Wells and Wellbeing: gender dimensions of groundwater dependence in South India

Divya Susan Solomon and Nitya Rao

Abstract

Groundwater has played a pivotal role in transforming the rural agrarian landscape, augmenting rural livelihoods and improving household wellbeing. Through our research, we attempt to understand how the growing prevalence and importance of groundwater has impacted intra household relations, in particular the gendered divisions of labour, and use of assets. Further, we explore the impacts of failed borewells on gendered vulnerabilities, identities and wellbeing. Our research indicates that groundwater usage in semi-arid regions has increased the short-term resilience of communities in the region, but simultaneously increased gendered risks, especially for small-holders, by promoting unsustainable livelihood trends and risky coping strategies to groundwater shortages.

1. Introduction

Over the last 50 years, groundwater has emerged as the backbone of irrigated agriculture in India. In 2010, groundwater irrigated nearly 27 million hectares of land compared to 21 million hectares irrigated by surface water sources (Mukherji et al., 2013). Groundwater usage is growing at an unprecedented rate; it is estimated that one in four rural households owns at least one ground water irrigation structure (Shah, 2009).

Groundwater development has had manifold benefits for India's agricultural sector. It has been credited with increasing farm incomes and wellbeing through increasing productivity (Roy and Shah, 2002; Sekhri, 2014). On the flipside, it has resulted in chronic depletion in quality and quantity of the resource (Gleeson et al., 2010). Presently groundwater irrigation is at an impasse, it has cemented its vital position in drought-proofing agriculture, however, the exploitation of the resource for irrigation

has resulted in critical groundwater levels, particularly in already water stressed regions (Kumar and Singh, 2008; Livingston, 2009). The number of irrigation blocks in India that have reported over-exploited groundwater levels has grown at an alarming rate of nearly 5.5 per cent per year (Gandhi and Namboodiri, 2009). Increased well proliferation has led to aquifer contamination and salinization along with increased costs of pumping. The problem is particularly severe in arid and semi-arid regions, where communities depend on groundwater for both domestic and agricultural purposes.

Water scarcity is expected to grow in the future, exacerbated by climatic changes in precipitation patterns and increase in temperatures (Shah, 2009). A study conducted by Geethalakshmi et al. (2011) on the impacts of climate change over the Cauvery basin of Tamil Nadu using regional climate models showed an increasing trend for maximum and minimum temperatures, and rainfall, with a decrease in rainy days. These climatic shifts will impact the hydrological cycles in the region, lead to more runoff and less recharge impacting the groundwater tables. Furthermore, there has been an increase in frequency of droughts in the state, Tamil Nadu declared droughts over the last two years (2016 and 2017) (Promod, 2017). This has driven farmers to increase dependency on groundwater resources to secure their crops. Climate changes acts as a force multiplier increasing the criticality of the resource while simultaneously threatening it (Shah, 2009).

The emergence and spread of an intensive groundwater based irrigation regime has had important socio-economic consequences for rural households (Roy and Shah, 2002; Shankar et al., 2011). Curiously, given the centrality of groundwater to the contemporary agricultural economy, few studies have focused on the socio economic impacts, particularly gendered intra household impacts of groundwater usage and dependence (Mukherji and Shah, 2005). In fact, a recent review of the literature on water and gender in India (Kulkarni, 2016) focused entirely on surface water and the gendered and social facets of its management. In our research, we attempt to fill this gap by focusing on the relationship and micro politics between gender and the multiple uses and users of groundwater, in both agriculture and the domestic sphere. Specifically, we focus on the everyday experiences of men and women to understand

the gendered segmentation of agricultural labour and its relationship to the control over assets.

This paper is structured as follows. Section 2 presents the context of the study, briefly recounting the groundwater story in Tamil Nadu, and describing the physical and socio economic features of the study area. Section 3 discusses the main findings of the study, and Section 4 concludes with reflections on the gendered perceptions of wellbeing due to groundwater access.

2. Context and Methodology

2.1 Groundwater in Tamil Nadu

Tamil Nadu is one of the most water vulnerable states in India; it has only 3 per cent of the national water resources (Janakarajan, 1999). 15 per cent of the land area of Tamil Nadu falls within the semi arid zone with rainfall less than 700 mm/ per year (Walker, 2012). Agriculture in these circumstances requires some form of irrigation, explaining why 56 per cent of net sown area in Tamil Nadu is irrigated (Amarasinghe et al., 2009).

