

Mitra, A. and Rao, N. 2019. Gender, water, and nutrition in India: An intersectional perspective. *Water Alternatives* 12(1): 169-191



Gender, Water, and Nutrition in India: An Intersectional Perspective

Amit Mitra

Independent Researcher, New Delhi, India; artimtima@gmail.com

Nitya Rao

School of International Development, University of East Anglia, Norwich, UK; n.rao@uea.ac.uk

ABSTRACT: Despite the global recognition of women’s central role in the provision, management, and utilisation of water for production and domestic use, and despite the close links between production choices, the security of water for consumption, and gendered social relations, the implications of these interlinkages for health and nutrition are under-explored. This paper seeks to fill this gap. It unpacks the gendered pathways mediating the links between water security in all its dimensions and nutritional outcomes, based on research in 12 villages across two Indian states. The findings point to the importance of the dynamic links between natural (land and water) systems and gendered human activities, across the domains of production and reproduction, and across seasons. These links have implications for women’s work and time burdens. They impact equally on physical and emotional experiences of well-being, especially in contexts constrained by the availability, access, quality, and stability of water.

KEYWORDS: Gender, water, agriculture, nutrition, food security, India

INTRODUCTION

Six years ago, on a hot summer afternoon, Rajesh’s mother went to fetch water from the deep open well at the end of Sitapur village,¹ in Wardha District of Maharashtra. Her home is about 500 m from the well. She fell into the well and drowned. Nobody heard her cries as everyone was out to work or engaged in domestic chores. Her drowning led to the panchayat covering the well with an iron grill.

In developing countries, including India, the major burden of domestic water collection, storage, and handling is borne by women and girl children. The cultural constructs around gender roles and responsibilities place household maintenance tasks in women’s domain (Sultana, 2009; Jackson, 1998; O’Reilly, 2010). Yet, as in the case of Rajesh’s mother, ignoring the gender and wider social, ecological, and technical dimensions inherent in accessing water of reasonable quality can take lives (Birkenholtz, 2013; Crow and Sultana, 2002). This is even more the case as water management at the community level prioritises productive purposes, which are defined largely as irrigation systems and are seen as the domain of men, who are constructed as ‘farmers’ (Rao, 2008; Meinzen-Dick and Zwarteveen, 1998). The larger farming systems (which include livestock, homestead gardens, and other forms of food collection and processing) and their close interlinkages with household reproduction (Clever, 1998a) and well-being are ignored. Water and sanitation interventions target women as custodians of the domestic

¹ Names of all people and villages have been changed to ensure anonymity.

sphere, however these interventions also tend to disempower women by ignoring pre-existing sociocultural practices and relationships (Birkenholtz, 2013; O'Reilly, 2010).

Principle No. 3 of The Dublin Statement on Water and Sustainable Development, 1992, recognised women's central role in the "provision, management and safeguarding of water"², re-emphasised by Sustainable Development Goals 5 and 6. Highlighting the need for gender equality in access to productive resources in general, Goal 6 pays special attention to the needs of women and girls in achieving adequate and equitable sanitation and hygiene³. While global recognition of the gendered division of labour, rights, and responsibilities in the water sector is important for ensuring women's rights and entitlements, these statements nevertheless perpetuate assumptions about women's priorities and preferences, representing women as passive recipients rather than instigators of social change (Jackson, 1998; Cleaver, 1998a; Sultana, 2009).

The water sector remains male dominated at different scales, from engineers and technocrats responsible for designing irrigation systems, to upper caste/class men who decide on the location of canals, borewells, tanks, and other water systems at the grassroots level (Zwarteveen, 2008). While women are involved in the daily management of water for food production, especially on small farms, they have little say on water provisioning decisions (Solomon and Rao, 2018), pointing to the persistence of "invisible power and structural violence" (Mehta, 2016: 11) in the water sector, derived from patriarchal social relations.

This paper seeks to understand the gendered pathways mediating access to, and use of, water, and the implications for nutrition outcomes and gender equality. Specifically, it explores how social identities of caste, ethnicity, and class shape dependence on particular water sources, and the trade-offs between production/livelihood choices and health and nutrition outcomes within household subsistence decision-making. This entails understanding the linkages between the availability of water and its various uses (production and household reproduction), food and nutrition security, and gender roles, responsibilities, and relations. Changes (both short and long term) in one sphere can affect others, so, for instance, the location of water in a particular agro-ecosystem, the seasonality of its availability, and the technologies used for its extraction, mediate the gender division of labour involved in water collection, storage, and, in turn, quality (Rao and Raju, 2017). Further, in drawing on grassroots insights that represent the perspectives of women of different castes and classes – what Jackson (1998: 322) calls 'embodied subjectivities' – an attempt is made to develop a nuanced, intersectional approach to examining the links between water, food and nutrition security, and gender relations across particular spatial and ecological contexts (Sultana, 2009).

As part of the Farming System for Nutrition (FSN) study, under the research programme on Leveraging Agriculture for Nutrition in South Asia (LANSA), this paper uses data from 12 villages in two districts of two states (Wardha in Maharashtra and Koraput in Odisha). The paper has five sections. We first set out the conceptual starting points in relation to the literature on gender, water, and nutrition security. The methodology and the study areas are then presented, followed by a discussion on the insights from the field in relation to the literature, and finally the conclusion.

CONCEPTUAL FRAMING

Research insights and gaps

Over the last two decades, research using political ecology and feminist lenses has questioned the binaries of production/reproduction and women/men in understanding mechanisms for accessing and

² www.gdrc.org/uem/water/dublin-statement.html

³ <https://sustainabledevelopment.un.org/sdg6>

using water, particularly in contexts of scarcity. Rather than using gender as a proxy for women (a static biological difference between men/women), more nuanced perspectives that conceptualise gender as socially constructed relationships, shaped by the intersecting ties of ethnicity, caste, class, age, marital status, religion, and other forms of social difference, are being adopted (Nightingale, 2010; Crow and Sultana, 2002; O'Reilly et al., 2009). Further, nature – society interactions are understood as dynamic, changing in response to shifts in agro-ecological and technical landscapes (Bakker, 2007; O'Reilly 2012).

Three interconnected themes dominate discussions of gender and water: gender divisions of work, access to resources, and decision-making agency. Women have long been a focus of the domestic water subsector, their roles in the provisioning of clean drinking water, hygiene information, and health services at the household level being taken for granted (Cleaver, 1998a). However, women in agrarian societies, especially of the 'lower' social groups, play major roles in food production (subsistence and for markets) across farms and homesteads (Prakash, 2012). They are also involved in the maintenance and management of water sources for production, be it in the cleaning of channels, the maintenance of bunds, or the redirecting of waste water to their homestead plots⁴ – a role often unacknowledged.

Barring a few exceptional interventions that guarantee equal water rights to all members of the community, such as the *pani panchayats* in Maharashtra⁵, access to water for irrigation is usually aligned with landownership (cf. Mehta, 2014). Women rarely have land in their names, though in several tribal areas – including Koraput, one of the study sites – Scheduled Tribe (ST) women can negotiate access to a few household plots in the uplands for food production (Rao, 2008; Rao and Mitra, 2017). These plots rarely have access to water, as the power over water sources remains with men of the better-off groups. There are, however, growing examples of collective farming by women as a strategy for overcoming some of the constraints they confront (Agarwal, 2018).

The implication is that men are usually given control over 'productive' water and its management (Meinzen-Dick and Zwarteveen, 1998), while women are relegated to the domains of nutrition, health, hygiene, and sanitation (O'Reilly, 2010, 2012; Lahiri-Dutt, 2015). In the process, just as women's roles in irrigation, water harvesting, or management are largely ignored (Zwarteveen and Neupane, 1996), so are potential male contributions to domestic tasks overlooked (Solomon and Rao, 2018). This raises an important point about sharing, complementarity, and reciprocity in gender divisions of labour at the household level. Especially in contexts of poverty and scarcity, where survival becomes a household priority, it is not just about separation and conflict. It also highlights the overlaps between production and reproduction, and that nutrition and health result not just from safe drinking water – appropriate 'reproduction' – but also safe and appropriate 'production'. While reliable irrigation is crucial to increasing and stabilising incomes through enhanced food production, excessive groundwater withdrawals for cash crops/commercial agriculture, for instance, can lead to water shortages (Joshi and Palanisami, 2011); and excessive use of synthetic fertilisers and pesticides can pollute drinking water (Gandhi and Namboodiri, 2009).

Women hardly have a role or voice in formal management and governance systems, especially at the community level, in the setting up of modern irrigation systems (Zwarteveen, 2008), or in the choice of crops or the nature of the production systems these would entail. While context-specific negotiations do occur (Birkenholtz, 2008), men – especially men of the upper castes/classes – dominate the decision-making processes relating to water allocation, even though they do not bear the responsibility of procuring water for food preparation and household reproduction. One needs to recognise, however, the interconnections between social institutions and scales of decision-making, with women often better able to engage with informal networks and structures than with more formal

⁴ Personal field observations of the authors.

⁵ <http://unossc1.undp.org/GSSDAcademy/SIE/Docs/Vol6/panipachayat.pdf>

ones, due both to their rules of membership, and "the balance of costs and benefits to be derived from involvement" (Meinzen-Dick and Zwarteveen, 1998: 340). In the present political economy context of neoliberal policies where decentralisation and marketisation of natural resources, including water, are advocated, the mismatch between responsibility and control over decision-making in the public realm can increase women's labour in domestic water provisioning (cf. Solomon and Rao, 2018), as well as intensify unequal gendered power relations (Harris, 2009; Ahlers and Zwarteveen, 2009).

