Current Research in Environmental Sustainability 4 (2022) 100104

Contents lists available at ScienceDirect

Current Research in Environmental Sustainability

journal homepage: www.sciencedirect.com/journal/current-research-in-environmental-sustainability

# Gender dimensions of the migration, sustainability and care nexus: The case study of the Mahanadi delta, India

Giorgia Prati [a,1], Ignacio Cazcarro [b,c,*], Somnath Hazra [d]

[a] Food and Agriculture Organization of the United Nations, Rome, Lazio, Italy
[b] ARAID (Aragonese Agency for Research and Development), Agrifood Institute of Aragon (IA2), Department of Economic Analysis, Faculty of Economics and Business Studies University of Zaragoza, Gran Vía, 2, 50005 Zaragoza, Spain
[c] Basque Centre for Climate Change Research (BC3), 48008 Bilbao, Spain
[d] School of Oceanographic Studies, Jadavpur University, Kolkata, India

ARTICLE INFO

*JEL codes:*
B54
D63
E24
E26
O12
O13
J16
Q56
Q57

*Keywords:*
Gender
Sustainability
Care
Deltas
Climate change
Migration
Political ecology
Intersectionality

ABSTRACT

Migration and environmental change are deeply interconnected processes, intimately linked to development pathways. The gender dimension of these complex interactions is often overlooked. Yet there are profound linkages and implications. This paper focuses on the gender division of labour to investigate how migration and environmental change relate to gender equality and sustainability. The study draws on research conducted in the Mahanadi delta, in the eastern Indian state of Odisha. In the Mahanadi delta labour migration is largely male dominated. Women remain behind in vulnerable environments facing social and economic challenges having impacts on their empowerment and wellbeing. The findings show shifts in work burden, as women often engage in new activities alongside the traditional domestic and social reproductive work but highlight differences across age and household headship. Firstly, this paper identifies the connections between gender, sustainability and care –conceptually and empirically. Secondly, it explores the gender division of labour in the study area by discussing its structural causes. Thirdly, it provides insights into migration dynamics and examines how they feed back into gender equality and sustainability. Finally, it argues for the need of integrated analytical approaches that reflect ecological and social-equity challenges.

## 1. Introduction

Care, migration and environmental sustainability are intertwined and multifaceted phenomena. As migration is rapidly gaining attention in the climate change discourses its implications for sustainability, inequality and adaptation have also been increasingly explored, although not necessarily with synergism. Migration leads to changes in the household composition, social relations and gender roles entailing a reconfiguration of care giving activities. The relationship between migration and care has been extensively researched (Beneria et al., 2012; Bastia, 2009; Bettio et al., 2006; Parreñas, 2000), however the debate has largely focused on female migrants, care deficit and transnational care. The implications of male-out migration for the women who are left-behind in terms of equality and opportunities (including paid and unpaid contributions) under conditions of reduced mobility and environmental change is far less explored. Although climate change cannot be a single cause, there is large agreement that it is acting (and could act even more) as a threat multiplier and reinforce the existing drivers of migration while changing migration patterns (Black et al., 2011; Afifi and Warner, 2008). There is therefore a clear, although not

* Corresponding author at: ARAID (Aragonese Agency for Research and Development), Agrifood Institute of Aragon (IA2), Department of Economic Analysis, Faculty of Economics and Business Studies University of Zaragoza, Gran Vía, 2, 50005 Zaragoza, Spain.
*E-mail addresses:* giorgia.prati@soton.ac.uk (G. Prati), icazcarr@unizar.es (I. Cazcarro), somhazra24@gmail.com (S. Hazra).

[1] The views expressed in this publication are those of the author(s) and do not necessarily reflect the views or policies of the Food and Agriculture Organization of the United Nations.

https://doi.org/10.1016/j.crsust.2021.100104
Received 5 July 2021; Received in revised form 15 October 2021; Accepted 9 November 2021
Available online 11 December 2021

fully casual, linkage between migration and (un)sustainability. In this paper sustainability is intended in its wider economic, social and environmental connotation[2] to also include concepts of social justice, well-being and equality over time and between social groups. Ecological, human and economic systems are indeed interdependent and complementing (Costanza and Daly, 1992).

The dominant models of economic growth have led to unsustainable patterns of natural resources exploitation and inequality whose adverse impacts have produced enormous challenges for resource dependent populations, especially in developing countries (Howarth, 2012; WESS, 2013; Islam, 2015). Similarly, mainstream economic models have reinforced gender inequality by exploiting and invisibilizing women's unpaid labour despite its pivotal role in sustaining and reproducing the work force, thus maintain growth (Beneria and Sen, 1981; Folbre, 2001; Benería et al., 2015). In capitalist markets the provisioning of care and the environmental costs of production are both externalized and undervalued creating social and ecological unsustainable pathways of production and consumption that rely on human and nature exploitation and pose concerns of inter- and intra-generational equity (Leach et al., 2018, Benería et al., 2015). Finally, there is consistent evidence of the gendered impact of climate change and natural disasters deriving from socially constructed vulnerabilities (BRIDGE, 2008, Neumayer and Plumpert, 2007, Bradshaw, 2004, Dankelman, 2002). Women's limited salaried activities leading to overreliance on resource-dependent livelihoods, limited access and control over assets and reduced mobility are only some of the structural factors that highlight the critical role of gender in shaping women's capacity to adapt to climate and environmental change.

This study seeks to trace interlinkages between migration, sustainability and gender with a focus on care work in the Mahanadi delta in India. The overall aim is to investigate how the three aspects of sustainability (environmental, economic and social) intersect and what the role played by gender is. The Mahanadi delta constitutes an exceptional case study from which to enhance our understanding of entrenched processes of migration, sustainability and inequality, due to the presence of significant out migration, environmental change and gender inequality. It goes without saying that India has been the focus of many interesting studies on development, poverty, inequality (among others, Sen, 1993, 1999, Drèze and Sen, 1999, Deaton and Drèze, 2002, Drèze and Sen, 2013), as well as on gender, agriculture, resource use or environmental change (among others, Leach et al., 1999, Agrawal and Sivaramakrishnan, 2000, Agrawal and Ostrom, 2001, Bhattacharya, 2001, O'Brien et al., 2004, Agrawal, 2005, Patnaik and Das, 2017). Regarding deltas, it has been found that these are highly sensitive to even small climate and human induced changes (Syvitski et al., 2009; Vörösmarty et al., 2009) and, being traditionally densely populated areas, they are increasingly gaining attention. In the Mahanadi delta labour migration is largely male dominated, and women typically remain behind to look after the family and the household. The many implications of these environmental and human patterns for gender equality and sustainability deserve to be explored.

This paper provides an empirical and up-to-date analysis of the gender dimensions of the migration, environment and care nexus, taking the Mahanadi delta, in India, as case study. It draws on qualitative data collected in the field complemented with an analysis of the past censuses from the delta and, in particular, of the Kendrapara district. Gender and migration are fields largely researched. Besides, environmental migration has seen increased attention in the last few years. However, the gender dimension of environmental migration and its impacts on sustainability is still underexplored. In addition, this study takes an intersectionality approach to analyse the impacts of migration along the spectrum of multiple identities and to highlight differences between women depending on their age, caste, marital status and position in the household.

This paper reviews in the first place some of the key concepts of gender, care and ecology. It then explains the methodology and case study. It follows a discussion on paid and unpaid work, division of labour and implications for gender equality. Finally, the paper analyses the challenges associated to migration and environmental change in the delta to further connect them to sustainability, gender and care in the final section.

## 2. Gender, ecology and care

### 2.1. Conceptualising gender in sustainability discourses

In the work of early ecofeminist theorists, the women-nature connection was portrayed as substantially related to biological and inherent traits, thus disconnected from social and geographical contexts (Salleh, 1997; Merchant, 1996; Mies and Shiva, 1993). The ecofeminist perspective of women and environment is grounded on the idea that because women care for humans through their nurturing and reproductive roles, they also care for the environment on which life is dependent. Women are considered better carer than men (Mies and Shiva, 1993) because of their innate higher moral and civic values. Their unique relationship with nature should therefore be celebrated and privileged because it brings caring values into the dominant materialistic and environmentally unsustainable ways of living. This view is problematic for at least two reasons. Firstly, because it focuses substantially on the benefits for the subjects of care – the environment and humans – neglecting the negative implications that care could have for women. It hints that care is always a choice made under conditions of equity and freedom (McGregor, 2004; Bowden, 1997; Cuomo, 1998). Secondly, because it suggests that women have an instinctive and inherent disposition to caring roles. That is a belief that invisibilizes women's agency by implying that they should be the guardian of nature based on their alleged closeness to it, rather than because of their situational knowledge or capacities (see Code, 1991).

Feminist environmentalists and political ecologists challenged the ecofeminist care ethic pointing out the relevance of socio-cultural, economic and historical factors in determining power relations and division of labour and, in turn, also women's relationship with nature (Agarwal, 1988, 1992; Rocheleau, 1988). New ecological, social and economic reformulations led to renewed perspectives on feminism and ecology (see Warren, 1987; Cuomo, 1998) that highlight the role of power and social structures in influencing the women-nature link. Social, economic, political and cultural factors differently shape men's and women's experience of the environment and their perception of sustainability. The new feminist approach also criticises the tendency to conflate women (and men) into unitary categories and recognises diversity across and within social groups based on intersecting identities (age, marital status, class, race etc.)

### 2.2. Care work and inequality

Closely related to the above discussion on women and environment is the discourse on women's care and reproductive roles (Beneria, 1979, Laslett and Brenner, 1989, Badgett and Folbre, 1999, Nelson and England, 2002). One of the main arguments that has been firmly put forward by feminist scholars is that the gendered division of labour is not biologically given but produced within social, economic, political and cultural landscapes (Beneria, 1979). As such, it is dynamically shaped by changes and interactions among the factors that constitute these

[2] The three pillars of sustainability, as defined in the 2005 World Summit on Social Development (UNGA, 2005), are: *Environmental Sustainability*, the ability to maintain rates of renewable resources to satisfy the needs of present and future generations; *Economic sustainability*, the ability to support a defined level of economic production indefinitely; and *Social sustainability*, the ability of a social system, such as a country, to function at a defined level of social well-being indefinitely.

structures. An unequal gender division of labour goes together with an ideology that justifies it at multiple institutional levels (Chafetz, 1990, 1991), for instance by defining what is an 'appropriate' and 'acceptable' behaviour for men and women or how the societal expectations differ by gender, age, ethnicity and other social identities. In patriarchal societies, women's work can be restricted to the domestic sphere while men engage in income generating activities. A structure that typically reinforces patterns of economic dependency.

The seclusion of women to the domestic sphere, including care and reproductive work, should be seen not only as a product of subordination and unbalanced power relations but also as means of maintaining inequality (Antonopoulos, 2009; PAHO, 2010; Ferrant et al., 2014). Control over reproduction is an expression of dominance that feeds privilege and gender inequality, and it is often also manifested by mobility restrictions (Beneria, 1979). The household becomes the main place of work for women, since it is where most of the reproductive and care activities take place. Reproductive roles inevitably condition women's participation in productive activities, often in self-reinforcing ways. The boundaries between production and reproduction[3] can be very thin, especially in rural economies where often women help men with agricultural activities as an extension of their domestic work (Beneria, 2001). It is also key to avoid treating and considering women as a monolithic category (as if all women had the same characteristics and position) when analysing several aspects. For example, it is critical to consider diversity of experiences and vulnerability by taking into account individual and social traits (such as age, caste and marital status) when analysing the relationship of women and nature, and the gender division of labour.