The dependence on surface water for irrigation has been overtaken by the extensive use of groundwater in the region (Kajisa et al., 2007); the area irrigated by groundwater doubling since 1950 (Janakarajan and Moench, 2006). 56 per cent of land is currently under groundwater irrigation in Tamil Nadu, while tanks and canal irrigate 44 per cent of the net irrigated area (Department of Economics and Statistics, 2011). In the last decade, state government subsidies to encourage irrigation, particularly subsidy for free electricity for pump sets, and loans for deepening of existing wells and construction of new wells, has reoriented the role of wells from a source of supplemental irrigation to a key productive asset.

In the absence of appropriate and properly enforced state regulation there is stiff competition among farmers who grow water intensive cash crops to extract groundwater (Phansalkar and Kher, 2006). From 2002 to 2012, there was an average annual groundwater decline of 1.4 m year, indicating groundwater usage that was

nearly 8 percent more than the annual recharge rate (Chinnasamy and Agoramoorthy, 2015). Larger farmers with more resources can drill deeper and have a considerable advantage over small and marginal farmers, who are burdened with 73 per cent of non-functioning wells (Kulkarni et al., 2015). Furthermore, in Tamil Nadu, the extensive pollution from industries particularly textile and paper industries has led to ground and surface water pollution seriously impacting the availability and quality of drinking water and, in turn, human health and wellbeing (Puthiyasekar et al., 2010; Saravanakumar & Kumar, 2011).

2.2 Study Area

This article is based on 25 in-depth interviews and a 200 household (HH) survey conducted in 2016 in two villages in Coimbatore district of Tamil Nadu, India. For the household survey, stratified proportional sampling based on landholding size (large: 7 acres and above, medium: 3-6 acres and small landholders: 0-2 acres) and caste, to ensure weighted representation, was used. Two panchayat villages, Marudur (50 per cent small, 43 per cent medium, 7 per cent large) and Chinnakalipetti (47 per cent small, 45 per cent medium, 8 per cent large), were selected for the surveys and household interviews. 25 households were selected for in depth interviews based on landholding size to understand the intra household dynamics of groundwater usage among different economic classes of farming households. While the surveys provided information on broader dimensions of livelihoods, in-depth interviews were used to understand groundwater usage, dependency and intra household relations. The names of interviewees have been changed to retain confidentiality.

Coimbatore is a drought prone semi-arid district in Tamil Nadu. In the 1950's, Coimbatore was known for the cultivation of dry land crops over large areas using tank irrigation, and a high concentration of land ownership (Kosalram, 1973). The region developed into a major textile hub and producer of cotton and rice after Independence. Over the last two decades agriculture has significantly declined largely attributed to the scarcity of both water and labour (Selvaraj and Ramsamy, 2006).

Chinnakalipetti and Marudur are small agricultural villages in Coimbatore district, having settlements of about 1000 households. The majority are Vellala Gounders, Vokkaliga Gounders, Vettaiyar Gounders, all falling under the Other Backward Caste (OBC) categorization, with a small population of Pallars (Scheduled Caste) and Kurumbas (Scheduled Tribe) who have small and medium land holdings. Post land distribution in the 1970's, OBC castes established their hegemony in the region; they are the main land holding castes and occupy majority seats in the Gram Panchayat[1]. 80 per cent of the farmers use groundwater for irrigation in our study region, of these 74 per cent reported at least one borewell failure in the last decade. The groundwater revolution has allowed farmers to grow water intensive cash crops, buffering against climate risks but simultaneously increasing the vulnerability of both the resource and the communities dependent on the resource.

Over the last decade, there has been a shift to intensified, cash crop cultivation aided by mechanization and the introduction of hybrid seed varieties. Secondary sources of livelihood include livestock, small ruminants and agricultural labour. As the region is close to the textile and manufacturing centres in Coimbatore and Thiruppur, many young people from the village migrate daily or seasonally for work. This is a common practice, particularly among young women before their marriage.

3. Findings & Discussion

Women play an essential role in the agrarian system in this region. Our survey showed that women contributed significantly to agriculture and related activities including animal husbandry, postproduction processing and farm based cottage industries. Additionally women contributed to household nutrition through maintenance of sustenance crops such as millets, vegetables and fodder. Despite women's role and contribution in the farming homestead, they remain subordinate to male kin with respect to agricultural decision-making. Our household survey indicated that men (94 per cent) are the primary farm decision makers with respect to cash crops; including crop choices, irrigation inputs and markets. Men also carried out most technology related, and indeed, the more remunerative tasks. In this section, we discuss the

implications of shifting cropping patterns and livelihood choices, resulting from shifts in climate, as well as both policy signals and people's aspirations.