As noted briefly above, much progress has been made in exploring the complex interlinkages between gender and water, across several analytical dimensions. Similarly, there is a small but growing body of work examining the gendered pathways between agriculture and food and nutrition security (Kadiyala et al., 2014; Rao et al., 2018). These studies focus on the way in which child-nutrition outcomes are mediated by women's income control and empowerment, time trade-offs between different forms of work and care, and women's own health. Despite this, and acknowledging water – especially safe domestic water – to be central to food and nutrition security, there is scant research on the linkages between gender, food and nutrition security, and water, especially at the micro level (cf. HLPE, 2015). The literature on gender, water, and nutrition mostly focuses on women, and on issues related to domestic/drinking water provisioning (cf. Zwarteveen et al., 2012) and, with a few exceptions, it ignores the links to reliable water supply for food production, and the critical role of women therein. Given the scant⁶ and largely contradictory micro level data on this theme (Seager, 2010), this paper seeks to provide insights, both empirical and conceptual, into some of these linkages. The importance of context is highlighted, as is the way in which practices around water access and use are relationally produced.

Linkages between food and nutrition security, water, and gender

The debate on food and nutrition security is long-standing, ranging from discussions around famine and lack of food (Sen, 1981) to, more recently, malnutrition and obesity (IFPRI, 2017). The commitment to food and nutrition security adopted at the World Food Summit (FAO, 1996), defined food security as comprising four dimensions: availability, access, quality, and stability/absorption (ibid). Articulating the need for gender equality and women's empowerment in line with the Beijing Platform for Action, 1995, it supports the equal participation of women and men by ensuring equal access to productive assets (land, water, credit), technologies, and services. Nevertheless, it falls short of the goals of gender equality by ignoring the reality of unequal gender relations (divisions of labour and social normative expectations) across societies. These have implications for both the availability, access, and quality of food consumed within the household (Pradhan and Rao, 2018), and the relative energy expended on productive and reproductive work by different groups of women and men (Rao and Raju, 2017).

The High Level Panel of Experts on Food Security and Nutrition (HLPE) applied these same dimensions to the realm of water, given the centrality of water for all the "activities, processes and outcomes" related to the food system (Ericksen et al., 2010: 27; HLPE, 2015: 28). Specifically, HLPE (2015: 27-28) defines these dimensions as follows:

- Availability of water is understood as its physical availability through rainfall, rivers, and other water bodies and aquifers in a particular region.

⁶ The Joint Monitoring Programme (JMP), a joint endeavour of UNICEF and the World Health Organization (WHO), reports globally on the status of water supply and sanitation sectors, to enable countries to improve their performance. The only gender indicator, introduced in 2008, relates to the person in the home with primary responsibility for collecting water (adult female, adult male, girl, boy) (JMP, 2008)

- Access to water focuses on the mechanisms for water allocation and regulation of use, and the infrastructure (pumps, pipelines, taps) that may support or hinder access, despite the availability of sufficient water in local water bodies.
- Quality of water is important for health and hygiene, through food processing, preparation, and direct consumption. Production and processing may, however, have a negative impact on water quality through pollution.
- Stability of water refers to the temporal dimension of availability, access, and quality of water. Variability results from hydrosocial⁷ cycles, intensified by both climatic changes, and human intervention, through changes in water flows, land use patterns, deforestation, and so on.

While the HLPE (2015) recognises that these dimensions overlap and are shaped by physical and sociocultural, economic, and political correlates, the critical part played by gendered roles, ideologies, and power relations are the specific focus of this paper. The choice of crops, for instance, determines the intensity, quantity, and timings of water requirements, with effects not just on health, but also on gender relations through divisions of work, control over resources, and patterns of decision-making. In India, local politics, caste, kinship, and gender further interact to shape access (Pradhan and Rao, 2018).

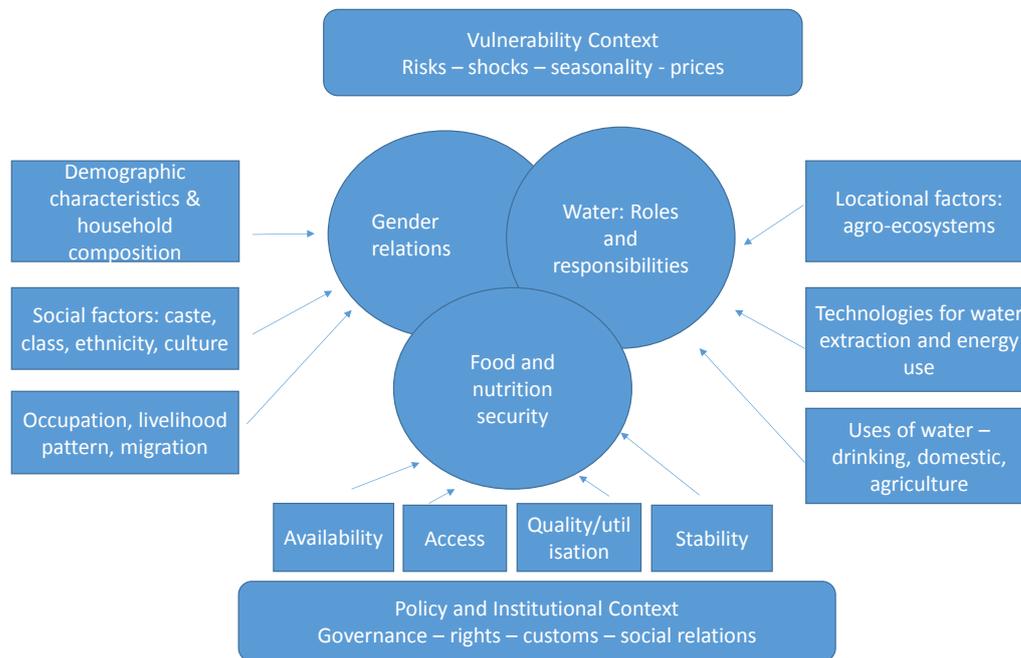
Seasonality informs all the above factors. Water for food production/crop cultivation may be physically in plenty during the monsoons, yet safe domestic water, especially for drinking, may be problematic when rivers, lakes, and wells overflow, or may get contaminated with both human and chemical residues. Excessive rainfall can lead to floods and destroy crops. In many parts of the country the state solution to recurrent floods has been to build embankments, but these lead to waterlogging, crop loss, and major health issues (Mitra et al., 2015; Lahiri-Dutt, 2012; Udas et al., 2018), with differential impacts on women and men. In fact, besides the condition of the water source and the nature of infrastructure, social positioning and social relations shape the nature of water scarcity or surplus, as well as its quality, reliability, and costs, and how it is experienced (Crow and Sultana, 2002: 711).

In conceptualising the linkages across these dimensions between water, food and nutrition security, and gender, this paper has three basic postulates. First, water – whether for irrigation or domestic purposes – is a highly gendered subject. Women cannot be relegated to the sphere of domestic water only, given the important roles they play in both agriculture (food production) – integral to which is irrigation management – and transforming the food into culturally appropriate edible items (food processing and preparation). Second, drinking water is itself a food insofar as it is critical for human metabolism and the absorption of nutrients. Safe drinking water is as essential for a healthy life as is avoiding contaminated food. Third, there are multiple linkages between food security, nutrition, and water, and analyses of gender relations help unpack and better understand these linkages and their implications for the well-being of individuals and households in a particular context. The disconnect between global discourses around water (Seager, 2010) and the situation on the ground, marked by inequality (cf. Nightingale, 2010), makes such an analysis critical for addressing the persistent problem of malnutrition in India. Our conceptual framework is summarised in Figure 1.

Building on the contributions of research on gender and water, this paper explores the interlinkages with food and nutrition security. While for purposes of analytical clarity, the four dimensions articulated by the HLPE (2015) are discussed separately; their intersections are highlighted in responding to the key questions around differentiated access and the trade-offs involved.

⁷ Bakker (2002) uses the term hydrosocial to reflect the co-production of water availability and scarcity through natural (hydrological) and social means.

Figure 1. Conceptualising the links: gender relations, water, food and nutrition security.



METHODOLOGY AND STUDY CONTEXT

Baseline household and nutrition surveys were conducted in the 12 study villages as part of the FSN study (Rao and Raju, 2017). While there are several ways to measure nutrition outcomes, a commonly used and reliable indicator is undernutrition, measured by Body Mass Indices (BMI). While data is also available for dietary diversity and micronutrient deficiencies, these have not been used in this paper.⁸ Specific data on water (availability, access, use, and handling) was collected from in-depth interviews with women and men, focus group discussions, discussions with panchayat functionaries, school teachers, and NGO personnel. Participatory exercises and observation played a key role. All the village and respondent names have been changed to protect identities.

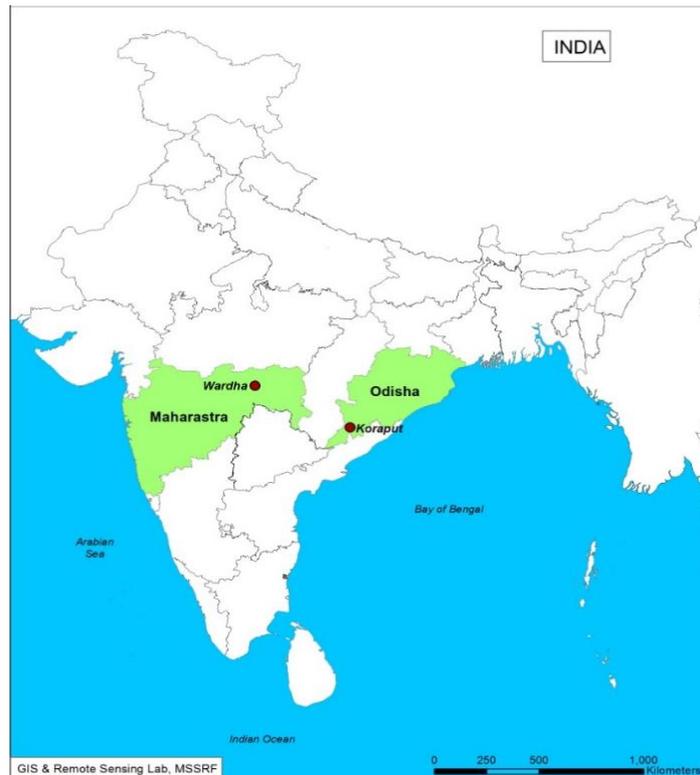
Wardha, one of the 36 districts of Maharashtra, lies in the semi-arid Vidarbha region. According to the 2011 census, its population was 1.3 million, literacy rate was 87 percent (males 92 percent and females 82 percent), and the sex ratio was 946 females per 1000 males. The child sex ratio was 919 girls per 1000 boys. The rural population constituted 67 percent of the total, of which Scheduled Castes (SCs) comprised 14.5 percent, and Scheduled Tribes (STs) 11.5 percent.⁹

Rainfed agriculture with monocropped Bt cotton is the norm, though some sorghum and pigeon peas are also cultivated. The district has received a lot of attention in the past decade due to the high rate of farmer suicides, a result of agrarian distress (Sainath, 2014). The study villages comprise a mix of SC (12 percent Mahar), ST (42 percent Gond), Other Backward Caste (OBC) (21 percent, mostly Mali), and other castes (25 percent). Despite the administrative categorisations, these are not homogenous groups; they are differentiated in terms of their livelihoods and cultural practices, especially gender norms and relations. While the ST Gonds are the largest group numerically, the OBC Malis rank higher in terms of economic power, with many in urban informal-sector jobs. The situation of the SC Mahars

⁸ This data is available on request.