## 3. Methodology

A mix of quantitative and qualitative methods were used to analyse the interrelation of (im)mobility, sustainability and inequality with attention to the gendered implications for care and reproductive work in the Mahanadi delta, in the state of Odisha. The Mahanadi delta is one of the three target deltas of the DECCMA (DEltas, vulnerability and Climate Change: Migration and Adaptation) project in the framework of which this study was conducted. Accordingly, we use the DECCMA definition for the delta[4] which in Odisha comprises five coastal districts (Puri, Kendrapara, Bhadrak, Jagatsingpur and Khurda). The qualitative analysis is focused on three villages in the Rajnagar block in the district of Kendrapara that is among those exposed to the highest multi-hazard risk in the whole delta (Das et al., 2016). The selection of Rajnagar block and study within it still should be considered as a form of purposive sampling[5] therefore the sampling finally emerges to be purposive random type (see also Tompkins et al., 2020).

The villages were randomly selected based on three main criteria: exposure to climate stresses and hazards; occurrence of migration and presence of different castes to reflect social differentiation. A total of 26 focus groups with men and women were conducted in two phases between 2015 and 2016 along with 65 semi-structured interviews with women belonging to three different caste groups,[6]The interviewed women were of different age, different marital status and living in households with and without migration. The interviews aimed at exploring intra-household changes in gender relationships and allowed to further investigate the linkages with migration and sustainability across caste, household position, age and other context-relevant social traits. The data analysis may be limited by issues related to translation from the local language and both researcher and translator's positionality.

The quantitative work consists of statistical analysis of the 2001 and 2011 Census (PCA-Odisha, 2001, 2011; GoO 2015; GoO, 2016) covering national, delta and district level. When data at district and village level was not available, the analysis was extended to the whole delta. The quantitative analysis provides the contextual socio-economic background in which the narrative of the qualitative findings is explained. The inadequate (or lack of) data on migration at block, district and village level, and sometimes even state level, represents a significant limit to the analysis. This study could have benefited from a geographically more extended qualitative data collection.

## 4. Environmental change and socio-economic landscape

### 4.1. Environmental change in the delta

The Mahanadi delta is among the most vulnerable deltas in the world (Syvitski et al., 2009). Sea level rise, cyclones and floods are the most prominent climate hazards affecting this area through several adverse impacts on livelihoods, natural resources and populations (Chand and Acharya, 2010; Roy and Mruthyunjaya, 2002; Roy et al., 2004).(Map 1)

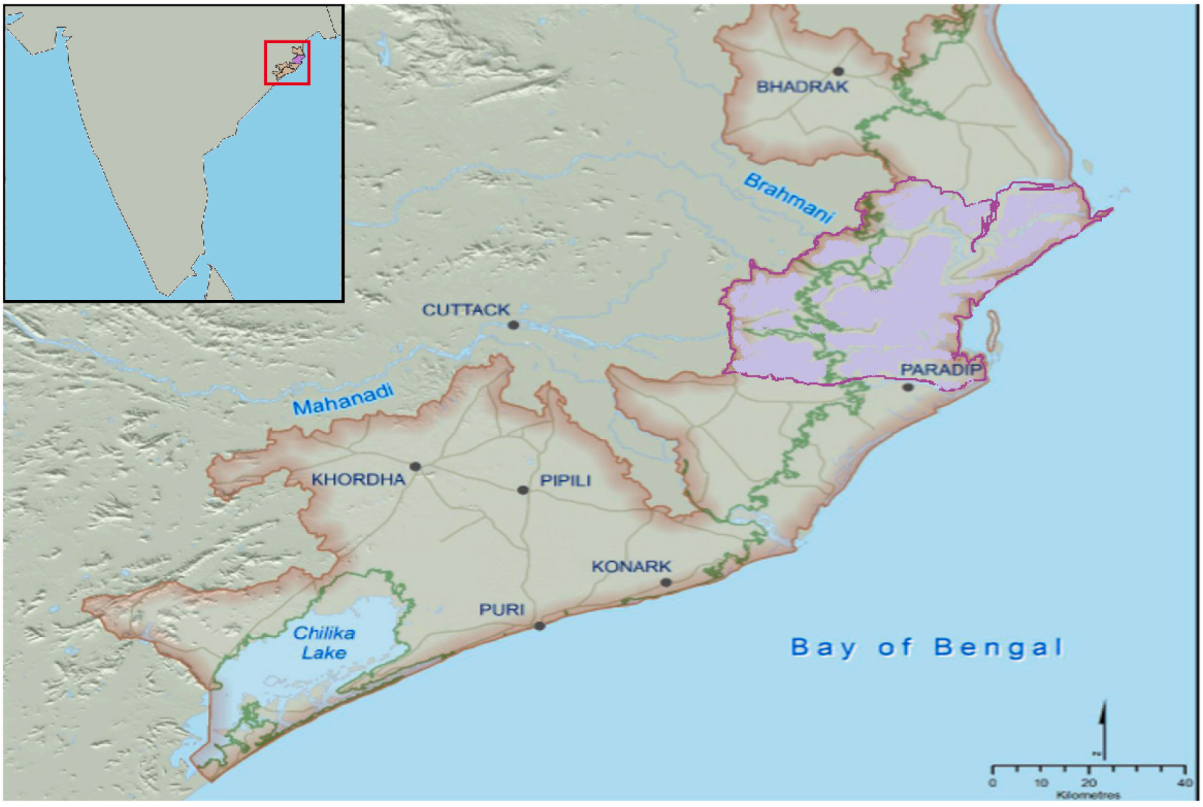
Kendrapara, among the other districts in the delta, appears to be particularly sensitive to climatic changes due to concurring environmental and socio-economic factors, including high dependency on rainfed, low-tech agriculture (Mishra and Sahu, 2014; Jain et al., 2010). In the study villages, the respondents reported issues of declining agricultural production (mainly rice crop), partially related to changes in rainfall patterns. Less regular but more intense rainfall, alongside a late onset of the wet season (lasting traditionally June-October), are also observed. It was also claimed by some that the start of the monsoon season has shifted from June to September, leaving only two months of rainfall. The fact that the monsoon arrives somehow later (mostly still already in June, although June shows less rainfall than July and August, see e.g. IMD, 2020) may have changed the perception, into some exaggeration of the late arrival of the monsoon. Salinity intrusion is reported as the main environmental concern because of its negative effects on yields and water quality. Discussions with the elders revealed that although the area has been always vulnerable to saltwater intrusion, the problem has become more evident in the last decade to the extent that traditional seed varieties have become unsuitable for cultivation. To overcome this deficiency, and in absence of farmers' access to salt tolerant seed varieties, farmers started to use large quantities of chemical fertiliser with evident implications for land degradation, crop quality and environmental sustainability (Bhawan, 2014). Women highlighted a sharp decline in drinking water quality, especially when the wells are located close to the water bodies in areas of the villages that are often prevalently populated by Scheduled Castes (SC) and Other Backward Classes (OBC). In addition to devastating effects on livelihoods, climate change also directly and indirectly affects health and wellbeing (spreading of water-borne diseases, food insecurity, poor diets, damages on houses and infrastructures, mental stress etc.). Kendrapara is one of the districts most affected by riverbank erosion in Odisha (Choudhury et al., 2012) which has led to land losses and sometimes even displacement of entire households. In the study villages, the households that had lost agricultural land were more likely to have one or more migrants' members. Because vulnerability is shaped by both climatic and non-climatic factors, we explore next the socio-economic context in which the above depicted changes take place.

[3] In this paper reproduction is intended in its broader feminist notion of social reproduction that goes beyond biological defined reproductive functions (Beneria, 1979; Laslett and Brenner, 1989; Luxton and Benzason, 2006).

[4] Districts falling within the 5 m contour.

[5] Also known as judgmental, selective, or subjective sampling, as a form of non-probability sampling in which researchers rely on their own judgment when choosing members of the population to participate in their surveys.

[6] This study uses the three general categories of Scheduled Castes (SC), Other Backward Classes (OBC) and General Castes. Scheduled Tribes (ST) are left out from the analysis because they are absent in the study villages and barely in the delta.




**Map 1.** Map of the Mahanadi Delta Region depicting the extent of our study site (region within the red line).
Note: The Kendrapara district appears in purple; we preserve also the green line of 5-m contour and other relevant info.
Source: Source elaboration from DECCMA WP2 team at Geodata (Southampton).

### 4.2. Socio-economic landscape

In recent years, the state of Odisha has experienced a relative rapid growth[7] coinciding with a fast industrialisation heavily based on mineral extractive industries. Traditional activities, such as fishery and agriculture, that still constitute the largest share in the Gross Domestic Production (GDP), are steadily declining. The industrial expansion has been accompanied by major infrastructure plans that have raised concerns and met the strenuous opposition of local communities (Nayak, 2015). Water availability and quality has been one of the most prominent issues. National development plans have increasingly diverted water to industrial areas at the expenses of rural communities that rely on these resources for livelihoods and domestic consumption. The two major rivers of the state, the Brahamani and Mahanadi, have shown significantly high levels of water pollution (Mishra and Nayak, 2014). Large quantities of pollutants are discharged into the rivers affecting downstream populations (Nayak, 2015; Mishra and Nayak, 2014; Choudhury et al., 2012). Finally, the construction of dams for the hydropower industry have demonstrated to alter the spatial distribution of floods in the deltaic region (Beura, 2015). Flooding began to occur also in areas that were not traditionally flood prone (Choudhury et al., 2012). Smallholder farmers and marginalised rural communities are those paying the highest cost of this development pathway suffering resource depletion, expropriation and dispossession, which has lead to increased inequality in the region. The long-term implications for the environment can be notable and are further magnified by the impacts of climate change.

Most of the population in the delta lives in rural areas, especially in Kendrapara (see its location in Map1) which shows the lowest urban population rate of all the delta districts (CPA-Odisha, 2011). Odisha's population stands at 44 million people, 18% of which live in the delta. The total population in the delta was steadily growing at an average of 1.4% per year up to 2011 (Fig. 1) accentuating the population density up to 625 inhabitants/km$^2$.

The new Census needs to appear for 2021. According to PopulationU (2021) Odisha population is currently estimated at 47 million in 2020, and the delta population at 9.1 million (projecting a growth of 14% for all districts in the period 2011–2021, considering that the delta

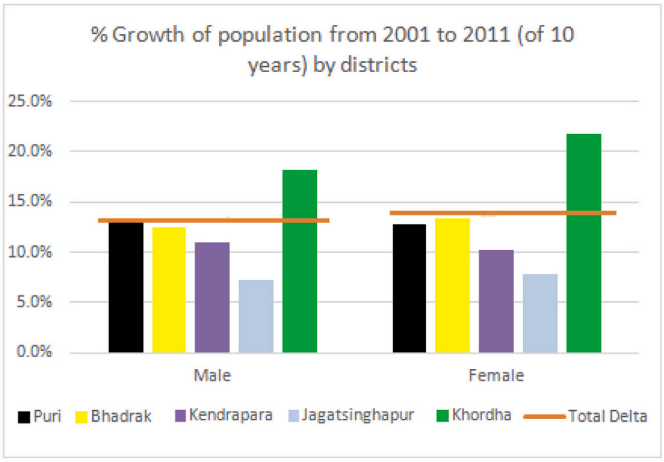



**Fig. 1.** Population growth rate (%) 2001–2011.
Source: Census 2001, Census 2011. Growth from 2011 to 2021 is projected as 14% in all districts in PopulationU (2021).

[7] The steady growth of Odisha has been found above the national average in the period 2004–2009 as reported by the Ministry of Statistics and Programme Implementation (2015, GSDP Growth at Constant prices).

population represented 19% of that of all Odisha, in both periods).

As shown in Table A1, in terms of caste distribution, the Scheduled Caste (SC) population accounts for around 20% of the total population in the study district whereas the presence of Scheduled Tribes (ST) is notably low (only 5% in Kendrapara) except for Khorda.

