is presently being strongly promoted as a 'scalable' output of resilience initiatives throughout semi-arid Karnataka. Worryingly, the socio-economic differences in benefits noted above are accentuated when

farmers have to pay the full costs of ponds upfront. While local RSK extension offices do offer reduced rates of between fifty to ninety percent of the total cost depending on the scheme operating and the caste status of the applicant, these incentives come only in the form of reimbursements for costs. The waiting period for refunds are substantial with farmers noting that they could anticipate anywhere from six months to two years. This meant that regardless of subsidisation, farmers effectively needed to have access to either cash reserves or stable credit facilities to take on the costs of installing the pond, a luxury that few smallholders enjoyed.

6. Building resilience 2: cropping practices

Given that the distribution of water within the watershed development side of the project was both geographically and socially uneven, many farmers could not transition into the higher value horticultural crops that were envisaged to help raise household incomes. For those farmers who remained reliant primarily on rainfed agriculture, the project encouraged the adoption of new short-duration varieties of staple crops that had been produced through the Indian agronomic breeding system. These short duration varieties were presented as useful tools for building climate-resilience in rainfed agriculture owing to their quicker maturation times. While farmers have typically used such varieties whenever the monsoon is delayed, the project recommended a more systematic usage of such varieties as a means to mitigate the possibility of uncertain rainfall later in the season. By planting short duration crops even when the monsoon arrived on schedule, farmers would be hedging against the possibility of a shorter wet season that would otherwise affect the final stages of plant development. On this basis KVK officials recommended a short-duration finger millet variety (ML-365) alongside varieties of groundnut, chilli and tomato produced within the public research system. Each variety, they argued, could mitigate climatic risks without sacrificing yields.

In many respects, these varieties were widely accepted and represented a successful element of the project. The prescribed short duration variety of finger millet – the local staple crop – was particularly well received by farmers. What project officials tended to elide in their focus on the technical attributes of short duration crops, however, was that farmers gravitated to them not simply as a means to mitigate potential rainfall variability but because they were distributed with a major subsidy through the local state-led RSK extension office and, within the climate-resilience project, were accompanied with free fertiliser and pesticides. This heavily subsidised distribution of key inputs was strategically important for small and marginal farmers because it helped them reduce their dependence on credit at the start of the season. With even middle-sized landowners excluded from formal bank credit, informal debt relations prevailed for such transactions with money lenders – often local merchants or large landowners – playing a central role in enabling households to meet financing needs at the beginning of a season (Deshpande and Shah, 2010). Availing such informal loans, however, typically ties borrowers into significant economic and social obligations (Guérin, 2014). Credit is granted high interest rates or – when offered by merchants – by tying the debtor into dependent and unfavourable marketing agreements for their output (see Aga, 2018). As a result, the rush of farmers to adopt varieties recommended by the project was not solely a function of their superior technical attributes in managing drought. It occurred as a means to reduce input costs in ways that helped mitigate farmer indebtedness and avoid the power relationship between farmers to lenders that the latter implied. In short, *pace* the formal emphasis on building resilience through technological improvements to cropped varieties, the success of this aspect of the project lay in its inadvertent remedial impacts upon the social relationships of credit and debt.

Alongside short duration varieties, the KVK also recommended that farmers deploy intercropping as a route to minimize risks in crop production. Under highly variable climatic conditions, intercropping rows of complementary crops can help ensure returns from at least one of the varieties during years of low rainfall and to maximize returns during the years of favourable rainfall (Rao et al., 2016). In agroecological terms, intercropping can help utilize light and moisture more effectively to promote plant growth while simultaneously contributing to the maintenance or improvement of soil fertility in comparison with monocultures (Khatri-Chhetri et al., 2016). On this basis, the project recommended that farmers adopt various intercropping parings, particularly cultivating the staple crop of finger millet not as a monocrop but rather interspersed with rows of red gram (lentil). A similar combination with red gram was also recommended for groundnut and maize cultivation.

As was readily apparent from field cropping patterns and confirmed through interviews, this kind of intercropping was a relatively common practice used across many smallholder fields. Despite the enthusiasm of the project to represent such techniques as successfully introduced climate-resilient innovations, however, intercropping was widely practiced across the district. While some cultivators in Nagenahalli indicated that they had learned specific patterns from the project – particularly intercropping within commercial flower production – most argued that these were longstanding local practices, used for generations to deal with climatic variability. Notably, some farmers used more elaborate intercrops than taught under the NICRA project. One smallholder from a neighbouring village located outside of the project's remit, for example, practiced triple row intercropping in combination with manure drawn from his stock of native cattle and a small herd of goats. Where possible he used natural anti-pest creations from local plants rather than purchased pesticides, rotated crops across fields to avoid nutrient depletion, deployed diverse varieties of crops between plots, and stored fodder over the years to hedge against bad years. The farmer claimed to have used these practices for decades having learned them first and foremost from his parents, although he clearly was aware of local networks promoting agroecological farming techniques that reduced the need for purchased inputs (Khadse et al., 2018).