⁹ www.censusindia.gov.in/2011census/dchb/2708_PART_B_DCHB_%20WARDHA.pdf

Figure 2. Map showing study locations.



has changed considerably over the last few decades thanks to reservation policies and the influence of the Ambedkarite movement in Maharashtra. Overt physical untouchability is a thing of the past, even if non-Mahars will not drink water touched by a Mahar. Except for in the general/upper castes, all women engage actively with household production. Amongst the Mahars, especially the upwardly mobile, signs of men's control over women's mobility are gradually emerging (cf. Kapadia, 1995).

Koraput, one of the poorest districts of Odisha (and of all India), had a population of 1.37 million in 2011.¹⁰ The sex ratio of 1032 females per 1000 males, and the child sex ratio of 979 females per 1000 males, are generally favourable to women and girls. This could be because Koraput is a largely rural and tribal district, with STs comprising over half the population. Located in the semi-humid tropics and dependent on rainfall, the district is famous for its indigenous rice varieties, the growing of which is, once again, dominated by women. Gender gaps, however, persist in access to opportunities. The average literacy rate is 49 percent, with 60 percent for males and 38.55 percent for females. The study villages have 9 percent SCs, 42 percent STs, 46 percent OBCs, and 3 percent others (See Appendix, Table 1 for sample distribution).

Socially, the Bhumias (a landed ST group), top the hierarchy, followed by the Ranas, who are OBCs. The Parojas (also STs) are at the bottom, with very little land or other assets (Mohanty, 2011). Economically, the Malis (OBCs) are the richest, and are mostly vegetable cultivators. The Dombs (SCs) who were included in the 'criminal tribes and castes' in the colonial period, are mostly landless agricultural wage labourers, but many migrate to work in the construction sector as masons. Ritually, nobody drinks water touched by the Parojas and the Dombs. Across these groups, women participate in

¹⁰ www.census2011.co.in/census/district/422-koraput.html

agriculture, either on their own farms or as wage labourers, and are primarily responsible for domestic work.

INSIGHTS FROM THE FIELD: GENDERED SUBJECTIVITIES, WATER, AND FOOD AND NUTRITION SECURITY

This section discusses the field observations in terms of the linkages between availability, access, quality, and stability of water, and food and nutrition security, through exploring their gender subtext.

Availability

Given the global emphasis on 'improved water sources' for drinking and domestic purposes over the last two decades (WHO and UNICEF JMP, 2014), there has been a rapid expansion of piped and borewell water in India. In the 12 study villages, with the exception of two each in Wardha (Sakhi and Sitapur) and Koraput (Kolpur and Kotra), a majority of households have access (Appendix, Table 2). In all of them, women have the prime responsibility for collection, storage, and handling. The effects on the average time for water collection, however, can be debated. While the National Sample Survey Office (NSSO, 2014) data places this at roughly 20 minutes,¹¹ women have to often make multiple trips to the borewell to collect adequate water and, as in the case of Kanakguda in Koraput, they additionally have to collect water for men who no longer want to bathe outdoors.

The emphasis on 'improved water sources' misses elements of reliability, social arrangements, and costs (Goff and Crow, 2014), linked in turn to the size of the household and its composition, social networks, caste relations, and livelihood strategies. Therefore, while improved water sources exist in most of the villages, access varies by social group, which shapes, and is shaped by, patterns of settlement. The Dombs and Parojas in Koraput, who are lowest in the social hierarchy, and the Gonds and Mahars in Wardha, are least likely to have access to piped water, and most depend on open dug wells (Appendix, Tables 3.1 and 3.2). While all households get water from multiple sources (depending on the functioning of the piped source/handpump, the timing of water supply, and the pressures of gendered farm work in different seasons) for the lowest social groups there are additional factors relating to conflict avoidance and maintenance of dignity (cf. Cleaver, 1998b). Further, the improved water sources do not really address domestic water needs, apart from drinking water (Goff and Crow, 2014).

Regarding irrigation water, the Wardha villages are dry and mostly practise rainfed agriculture. In some villages, like Sakhi, those with larger landholdings draw water from dug wells through diesel pumps. Cultivation of water-intensive crops like Bt cotton in an area experiencing recurrent rainfall deficits has led to competitively digging deeper for water. Digging of wells is financed by bank and private loans, which both depletes water resources and initiates a cycle of indebtedness in the process. Women generally prefer traditional cotton varieties. "Traditional varieties need less water, fertilisers and pesticides, and the risks are lower. The yields improve if the number of plants per row are increased. We can plant pigeon pea and sorghum, which do not require much water, between rows of cotton", says Neelam, 32, of Sakhi. Neelam's husband, however, prefers Bt cotton, apparently because the returns are higher. While Neelam has a perspective on cropping patterns and crop varieties that is informed by her knowledge of farming, by the availability of water, and by the food and nutrition security needs of her family, in a context of competition between men she is unable to influence her husband's planting decisions (cf. Rao, 2008). He too seeks the well-being of the household by improving incomes.

Expansion of borewells for cultivation of Bt cotton has adversely affected groundwater levels in the surrounding villages. Sitapur had two sources of domestic water, including one large well at the end of

¹¹ As per WHO guidelines, if more than 30 minutes is required to collect water, it is considered inaccessible (Singh, 2015).

the village. "Behind the big well begins the forest department's land. The village lands are demarcated from the forest by a small stream. Even a decade ago, it used to be perennial, but now it remains dry most of the year. The water level in our well is also going down", says Meshram, a Dalit farmer of Sitapur.

But it is not just borewell digging; neoliberal policies have also encouraged investments in land by non-resident entrepreneurs. Ramlal, 70, a Sitapur villager recalls that the stream was perennial, enabling the cultivation of two crops a year. Things changed two decades ago, when businessmen from Nagpur, the political and economic hub of the region, acquired 110 acres of agricultural land across the stream adjacent to the forest for a eucalyptus plantation and factory. A walk through the area showed that they built a road that interfered with the natural drainage. The road now acts as an embankment, inundating the entire plot of land in the monsoons and making crop cultivation impossible. The water remains until the end of February and the plot has become a marsh. Shamli has had a similar experience. With a 100-acre eucalyptus plantation on the upper bank of the village stream, not only has crop irrigation been affected by the drying of both the stream and nearby wells (cf. Joshi and Palanisami, 2011), but, as cattle farmer Somnath Gawli pointed out, the lack of water has led to a reduction of cattle. (The role of commercial plantations in affecting water supplies is discussed later). Human interference seems to have 'killed' the streams in both villages and, as discussed next, in Sitapur there are visible effects on access to, and quality of, domestic water.

Access

Despite being much more 'developed' in terms of infrastructure, more households in the study villages in Wardha district get water from dug wells than do villages in Koraput (Appendix, Tables 2 and 3.2). This happens because a) many households do not opt for piped-water connections in the villages where it is available; and b) frequent breakdown of the electric motors pumping groundwater to the overhead tank make this source unreliable. Further, the decision to opt for a piped-water connection, and decisions about location of street taps, are taken by men, and are not always convenient for women.

Access here is linked to the overall bundles of power and legitimacy, which determine who benefits from the water source across institutions and contexts (Ribot and Peluso, 2003). Crow and Sultana (2002) identify four main modes of access: private ownership of land and/or well; market access through purchase of water; common property access through common water bodies including wells and tanks; and state provision, especially of piped or pumped water. Each of these modes of access is dynamic, shaped by factors like distance, time, cost, and physical burden, as well as elements of class power, the gendered nature of spaces and decision-making, and caring and emotional labour. Examples of state provision and common property are discussed below in order to demonstrate the workings of social structure in mediating access, the trade-offs between different uses of water and the gendered interests therein, and ultimately the implications for food and nutrition security.

As part of state provisioning of drinking water, a concrete overhead water tank was constructed in Sitapur 12 years ago. Water is pumped up to the tank from a borewell, and is distributed twice a day at specific times through several street taps, for half an hour each time. Shamrao, the person in charge, is on a monthly salary of Rs1000 from the panchayat. He says that, of the 71 households, only 10 to 15 do not have piped water in their homes and get the water from their neighbours. Every household has to pay Rs60 monthly as electricity charges, irrespective of the number of household members. Officially, while everyone has access to safe domestic water, often the pump breaks down, the power supply is erratic, or households default in making payments and the electricity department cuts off the power supply. The women then fetch water from the well, or carry their washing to the well. A wealthier Gawli household has a handpump and those on good terms with them are allowed water. In fact, it is sometimes in their interest to not contribute towards maintenance of a common facility in order to ensure that, besides economic dominance, their patron – client ties are also maintained (Prakash and

Sama, 2006; Lal et al., 2006). Many women, however, seek to avoid such obligation (cf. Cleaver, 1998b) or, at times, loss of dignity, even though the source is safe and closer to their homes (Sultana, 2011).