The gender gap in education is less prominent in the delta than in other areas of Odisha, out of the 76% of the literate population, 54.5% are male and 45.5% are female. However, Kendrapara has the highest gender gap in the whole delta. In the study villages a high proportion of the household expenditures is given to private tuition fees for children education, independently from their sex. Yet, in the case of households that can afford only to educate one child, there is a tendency to prefer boys over girls. The common view is that girls will eventually get married and move with their in-laws, whilst boys will stay in the native home and support their parents. Literacy rate is the lowest among ST, while the number of educated SC is only slightly lower than the average for all castes. In terms of income, Kendrapara has the lowest Per Capita Income in the delta (Odisha Economic Survey 2013–14) confirming its reliance on subsistence agriculture and low-income activities.

## 5. Paid and unpaid work, division of labour and implications for gender equality

### 5.1. (Formal) Employment

Around 34% of Odisha's population is formally employed, 82% of which are men and only 18% women (GoO, 2016). These figures describe a significant gender disparity, also when compared to national female participation rates. Women employed in the public sector in Odisha represent 3.2% of all India, whereas they account for only 0.5% of the female national employment in the private sector (GoI, 2011). (Fig. 2)

In the delta, the gender disparity is even more accentuated. Of about 1.7 million people formally employed, 92% are men and 8% women. The primary sector is the largest formal employment sector, including cultivators, agricultural labourers and other primary activities (livestock, hunting, fishing etc.). As shown in Fig. A1, women have a lower share of participation in all the sectors. Only in the primary and some minor sectors (mining and quarrying and hospitality) women's employment rate is higher than 25%.

A disaggregation by caste of main and marginal workers[8] in the delta shows that the share as marginal workers of both ST and SC is higher than their representation in the population (Fig. 3)(Periodic Labour Force Survey (PLFS), 2021).

The ST comprise only 2% of the total population, indeed only 3% of the marginal workers are from ST against a share of 36% in the whole Odisha. Interestingly, around 26% men marginal workers of both ST and SC in the delta are SC meaning that the SC share in the group of marginal workers is higher than their share in the total delta population. This is even more notable for SC women, which account for 29% of marginal workers in the delta, a significantly higher percentage than their share in population (Table A2). A final remark must be made with regards to informal employment. Although it has been estimated that more than 90% of the workforce in India falls into the unorganised and informal sector (Mohapatra, 2012), especially women and migrants, data on informal employment is still scattered and constrained by the limited size and distribution of statistics. As a result, informal work remains largely unaccounted and invisible.

In Kendrapara the gender and caste differences in main and marginal work are very similar to the situation in the delta as shown by the Census data. However, the qualitative analysis shows that women's participation in paid work is notably low. Except very few women employed in the public sector as teachers, school cookers or village health workers (Accredited Social Health Activists, ASHA), women do not engage in any type of paid activity. Rigid social norms of masculinity and patriarchy play a major role in determining the gender division of labour and constraining women's mobility. The fact that gender inequality was acknowledged and perceived did not imply willing to end it, but often willing to maintain it. As a male participant said:

"If we both earn money and I am not happy about something my wife could tell me - who are you? I earn money too – and I lose respect and power [...] Women belong in the house." (Man, 35 years old).

Engaging in paid work is seen by women as a step towards empowerment and more equality but also as a means of improving their own wellbeing. As explained by a woman whose husband migrated to another Indian state:

"I want to work because I want to be economically independent. When I need to buy something for myself I have to ask to my brother-in-law. It's very tough." (Woman, 28 years old). Another woman pointed out the link between paid work and bargaining power in the household:

"We need to work, if we work we have more voice in the decision-making." (Woman, 40 years old).

Disaggregation by sector and caste of main and marginal workers cannot be obtained for more recent data. The Periodic Labour Force Survey (PLFS) provides information of many years, but the Industry Code (NIC) and Occupation Code (NCO) of the interviewed is overall absent. The analysis of the available data for the recent years (PLFS 2018–2019), avoiding the most recent COVID19 years, allows us to see though the distribution of the main activity (Status Code for activity 1) by gender in the Mahanadi delta. (Fig. 4)

We may highlight how "attended domestic duties only" (also "attended domestic duties and was also engaged in free collection of goods" but being a less common main activity) is clearly dominated by women, at a 98% (blue bar), being the main activity for 60% of them (see red dots, based on the right axis). On the contrary, the status of "own account worker" (which is the main activity for 26% of men) is dominated by 94% by men, and other types of formal employment are also typically dominated by men, while "attended educational institution", which is the status for 24% of women and 28% of men is much more balanced (47% of women in that category).

### 5.2. Gender differences in time use and unpaid work

Formal (and informal) employment is only a fraction of the total work of a person. Analyses that only focus on formal employment overlook unpaid and care work veiling women's contribution to economy, especially in contexts with low female participation rates in the formal sectors. As highlighted earlier, care and reproductive work is essential for the family wellbeing and development and, in turn, for economic growth (see Hans et al., 2020 on the important role in development of women in the State of Odisha). Moreover, understanding the time spent by men and women in paid and unpaid activities can provide valuable insights into gender inequality within and beyond the household. The Time Use Surveys (TUS) have been used for this purpose. In TUS, the time spent in the System of National Accounts (SNA) activities (formal employment activities) is differentiated from the time spent in the so-called Extended SNA (ESNA) activities (including unpaid and care work). It can be said that the total economy is constituted by, and is dependent on, both SNA and ESNA work.

An analysis of the TUS of India conducted in 1999 allowed to gain a general understanding of the gender division of labour and distribution of work in Odisha (GoI, 2001). As shown in Table A3, SNA activities represent 25% of the men's time in Odisha (slightly more in urban areas). If SNA and ESNA are compared (excluding Non-SNA activities such as leisure time), men spend 93% of their time on paid work. On the contrary, women spend only 11% of their time on paid work, when this is compared to the time spent on ESNA activities it is around 38%. If we converted the time spent on ESNA activities to equivalent employment -

[8] Defined as those who work or were seeking/available for work (Census 2011).

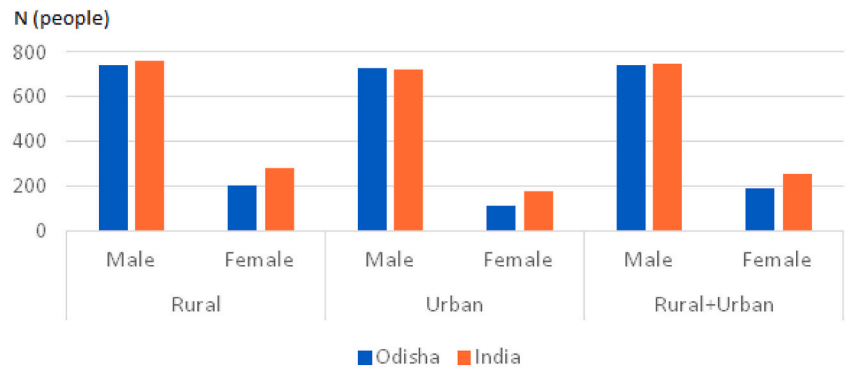



**Fig. 2.** Labour force participation rate (Per 1000) for persons of age 15 years and above.
Source: Own elaboration from the data of Ministry of Labour & Employment, Government of India. (ON290). Current Daily Status Approach (July 2011–June 2012).

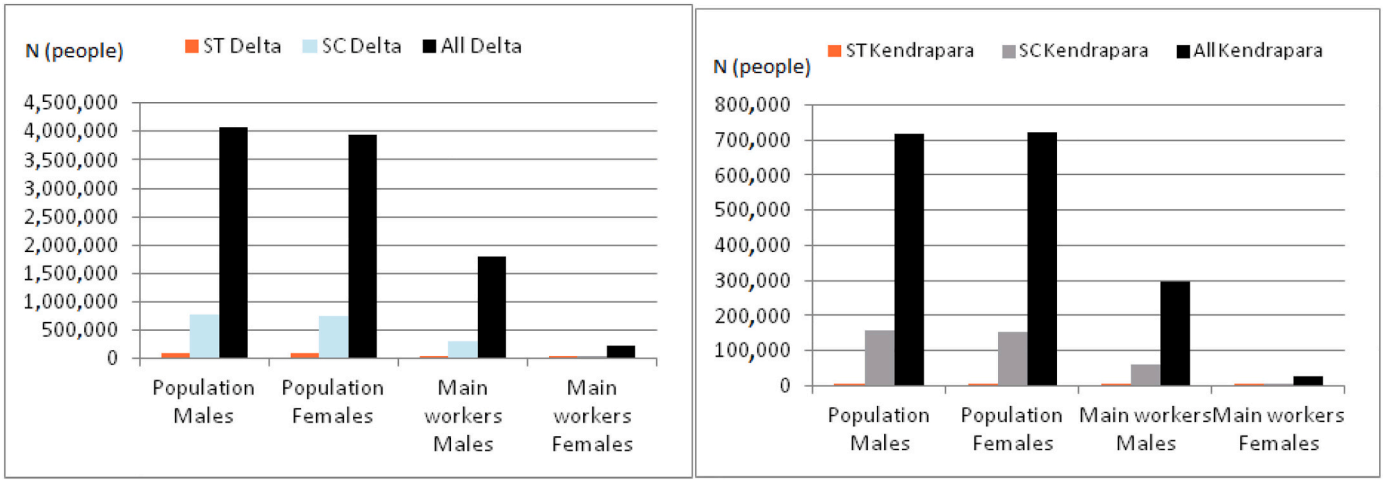



**Fig. 3.** Mahanadi delta and Kendrapara district population and Main Workers by caste (Source: Census 2011).

assuming that the time serves the same - we would find that the total full-time employment in SNA and ESNA is of 6 million female workers against 9.6 million male workers.

The TUS of India conducted in 2019 by the National Statistical Office (GoI, 2021a; NSS, 2020) also allows us to see this complementarily the question of time spent in different activities. Results on the percentage of persons of age 6 years and above participating in different activities in a day are informative, but do not tell us much about the distribution during the day (e.g. all persons devote time to "self-care and maintenance", and hence it shows a 100% of people doing them). More informative is the average time spent in a day on those activities, understanding that some of the activities may take place at the same time (indeed, the sum of time spent in each of the activities, as it is allocated "considering all the activities in a time slot", adds up to more than 24 h in a day). The different possible allocations, i.e. the above, or "considering only the major activity in a time slot" (see the readme files GoI, 2021b, NSS, 2020), may each have its advantages and disadvantages, and may not avoid e.g. some of the challenges on the "self-care and maintenance" response. Still using the first allocation option (see NSS, 2020) it is shown, as we do below with Fig. 5 the distribution of different tasks by different members, by their rural/urban and gender condition for all India. The results are also consistent for the delta districts that were analysed. For the purpose of the study, of particular interest is the quite differential time devoted to unpaid and paid work by male and female. If we exclude the about 50% of the time for "self-care and maintenance" that is represented, "Unpaid domestic services for household members" represents most of the time devoted by female (35% of all other time by rural, and 32% by urban) while for male this is minimal (4% of all other time than "self-care&maint." by rural, 3% urban). Men spend 42% of their non "self-care and maintenance" time in (formal) employment and related activities. With that exclusion, about 53% of the time of all groups (except rural female, with 47%) is devoted to "Learning", "Socializing and communication, community participation and religious practice" and "Culture, leisure, mass-media and sports practices".

From the above analysis, it clearly emerges that in Odisha female's work is done mostly at home and is unpaid. The boundary between SNA and ESNA is blurred (Hirway, 2015) thus these results should be contextualised and taken with caution. For instance, women's contribution in subsistence and production activities such as vegetable gardens or post-harvest processing of rice and other crops, tends to be anonymised under domestic work, and remains unaccounted.

The findings of the daily clock group activities conducted in the study villages are consistent with these findings showing that women spend most of their time in care and reproductive-related work (Fig. 6), especially food preparation. Women are also primarily responsible for the livestock grazing and maintenance which fall within the 'extended' definition of unpaid work, being livestock predominantly owned for self-consumption.