3.1 Shifting cropping patterns: Changing divisions of labour

The North East monsoon, which arrives in early November, is the primary monsoon in the region and marks the peak '*Aadi*' cultivation season. The South West monsoon, which extends from the end of May to August is comparatively weaker and marks the '*Avani*' cropping season. A recent study conducted in the region found a significant shift in monsoonal patterns, with a weakening North East monsoon and a strengthening South West monsoon (Bunyan et al., 2018 forthcoming). Results from our survey indicated that 98 per cent of farmers felt that the total annual rainfall has decreased and 84 per cent reported that rainfall variability had increased over the last decade. This monsoonal irregularity along with increasing instances of drought has prompted farmers to adapt by shifting from supplemental to complete groundwater irrigation. A functional borewell hedges the household's fortunes against the capricious nature of monsoons, and provides a reliable source of water.

The expansion of groundwater irrigation in turn has led to a dramatic shift in cropping systems and crop management practices. It has facilitated the shift from rainfed, food and fodder crops (jowar, pearl millet, foxtail millet and ragi), to high-value and high-risk perennial cash crops such as banana, turmeric, jasmine, tobacco and recently, curry leaf. Rainfed millets are hardy and resistant to long dry spells, they do not require expensive agricultural inputs, and provide nutritional security to families, however, the market for these crops is limited, and returns are low.

72 per cent of farmers reported that they grow only perennial cash crops in more than 50 per cent of the cropping area. This shift has increased risks associated with farming. Cash crops are input intensive and require considerable financial outlays. Our surveys indicated that almost 78 per cent of farmers reported significant losses from agriculture in the last five years, due mainly to drought and water scarcity. Small holders depend on loans for inputs. Sources for loans include banks (24 per cent), moneylenders (36 per cent) and relatives (40 per cent), with interest rates of 4-7 per

cent, 20-40 per cent and 10 -30 per cent respectively. The implications of this are discussed further in section 3.3.

The shift in cropping patterns entails gendered costs and risks: cash crops are water and labour intensive. Crops such as curry leaf and jasmine require regular pruning and weeding, and are harvested through hand picking. Post introduction of cash crops, labour requirements have tripled. With an increase in off farm employment opportunities primarily for men, and the MGNREGA [2] scheme, the study area has witnessed a severe labour deficit for farming activities. To offset this deficit, women have taken up additional work burdens in agriculture. This is particularly relevant for poorer farmers who cannot afford to pay higher wage rates resulting from a tight labour market. Furthermore, continuously engaging in physically strenuous work has taken a toll on women's health, women have reported suffering from chronic back pain.

Rengalakshmi, 41, from Chinnakalipetti village who belongs to the Vokkaliga Gounder caste, and has a 6-acre farm, expressed her thoughts on her increasing work burden,
"…. it is so difficult to get labour to work on our farms, especially during harvest season and when they do come, they demand too much money for us to pay[...]. I have started working more on the farm now, I don't have a choice. My husband goes for construction work in the neighbouring town, and if I don't do agricultural work the crops will die."

Well to do farmers with larger land holdings use technology such as drip irrigation to reduce labour requirements, but medium and small farmers depend on women in the household for additional on-farm labour requirements. Our study shows that the time women from medium size farming households have available for household activities and reproductive chores has reduced from an average of 8 hours to 6 hours per day. 47 per cent of women in our study reported that they handled the majority of irrigation activities on the farm. Borewells have ensured the availability of household water, reducing women's household drudgery, however, this time is often reallocated to unpaid farm work.

While irrigated agriculture has increased on farm unpaid labour for women, studies have shown that irrigated agriculture has had a positive impact on gender wage

differentials in agriculture (Narayanamoorthy and Deshpande, 2003). With an increase in demand for labour, women have been able to negotiate higher daily wages for their work on agricultural fields. Lakshmi 35, a Kurumba agricultural labourer from Marudur, explains, "Before we would get paid much less than men, women would get about 100 Rs/day for work on the field while men would get nearly 200. Now since there is so much work on the fields and so few people, we can demand for more wages [...] men get Rs 350 and women get Rs 300 for one day's work". This has been particularly significant for ST and SC women, with marginal and small land holdings, 75 per cent of who indicated in our survey that they are engaged in agricultural labour outside their farm.