Running pumps by illegally tapping electricity, or not paying bills and the subsequent disconnection, are common in Koraput too. In Kolpur, the overhead tank is not functional as people didn't pay and the connection was cut. The pump also broke down and, in anger, some boys broke the tank. The villagers now depend for domestic water on the two hand pumps and the open well. Why don't people pay their dues for electricity? The amounts are not large, ranging from Rs20 to 60 per month. An answer came from Khuntiguda where a tank and pump were set up a year ago, pipes were laid, and faucets fixed, but where the electricity connection is yet to be given. A group of women from the village in a focus group discussion with the researchers said,

We cannot pay on our own. Our husbands have to go to the electricity office and pay initially. After that, the linesman [official from the electricity department in charge of infrastructure maintenance] comes and collects the monthly charges. But how can we pay without the consent of our men?

Surprisingly, all these women were members of the four self-help groups (SHGs) in the village. Queries as to why the SHGs do not take over the responsibility of water management and payment collection drew no response. Further exploration is needed to understand this phenomenon, but on the face of it, there appears to be a divergence between the work and interests of women and men, with women not wanting to take on the additional responsibilities involved in dealing with the electricity department. Women also face practical constraints in doing so, given the remoteness of their village from the block headquarters where the electricity office is located.

Apart from the social structure itself, institutions also matter (Lal et al., 2006; Franks and Cleaver, 2007). While in the Wardha villages the piped-water supply is the responsibility of the panchayat, amongst the Koraput villages it is only in Khiching that the water tank and pipe connection were set up and are maintained by the panchayat. In other villages an NGO installed the tanks with government funds. Water-users committees were formed with at least one woman member, but the committees rarely meet for a range of reasons (cf. Lal et al., 2006). In Khuntiguda and Kanakguda, the women members were not even aware that they were on the committee. Unlike in the case of Chattis Mauja in Nepal (Zwarteveen and Neupane 1996) – where women avoid committees so that they can subvert and break rules to their advantage – here the committees are not organised properly, and especially lower caste women feel they have nothing to gain from participation (Meinzen-Dick and Zwarteveen, 1998; Franks and Cleaver, 2007). A few men from the dominant castes/ethnic groups make decisions which ensure that their social group or kin get the maximum benefits (cf. Pradhan and Rao, 2018). Thus, in Kolpur's Colony Sahi, a Paroja hamlet, there is no pipeline or handpump. The taps are located in the dominant community hamlets, and the Parojas use an unlined open well that has no boundary wall. Lack of political connections and informal social networks seem to reinforce the exclusion of the historically marginalised (Birkenholtz, 2013), in this case, the Parojas.

Today caste discrimination in terms of drawing domestic/drinking water does not exist in the Wardha villages, thanks also to the Dalit mobilisation in the region. Women and girls of all castes freely draw water from the handpump in Shampur on a first come, first served basis. In Koraput however, even 15 years ago, the Bhumias, the dominant tribe, prevented the Parojas and Dombs from touching the water taps in Kotra. A physical fight led to the Paroja men leaving the village for a few days. The district collector and police superintendent finally intervened after informal efforts to resolve the conflict failed, and a written agreement was made. Peace prevails now, but when it comes to collecting water the Bhumias still get priority "out of respect", said Sridhar Paroja, 50, a key figure in the past dispute. Ghasia, a Domb (SC) labourer of Kotra, says, "Drinking water is scarce in summer since there is only one tube well in the Bhumia *sahi* (hamlet). Our women have to wait till the Bhumias draw their water requirements. Sometimes we have no choice but to drink water from the dug well". In Ghasia's eight-member household (himself, his wife, his mother, and five children) everyone is undernourished.

Clearly, caste/ethnicity determines who gets the water first and even where the "improved water source", like a piped-water tap or handpump, is situated. Women higher in the social hierarchy are given priority by those lower down, ostensibly out of "respect", pointing to a clear "intra-gender" difference (Birkenholtz, 2013). This arises from deeply ingrained ideologies of purity/pollution in which water is a key marker (cf. Sharma, 2017), as well as socially embedded principles that result in a strong desire to avoid fights and as much as possible maintain relations of reciprocity (Cleaver, 1998b; Sultana, 2011).

Even in well-conceived NGO interventions, unawareness of gender and social hierarchies and power relations can create access problems for women low in the social and caste hierarchy. A tank and water supply system was installed in Khiching in 2009 under the Swajaldhara scheme of the Central Government, to supply drinking water to this village and the neighbouring Kadaguda, a village dominated by the Ranas and Brahmans. While the panchayat pays the electricity charges, those who want a pipe connection have to pay Rs1000 upfront and Rs100 per month subsequently. Water is supplied for five hours daily. None of the 40 Paroja households in Kadaguda have a piped connection as they could not afford it. A roadside tap was built for them, and they have to collectively pay if the pipe leaks or the faucet breaks. However, Damodar, a powerful and well-connected Domb in the village has a big plot of land in which an NGO took up as a demonstration plot for a kitchen garden programme to enhance nutrition. Damodar uses the inputs from the NGO to grow vegetables commercially: he connects a long pipe to the roadside tap, drawing most of the potable water to irrigate his vegetables and leaving the Paroja women deprived. Perforce they have to depend on unlined wells or the handpump at the other end of the village, with negative health and nutrition outcomes (Appendix, Figure 1), but, with heavy burdens of work, they do not have the time or the space to protest (Rao and Raju, 2017). Not realising the local dynamics, the NGO functionaries see successful vegetable cultivation by a Dalit as a case of empowerment.

In terms of water for cultivation, Kanakguda in Koraput district has water year-round from a canal flowing from the check dam above the village. The canal is meant to irrigate the fields of not only Kanakguda but of Kadaguda, Khiching, and Khuntiguda downstream. The Malis, the majority community in Kanakguda, grow vegetables year-round. According to a Khiching resident, the Malis have encroached at least 100 acres of forest land on the hill slopes above their village since the check dam was built in the 1970s. They do not hesitate to divert the water into the encroached plots, depriving villages downstream. Khiching villagers often protest. They have tried to steal water at night, which has resulted in conflicts and police complaints, yet the issue remains unresolved. Though an inter-village committee exists, adequate attention has not been paid to ensuring that all stakeholders are represented and have voice (Gujja et al., 2006). The lined canal becomes a shallow, dry, unlined trench by the time it reaches Khuntiguda, yet the village does not have any representatives. The resident Gadabas are low in the local social hierarchy and therefore are economically and politically weak, hence they are unable to defend their rights (cf. Funder et al., 2012). This problem of tailenders not getting sufficient water is common in India, and is a reason for the many micro level conflicts that ensue (Development Support Centre. 2004; Gujja et al., 2006). Solutions would necessarily involve forming inter-village committees, curbing encroachments and water-intensive crop cultivation, and developing mechanisms to facilitate equal access and voice – what Goff and Crow (2014) call 'water equity'. Inter-sectoral and cross-disciplinary strategies are required which take note of historical and political factors as well as the dynamics of social power.

This example not only reveals the social hierarchies in the area, but also shows the gender relations both within Kanakguda, and between Mali women and women of other groups in the neighbouring villages. The Mali women work extra hard at tasks such as cultivating vegetables and maintaining the water channels, leaving them little time for household chores, hygiene, or indeed leisure (O'Reilly et al., 2009). Furthermore, the settlement pattern is against the lines of the natural drainage, leading to waterlogging, cesspools, mosquitoes, and domestic water contamination, with negative impacts on

their health and nutritional status. Despite the cultivation of vegetables and a reasonable degree of dietary diversity, malnutrition is rampant here. This is driven by, amongst other factors, the time and energy deficits confronted by women, lack of sanitation and hygiene, a high prevalence of illness, and the lack of control over income and decision-making agency (Appendix, Figure 1). A clear trade-off is seen between productivity and health concerns. While these are gendered, they do not necessarily reflect the stereotypical view of men pushing for production and women for reproduction, rather they present complex and nuanced negotiations around future aspirations and well-being. The conflict over water, however, also ends up isolating the Mali women from those of other castes/ethnic groups.

Water quality

In the traditional farming systems across both study areas synthetic fertilisers and pesticides were hardly used, but this has changed with the coming of commercial agriculture, be it Bt cotton in Wardha, or vegetable crops in villages like Kanakguda of Koraput. Water mining has lowered the water table considerably in Wardha, and anecdotal evidence suggests that water has become scarcer in villages downstream of Kanakguda. While changes are likely in the biophysical aspect of water as a resource, no studies are available to confirm the contamination or quality of ground and surface water due to these processes.

The following potential quality problems were observed with the supply of drinking water across both districts. First, where there are overhead water storage tanks, there is no mechanism to clean them regularly. Since groundwater is pumped into them, a certain amount of silt/sand can be expected in the tanks. In the Wardha villages, the panchayat is supposed to test the water quality of the overhead tanks and wells and clean them every month. In just one village, the panchayat *chowkidar* (guard) had put some bleaching powder into the overhead tank "some time ago" due to pressure from the local youth. Khuntiguda's overhead tank is yet to start functioning, and the villagers rely on one tubewell and a well in the village. Budura, of Khuntiguda, says he takes the initiative to keep the area around the tubewell clean. When the tubewell is out of order, water is collected from the well and the river. Villagers report straining this water with a cloth and at times boiling it before drinking. Maintenance of quality is thus left to a few individuals due to the absence of functioning institutions, and, given the condition of water scarcity, tends to be deprioritised.

With this growing individualisation of responsibility for maintaining water quality, women's workloads are likely to rise, including procuring extra fuelwood for boiling water. In the monsoons – the peak cultivation season – women don't find sufficient time to maintain water quality, contributing also to an increase in waterborne diseases during this period. Gouri, a Mali from Kanakguda, admitted that they drink pond water when the tubewell is under repair. Ujwala, a Mahar woman of Shamli in Wardha said, "Diseases like cough, cold and diarrhoea increase in the rainy season. This might be due to mixing of surface runoff water with the drinking water sources. Also waterlogging in low lying areas leads to the breeding of mosquitoes".