It is worth noticing that Fig. 6 shows a non-exhaustive list of women's activities based on a typical day at the time of data collection. In fact, there could be seasonal shifts in time use. Similarly, task allocation varies among women depending on kinship, age and household composition as earlier discussed. For instance, in extended families the chores are shared by the women in the household, whereas in nuclear households the whole burden is on the wife (and daughters). It was also

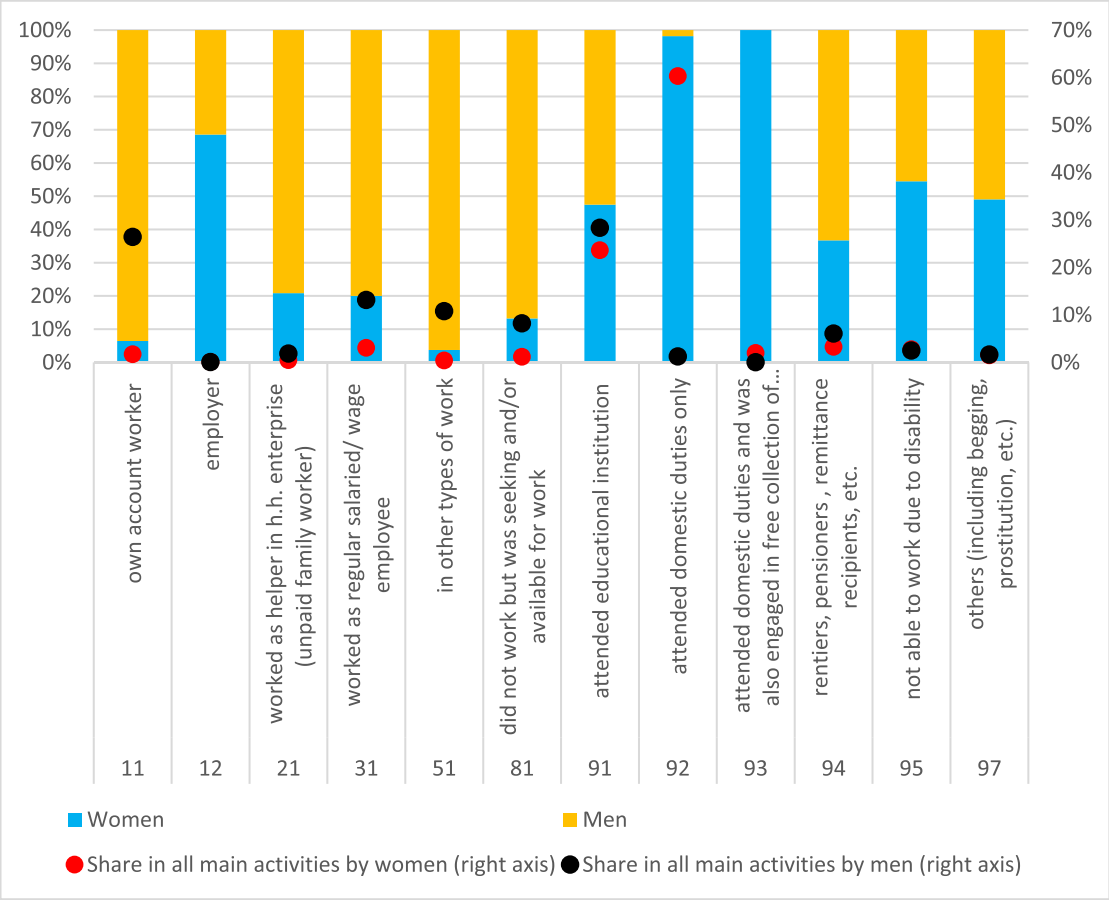



**Fig. 4.** Gender distribution according to the Periodic Labour Force Survey (PLFS), July 2018–June 2019.
Note: Mahanadi delta districts (Bhadrak; Kendrapara; Jagatsinghapur; Khordha; Puri).
Source: Own elaboration from the PLFS of July 2018–June 2019.

noted before that, in extended families, there is a hierarchy of work duties between female members which often requires young daughters in-law to be primarily responsible of the household chores, especially cooking. Because of the time of data collection, which corresponded to the pre-harvest agricultural lean periods Fig. 6 does not show the time women usually spend helping men in processing and storing rice during the post-harvest season (December-January), which is additional to the described daily activities. Seasonal shifts in time use can also occur during the monsoon season when some women cultivate vegetable gardens in the house back yard. The products are used for self-consumption reducing the household food expenditures.

The same exercise conducted with male groups (Fig. 7) shows that men's tasks are generally confined to wage and/or agricultural work, leisure and grocery shopping. The latter is traditionally a male activity since women are not allowed to leave the village unaccompanied. The time that men spend to rest is almost twofold the time spent by women.

Because men produce an income, the perception is that they work more than women. As a woman focus group participant said: *"We have to carry out all the household activities and to look after the family. Still they [husbands] tell us: you don't do anything, you don't earn money"* (woman, 45 years old). The time dedicated to unpaid activities is considered of less value despite being essential to the family well-being.

This contributes to reinforce power relationships and an unequal share of intra-household labour allocation. As a man pointed out: "I have my work. If my wife can't fulfil her household responsibilities, I'll marry another woman" (man, 33 years old). Only when women are sick, men help collecting water and firewood and taking care of the livestock.

The unequal allocation of time could constrain women's ability to develop their own capabilities (Folbre, 2006; Gammage, 2010). The issue of time poverty is entrenched into that of inequality. Lack of time could indeed deprive a person from taking opportunities and develop capabilities. Lack of time is one of the main issues preventing women from taking part in self-help group meetings which play a critical role in enhancing confidence and boosting empowerment. In addition, time poverty affects wellbeing and has physical and psychological impacts. Women in the study area often perform multiple simultaneous activities to cope with time scarcity. They reported to teach their children while preparing food for dinner or to take bath while washing clothes in the morning. The limited resting time can have serious effects on health especially when women's working hours increase, for example in the post-harvesting and monsoon season, or when they have to walk longer distances to graze livestock and fetch water due to natural resources degradation. The findings show that time scarcity hinders women's ability to engage in paid activities. Many interviewed women reported being willing and able to work but having no time. As a woman said "I want to work but only if the work is available here (the village). I have to take care of the household and I can't leave the village" (woman, 36 years old). The findings show that under conditions of time poverty and overburden women do not engage in paid work even if social norms were allowing that.

## 6. Environmental change and migration in the delta

The relationship between environmental change and migration has animated several academic and political debates (Foresight, 2011; Black et al., 2011; Afifi and Warner, 2008). Although it remains a controversial

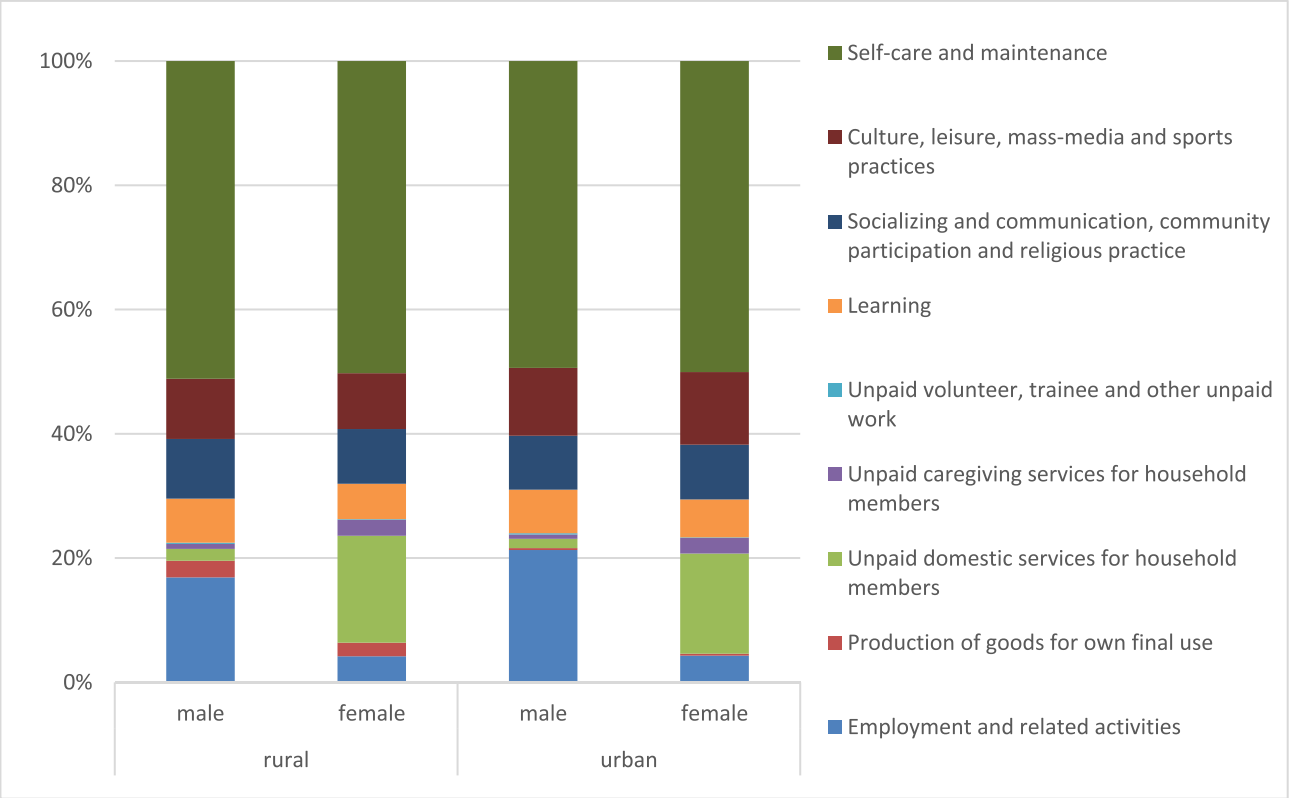



**Fig. 5.** Percentage share of total time in different activities in a day per person of age 6 years and above for all India.
Source: Own elaboration based on GoI (2021b), NSS (2020).

issue, there seems to be widespread agreement in considering environmental change a magnifier of the existing drivers of migration (IPCC, 2014; Black et al., 2011). Some scholars argue that migration is a consequence of the failure of socio-ecological systems and could increase vulnerability in the long-run (Oliver-Smith, 2009). Others point out that migration could be an effective strategy for risk diversification (Gioli et al., 2014; Tacoli, 2009). It is beyond our scope to determine whether migration is a successful strategy to cope with climate change, but we highlight next some linkages between these two processes.

In the context of the Mahanadi delta, the close relationship between environmental change and migration is particularly visible. As discussed earlier, the delta is vulnerable to multiple climate hazards and most of its population depend on climate-sensitive livelihoods. The coupled effects of climate and environmental change on income, livelihoods and living conditions influence migration patterns. Sustainability is therefore a central issue. In the studied villages, migration and environmental change are not perceived as casually related. Still, the respondents pointed out a sharp decline in the profitability of traditional livelihoods, especially agriculture, over the past 10 years. The increasingly large quantities of chemical fertiliser used to offset the salinization of paddy water raise production costs while also affecting the rice quality, thus its market value. Agriculture is shifting from being an income generating to a self-consumption activity and youth are losing interest in agriculture preferring to migrate to earn what the elders describe as 'fast cash'.

The limited available data on outmigration at district level, especially internal migration, makes it difficult to draw a clear picture. In Table A4 we observe that close to 8% of people living in urban areas of the neighbouring (in the south) Jagatsinghapur comes from Kendrapara. Interestingly, more female than male which can be due to family-linked migration (e.g. for marriage). Also, urban Khordan (the district where Odisha's capital city is located) shows close to 3% (in this case a slightly higher share of males). Urban Sundargarh, which is located in the northwest, also shows a relatively high share.