78 per cent of farmers reported that they no longer grow any food crop. The declining production of nutritive millets and vegetables at the farm level has lead to the increasing reliance on markets and the Public Distribution System (PDS). PDS in Tamil Nadu is among the most efficient in the country, characterized by close to universal coverage and a relatively effective delivery system. The security that PDS provides is one of the reasons that households can make the shift away from food crops. On the flipside, PDS has further entrenched the dietary shift away from millets and coarse cereals to low nutritive polished white rice as the major consumed cereal crop.

Reflecting on the dietary changes in her household over the last decade, Revathy (Vellara Gounder), 53, from Marudur village, who has a 4 acre farm said,
"Our profits in the farm have increased, but now we don't grow ragi or jowar. The rice we eat does not give us the energy to work in the fields all day, before we used to eat ragi *mudde* (traditional ragi ball) and not have any health problems, now almost everyone in the village has diabetes and other problems [...]. I ask my husband to buy ragi when he goes to the market but he says it is expensive, moreover it takes a lot of time to make and my children prefer rice."

Revathy indicates that the reduction in cultivation of cereals on farm has reduced her autonomy in making choices on household nutrition, nutritional choices are now based on prices and market availability.

3.2 Gendered Assets:

Bargaining power and agency of men and women in the household is shaped by their control over material assets and perceived (economic) contributions to the household (Sen, 1990; Kelkar and Jha, 2016). Access and control over assets, however, are not necessarily determined by legal ownership, rather they are shaped by larger socio cultural contexts and notions of legitimacy prevalent therein (Rao, 2017). State-led gender discourses too shape gendered livelihood opportunities, this is particularly prominent in Tamil Nadu where state sponsored welfare schemes, targeting women, have strongly influenced notions of gendered asset control and ownership. In the following section, we discuss the impacts of borewells on two highly gendered assets: gold and livestock.

3.2.1 Gold

The total cost of digging a borewell in Tamil Nadu averages between Rs 1,00,000-1,50,000, a substantial amount in a region where the average monthly income of families is around Rs 5000-10,000.[3] 62 per cent of farmers reported having sold household assets to finance well boring, of them, 72 per cent had medium and small land holdings. 85 per cent said that gold was the primary asset to be pawned or sold.

Gold ornaments are a strongly gendered asset in the region (Swaminathan et al., 2011). It is traditionally given as *dowry* or a gift to the daughter during her wedding. While dowry has been used to control and exploit women, in these communities, women have control over their gold ornaments. With social legitimacy as women's asset, gold is not just a source of security for women, which can be pawned in exigent circumstances, but also enhances their bargaining power within the household.

Jaya (48, Pallar, 4 acre farm) from Marudur village pointing to her wedding photo describes the dowry she brought during her wedding, *"*My parents gave 50 *pauns*[4] of gold for my wedding, it was not demanded by my in-laws, but my parents chose to present it to me. I have kept it safely for the last twenty years, but over time I have had to pawn most of it. Two years ago to dig a new borewell my husband pawned nearly all

of it, I was very upset, I wanted my daughter to have it for her wedding [...]. Now I have only this *thali* (wedding pendant)"

Jaya expressed resentment towards her husband for pawning her gold, she even suggested that she was made to part with it forcefully, however, she pacifies herself stating that such situations are commonplace in the village. With borewells increasingly seen as essential for a secure livelihood, and many failing, women's gold is now being used for financing this investment. She still worries about gold for her daughter's marriage and has started a small chit fund from the money she makes doing agricultural labour in order to buy gold.

3.2.2 Livestock

Livestock rearing is an important source of supplemental income (sometimes providing as much as Rs 3,000 per month) for agricultural households and provides nutritional security; it serves as a buffer against crop failure and periods of declining agricultural productivity. Livestock ownership is strongly gendered owing to cultural norms and various government subsidies to promote the dairy industry; the ruling AIADMK party launched a scheme for the free distribution of milch cows and goats/sheep to poor women. Presently about 36,000 milch cows have been distributed in Coimbatore district under this scheme. 84 per cent of women in the survey reported that up to 60 per cent of their daily time is devoted to livestock rearing activities; it is more or less a female domain.

Women value the managerial and economic autonomy that maintaining livestock provides. Older women who cannot undertake rigorous farm activities contribute to the household by taking care of livestock. Women handle the processing of milk into ghee, butter and other dairy products and maintain personal savings through the sale of these products. The prevalence of women's milk cooperatives in the region reinforces the importance of livestock as a source of women's income. Income generated from livestock plays an important role in women's wellbeing, often spent on their personal or children's needs. Larger incomes from crop sales are spent on consolidating agricultural investments, seen as the responsibility of men as 'providers', alongside other household expenses (Garikipati, 2009).