Second, there are many issues regarding drinking water storage and handling. In both locations, water stored overnight is thrown away as it becomes *basi* (stale). This cultural practice, carrying symbolic meanings related not just to purity but also to women's work and care, nevertheless adds to women's time burdens as, even if the water tap is located close to their homes, multiple trips are required for water collection. The water is then stored in earthen or metal vessels in the kitchen area, often next to cereals, with a loose cover if covered at all. Contamination from dust, and from rat urine and droppings is possible. A small vessel (a metal tumbler, sometimes with a long handle) that is usually kept on the mud floor, is used to take the water out. Also, most of the households practice open defecation (discussed in the next section), washing hands with mud at the place of defecation itself. Handwashing with soap after defecation or before cooking, drawing drinking water, or eating is a rare phenomenon. Only in one household, that of a health worker in Wardha, handwashing with soap was seen.

Third, even when there is a functioning piped-water supply or handpump in a village, in the peak seasons (such as transplanting of paddy in Koraput or harvesting of pigeon peas or picking cotton in Wardha), women leave early in the morning for the fields, and often cannot wait for the water to be supplied. Shamrao, of Sitapur, who is in charge of switching on the pumpset, said,

I can switch on the pump only when there is electricity. Three days in the week, I switch it on at 9 am for half an hour. On other days, I switch it on at 12 pm again for half an hour. Thrice a week the water is available at 6 pm again for half an hour.

When asked about the convenience of the women who go to work usually by 7 or 8 am, he said, "What can I do? They have to make other arrangements". In most cases, their daughters rush home when the water comes. In Sakhi, the school teachers said they allow the "girls to go home to fill water in the mornings when necessary. Their studies suffer but water is essential". The fall back is the dug well, with water that is likely to be of poorer quality, thus negatively impacting health and nutrition. The phenomena of girls dropping out of school to share the water burdens of their mothers is universal (cf. Joint Monitoring Programme (JMP) 2012; Mehta, 2014), and while reflecting a loss of future opportunities for these girls, the crucial issue is that women's work patterns and timings are not taken into consideration in supplying piped water.

Women here face a time trade-off, and often end up prioritising their 'production/cultivation' functions over their 'domestic' ones. In terms of food and nutrition security, food production is as important to them as clean drinking water. As Jackson (1998) suggests, it should not be assumed that women's roles and responsibilities follow from their preferences; rather, the implications of their lived experiences need to be observed and considered. Such an approach can help bring discourses on labour and production into dialogue with questions of health and well-being. At present, it appears that water quality lies firmly in the health domain, with a near-exclusive focus on drinking water (Goff and Crow, 2014).

Stability

The above discussion leads to a focus on stability, embedded in hydrosocial cycles and the associated conflicts and trade-offs. In both the districts, barring the resettled villages of Kanakguda and Sitapur, the entire landscape – the habitat, defecation spots, croplands, sacred spaces – was an eco-cultural decision, and made according to the flow of water, and emerging from a worldview that considered human beings as a part of nature (cf. Morrison 2015). Some sense of rudimentary hygiene seemed to have prevailed, especially in the location of the defecation spots in the village which followed unwritten codes of conduct that allocated separate spaces for women and men downstream of the village (cf. Next Section).

Water is traditionally considered an exhaustible resource to be nurtured and conserved. Rainwater was harvested and, during the monsoons, river overflows were diverted into ponds on farms. The cultivation pattern also depended on an assessment of available ground and surface water, soil conditions, and moisture. Thus, in Koraput, the paddy varieties grown on highlands and lowlands are different: *aus dhan*, grown on highlands, requires less water and is broadcast. To prevent water pollution downstream, synthetic fertilisers are still not used. In Kolpur, women were carrying cow dung uphill to apply to the soil as fertiliser. Very often, plantains and arums are grown on the banks of ponds or field bunds to absorb the excess water. Women, especially amongst the Parojas, play a big role both in maintaining the water structures and channels, and in the choice and regulation of crops. This has intensified with male migration, where women are left in charge of agriculture, running the household, and also maintaining the *podu* (shifting agriculture) plots on the highlands (cf. Mohanty, 2011; Rao and Mitra, 2017). All this, however, is changing fast.

In Wardha, the change has been more rapid than in Koraput, and is perhaps irreversible. Not just commercial crops like Bt cotton, but commercial agro-forestry in the form of eucalyptus plantations

have played a major role in this transformation. In the 1970s a check dam was built in Shampur for irrigation, and substantial amounts of crop and common lands were acquired for this purpose, but this has now silted almost totally. With the felling of trees, the stream that flowed through the village is almost dead and the top soil on the commons as well as on croplands has eroded away. Sunil, who is in his early 50s, says his family lost about four acres of land. He added,

As children we were scared of coming here. I have seen tiger pugmarks in my childhood. Most of the village fuel supply came from the trees on the commons. I still have some land there but can grow nothing as it is barren and rocky. But most importantly, the water has gone and our fields depend mostly on the rain.

Moving around the area with Sunil, it was observed that people do not defecate there. Sunil explained, "This area is not for defecation traditionally though some nowadays do not follow customs. This is upslope of the village and if people defecate here the whole village will get polluted".

Eucalyptus plantations are making inroads in Koraput too, with the accompanying ill effects. Lakhinath, of Kolpur, who is in his late 60s, says,

Earlier a stream used to flow through our village. It was full of trees, especially tamarind. First the trees disappeared. Then eucalyptus replaced the trees on the slopes. The stream just vanished. Now it gets difficult to get water from the handpump in summer. The women have to slog much harder as the water level has gone down.

In Koraput, the conversion of *dongar* (uplands) to eucalyptus plantations is evidence of growing commercialisation, and with the accompanying individualism one finds a breakdown of community institutions responsible for overall ecosystem and water management (Harris, 2009). Earlier, cropping patterns or the land and water use was a community decision, with women playing important roles in the decision-making processes (Rao and Mitra, 2017). Now, patterns of gendered reciprocity too are on the decline, seen also amongst the Malis, the commercial vegetable cultivators of Kanakguda (see above). Hydrosocial change here is led by the private sector, playing on people's aspirations as shaped by a neoliberal economy.

The overall commercial ethos, while threatening soil fertility, water stability, and food security, enhances the need for cash in the household to meet basic needs including food and clothes. People depend on either labour markets or social protection. Migration, which has been rare, is now increasingly common, especially in summer. Once the rains come, men return to plough and prepare their lands for the cultivation of paddy. Absence of a few individuals or whole families has adverse consequences on gender relations, in particular on children's well-being. They are often withdrawn from school to help with work in the domestic economy, confirmed by the low female literacy rates in the district. In a focus group discussion with 12-15 year old girls in Kotra and Kolpur, several reported dropping out of school after grade five and engaging in agricultural work, both paid and subsistence.

In terms of nutrition, gender and age-differentiated outcomes are seen alongside a general decline in health and nutrition status, especially amongst the ST groups in Koraput, and both SC and ST groups in Wardha (cf. National Nutrition Monitoring Bureau (NNMB) 2009; Appendix, Figure 1 and 2). When away from home the male migrants mainly consume rice, and few vegetables or pulses. The women left behind also experience a reduction in dietary diversity because, being responsible singlehandedly for household production and reproduction, they find little time to collect uncultivated foods like arums, tubers, and fruits. With eucalyptus plantations, the availability of these crops is also declining. In Wardha, several girl children were emphatic that they wanted to complete secondary education. They therefore worked on weekends plucking cotton in order to finance their own education. Good quality food, however, is sacrificed in the process.

Defecation and sanitation

In this final part, water and sanitation as critical enablers of good health and nutrition are discussed. India has the largest population practising open defecation in the world. According to the JMP, in 2015, only 31 percent of the population used improved sanitation, and 40 percent practised open defecation (Joint Monitoring Programme (JMP) 2017: 82). Recent analysis suggests that household sanitation and the mother's personal hygiene practices are strong predictors of child stunting in India (Cronin et al., 2016). In order to address considerations of health and nutrition as well as safety, especially for women and children (Centre for Youth and Social Development (CYSO), undated), building toilets and improving sanitation is currently managed by a high profile national mission, the *Swachh Bharat Abhiyan* (Clean India Campaign).

This has indeed become an urgent priority, as interventions for watershed development such as the construction of embankments are destroying traditionally demarcated areas for defecation by women and men, usually downstream of the habitation. In Sakhi village, Wardha, a gully was built as part of the intervention, cutting through the defecation grounds. Consequently, people now defecate closer to the village – in fact almost in the backyard of some Dalit (Mahar) residences. The stench and the flies are unbearable.

No incidence of molestation of women resulting from open defecation was found. Women do, however, face difficulties, especially if they need to relieve themselves during the day. As Durga, a Bhumia woman of Kolpur, pointed out, "We face a lot of difficulties especially during the monsoons. The problem is compounded as the scrub cover is almost gone and eucalyptus plantations have come up everywhere. During the monsoons, when diarrhoea is rampant, things get difficult". Disposing of infants' and small children's excreta is also a major issue. Usually, the children are cleaned with a piece of cloth which, along with the excreta, is thrown into the backyard.

The toilets constructed in both the districts under the *Swachh Bharat Abhiyan* are poorly designed. Sometimes the pan is forward sloping or the space is too narrow for anyone except a child to sit. Usually small shallow pits are made instead of the Y-shaped twin pits. Often the doors are missing. Small water troughs that hold at most 20 to 30 litres of water are built next to the toilet. Householders, especially women, are not consulted on the location of the toilet, which is often built at the entrance of the house in full public gaze. Women are reluctant to use such toilets, due to notions of shame and for other reasons. The toilets lie unused or sometimes fuelwood or other material are stored in them.

An important, though neglected, issue relates to the cleaning of the toilets and filling of the water trough, both of which would increase the workload of women.¹² Furthermore, strong caste-based purity and pollution norms disallow the cleaning of even their own toilets or pits by the middle and upper castes, even though this could be a good source of fertiliser (Chambers, 2017; Coffey et. al. 2017; Spears and Thorat, 2015). Not surprisingly, none of the schools in the 12 villages had functioning toilets with water, let alone soap. Without resolving the problem of water collection and storage for use in the toilets, and without assigning or sharing responsibility for cleaning and maintenance even within households, improved sanitation and an end to open defecation is unlikely to be achieved.