What was striking about this farmer was the way in which he represented many traits that could be considered archetypes of resilience in terms of the ability to avoid or adapt to adverse events, yet these were directed at a much broader set of vulnerabilities than those identified in the resilience-building project. While his efforts certainly sought to meditate potential climatic risks, his greater objective was to strategically avoid being drawn into monetized chains of trade and debt that exposed him to market forces and power relations beyond his control. In a strategy reflective of Chayanov's characterisation of peasant autonomy (see van der Ploeg, 2013), this farmer sought to engage market relations in a controlled manner by selling surplus beyond subsistence needs, retaining stores of seed and fodder across seasons, and cultivating a single field of groundnut purely to meet cash needs. His actions, therein, were orientated as much as possible to retain a calculated distance from market impositions. Notably, he demonstrated an unwillingness to invest in watershed development through farm ponds or borewells, both of which would require incurring debts and the associated relationships with powerful moneylenders. This absence of water harvesting infrastructure undoubtedly left him vulnerable to periods of poor rainfall. It nonetheless highlighted an aspect that the climate-resilient village project went to great lengths to silence. Climatic variability was a significant problem for smallholder farmers, yet it was relationships of debt and unequal trade that they feared the most as those formed the principal levers of rural expropriation and destitution (Deshpande and Shah, 2010).[3] Notably, across Nagenahalli, farmers

[3] To clarify, there is no intention to romanticise this 'resilient' farmer who was at pains to indicate the austere modesty of his life. Despite his strategic efforts, he emphasised that his livelihood remained precarious and he hoped his children would, through education, gain access to very different job markets in urban India.

spoke of seven or eight households who had lost their land owing to chronic indebtedness and a similar pattern was confirmed in neighbouring villages.

7. Building resilience 3: agroforestry

The third pillar of the NICRA project in Nagenahalli was agroforestry. This initiative was unique in the way it sought to combine new forms of remunerative agriculture with the advancement of conservation goals and biodiversity preservation. Forestry officials throughout the region heavily promoted such prospective win-win scenarios. The head of Tumkur's forestry department, for example, emphasised how planting timber crops such as *melia dubia* and sandalwood offered excellent economic returns and could be combined with staple crops such as millet or lentils grown under the canopy. This combination, he argued, could serve as an effective means to reforest agricultural lands and extend tree coverage across a heavily deforested region.

A significant constraint with such a plan, however, is that *melia dubia* has a ten year timeline until it can be harvested for wood while sandalwood can take up to twenty five years. Wary of the long timeframes involved, the NICRA project focused instead on the establishment of intercropped orchards through the ordered planting of fruit and nut trees between which lines of millet or lentils could be cultivated. In particular, the project was keen to advance these techniques on marginal lands at the edges of the village that had typically been used only for low intensity millet and fodder production. To advance these goals, the project provided free saplings, funds to cover plantation, technical advice on how to manage the orchards, and small subsidies for the maintenance of tree cover.

Undoubtedly, this agroforestry initiative produced considerable success in both economic and ecological terms. A significant portion of marginal lands that had previously been suited only to grazing or partial millet cultivation were transformed through the line planting of fruit and nut trees such as amla (Indian gooseberry), cashew and mango. These were productively combined with millet intercropping under the fledgling canopy for the initial five-year period during which the commercial trees fully developed. At that stage, canopy coverage made intercropping less feasible but this occurred at the point in which trees started to produce fruits even in conditions of restricted water. Standing among these orchards, it was easy to view this as a climate-resilience success story, not least because of the potential benefits to biodiversity within intensive agroecosystems.

Regrettably, however, these benefits were not evenly distributed because there existed strong socio-economic barriers to successful pursuit of agroforestry for small and marginal farmers. While such farmers were aware of the potential for strong medium and long-term returns to agroforestry, they typically lacked the extent of landholdings to effectively plant trees at the required spacing to maximise intercropping benefits and to reap economies of scale. At the same time, they also felt they lacked the fiscal security to forego immediate food production for medium-term gains by devoting land to fruit or timber crops (see Cavanagh et al., 2017: for a comparable study in Kenya). In contrast, farmers who did have significant landholdings, financial resources and good contacts with extension officers were able to accrue considerable benefits from agroforestry. As a result, the primary agroforestry benefits were concentrated among a relatively small cadre of farmers who had larger landholdings and the security to turn from short-term crop production to longer-term planting cycle in which payments were tentative in early years but particularly strong after the five-year mark.