Rearing of livestock is a water intensive activity. Most of the water for livestock is provisioned from bore wells. During periods of water scarcity there is stiff competition within the household over limited water resources; men prioritize water for maintenance of cash crops while women prioritize the maintenance of cattle. In extreme scarcity situations, women are unable to maintain their cattle and have to resort to distress sales. With mechanization, cattle have no direct role in farming, hence in our survey 82 per cent of male HH heads, reported that cattle are sold in case of financial stress. Furthermore, the shift in cropping patterns away from fodder and food crops has resulted in a scarcity of on-farm availability of fodder from crop residue. Reduced fodder production has led to increasing prices of fodder impacting cattle ownership, which has reduced by nearly 40 per cent in the last 20 years. This has resulted also in a decline of household dairy usage, with accompanying impacts on household nutrition.

3.3 Borewells and Indebtedness

There are about 250 drilling units in Coimbatore alone, which charge around 200 Rs/meter for drilling. A traditional water diviner determines the exact location for the well. Farmers prefer to use water diviners, as they are cheaper and more easily available as compared to hydro geological experts. The State government has schemes (Tamil Nadu Minor Irrigation Scheme) that provide support for expertise, machinery and funds for drilling wells. However, due to poor awareness, and an excessively bureaucratic and inefficient delivery system, many farmers hire private contractors to drill borewells and obtain funds through informal loans from moneylenders or through the sale of assets. The costs associated with informal borrowing range from 10-40 per cent, as noted in section 3.1. Tamil Nadu has some of the highest levels of household indebtedness in India (82.5 per cent) compared to the national average (52 per cent) (NSSO, 2013). Contemporary farm debt driven by social and economic aspirations is leading to pauperization, marginalization and impudence of the local elite (Guérin et al., 2013). Although the digging of borewells is not the sole reason for the high level of indebtedness in the region, it has a significant association with the reckless debt-taking attitude of people (c.f Taylor, 2013).

The hydrogeological characteristics of the region and exploitation of groundwater have resulted in a high failure rate for borewells. A study conducted by Palanisamy et al. (2008) reported that farmers had a success rate of only 30 per cent in borewell drilling in Coimbatore district. A failed borewell can lead to financial ruin, farmers often take loans with the hope that a 'bumper crop' provisioned by irrigation will allow them to pay off debts. Depleting ground water tables can drive farmers to bore up to three times in the same plot to ensure a functioning well, often accruing substantial debts in the process. 67 per cent of households in our study reported failed bore wells as the primary cause for agricultural debt, and 54 per cent reported selling household assets to finance borewells.

Rajeshwaree (42 years, Pallar, 2.5 acre farm) of Chinnakallipeti village told us about the indebted state of her household due to multiple failed borewells on her farm.
"I was not even aware of the cost of drilling the bore well, or the loan taken, we simply continue to pay monthly to the debt collector, hoping that one day we can clear our debts."

Rajeshwaree's household has accumulated significant debt with the local moneylender over the past ten years. Unable to repay the full amount they have resorted to taking smaller loans from multiple sources to clear the initial debts. Rajeshwaree's 17 year old daughter had to discontinue her college studies and take up a job in a textile factory in Thiruppur to help pay off the debt. Presently, Rajeshwaree works as a cleaner in the local Panchayat office apart from domestic and farm duties. She also invests any small savings in the village-level Self Help Group and chit funds.

Indebtedness in the region has pushed men and women to diversify their livelihood portfolios. 74 per cent of male farmers reported seasonal migration to clear farm debts; of this 92 per cent had land holding sizes below 6 acres. Furthermore, 64 per cent of them were Pallar(SC) and Kurumba (ST), ndicating that indebtedness in disproportionately prominent among small farmers belonging to SC and ST groups. Reinforcing the fact that indebtedness and coping strategies are shaped by class and caste positions, 72 per cent of women above the age of 30 in our survey reported

engaging in jobs outside the farm and home, with 31 per cent engaging only in MGNREGA, 40 per cent working as agricultural labour and 29 per cent engaging in both. The MGNREGA provides a valuable source of income for women during the summer months. Given the restrictions on their mobility due to domestic and reproductive chores, the options that married women have for earning additional incomes are limited. They end up, engaging in physically demanding and poorly remunerated jobs locally.