DISCUSSION AND CONCLUSIONS

This paper analysed the links between water in all its dimensions, and food and nutrition security. It considered the ways in which gender relations and responsibilities mediated this. What emerges clearly are the ways in which water availability, access, quality, and stability are closely linked with local farming systems and crop choices, as well as gender and wider social relations and hierarchies.

¹² Assuming a normal household of five members using the toilet twice a day on average, flushing alone would require $10 \times 2 \times 5 = 100$ litres, at 10 litres per flush using a small bucket (Chambers, 2017).

Development of infrastructure such as roads or embankments, or shifts in cropping patterns with commercialisation can disrupt the natural water-flow cycles, which in turn disrupt people's livelihoods, survival strategies, and gender relations. Water and land are very closely tied to people's well-being; indigenous communities therefore developed norms and customs to ensure harmony with nature. This was not just an ideal but was closely linked to the understanding of the links between human and environmental health and well-being. The first important point then is to take a holistic ecosystem approach that recognises the mutuality between people and water (and resources more generally) and the co-production of both security and scarcity, and registers the implications for food and nutrition security.

The emphasis in government or global statistics on water, in line with the Sustainable Development Goals, is on providing "improved water sources". This involves building overhead tanks, tube wells, or toilets at the micro level for drinking and domestic water, or mega structures like dams and embankments at the macro level to support production. Water is critical for both food production and domestic purposes; the two are mutually bound together through the links between people (both women and men) and their labour, and water. In the enthusiasm to meet the goals, the deep connections between the ecology (especially land use as shaped by water flows), the embeddedness of food production and preparation systems within such ecologies, and the ways in which they are mediated by gendered labour use patterns reflective of contextual power relations, are largely ignored.

As market penetration occurs in agrarian settings, land and water use patterns change and, along with them, gender relations. While class, caste, and ethnicity differentiate the precise roles of women and their modes of access, women are central to both food production and preparation, as well as to domestic water provisioning. Yet in planning and decision-making mechanisms on situating water-related infrastructure both at micro and macro levels, women are bypassed and social and gender norms and relations are largely ignored (Mehta, 2014, 2016; HLPE, 2015). This oversight can potentially end up increasing the work burden (especially for poorer women) and the possibility of conflict, as well as negatively affecting their social status, use of facilities, and infrastructure. This, in turn, contributes to poor household nutrition (Smith et al., 2003). While greater involvement of women at all levels of planning, designing, and locating is necessary, this needs to recognise differences within the categories of women and men. Decision-making processes must ensure representation and voice to all stakeholders (who are often in conflictual or dependent relations with each other). Participatory institutions have the potential to address and resolve emergent trade-offs between food and nutrition security, and increased time, drudgery, and conflict.

In the ultimate analysis, gendered pathways mediate the links between water for production (agriculture), consumption and household reproduction, and food and nutrition security. Contemporary production systems and the commercialisation of agriculture lead to greater stress on water resources and create shortages, triggering diversification and male migration. Consequently, women's time and work burdens increase, including in the provisioning of domestic water and in maintaining clean and hygienic water for household use. The time women spend on these different tasks (related to the availability and accessibility of clean water) influences the conditions of food preparation, and impact their own as well as the household's nutrition security. It is important to understand the roles and responsibilities of women (and men) in different socioeconomic groups and in different agro-ecological, cultural, and developmental contexts, not only with regard to agriculture for food and water security, but also as these roles and responsibilities variously affect water security for nutrition and hygiene.

The insights presented here have implications for policy. Apart from the need to shift away from binaries of production/reproduction and women/men in thinking about water use for food and nutrition security, there is need for a more holistic and intersectional perspective. Central to this is attention to women's subjectivities, the time and labour invested by differently positioned women in water collection and management, the seasonal time stresses they encounter, and the choices they make, however constrained. Lack of attention to this dimension can lead to overlooking the issue of

water quality – especially when water is scarce – and its health impacts. It is equally important to understand cropping patterns in parallel with domestic and drinking water, as they do not just overlap: the former has implications for women's time, as well as for water quality, availability, and stability. The SDGs provide scope for such an approach; it remains to be seen how far it will be implemented.

ACKNOWLEDGEMENTS

This article is part of the gender research in India generated by the Leveraging Agriculture for Nutrition in South Asia (LANSA) Research Consortium, and is funded by UK aid from the UK government. The views expressed do not necessarily reflect the UK Government's official policies. The authors are grateful to Akshaya Kumar Panda, Anurakta Deuria, Rajlakshmi Lenka, Devdutt Gauda, Max Aurthor Gill, Vikas Meshram, Pranali Mete and Pranali Hulse for help in data collection in the two districts. We are also grateful to Nithya, D.J for processing the quantitative data. We also thank two LANSAs internal reviewers and the three anonymous reviewers of Water Alternatives for their helpful comments on earlier drafts. Last but not the least our thanks to all the women, men and children in the field for giving us so much of their time.

REFERENCES

- Agarwal, B. 2018. Can group farms outperform individual family farms? Empirical insights from India. *World Development* 108: 57-73.
- Ahlers, R. and Zwarteveen, M. 2009. The water question in feminism: Water control and gender inequities in a neo-liberal era. *Gender, Place and Culture* 16(4): 409-426.
- Bakker, K. 2002. From state to market? Water mercantilization in Spain. *Environment and Planning A* 34: 767-790.
- Bakker, K. 2007. The "commons" versus the "commodity": Alter-globalization, anti-privatization and the human right to water in the global South. *Antipode* 39(3): 430-455.
- Birkenholtz, T. 2008. Contesting expertise: The politics of environmental knowledge in northern Indian groundwater practices. *Geoforum* 39: 466-482.
- Birkenholtz, T. 2013. "On the network, off the map": Developing intervillage and intragender differentiation in rural water supply. *Environment and Planning D: Society and Space* 31: 354-371.
- Chambers, R. 2017. India's rural sanitation: From lose-lose to win-win. www.communityledtotalsanitation.org/blog/indias-rural-sanitation-lose-lose-win-win?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+CLTS+%28CLTS+blog%29 accessed 3 January 2018.
- Centre for Youth and Social Development (CYSD). Undated. An evaluative study on water and sanitation in the KBK Region of Orissa – A study conducted on behalf of the government of Orissa, CYSD Bhubaneswar.
- Cleaver, F. 1998a. Choice, complexity, and change: Gendered livelihoods and the management of water. *Agriculture and Human Values* 15: 293-299.
- Cleaver, F. 1998b. Incentives and informal institutions: Gender and the management of water. *Agriculture and Human Values* 15: 347-360.
- Coffey, D.; Gupta, A.; Hathi, P.; Spears, D.; Srivastav, N. and Vyas, S. 2017. Understanding open defecation in rural India: Untouchability, pollution, and latrine pits. *Economic and Political Weekly* 52(1): 59-66.
- Cronin, A.A.; Rah, J.H.; Ngunjiri, F.M.; Odhiambo, F.; Aguayo, V.M and Coates, S. 2016. Water, sanitation, hygiene (WASH) and the nutritional status of children in India: Understanding the linkages and structuring the response. In Desai, S.; Haddad, L.; Chopra, D. and Thorat, A. (Eds), *Undernutrition and public policy in India: investing in the future*, pp 99-117. New Delhi: Routledge.
- Crow, B. and Sultana, F. 2002. Gender, class, and access to water: Three cases in a poor and crowded delta. *Society and Natural Resources* 15(8): 709-724.
- Development Support Centre. 2004. Proceedings of the National Workshop on Tailenders and other Deprived in the Canal Irrigation System, November 28-29, Ahmedabad.

- Ericksen, P.; Steward, B.; Dixon, J.; Barling, D.; Loring, P.; Anderson, M. and Ingram, J. 2010. The value of a food system approach. In Ingram, J; Ericksen, P. and Liverman, D. (Eds), *Food security and global environmental change*, pp. 25-45. London: Earthscan.
- FAO (Food and Agriculture Organisation). 1996. *Declaration on world food security*. Rome.
- Franks, T. and Cleaver, F. 2007. Water governance and poverty: A framework for analysis. *Progress in Development Studies* 7(4): 291-306.
- Funder, M.; Bustamante, R.; Cossio, V.; Huong, P.T.M.; van Koppen, B.; Mweemba, C.; Nyambe, I.; Phuong, L.T.T. and Skielboe, T. 2012. Strategies of the poorest in local water conflict and cooperation – Evidence from Vietnam, Bolivia and Zambia. *Water Alternatives* 5(1): 20-36.
- Gandhi, Vasant P. and Namboodiri, N.V. 2009. *Groundwater irrigation in India: Gains, costs, and risks*. Ahmedabad, India: Indian Institute of Management.
- Goff, M. and Crow, B. 2014. What is water equity? The unfortunate consequences of a global focus on 'drinking water'. *Water International* 39(2): 159-171.
- Gujja, B.; Joy, K.J.; Paranjape, S.; Goud, S. and Vispute, S. 2006. 'Million Revolts' in the making. *Economic and Political Weekly* 41(7): 570-574.
- Harris, L.M. 2009. Gender and emergent water governance: comparative overview of neoliberalized natures and gender dimensions of privatization, devolution and marketization. *Gender, Place and Culture* 16(4): 387-408.
- HLPE, 2015. *Water for food security and nutrition*. A report by the High-Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome. www.fao.org/3/a-av045e.pdf
- IFPRI. 2017. *The Global Hunger Index 2017: The inequalities of hunger*. Washington, DC: International Food Policy Research Institute.
- Jackson, C. 1998. Gender, irrigation, and environment: Arguing for agency. *Agriculture and Human Values* 15: 313-324.
- Joint Monitoring Programme for Water Supply and Sanitation (JMP). 2008. Progress on Drinking Water and Sanitation: Special Focus on Sanitation. Geneva: World Health Organization (WHO) and New York: United Nations Children's Fund (UNICEF).
- Joint Monitoring Programme (JMP). 2012. *Progress on sanitation and drinking water: 2013 update*. Geneva: World Health Organization (WHO) and New York: United Nations Children's Fund (UNICEF).
- Joint Monitoring Programme (JMP). 2017. Progress on drinking water, sanitation and hygiene: 2017 update and SDG baselines. Geneva: World Health Organization (WHO) and the United Nations Children's Fund (UNICEF). <https://washdata.org/report/jmp-2017-report-final>
- Joshi, M. and Palanisami, K. 2011. Impact of eucalyptus plantations on groundwater availability in South Karnataka, ICID 21st International Congress on Irrigation and Drainage, 15-23 October. Tehran, Iran.
- Kadiyala, S.; Harris, J.; Headey, D.; Yosef, S. and Gillespie, S. 2014. Agriculture and nutrition in India: Mapping evidence to pathways. *Annals of the New York Academy of Sciences* 1331(1): 43-56.
- Kapadia, K. 1995. *Siva and her sisters: Gender, caste and class in rural South India*. Oxford: Westview Press.
- Lahiri-Dutt, K. 2012. Large dams and changes in an agrarian society: Gendering the impacts of Damodar Valley Corporation in Eastern India. *Water Alternatives* 5(2): 529-42.
- Lahiri-Dutt, K. 2015. Medicalising menstruation: A feminist critique of the political economy of menstrual hygiene management in South Asia. *Gender, Place & Culture: A Journal of Feminist Geography* 22(8): 1158-1176.
- Lal, P.; Singh, K and Prasad, K. 2006. Failure of community institutions: Shaping river basin in Jharkhand. *Economic and Political Weekly* 41(7): 598-600.
- Mehta, L. 2014. Water and Human Development. *World Development* 59(July): 59-69.
- Mehta, L. 2016. Why invisible power and structural violence persist in the water domain. *IDS Bulletin* 47(5): 31-42.
- Meinzen-Dick, R. and Zwarteveen, M. 1998. Gendered participation in water management: Issues and illustrations from water users' associations in South Asia. *Agriculture and Human Values* 15: 337-345.
- Mitra, A.; Wajih, S. and Singh, B. 2015, *Wheezing ecosystems, depleting livelihood services and climate change resilience in Uttar Pradesh*. IIED Working Paper Series 18: 2015.
- Mohanty, G. 2011. *Paraja*. Oxford University Press, New Delhi (Translated from Oriya by Bikram Kumar Das).