Outmigration from the Mahanadi delta is mostly male (see Tables A5 and A6). In total about 30% of migrants are male while and 70% are female. For rural migration the shares are respectively 14% and 86%, while for urban migration they are approximately 48% and 52%. Higher shares of female migration in urban areas can be explained by family-linked migration as after marriage women join their in-laws household.

All in all, female represent 73% of the immigrants in the delta, but only 16% of those with purposes of work or employment.

We explain the timing, destination and purpose of migration more generally for the whole Odisha, but the patterns are very similar in the delta districts. Immigration data in Odisha (from different districts than the one of enumeration, or from different states or countries) show that migration to urban area,s with duration of less than 1 year, is male dominated. In terms of purpose, in 2011 marriage as reason for migration accounted for 54.09% of the total migration. Of this share only was 4.81% of male migration, while 72.69% was female migration. The ambiguous classification of "Others" accounted for 23.18% of migration, 45.88% male and 14.61% female migration. Migration for work and employment reasons which constitutes 5.52% of the total migration was 16.91% male and only 1.22% female. Similarly migration for business (1.39% of total migration) was 4.49% male and 0.23% female. Overall labour migration does not emerge as a top reason for movement but it is clearly dominated by male pointing to possible gender implications for intrahousehold distribution of tasks and responsibilities. Even more noteworthy is the fact that the 6.91% of total migration for work and businesses, goes up to 21–26% (17–19% 3–6%, depending on the duration of residence) in the case of urban migration, explaining 42–55% of male urban migration. It is also observed that the higher is the duration of residence, the higher is the share of male migration. All in all, there is clear evidence that labour migration is male dominated (Table 1)

Also, a study conducted by The Centre for Migration and Labour Solutions (2014) revealed that in the coastal districts 67% of people

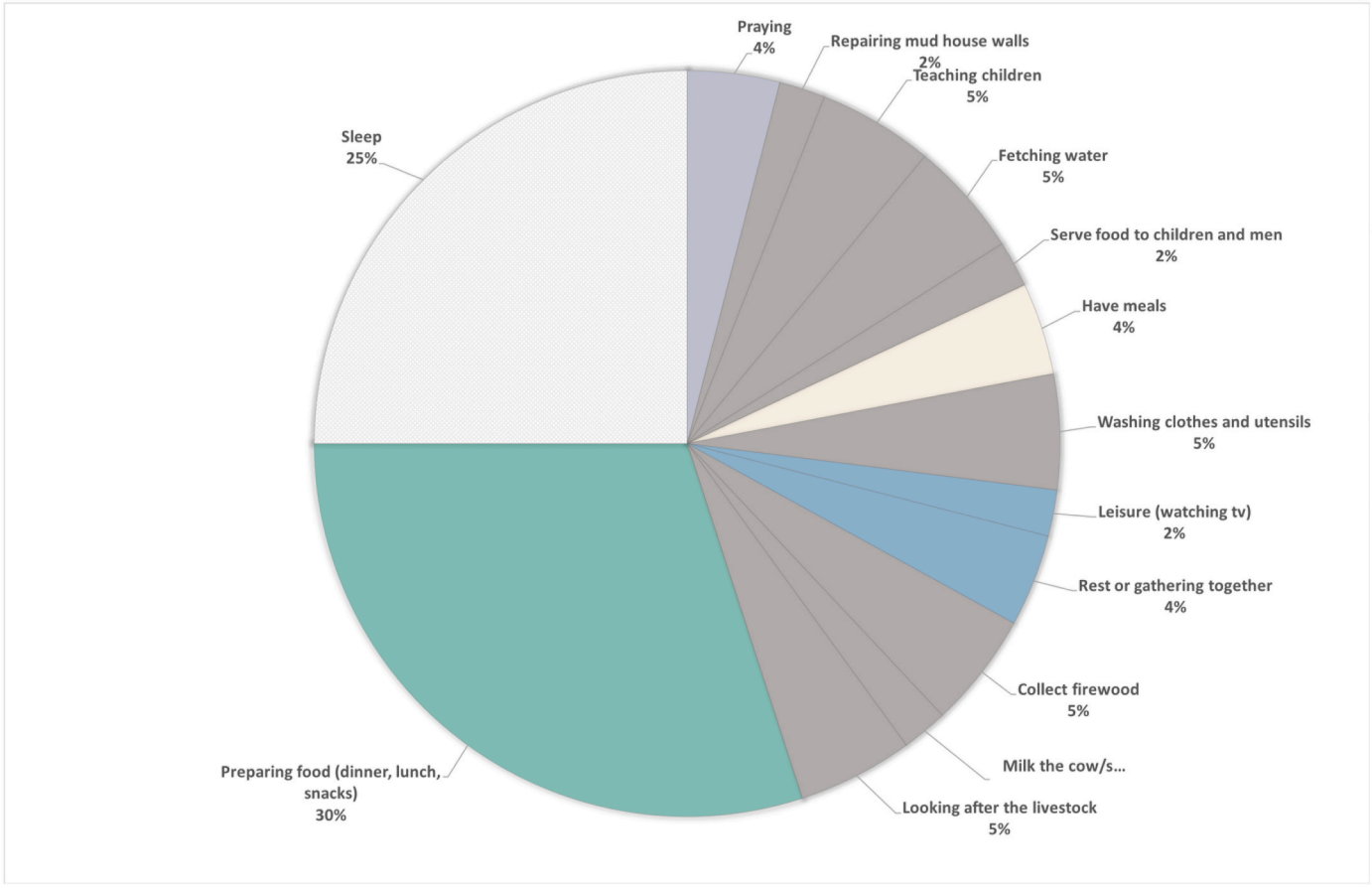



**Fig. 6.** Women's time use in daily activities in the study villages from the daily clock activity.

migrate, of this only 1% are women, whereas in western Odisha women represent 25% of total migrants. The qualitative data confirm a low, almost absent, female migration for work purposes. In the three study villages, there is no case of female migration, only men migrate while women remain behind to look after the household. Migration is higher among General Castes and Other Backward Classes than among Scheduled Castes households who often lack assets and resources to migrate, especially outside Odisha. There is a prevalence of long-term and long-distance migration to large urban areas (Kolkata, Delhi, Mumbai, Chennai and Hyderabad) where migrants are mainly employed in the informal sector in low skilled and low paid jobs.

### 6.1. *The feedback process of migration*

In the context of environmental migration[9] the attention most frequently falls on its drivers. The implications of migration for environmental sustainability and climate change adaptation are far less explored. The economic dimension of migration tends to prevail in the migration-adaptation discourses overlooking the complex sociocultural and environmental implications for human and ecological systems. Neoclassical theories of migration have emphasized the positive effects of remittances on poverty alleviation (de Haas, 2012; Kundu and Sarangi, 2007; Arjan and Dubey, 2006) and further studies in the field of adaptation and resilience (see the questions of uncertainty in Adger and Vincent, 2005, Vincent, 2007, and recently on indicators Dublin and Natori, 2020) have pointed out the positive role of remittances as a means to diversify risk and income in the households of origin for instance in buffering the impacts of environmental and climate change (Benerjee et al., 2017; Barnett and Weber, 2010). A growing body of literature highlights the impacts of migration on power relationships and social structures (Hagen-Zanker et al., 2014; Rao and Mitra, 2013), also specifically on the wellbeing of the left behind (Gartaula et al., 2012; Biao, 2007). However, these analyses are rarely framed in the broader context of sustainability and environmental change.

The characterization of migration in the Mahanadi delta is depicted in Fig. 8 that summarises the main types of migration and identifies its main drivers as explained claimed by the respondents.

The women who remain behind face the double challenge of enduring life alone in a patriarchal society dominated by men while coping with climate risks in highly vulnerable environments. It is therefore necessary to understand how migration, environmental issues and gender inequality intersect. When men migrate, the responsibility to look after the house and the family falls heavily on women with differences determined by their age, caste and position in the household.

In nuclear households left behind women take on increased responsibilities by taking up tasks traditionally performed by men outside of the village and bear the highest physical and psychological burden. Most of the women interviewed reported that they were 'unhappy' to have more responsibilities, which made them feel 'tense' and 'mentally overburdened'. In contrast, they felt 'relaxed' when their husbands returned for home visits and took back 'control' of the household. This raises questions over the assumption that is often made on the causal relationship between increased decision-making and empowerment. As

[9] According to the definition of IOM (2007: 33, 2021) that we follow: "Environmental migrants are persons or groups of persons who, predominantly for reasons of sudden or progressive change in the environment that adversely affects their lives or living conditions, are obliged to leave their habitual homes, or choose to do so, either temporarily or permanently, and who move either within their country or abroad".

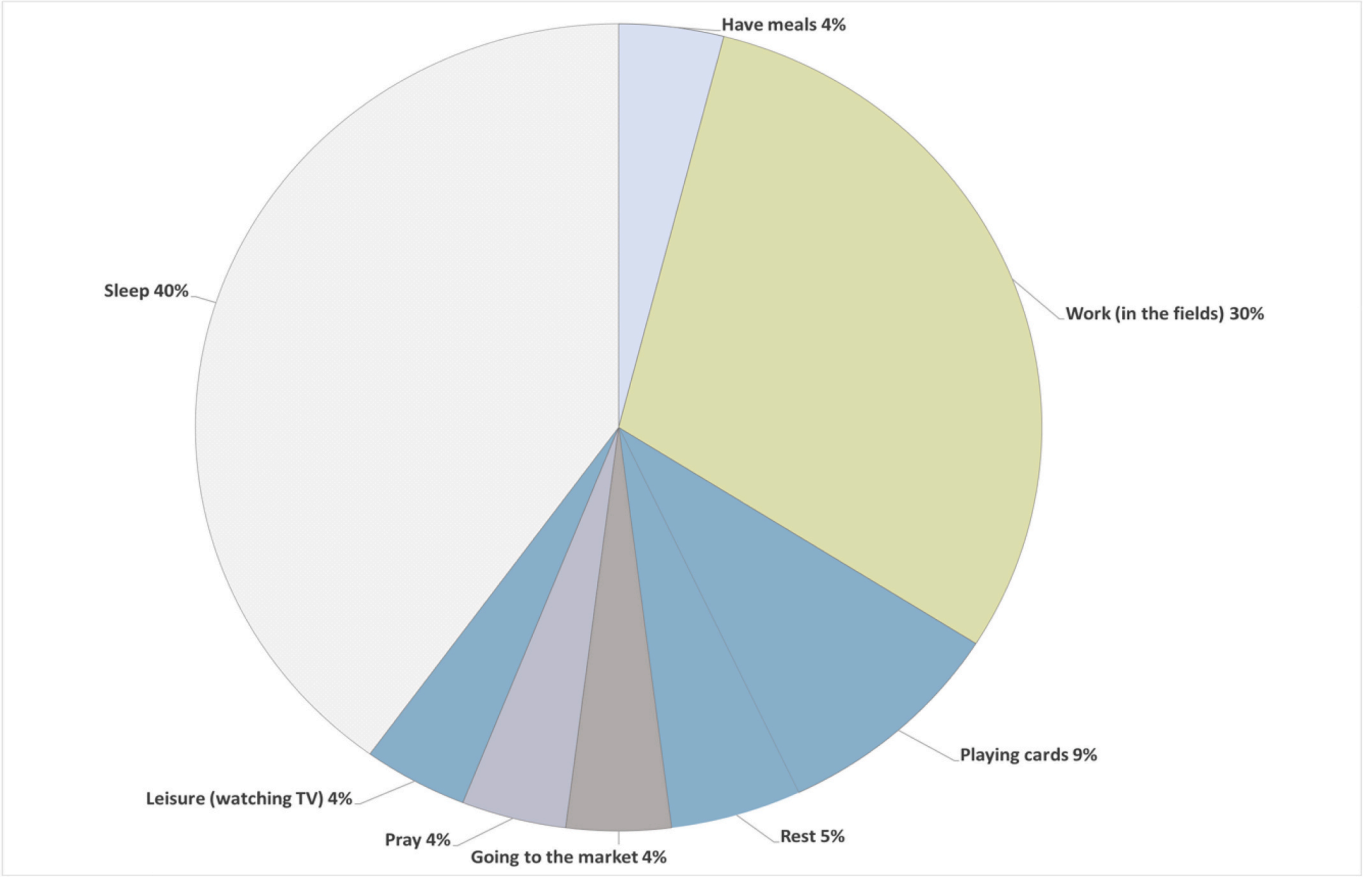



**Fig. 7.** Men's time use in daily activities in the study villages from the daily clock activity.

**Table 1**
Absolute total and female migrants (2 first rows) and female share in each type of movement (all other rows) for all Odisha districts (Census 2011).