3.4 Household cooperation, conflict and decision-making

While women in rural South India are seen to have more autonomy than their North Indian counterparts (Dyson and Moore, 1983), they defer to men, particularly with regard to farm management practices. The boring of wells is seen as a strongly masculine process. The drilling of boreholes is conducted by private drilling agencies, which are strong patriarchal enterprises. Women rarely take an active role in decision making with regards to the boring, although the work burden of irrigation often lies with them.

Selvi (53, Vokkaliga Gounder, 9 acre farm) from Chinnakalipetti, who has eight failed borewells, discussed the decision to invest in well boring:
"The first well was dug about ten years ago, before that we depended only on the rain. My husband wanted to start growing different types of crops, so he suggested that we dig the well [...]. Initially, I was not convinced, it is a lot of money, and I was not sure if we will get water, but he convinced me and dug the well. After two years the water in the first borewell decreased, we had also bought more land for agriculture, so we needed water to irrigate the crops; we decided to dig for another well. [...]. My husband did not consult me on this [...], the first bore failed, and I asked my husband to stop digging, he didn't listen to me[...]. If we hadn't spent so much money on the wells we could have invested in something else, maybe a *petty kadai* (small shop)."

Through Selvi's narrative, a sense of resentment towards her husband's decision to assume more risk by boring for more wells is palpable, this is reflective of the attitude of several women in the area who felt that they had limited agency in influencing

decisions on the digging of borewells. Women preferred to invest in small businesses or in assets such as land; they regarded the digging of borewells to be a precarious gamble that could result in financial ruin.

Borewells are useful to both men and women, but perceived as a symbol of a productive farm and a successful (male) farmer, it is socially constructed as a 'male' asset. During our interviews, borewell ownership was often used as a qualifier of success, even replacing land as a source of prestige and status within the community. Paramasivam, a farmer in the Bhavani, pointed to the neighbouring field of his brother exclaiming, "My brother has no worries, he has two working borewells and is doing very well in his farming!" This sense of 'success' shapes normative male behaviour, in this case leading to unhealthy and unsustainable competitive behaviour in relation to boring.

The construction of the borewell as associated with men's identity can be unpacked using Sandra Harding's seminal text on how gendered social life is produced via symbolism (Harding 1986; Zwarteveen, 2008). The hegemonic construction of irrigation, particularly borewell irrigation, can be attributed to the androcentric trappings of 'cash cropping', a co-production of irrigated systems in the region (c.f Connell et al., 2005). The very term cash crop alludes to crops grown only for sale relegating it to an 'enterprise', which under traditional cultural and societal norms falls under the purview of men. Moreover, technology required for boring and pumping has strong masculine connotations. Women lack knowledge and skills to engage with these 'technical' processes in male dominated spaces and have been systematically discouraged by state and community from entering these spaces. Colonial and neo colonial relations of technology and gender have informed these 'traditional' (Irrigators) and 'globalized' (engineers and mechanics) masculinities (Zwarteveen, 2008).

This is what Selvi's husband Murugan said on why he decided to bore multiple wells despite multiple well failures.

"I initially got the idea to dig a borewell after our *Ooru thalevar* (village head man) dug his borewell, this was twenty years ago. The well functioned well and allowed me to plant all the crops that I wanted, it provided enough water for the cattle and house as

well. But water in the well started decreasing in the past ten years this is because everyone around has started to dig many wells. I had to ensure that I had enough water so I dug two more wells, these failed so I took a loan and dug another well [...]. Of course I have to keep digging to ensure that I have a functioning well, how else will I irrigate my crops, I cannot go back to rainfed farming, all the farmers in the village have wells, if I have a good well I can make my farming very successful [...]. I cannot consult my wife regarding these decisions, she does not understand farming!"

The borewells in Murugan and Selvi's farm have been financed through a combination of money from personal savings, bank loans and more recently loans from relatives and moneylenders. The household has sold assets to repay these loans but they still have outstanding debts to pay off. Murugan hopes that he can at least pay back the loans to the moneylender after the next harvest of his banana crop.

The proliferation of borewells has had important implications for intra household gender relations. Economic success and financial provisioning are an important conjugal expectation from men in patriarchal rural societies, who in turn expect their wives to meticulously perform familial and mothering roles (Rao, 2012). Financial stress associated with what is regarded as a male decision on well boring within the household has caused a strain in marital relationships. Women have suggested alternate investment strategies, but once the borewell option is pursued, they have no choice but to also contribute to the repayment of loans. Men frequently resort to drinking to cope with a sense of 'hopelessness' as a result of failed borewells and mounting debt burdens, sometimes even leading to violence.