- Morrison, K.D. 2015. Archaeologies of flow: Water and the landscapes of Southern India past, present, and future. *Journal of Field Archaeology* 40(5): 560-580.
- National Nutrition Monitoring Bureau (NNMB). 2009. Diet and nutritional status of tribal population and prevalence of hypertension amongst adults: Report on second repeat survey. NNMB Technical Report No. 25. Hyderabad. National Institute of Nutrition (ICMR).
- National Sample Survey Office (NSSO). 2014. India – Drinking Water, Sanitation, Hygiene and Housing Condition. NSS 69th Round, July 2012-December 2012. Ministry of Statistics and Programme Implementation. Government of India. New Delhi.
- Nightingale, A.J. 2010. Bounding difference: Intersectionality and the material production of gender, caste, class and environment in Nepal. *Geoforum* 42(2011): 153-162.
- O'Reilly, K. 2010. Combining sanitation and women's participation in water supply: An example from Rajasthan. *Development in Practice* 20(1): 45-56.
- O'Reilly, K. 2012. Modern water for modern women: Questioning the relation the relationship gender, empowerment and participation, In Zwarteveen M.; Ahmed S. and Gautam, S.R. (Eds), *Diverting the flow: Gender equity and water in South Asia*, pp. 273-300. New Delhi: Zubaan.
- O'Reilly, K.; Halvorson, S.; Sultana, F. and Laurie, N. 2009. Introduction: Global perspectives on gender-water geographies. *Gender, Place and Culture* 16(4): 381-385.
- Pradhan, M. and Rao, N. 2018. Gender justice and food security: The case of public distribution system in India. *Progress in Development Studies* 18(4): 252-266.
- Prakash, A. and Sama, R.K. 2006. Social undercurrents in a water-scarce village. *Economic and Political Weekly*. 41(7): 577-579.
- Prakash, A. 2012. Groundwater vending and appropriation of women's labour: Gender, water scarcity and agrarian change in a Gujarati Village, India. In Zwarteveen M.; Ahmed S. and Gautam, S.R. (Eds), *Diverting the flow: Gender equity and water in South Asia*, pp. 312-336. New Delhi: Zubaan.
- Rao, N. 2008. "Good women do not inherit Land": *Politics of land and gender in India*. New Delhi: Social Science Press and Orient Blackswan.
- Rao, N. and Mitra, A. 2017. Understanding transitions in gendered work and care in a fragile ecosystem of Eastern India. Presented at the Sustainability, Ecology, and Care Conference, 19-20 January 2017. Berlin: Friedrich Ebert Stiftung.
- Rao, N. and Raju, S. 2017. Gendered time, seasonality and nutrition: Insights from two Indian districts. *LANSAs Working Paper Series No. 22*. Chennai, India: MSSRF.
- Rao, N.; Gazdar, H.; Chanchani, D. and Ibrahim, M. 2018. Women's agricultural work and nutrition in south Asia: from pathways to a cross-disciplinary, grounded analytical framework. *Food Policy*.
<https://doi.org/10.1016/j.foodpol.2018.10.014>
- Ribot, J.; Peluso, N.L. 2003. A theory of access. *Rural Sociology* 68(2): 153-181.
- Sainath, P. 2014. Maharashtra crosses 60,000 farmer suicides. July 15th. People's Archive of Rural India. <http://psainath.org/maharashtra-crosses-60000-farm-suicides/> accessed on 2 February 2018.
- Seager, J. 2010. Gender and water: Good rhetoric, but it doesn't "count". Editorial. *Geoforum* 41 (2010): 1-3.
- Sen, A.K. 1981. *Poverty and famines: An essay on entitlement and deprivation*. Oxford: Oxford University Press.
- Sharma, M. 2017. *Caste and nature: Dalits and Indian Environmental Politics*. New Delhi: Oxford University Press.
- Singh, P. 2015. The long walk to water. www.livemint.com/Opinion/P0Z53B0wcPw4SjMRnm028L/The-long-walk-to-water.html accessed on 3 February 2018.
- Smith, L.C.; Ramakrishnan, U.; Ndiaye, A.; Haddad, L. and Martorell, R. 2003. The importance of women's status for child nutrition in developing countries. *Research Report No. 131*. Washington, DC: International Food Policy Research Institute (IFPRI).
- Solomon, D. and Rao, N. 2018. Wells and wellbeing: Gender dimensions of groundwater dependence in South India. *Economic and Political Weekly (Review of Women's Studies on Gender and Climate Change)* 53(17): 38-45.

- Spears, D. and Thorat, A. 2015. Caste, purity, and pollution and the puzzle of open defecation in India: Evidence from a novel measure in a nationally-representative survey. Working Paper. Rice Institute. Princeton University.
- Sultana, F. 2009. Fluid lives: Subjectivities, gender and water in rural Bangladesh. *Gender, Place and Culture* 16(4): 427-444.
- Sultana, F. 2011. Suffering for water, suffering from water: Emotional geographies of resource access, control and conflict. *Geoforum* 42: 163-172.
- Udas, P.B.; Prakash, A. and Goodrich, C.G. 2018 (forthcoming). Gendered vulnerabilities in Diaras: Struggle with floods in the Gandak River Basin, Bihar, India. *Economic and Political Weekly (Review of Women's Studies on Gender and Climate Change)*.
- Zwarteveen, M. and Neupane, N. 1996. Free riders or victims: Women's nonparticipation in irrigation management in Nepal's Chhattis Mauja Irrigation Scheme. Research Report No.7. Colombo, Sri Lanka: International Irrigation Management Institute.
- Zwarteveen, M. 2008. Men, masculinities, and water powers in Irrigation. *Water Alternatives* 1(1): 111-130.
- Zwarteveen, M.; Ahmed, S. and Gautam, S.R. (Eds). *Diverting the flow: Gender equity and water in South Asia*. New Delhi: Zubaan.

APPENDIX

Table 1. Caste/ethnic group distribution of households in the study villages.

District	Villages	SC	ST	OBC	Others	Total
Wardha	Sakhi	15 (10)	45 (32)	7 (5)	76 (53)	143
(Total	Sitapur	27 (38)	28 (39)	-	16 (23)	71
Households:	Shampur	4 (3)	32 (26)	81 (66)	6 (5)	123
556)	Shamli	20 (44)	3 (7)	-	22 (49)	45
	Suli	2 (1)	124 (71)	31 (18)	17 (10)	174
	<i>Total</i>	<i>68 (12)</i>	<i>232 (42)</i>	<i>119 (21)</i>	<i>137(25)</i>	<i>556</i>
Koraput	Kotaguda	-	3 (4)	74 (96)	-	77
(Total	Kolpur	-	102 (80)	26 (20)	-	128
households:	Kotra	20 (21)	59 (63)	15 (16)	-	94
658)	Khiching	3 (5)	1 (2)	50 (85)	5 (8)	59
	Kadaguda	37 (21)	83 (46)	45 (25)	15 (8)	180
	Kanakguda	1 (1)	2 (2)	89 (97)	-	92
	Khuntiguda	1 (4)	23 (82)	4 (14)	-	28
	<i>Total</i>	<i>62</i>	<i>273</i>	<i>303</i>	<i>20</i>	<i>658</i>

Table 2. Distribution of households according to drinking/domestic water source.