Most notably, one specific entrepreneurial farmer dominated the agroforestry initiative. As head of the Village Climate Risk Management Committee, this farmer was the key liaison between the village and KVK and had strategically lobbied for Nagenahalli to become the model village for NICRA in the years leading up to the project. As Taylor and Bhasme (2018) note in a study of extension activities in a neighbouring district, the presence of a trusted local intermediary is often highly sought after by project managers as the former can help enlist the active support of a target population and manage project tasks when extension officers are not present. Such intermediaries, however, are typically drawn from more advantaged socio-economic classes and are well positioned to be prime beneficiaries of project outcomes. With irrigated and rainfed holdings on either side of the village, this lead farmer proceeded to expand his agroforestry holdings from under two acres to a full seven acres with 1400 amla trees, 600 cashew trees, and 2000 tamarind trees sourced primarily through the project at heavily subsidised rates. Moreover, as a member of one of the village's predominant households, he managed a further 21 acres of land belonging to his family, much of which had been also converted to agroforestry. Lastly, as the biggest fruit producer in the village, the project-sponsored equipment used for the processing of amla was also located under his watch and he headed the village initiative to commercialize agroforestry outputs.

As a result, while the agroforestry initiative was undoubtedly a successful project in agro-ecological terms, in socio-economic terms it served as an accumulation strategy for a minority of villagers who used the project to transform themselves from relatively well-resourced farmers into dynamic agro-capitalists. This did not prevent agroforestry initiatives being portrayed as a demonstration of success by project. The lead farmer mentioned above had become the face of agroforestry in the district and his lands were used as a demonstration site for visiting national and international NGOs, sustainability researchers, government officials, and commercial retailers. It is unclear whether such visitors recognised how this showcase project was embedded within the unequal social fabric of the village. To no small extent, this capture of resources appeared to be facilitated by the representation of resilience-building as a technical project that could be undertaken in separation from the consideration of socio-economic inequalities and hierarchies. This tendency was further strengthened by the demands upon local implementing agencies to rapidly implement the programme and demonstrate strong results within a short timeframe. In order to speed progress, implementers took the pragmatic yet ethically problematic step of relying upon the cooperation of village elites with whom they had established relationships. On this basis, the project would be better able to meet short term aims of farmers engaged despite the processes of socio-economic differentiation it abetted.

8. In conclusion: resilience to what?

With climate-resilient village projects becoming an increasingly prominent feature of rural development planning, it is essential to take a sanguine look at the possibilities and challenges they raise. It is particularly important to question how overarching conceptual frameworks guide policy implementation by foregrounding some issues and points of intervention while marginalising others, therein shaping the tangible unfolding of projects. In this respect, this study raises vital questions concerning the ability of the resilience rubric to provide an adequately holistic approach to rural development and adaptation. With its origins in ecological science, resilience perspectives struggle to gain any conceptual purpose on the complex social dynamics of climate change impacts and responses. The focus on building resilience at a village-level through technical interventions skirted over how socio-economic inequalities and imbalances of power affect project outcomes.

While the infusion of concentrated financial resources and agronomic expertise in Nagenahalli undoubtedly provided important potential benefits in the form of watershed development, new crop varieties and agroforestry initiatives, the distribution of such benefits were stratified by socio-economic criteria left invisible the overarching framework of the project. For those with suitable landholdings and access to more secure credit facilities, the project opened up new avenues of profitable accumulation as they were able to expand production into commercial crops such as flowers and vegetables or into agroforestry. Other farmers – particularly those with small and marginal holdings – saw fewer tangible benefits and relied primarily on the short-term

distribution of subsidised inputs that accompanied the project. These were valued not primarily in terms of being better cultivation technologies, but because their subsidisation lowered overall input costs and therein reduced the need to enter informal debt relations.

Overall, project interventions had the unintended effect of exacerbating longstanding processes of socio-economic differentiation, helping to transform one part of the village as a hub of commercially oriented farming and the other as a preserve of more subsistence orientated agriculture performed by a class of smallholders who remained squeezed between climatic variability and an austere agrarian economy that constantly renders them surplus to its needs. This reinforces a pivotal analytical point. While institutional strategies to build resilience often represent the object of resilience as practices that mitigate climatic shocks and stresses, smallholders were explicit that such meteorological challenges needed to be situated within the broader social context that shaped their livelihood activities. Meaningful resilience – in terms of their ability to cope with adverse events – would necessarily entail building a degree of autonomy from volatile market relations and lopsided debt relations. In their experience, it was the latter that provided the greatest threat to rural livelihood security. While improved technologies and infrastructures will of course be beneficial for some farmers, the notion that resilient villages can be fashioned independent of prevailing political economic contexts and social inequalities is a disconcerting element of contemporary policymaking.

Acknowledgement

The authors kindly acknowledge that research for this article was supported by funding from the Social Sciences and Humanities Research Council of Canada (SSHRC). We thank two reviewers for their helpful suggestions and Sarah Turner at Geoforum for timely assistance and advice. S. Manjunath provided excellent translation and research support services in Karnataka.

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