| Area | Durations of residence | Total migrants | Work/ Employ ment | Business | Education | Marriage | Moved after birth | Moved with household | Others |
|---|---|---|---|---|---|---|---|---|---|
| **Tot** | **All durations of residence. Total migrants** | **15,421,793** | **851,363** | **215,008** | **280,140** | **8,341,271** | **418,432** | **1,740,872** | **3,574,707** |
| **Tot** | **All durations of residence. Female migrants** | **11,195,367** | **136,760** | **25,401** | **129,485** | **8,138,036** | **184,336** | **945,692** | **1,635,657** |
| **Tot** | **All durations of residence** | **73%** | **16%** | **12%** | **46%** | **98%** | **44%** | **54%** | **46%** |
| Rur | All durations of residence | 78% | 25% | 20% | 50% | 98% | 44% | 47% | 46% |
| Urb | All durations of residence | 55% | 12% | 9% | 42% | 98% | 43% | 61% | 46% |
| **Tot** | **Duration of residence less than 1 year** | **57%** | **18%** | **15%** | **45%** | **98%** | **48%** | **58%** | **44%** |
| Rur | Duration of residence less than 1 year | 61% | 22% | 20% | 49% | 98% | 48% | 54% | 45% |
| **Urb** | **Duration of residence less than 1 year** | **48%** | **15%** | **12%** | **40%** | **98%** | **48%** | **62%** | **43%** |
| **Tot** | **Duration of residence 1–4 years** | **72%** | **17%** | **15%** | **47%** | **98%** | **48%** | **59%** | **57%** |
| Rur | Duration of residence 1–4 years | 79% | 24% | 22% | 51% | 98% | 48% | 54% | 60% |
| Urb | Duration of residence 1–4 years | 55% | 15% | 11% | 43% | 98% | 48% | 63% | 49% |
| **Tot** | **Duration of residence 5–9 years** | **77%** | **16%** | **11%** | **40%** | **98%** | **48%** | **58%** | **58%** |
| Rur | Duration of residence 5–9 years | 85% | 24% | 18% | 45% | 98% | 48% | 52% | 61% |
| Urb | Duration of residence 5–9 years | 57% | 13% | 9% | 38% | 98% | 47% | 63% | 52% |
| **Tot** | **Duration of residence 10 years and above** | **83%** | **15%** | **10%** | **28%** | **98%** | **38%** | **51%** | **63%** |
| Rur | Duration of residence 10 years and above | 89% | 26% | 19% | 39% | 98% | 38% | 43% | 68% |
| Urb | Duration of residence 10 years and above | 57% | 11% | 7% | 25% | 98% | 38% | 60% | 49% |

Notes: Total (Tot), Rural (Rur), Urban (Urb).
Source: Census 2011 from the National Sample Survey (NSS) data on migration, GoI (2012),GoI (2021b). https://censusindia.gov.in/2011census/migration.html

highlighted in other studies, when assuming responsibilities is not a choice this could lead to stress and psychological burden, especially when the new tasks conflict with traditional beliefs about men and women's behaviour in patriarchal societies (Salgado de Snyder, 1993; Mckenzie and Menjívar, 2011; Gartaula et al., 2012).

In extended families, migrants' wives have usually no control over the remittances and low or no involvement in decision-making. When they are the recipients of remittances they often give all the money

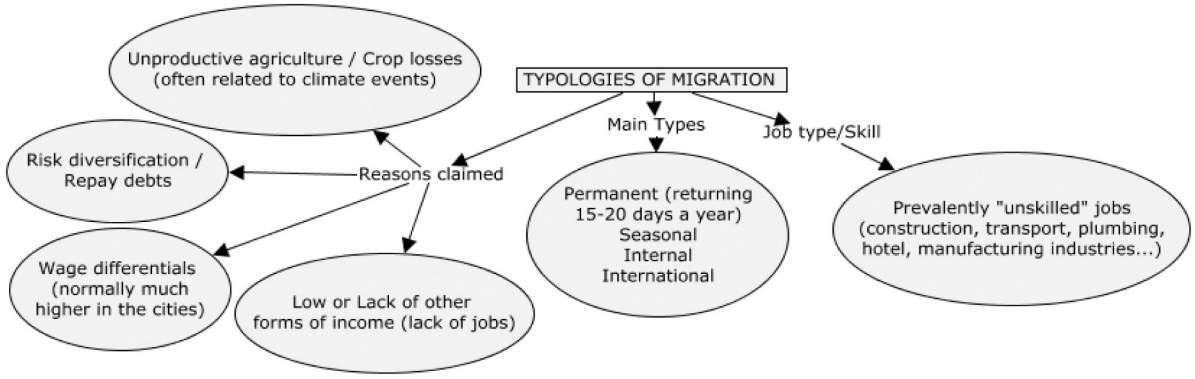



**Fig. 8.** Main characteristics defining the main types of migration in the Mahanadi Delta and reasons claimed.

received to the head of the household – generally one of the in laws. As it is demonstrated also in other studies, the recipients are not always the managers of the remittance income (Deere and Alvarado, 2016) which may not be necessarily an issue if they are then equally involved in the decision-making. However, in the study area this often does not seem to be the case.

Age and kinship position showed to play a significant role in shaping gender inequalities. Young daughters in law with migrating husbands living in joint families often experience oppression and subordination through renewed relationships of power of their in-laws. The authority of the mother-in-law is perceived as leaving less room for negotiation than with husbands, a situation often aggravated by the fact that the mother-in-law has full decision-making power and control over remittances. As a woman reported "There are certain things that you can discuss with your husband but not with your mother in law. If I want to buy something for myself I don't feel comfortable to ask her" (woman, 34 years old). The oppressive role of the mother in law that has been observed in other studies in the South Asian context (Kabeer, 1999; Sangari, 2008; Ahmed-Ghosh, 2004) emerged prominently in the findings. In the absence of their husbands, patriarchy is maintained by the in laws with forms that can exacerbate inequality.

Mobility is a controversial issue. The women left behind in nuclear households depend on neighbours or male relatives to be accompanied outside the village, a condition that makes them feel helpless. Some of them leave the village unaccompanied out of necessity, however they describe it as highly stressful and uncomfortable: "I go to the market by myself because I have to, my neighbours are not always there to accompany me. I don't like it but I'm forced to do it" (woman, 38 years old). In addition, this affects the already critical issue of time scarcity preventing women to engage in any activity outside unpaid work and leaving almost no leisure time. Family migration (in this case, women joining their husbands) is constrained by the high cost of living in the destination areas but also by the social responsibility of taking care of the in laws. Fig. 9 shows the above discussed typical issues for migrants and left-behind members in the Mahanadi.

The implications of migration for sustainability are complex. In the study area women do not usually take up men's roles in agriculture when these migrate, independently from their caste (something which one could have expected to occur, as it often happens in other contexts, see Rao, 2006). The land is either cultivated by another male family member (if any), given for sharecropping or sold. The changing structure of land holding is likely to produce shifts in agroecosystems in the long run. There is a growing concern among the elders about the lack of interest of youth in traditional livelihood activities which could also lead to a loss in traditional knowledge about local practices. The age of migration is shrinking and youth are increasingly disengaged with learning and practising agriculture. As an elder pointed out "My sons will have to rely on purchased rice, they are not interested in cultivating the land" (man, 70 years old). The prevalence of long-term over seasonal migration entails also a prolonged absence from the villages which can have both positive and negative impacts on community resources management. When the structure of the community is altered, there are inevitable implications for natural resources which deserve to be further explored. Finally, there are also considerations around social sustainability to be made. In the villages, some of the households with migration started to lend money and apply high interest rates to landless households unable to access formal financial loan mechanisms. These changes created tensions in the communities to the detriment of social cohesion and widened inequality, as mainly described in the focus groups and interviews. Social cohesion and social capital have been widely recognised as pivotal to adaptation and resilience (Adger, 2003, Jones and Boyd, 2011).

## 7. Connecting the dots: sustainability, migration, gender and empowerment

As emerged from the above discussion, in the Mahanadi delta climate and environmental change intersect with social and normative factors affecting human and ecological systems. Whilst we do not suggest that there is a direct link to migration, we showed that the effects of environmental change intertwine with existing drivers and influence migration decisions. Gender equality and sustainability are deeply interlocked. Unsustainable pathways of consumption, use of natural resources and production are likely to increase inequality. Whilst the analysis of the gender dimension of migration is not new there is little understanding of how this relates to climate induced migration. In the context of this study, labour migration is male dominated. It seems therefore particularly relevant to investigate its impacts on the left behind in terms of gender equality and sustainability.

The relationship between empowerment, wellbeing and migration is complex. In this study women who remain behind in nuclear households showed to gain decision-making power however this did not always equal to improved wellbeing.[10] Constraining gender norms and psychological burden overcome in most cases the positive impact of migration on women's empowerment. Taking up men's tasks and leaving the village alone is often associated by the respondents to anxiety, overburden and 'stress' of being judged by the other households. It is observed that to harness the benefits of migration for women's wellbeing and empowerment deeper sociocultural changes need to be in place.

[10] The women left behind in nuclear households showed to have more decision-making power over day-to-day financial decisions and increased mobility but also increased workload; whereas in extended households, women did not notice any significant change in terms of workload but seem to have generally less bargaining power than before migration and sometimes also less mobility. A closer look at these general patters reveals however a much more diversified and complex picture.

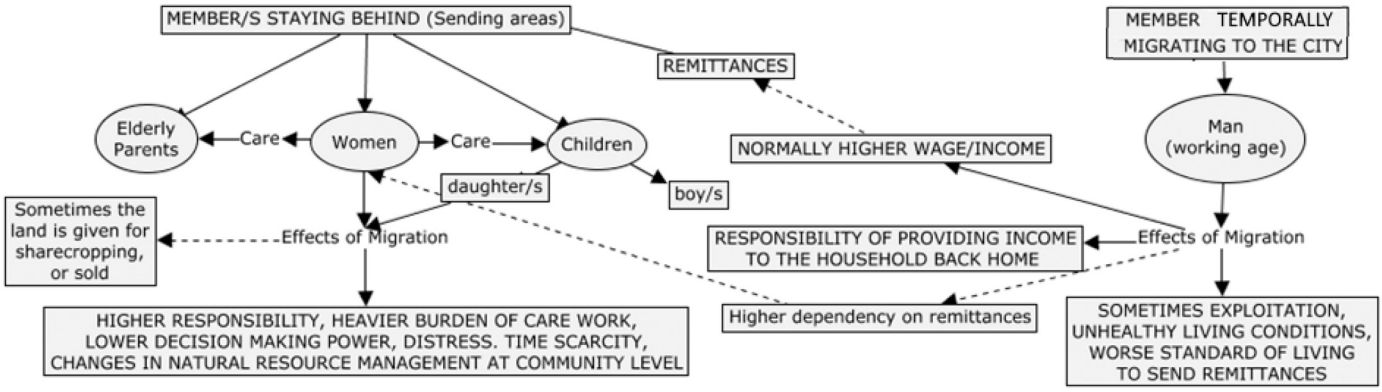



**Fig. 9.** Characterization of the typical issues for Migrant and non-migrant members of a migrant household.

Time poverty and overburden emerged as major issues, especially for the women left alone with children and elderly whose psychological and emotional burden is particularly difficult to bear. The number of tasks and time spent in unpaid work increase when the husbands migrate. Despite not being new in the migration literature, this finding should be put in a context of environmental and social vulnerability. According to the qualitative analysis land losses mainly due to soil erosion (also partly due to degradation) have reduced grazing land, forcing women to walk further distances as they are responsible of cattle feeding, lamenting fatigue and time scarcity issues. Some respondents point out that lack of time and overburden affect their ability to walk far, hence the livestock is not fed enough and the milk production is reduced with consequences on dietary intake. Women are also primarily responsible of collecting forest produce. In the study area, forest degradation, and the forest ban put in certain areas to mitigate its effects, is adding further strain on their burden. Despite these challenges, women in coastal Odisha formed community forest protection groups to conserve the forest and its biodiversity. According to Mishra (2010), since 2000 the group has re-generated around 15Km$^2$ of forest in the Puri district which is also a natural protection from the saline wind and sand particles.