Villages	Piped water	Tube well/bore well	Dug well
Sakhi	30 (21)	1 (1)	112 (78)
Sitapur	31 (44)	7 (10)	33 (46)
Shampur	28 (23)	76 (62)	19 (15)
Shamli	41 (91)	4 (9)	-
Suli	145 (83)	18 (10)	11 (7)
<i>Total Wardha</i>	<i>275 (49)</i>	<i>106 (19)</i>	<i>175 (32)</i>
Kotaguda	1 (1)	69 (90)	7 (9)
Kolpur	1 (0.8)	66 (52)	61 (48)
Kotra	-	66 (70)	28 (30)
Khiching	19 (32)	38 (64)	2 (3)
Kadaguda	80 (44)	68 (38)	32 (18)
Kanakguda	16 (17)	76 (83)	-
Khuntiguda	-	25 (90)	3 (11)
<i>Total Koraput</i>	<i>117 (18)</i>	<i>408 (62)</i>	<i>133 (20)</i>

Table 3.1. Households' source of drinking water by caste and sub-caste – Koraput¹³

Caste	Sub-caste	Dug well	Piped water	Tube well/bore well	Total
		No. (%)	No. (%)	No. (%)	No. (%)
SC	DOMB	20 (34.5)	7 (12.1)	31 (53.4)	58 (100)
ST	ADIVASI	4 (80.0)	0 (0.0)	1 (20.0)	5 (100)
	BHUMIA	24 (17.1)	26 (18.4)	91 (64.5)	141 (100)
	GADABA	14 (28.6)	8 (16.3)	27 (55.1)	49 (100)
	PAROJA	20 (26.0)	11 (14.3)	46 (59.7)	77 (100)
<i>ST Total</i>		<i>62 (22.8)</i>	<i>45 (16.5)</i>	<i>165 (60.7)</i>	<i>272 (100)</i>
OBC	GOUDA	4 (30.8)	5 (38.4)	4 (30.8)	13 (100)
	KAMAR	12 (57.1)	1 (4.8)	8 (38.1)	21 (100)
	MALI	6 (6.2)	16 (16.7)	74 (77.1)	96 (100)
	PAIKA	13 (61.9)	6 (28.6)	2 (9.5)	21 (100)
	RANA	13 (8.3)	30 (19.1)	114 (72.6)	157 (100)
<i>OBC Total</i>		<i>48 (15.6)</i>	<i>58 (18.8)</i>	<i>202 (65.6)</i>	<i>308 (100)</i>
Others	KARANA	3 (18.8)	4 (25.0)	9 (56.2)	16 (100)
	PATRA	0 (0.0)	3 (75.0)	1 (25.0)	4 (100)
<i>Others Total</i>		<i>3 (15.0)</i>	<i>7 (35.0)</i>	<i>10 (50.0)</i>	<i>20 (100)</i>

¹³ The source of the data presented in Tables 1-3 is the LANSAs Baseline Survey. The figures in parenthesis refer to percentages. The charts have been computed from the LANSAs nutritional surveys

Table 3.2. Distribution of households source of drinking water by caste and sub-caste – Wardha

Caste	Sub-caste	Dug well No. (%)	Piped water No. (%)	Tube well/bore well No. (%)	Total No. (%)
SC	MAHAR	27 (39.7)	37 (54.4)	4 (5.9)	68 (100)
ST	GOND	58 (24.9)	136 (58.4)	39 (16.7)	233 (100)
OBC	KALAR	2 (6.7)	26 (86.6)	2 (6.7)	30 (100)
	LODHI	1 (11.1)	8 (88.9)	0 (0.0)	9 (100)
	MALI	11 (14.3)	11 (14.3)	55 (71.4)	77 (100)
	WANI	3 (37.5)	5 (62.5)	0 (0.0)	8 (100)
OBC		17 (13.7)	50 (40.3)	57 (46.0)	124 (100)
Others	DHANGAR	2 (20.0)	8 (80.0)	0 (0.0)	10 (100)
	GOWARI	71 (58.7)	44 (36.3)	6 (5.0)	121 (100)
Others		73 (55.7)	52 (39.7)	6 (4.6)	131 (100)

Figure 1. Nutritional (underweight) status across social groups: Koraput

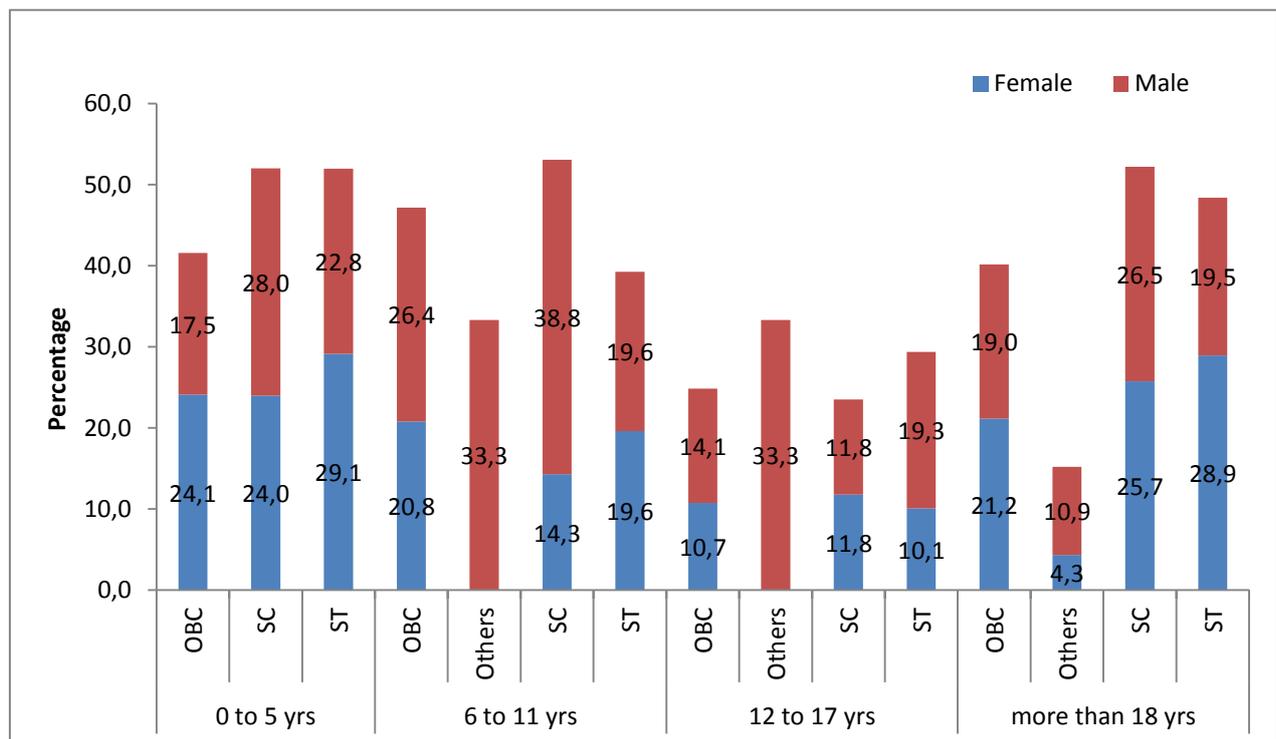
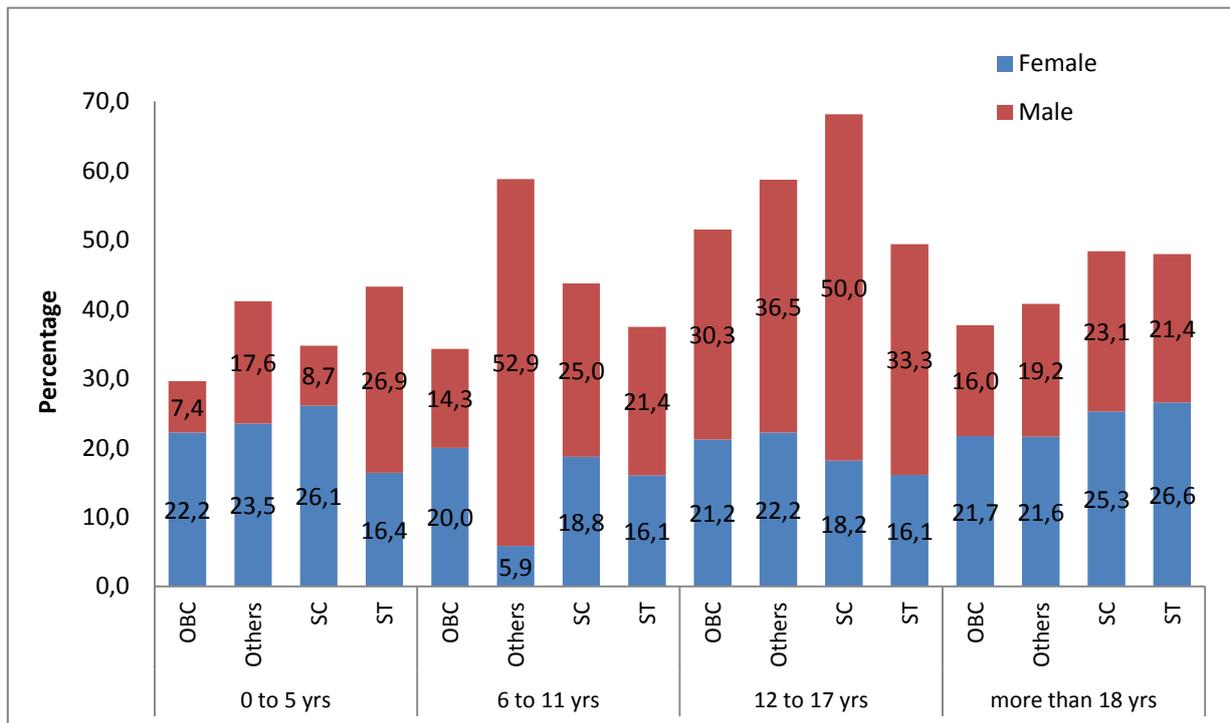


Figure 2. Nutritional (underweight) status across social groups: Wardha



THIS ARTICLE IS DISTRIBUTED UNDER THE TERMS OF THE CREATIVE COMMONS *Attribution-NonCommercial-ShareAlike* LICENSE WHICH PERMITS ANY NON COMMERCIAL USE, DISTRIBUTION, AND REPRODUCTION IN ANY MEDIUM, PROVIDED THE ORIGINAL AUTHOR(S) AND SOURCE ARE CREDITED. SEE [HTTP://CREATIVECOMMONS.ORG/LICENSES/BY-NC-SA/3.0/LEGALCODE](http://creativecommons.org/licenses/by-nc-sa/3.0/legalcode)