While tensions are rising due to failed borewells, new forms of cooperation are also visible. Although the primary impact of wells has been in the livelihood sphere, wells have also allowed easier access to water for domestic activities. Reproductive roles remain women's primary responsibility, and the direct burden of water provisioning falls on them, yet focus group discussions (FGDs) conducted with women indicated that men increasingly contribute both cash and labour to the provisioning of domestic water for their households.

Savitree, 32 years old, from Marudur (Vokkaliga Gounder, 4 acre farm), discusses this shared responsibility:

"During the dry years when there is less water in the borewell my husband goes to the stand pipe to collect water, I used to do it but he has a bike, and it is easier for him to do it especially later in the day when it is not very safe for women to go out [...]. When we have scarcity of water, usually during the summer months we have to buy water from tankers for household needs like cooking and washing, my husband knows I need water to cook for the family, so he will make sure we get water from the tanker even though it is very expensive [...]. We both contribute for this."

Men acknowledge the importance of water for domestic chores and contribute towards its provisioning. This is an interesting reversal of the gendered binary of domestic water as the domain of women, while its livelihood use becomes the domain of men (c.f van Koppen, 2007; Zwarteveen et al. 2012). Savitree and her husband Gopal both agree that it is no longer only women's responsibility to collect water; if there is no water in the house, they will all suffer. However, she does admit that during the summer months when there is no work on the fields and her husband goes to the town for construction work she has to collect the water herself.

3.5 Additional vulnerability of Female headed households

Feminist scholars have postulated that the atomization of water ownership through borewells allows women to circumvent historical inequalities in access to water by invalidating the necessity to participate in male dominated, patriarchal water user groups (Meinzen-Dick and Zwarteveen, 1998; Ilahi and Grimard, 2000). However, rights to water are tenuous and mediated through other constraining factors such as technology, knowledge and infrastructure (Boelens and Zwarteveen, 2005; Ahlers and Zwarteveen, 2009). This comes to prominence in the boring and maintenance process, when women have to depend on external support systems to operationalize their access to groundwater. Furthermore, ground water access has never been fully equitable and is often determined by other hydro geological features of the land, shaped by patterns of marginalization propagated through inheritance of less productive lands (e.g. located on hard rock aquifers).

There are a limited number of women headed households in this region; usually widowed, divorced or unmarried women. The amendments in 2005 to the Hindu Succession Act of 1956 established a gender equal basis for inheritance of land and resources (Kelkar and Jha, 2016). However, women continue to confront a host of barriers and taboos that makes their cultivation less productive than that of men (c.f Agarwal, 1994). Women headed households usually have to diversify their livelihood activities and prefer to undertake more gender-accepted livelihoods such as animal husbandry and millwork.

Recounting her experience, this is what Nagamma (48 years, Vellala Gounder), a widow form Chinnakellipetti village who owns 5 acres of land had to say,
"There was only one well on the 10 acres of land that my father owned. When it was time to divide the land I had no say or choice on which land I received. I received an equal portion of land because it is the law, but my land does not have any water source. I have to buy water from my brother to irrigate the land but he usually does not have enough water to spare. I cannot dig a well as I do not have the money and I will not be able to do it by myself, I will require support from my brother, and I do not wish to be indebted to him. I have decided to sell the land as it has become unprofitable ."

Nagamma cultivates only half of her land with millets and has kept the rest fallow; she has limited access to water even for supplemental irrigation and usually suffers crop losses in dry years. The unprofitability of the land has made her decide to sell it. Nagamma is the sole breadwinner of her family, she has two daughters, and her husband passed away ten years ago. She will work as an agricultural labour and perform odd jobs around the village to provide for her family as she cannot move out of the village for work. She says that she can save the money she gets from the sale of the land for her daughter's wedding. Nagamma is in a particularly vulnerable position, as she has no sons to help consolidate her social agency, she is vulnerable to land grabbing from the local land mafia and depends on her brothers' family to provide security for her and her family.