In the study villages, health problems related to water pollution are visibly increasing either due to water becoming polluted during water logging or because of large and improper use of chemical fertiliser. Women are significantly exposed to this health hazard by using the village ponds to wash clothes and clean utensils. Ponds that usually next to agricultural fields thus they have a high concentration of dangerous chemical fertilisers. Problems related to availability and quality of drinking water are frequent also during the wet season, when floods prevent access to tube wells and enhance the risk of water-borne diseases. As shown in the Economic Survey 2014–15 (GoO, 2016), access to safe drinking water in Odisha remains lower than national averages, both in rural and urban areas. Access to toilet facilities is strikingly low, open defecation is the norm in most villages causing severe health-related problems and becoming a severe issue during floods and water logging. According to the 2001 Census Report, only 9% of the total households receive municipal supply water and around 3% of the total population drink polluted water from rivers and canals. For domestic use each woman in the rural coastal region has to collect on average about 200 to 250 l of water in order to satisfy the household consumption needs (5 to 8 members). In the studied villages women observed a higher incidence of wind-borne diseases, especially skin and respiratory diseases, that they attribute to more pronounced saline wind caused by shore erosion (resulting in shorter distance from the sea) and mangrove forest degradation (the forest acts as a natural barrier to the wind). As the primary caregivers of the ill, an increase in diseases could put additional strain on women. In nuclear households this also implies having to accompany the family members to the hospital, a traditional male task.

In terms of social and economic sustainability, the interplay of migration and gender is rather complex. For instance, the role of remittances is contentious. Young women living in extended households were found to have little or no control over remittances and to be subject to renewed power relationships that constraint their involvement in decision-making. The situation is the opposite for women living in nuclear households. Although having full control over remittances is usually interpreted as beneficial for empowerment, and in some cases still is, our findings show that there is not a linear relationship. Women said to be 'forced' into taking responsibilities over decisions and finances and to be relieved when their husbands return home for holidays taking back control of the household decision-making. Interpreting these findings through predominant empowerment frameworks, where the equation between power and choices underpins that the latter are made to correct inequality and power unbalance, can be problematic. In our example, women choose to conform to the status quo. A possible explanation is that they have internalised their subordinate social status and are determined in adhering to the norms that define it; this could still be an expression of their agency (Kabeer, 1999). Agency can indeed take multiple meanings from bargaining and negotiation to resistance. What women value as worth being and doing it does not necessarily fit within our predetermined categories of worthiness and wellbeing and it may differ across women and contexts. Our understanding of empowerment and equality should indeed be contextualised. If empowerment is about having the ability to make free choices out of alternatives, even increased mobility or decision-making do not necessarily constitute alone achievements, especially when they are externally 'imposed'. Understanding women's empowerment in the context of migration and sustainability requires looking into socio-economic contexts and take holistic approaches that reflect various aspects of gender inequality, and of how wellbeing and happiness depend much on capabilities rather than on narrower measures of human development (see Sen, 1999- Development as Freedom, Sen, 1993- Capability and human well-being, and many others). This work emphasizes that while improving women wellbeing is important, enhancing agency is just as critical.

Furthermore, conforming to gender norms does not inherently signify passive acceptance, in fact it could itself be an act of agency and choice. Some women reported that resistance to oppression and disobedience would bring 'tension' and 'conflicts' in the household, whereas their role is to 'maintain unity and peace'. Such behaviour suggests that women have chosen themselves to comply with such norms at the expense of their own wellbeing. Despite being de facto a choice, it is a choice that results from – and reinforces – women's internalization of their subordinate status. Kabeer (1999:441) points out that *"power relations are expressed not only through the exercise of choice, but also through the kind of choices people make"* reminding us that dominance can also operate through consent, not necessarily through coercion. Similarly, agency is not a synonym for resistance and can also manifest in less intuitive ways, such as through acceptance. Women's internalization of their lesser social status challenges assumptions about

the power-choice-agency equation and demonstrates the need to contextualise these notions.

Although this study does not measure women's empowerment per se, understanding the underlying factors that shape one's ability to make strategic life choices –defined as empowerment- is key to identify the effects of exogenous (i.e. climate change) and endogenous (i.e. migration) processes on men's and women's wellbeing. Intra-feminine power structures were explored: young daughters in-law usually occupy the most vulnerable positions in the household while mother in-laws sit at the top of the hierarchy, often safeguarding gender oppressive behaviours. Contextualised analyses of the functioning of women laden hierarchies are as important as traditional analyses of men over women dominance. Age and kinship emerge as critical identities defining power and vulnerability, including vulnerability to the impacts of climate and environmental change (i.e. natural resources degradation, preparedness to cope with climate hazards).

Patriarchy manifests, and is reinforced, in multiple ways. It was however observed that under contexts of strict subordination women's agency may manifest through less conventional forms - for example by complying to patriarchal norms to protect family harmony and caste honour. Intersections between caste and gender points to interweaved patterns of oppression but also showing how caste ideologies may prevail over patriarchal structures, as in the case of upper caste women who break patriarchal norms when confronting with scheduled caste men.

Remittances and sustainability are closely linked. Remittances can have direct and indirect (positive and negative) effects on the environment. Remitted money can be invested in physical and human capital, both investments can improve wellbeing and opportunities but also change consumption patterns into less sustainable pathways. Remittances can be used as a risk diversification strategy and enhance resilience or create dependency patterns and concentrate the risk if other previous activities are abandoned, which can also increase vulnerability in the long run Adger et al. (2002) point out the effects of remittances on social structures. By increasing economic inequality remittances could indirectly affect social resilience and further marginalise the most vulnerable in the communities. When social resilience is eroded, cohesion in natural resource management is also reduced and there is a higher risk of environmental degradation.[11] Similar patterns could occur within the household where, for example, women are threatened with the warning that they could not receive remittances if they "do not fulfil their duties or do what they are told" (women focus group). There are therefore effects that demand further investigation. In the study area, remittance expenditure is prevalently orientated towards food, health, education and infrastructure (concrete house). Deep impacts on social inequality have not been observed apart from the most visible difference in housing. Concrete houses are often a distinctive sign of the presence of household migration and they appear in stark contrast with mud houses. In cyclone and flood prone areas living in concrete houses reduce damages and losses. In addition, mud houses require daily maintenance of the walls which is made by women implying more unpaid work. Capital and asset accumulation is overall uncommon due to a prevalence of precarious and low paid jobs that the migrants and high cost of living in urban areas of destination. Migration has inevitable effects on agroecology. Some studies high- light its gendered impacts, especially when women take up agricultural activities and decision-making over agricultural investments in the absence of men (Dev, 2012; IWD, 2015; Zimmerer et al., 2015; Khyade and Khyade, 2016; Choudhury et al., 2017). However, this study findings do not show evidence of this. As migration progressively becomes the only livelihood, the land is given for sharecropping. Because sharecropping is a form of tenancy cultivation, where the tenant enjoys the right to cultivate the land but is excluded from institutional entitlements (including access to institutional credits or insurance), it is also usually characterised by low capital investment, lower use of technology and low crop diversification (Kumar, 2005). In the long-run, rural-urban migration could also lead to loss of knowledge of indigenous practices that are 'traditionally' sustainable. Moving from self-sufficiency to purchased staple food present sustainability challenges on a larger scale related to transport and production.

[11] Due to this, in Orissa poor rural women are majorly affected. Involvement of poor rural women in the Watershed development and forest regeneration schemes may get good control on common property resources or sustainable development in broader sense Agarwal (1994, 1997). Thus the projects run with women participation are more operational than without involving them (Agarwal, 2010). Behera (2011) has examined the women's role in forest management and their participation in decision making process in Orissa, finding that men have the dominant role in decision making in relation with resource management at the local and state levels.

## 8. Conclusion

With this comprehensive and up-to-date analysis of the gender dimensions of migration, environment and care in the Mahanadi delta in India, we have tried to combine different qualitative and quantitative methods to highlight key nexuses among these concepts. Based on insights from the fieldwork complemented with an exploration of the past censuses, with a focus on the Mahanadi delta and in particular on the Kendrapara district, we try to highlight situations, dynamics and effects for individual and group development that are affected by those processes. Despite the vast research on gender and migration, the gender dimension of environmental migration and its impacts on sustainability, as addressed here, was still quite underexplored. This study has also taken an intersectionality approach to provide an analysis of migration, gender and sustainability that cuts across the spectrum of multiple identities to highlight differences between women of different age, caste, marital status and position in the household.

The linkages between sustainability, migration and gender are far from being clear cut and easy to detect. These processes continuously intersect and shape each other in dynamic and often unpredictable ways. We started with the premise that there are connections between migration, environmental change and sustainability and that the implications are gendered. We have found the intersection of migration and care to vary significantly depending on the age and household's position of the women left behind. We also delved into this complexity by paying particular attention to gender differences in unpaid and care work – a division where gender inequality is often rooted and reinforced. By ignoring and undervaluing unpaid and care work, the dominant development model risk to be ecologically and socially unsustainable in the long-run and to flake apart the pillars of labour force - for instance, by eroding values of care and leading to a crisis of social reproduction. The same market-led models can also cause and aggravate environmental problems which are felt in gendered ways and further exacerbate inequality (Leach et al., 2018). Migration enters this discourse for at least two reasons. First, it is a process that profoundly shapes socio-economic systems, producing changes that feed back into sustainability and (particularly gender) inequality. Second, climate and environmental change is already influencing migration patterns worldwide.

Disentangling the multiple interactions of the complex socio-ecological, socio-cultural and economic processes that underpin the migration-environment-gender nexus pose methodological challenges. This study used gender as analytical category to explore inequality that is a core issue of both migration and environmental change discourses. As it emerges from the discussion, the implications vary greatly among women showing that binary interpretations would veil intersectional axes of inequality. Quantitative measurements alone can be insufficient in capturing these many facades. Combined quantitative and qualitative methods are needed to detect and act on the mechanisms that create privilege and disadvantage on the first place.

Analysing gender through multiple lenses allows in fact to grasp the full spectrum of inequalities and power dynamics beyond men versus

women dichotomies. By delving into the roots of these mechanisms is possible to better examine how internal and external processes can remodel gender relationships and power dynamics.

All in all, this study points to the need of comprehensive frameworks that bring together environment, gender and migration issues. Enhancing the empirical understanding of how these processes unfold and interact is crucial to identify setbacks, opportunities and constraints to gender equality and sustainability – being this social, economic or environmental. Equality is not only a matter of social justice, but it is also pivotal for ensuring long-term sustainability and resilience. In times of escalating and increasingly interweaved environmental and social challenges, unpacking the complexity and favouring integration of disciplines rather than segregation is more critical than ever. A comprehensive understanding of how these phenomena interact can foster gender-sensitive approaches and promote inclusive policy dialogue and coordination between the areas of migration, environment and sustainability.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgements

The authors would like to thank the anonymous reviewers for their comments and suggestions, which have helped to improve the article; any remaining errors are the author's own responsibility. This work was carried out under the DEltas, vulnerability and Climate Change: Migration and Adaptation (DECCMA) project which is part of Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA), with financial support from the UK Government's Department for International Development (DfID) and the International Development Research Centre (IDRC), Canada. The views expressed in this work are those of the creators and do not necessarily represent those of DfID and IDRC or its Board of Governors. Ignacio Cazcarro also thanks the Spanish Government under projects PID2019-106822RBI00 and RTI2018-099858-A-I00.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.crsust.2021.100104.