4.0 Concluding Reflections: Groundwater and gendered wellbeing

The development of groundwater in the region has been credited with increased farm profits, reducing rural poverty and providing equitable access to water. Having access to a fully functioning bore well ensures uninterrupted water supply, allowing farmers to grow crops of their choice, increasing both productivity and incomes. Our research suggests that the availability of groundwater has had positive and negative implications on gendered wellbeing varying across class and caste. Groundwater has allowed for the spread of intensive cash crop based agrarian systems, augmenting livelihoods and increasing gender wage parity for agricultural labourers. It has also provided water for domestic usage, reducing women's domestic work burdens. One finds a flux in the gender roles concerning water, with men taking increasing responsibility for domestic water provisioning, while women spend more time in irrigation activities. Further, with groundwater now reframed as a symbol of wealth and prosperity; not just a productive asset, it has emerged as an embodiment of economic aspirations and gendered wellbeing. .

Over the last five years, this enhanced sense of wellbeing has begun to show signs of waning with the decrease in quality and quantity of groundwater. Farming households have indicated that household wellbeing, which in many ways is inextricably tied to ground water, both in the domestic and livelihood sphere, is seriously threatened by depletion of the resource in the region. Farmers in Chinakalipetti reported that twenty years ago ground water was available at less than 200 feet but now they must dig to a minimum of 800 feet to access water. The depth of boring has increased, as has the number of failed borewells.

Failing borewells are severely impacting agricultural productivity and livelihoods, ensnaring communities in debt cycles. Indebtedness has resulted in increased work burdens on both men and women. While men have wider options for more remunerative work owing to their mobility, women often have to shoulder additional burdens of paid and unpaid farm work. The cost of water significantly increases; women invest more time in collecting water from other sources such as public

standpipes. In particularly dry months, water is bought from tankers, which is expensive and has to be strictly rationed. Yet with a focus primarily on cash crop cultivation, women's nutritional choices have been compromised.

Jayamala, 62 (Vallala Gounder, Marudur village), whose family has been farming in the region for the last three generations had this to say regarding the present state of groundwater in the region:
"Twenty years ago we used to only grow millets and grains, sometimes vegetables. It was enough for the household. After we got access to a borewell, we have started growing jasmine, this gives us more money, but we have to buy our vegetables and grains from the ration shop or the village market [...]. The last five years we get less and less water from the wells, this year is the worst, our crop has failed we have no money to buy food, and there is no food in our fields."

Peer pressure and unhealthy masculinities has led to competitive borewell digging, with implications on the financial security of the household, alongside marital conflict. In such a context, women have a tenuous hold on their assets, vital to their social standing, household agency, and economic autonomy. In the absence of other risk management strategies, women's assets are the first to be pawned or sold.

Despite the precarious state of groundwater in Tamil Nadu, there remains no tangible implementation of regulation on ground water usage. A groundwater regulation bill that has been on the anvil for the last twenty years was passed in 2003, this bill included provisions for the setting up of the Tamil Nadu Groundwater Authority. In 2013, the act was repealed, and no further headway has been made in this regard. The lack of regulation has abetted the exploitation of ground water in the state (Moench et al., 2012; Palanisami et al., 2014). Communal water sources in the region, such as traditional tanks and farm ponds, have been neglected, leaving farmers with a lack of alternate viable water sources. With the growing threat to the resource from climate change and other development variables, the need for properly enforced regulation has become critical.

Although our entry point is groundwater, our analysis has allowed us to explore the complexities of decision making at the household level, where men and women hold gendered interests in resource management through their distinctive roles, responsibilities and livelihood stakes. These vary with class and caste position, with women in smallholder households, mainly SC and ST, often bearing the brunt of growing indebtedness, higher work burdens and less nutritive food.

Although groundwater is a 'multi use' water, its epistemic roots lie in the livelihood sphere. This has allowed patriarchal norms and practices from the male dominated agrarian space, to be carried forward into partisan decision rubrics in the domestic sphere. The experiences of women headed households emphasize the key gendered relational aspects of ground water usage. Women continue to require the support of male family members to operationalize their usage of ground water, pointing to the persistence of disadvantage confronted by women in resource access, use and control in the agrarian sphere.

Divya Susan Solomon is with the Ashoka Trust for Research in Ecology and the Environment (ATREE), Bangalore (divya.solomon@atree.org) and Nitya Rao is Professor, Gender and Development, School of International Development, University of East Anglia (UEA).

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[1]Body of local self government at the village level
[2]The "Mahatma Gandhi National Rural Employment Guarantee Act", MGNREGA, is an Indian social security measure that guarantees 100 days of work per household per year
[3] According to the National Sample Survey 70th Report, Situational Analysis of Agricultural Households 2012-13, the average income for farm households in Tamil Nadu is Rs 7,000
[4]Paun is a unit of measurement of gold, it is approximately equal to 8 grams