## References

Adger, W.N., 2003. Social Capital, Collective Action, and Adaptation to Climate Change. Econ. Geogr. 79, 387–404.
Adger, N., Vincent, K., 2005. Uncertainty in adaptive capacity. Compt. Rendus Geosci. 337 (4), 399–410.
Adger, N., Kelly, P., Winkels, A., Huy, L.Q., Locke, C., 2002. Migration, remittances, livelihood trajectories and social resilience. Ambio 31, 358–366.
Afifi, T., Warner, K., 2008. The Impact of Environmental Degradation on Migration Flows across Countries. Working Paper No.5/2008. UNU-EHS Working Paper Series. United Nations University, Bonn.
Agarwal, B., 1988. Structures of Patriarchy: State, Community, and Household in Modernising Asia. Kali for Women, New Delhi.
Agarwal, B., 1992. The gender and environment debate: lessons from India. Fem. Stud. 18, 119–158.
Agarwal, B., 1994. A Field of One's Own: Gender and Land Rights in South Asia. Cambridge University Press, Cambridge.
Agarwal, B., 1997. Gender, environment and poverty interlinks: regional variations and temporal shifts in Rural India: 1971-1991. World Dev. 25 (1), 23–52.
Agarwal, B., 2010. Gender and Green Governance: the Political Economy of Women's Presence within and beyond Community Forestry. Oxford University Press.
Agrawal, A., 2005. Environmentality: community intimate government and environmental subjects in Kumaon, India. Curr. Anthropol. 46 (2). April 2005.
Agrawal, A., Ostrom, E., 2001. Collective action, property rights, and decentralization in resource use in India and Nepal. Polit. Soc. 29, 485–514.
Agrawal, A., Sivaramakrishnan, K., 2000. Agrarian Environments: Resources, Representation, and Rule in India. Duke University Press - Business & Economics.
Ahmed-Ghosh, H., 2004. Chattels of society: domestic violence in India. Violence Against Women 10, 94–118.
Antonopoulos, R., 2009. The unpaid care work - paid work connection. Working Paper No. 86.
Arjan, De H., Dubey, A., 2006. Are migrants worse off or better off? Marg. J. Appl. Econ. Res. 38, 9–25.
Badgett, M.V.L., Folbre, N., 1999. Assigning care: gender norms and economic outcomes. Int. Lab. Rev. 3, 81–103.
Barnett, J., Weber, M., 2010. Accommodating Migration to Promote Adaptation to Climate Change. Policy Research Working Paper, Background Paper to the World Development Report.
Bastia, T., 2009. Women's migration and the crisis of care: grandmothers caring for grandchildren in urban Bolivia. Gend. Dev. 17, 389–401.
Behera, M., 2011. Gender issues in joint forest management: the Orissa scenario. J. Econ. Social Dev. VII (2).
Beneria, L., 1979. Reproduction, production and the sexual division of labour. Camb. J. Econ. 3, 203–225.
Beneria, L., 2001. The enduring debate over unpaid labour'. In: Loutfi (Eds.), *What is Equality and How Do We Get There? Women, Gender and Work*. International Labour Office, Geneva.
Beneria, L., Sen, G., 1981. Accumulation, reproduction and woman's role in economic development: bosreup revisited. Signs 279–298.
Beneria, L., Deere, C.D., Kabeer, N., 2012. Gender and international migration: globalization, development and governance. Fem. Econ. 18, 1–33.
Benería, L., Günseli, B., Floro, M., 2015. Gender, Development and Globalization: Economics as If All People Mattered. Routledge.
Benerjee, S., Kniveton, D., Black, R., Bisht, S., Das, P.J., Mahapatra, B., Tuladhar, S., 2017. Do Financial Remittances Build Household Level Adaptive Capacity. A Case Study of Flood Affected Household in India. KNOMAD Working Paper 18, 2017.
Bettio, F., Simonazzi, A., Villa, P., 2006. Change in care regimes and female migration: 'care drain' in the Mediterranean. J. Eur. Soc. Policy 16, 271–285.
Beura, D., 2015. Floods in Mahanadi River, Odisha, India: Its Causes and Management. Int. J. Eng. Appl. Sci. 2, 51–55.
Bhattacharya, R., 2001. Environmental Economics: An Indian Perspective. Oxford University Press, USA, 308 p.
Bhawan, B., 2014. Status of Ground Water Quality in Coastal Aquifers of India. Government of India. Ministry of Water Resources. Central Ground Water Board, Faridabad, Haryana.
Biao, X., 2007. How far are the left-behind left behind? A preliminary study in rural China. Popul. Space Place 13, 179–191.
Black, R., Adger, N.W., Nigel, W.A., Dercon, S., Geddes, A., Thomas, D., 2011. The effect of environmental change on human migration. Glob. Environ. Chang. 21, 3–11.
Bowden, P., 1997. Caring: Gender-Sensitive Ethics. Routledge, New York.
Bradshaw, Sarah, 2004. Socio-economic impacts of natural disasters: a gender analysis, vol. 32. United Nations Publications.
BRIDGE, 2008. Gender and climate change: mapping the linkages. A scoping study on knowledge and gaps. http://www.bridge.ids.ac.uk/reports/Climate_Change_DFID.pdf.
Centre for Migration and Labour Solutions, 2014. Studies, Stories and a Canvas: Seasonal Labor Migration and Migrant Workers from Odisha, Centre for Migration and Labor Solutions (CMLS). Bureau, Aajeevika.
Chafetz, J., 1990. Gender Equity: An Integrated Theory of Stability and Change, Vol. 176. Sage Publications, 1990.
Chafetz, J., 1991. The gender division of labor and the reproduction of female disadvantage: Toward and integrated theory. In: Blumberg, et al. (Eds.), Gender, Family and Economy: The Triple Overlap. Sage, Newbury Park, CA.
Chand, P., Acharya, P., 2010. Shoreline change and sea level rise along coast of Bhitarkanika wildlife sanctuary, Orissa: an analytical approach of remote sensing and statistical techniques. Int. J. Geomat. Geosci. 1, 436–455.
Choudhury, P.R., Sahoo, B., Sandbhor, J., Paranjape, S., Shruti Vispute, K.J., 2012. Water Conflicts in Odisha: A Compendium of Case Studies. Forum for Policy Dialogue on Water Conflicts in India, Pune.
Choudhury, P.R., Behera, M.K., Sharma, S., Haque, T., 2017. Combining Administrative and Open Source Data for Monitoring Land Governance: Mapping Women Land Rights in the Context of UN's SDG in India. 2017 World Bank conference on land and poverty, 20-24. The World Bank - Washington DC, March, p. 2017.
Code, L., 1991. What Can She Know? Feminist Theory and Construction of Knowledge. Cornell University Press, Ithaca.
Costanza, R., Daly, H.E., 1992. Natural capital and sustainable development. Conserv. Biol. 6, 37–46.
Cuomo, C.J., 1998. Feminism and Ecological Communities: An Ethic of Flourishing. Routledge, London.
Dankelman, Irene, 2002. Climate change: Learning from gender analysis and women's experiences of organising for sustainable development. Gend. Dev. 10 (2), 21–29.
Das, S., Hazra, S., Ghosh, T., Hazra, S., Ghosh, A., 2016. Migration as an Adaptation to Climate Change. Poster presented at Adaptation Futures 2016.
de Haas, H., 2012. The migration and development pendulum: a critical review on research and policy. Int. Migr. 50, 8–25.
Deaton, A., Drèze, J., 2002. Poverty and Inequality in India: A Re-Examination. Econ. Polit. Wkly. 37, 3729–3748.
Deere, C., Alvarado, G., 2016. Asset Accumulation Through International Migration. Gender, Remittances and Decision-Making in Ecuador. Lat. Am. Res. Rev. 51, 4.
Dev, S.M., 2012. Small Farmers in India: Challenges and Opportunities. Indira Gandhi Institute of Development Research, WP-2012-014, Mumbai. June 2012.
Drèze, J., Sen, A., 1999. India: Economic Development and Social Opportunity. Oxford University Press, OUP Catalogue.

Drèze, J., Sen, A., 2013. An Uncertain Glory India and its Contradictions. Princeton University Press.
Dublin, D.R., Natori, Y., 2020. Community-based project assessment using the indicators of resilience in SEPLS: lessons from the GEF-Satoyama Project. Current Res. Environ. Sustain. 2, 100016.
Ferrant, G., Pesando, L.M., Nowacka, K., 2014. The missing link in the analysis of gender gaps in labour outcomes OECD Development Centre (December 2014).
Folbre, N., 2001. The Invisible Heart: Economics and Family Values. New Press, New York, 267 pp.
Folbre, N., 2006. Measuring Care: Gender, Empowerment and the Care Economy Measuring Care. J. Hum. Dev. 7 (2), 183–199. https://doi.org/10.1080/14649880600768512.
Foresight, 2011. Migration and Global Environmental Change: Future Challenges and Opportunities. Foresight Report, London.
Gammage, Sarah, 2010. Time pressed and time poor: unpaid household work in Guatemala. Fem. Econ. 16 (3), 79–112.
Gartaula, N., Visser, L., Niehof, A., 2012. Socio-cultural dispositions and wellbeing of the women left behind: a case of migrant households in Nepal. Soc. Indic. Res. 108, 401–420. https://doi.org/10.1007/s11205-011-9883-9.
Gioli, G., Khan, T., Bisht, S., Scheffran, J., 2014. Migration as an adaptation strategy and its gendered implications: a case study from the Upper Indus Basin, Mount. *Res. Develop*. 34, 255–265.
GoI, 2001. Time Use Survey (TUS), Conducted by the Central Statistical Organisation. Women and Men in India 2001. Ministry of Statistics and Programme. Implementation, Government of India.
GoI, 2011. Several statistics on Women Employment in Organised Sector in Odisha. Women and Men in India, Ministry of Labour and Employment, Ministry of Statistics and Programme, Govt. of India. (ON220).
GoI, 2012. Primary Census Abstract (PCA), Office of the Registrar General and Census Commissioner, etc. In: Census of India of 2011. India, Government of.
GoI, 2021a. Time Use Survey (TUS), January 2019–December 2019. Data Quality Assurance Division, National Statistical Office, 164, Gopal Lal Thakur Road, Kolkata-108, Government of India (GoI). http://mospi.nic.in/time-use-survey-0.
GoI, 2021b. Data on migration 2011. Office of the Registrar General & Census Commissioner, India. Ministry of Home Affairs, Government of India. htstps://censusindia.gov.in/2011census/migration.html.
GoO, 2015. Activity report of agriculture and farmers' empowerment department during 2015-16 and programmes for 2016-17.
GoO, 2016. Odisha Economic Survey(s), 2011-12, 2013-14, 2014-15. Planning & Coordination Department, Bhubaneswar, Printed at Odisha Government Press. Odisha, Government of Odisha, Cuttack.
Hagen-Zanker, J., Mallett, R., Ghimire, A., Shah, Q.A., Upreti, B., 2014. Migration from the Margins: Mobility, Vulnerability and Inevitability in Mid-Western Nepal and North-Western. Pakistan, Overseas Development Institute.
Hans, A., Patel, A., Mohanty, B., Tripathy, S., 2020. Women Reinventing Development: The Odisha Experiment. Routledge, 334 p. ISBN : 9789350026717.
Hirway, I., 2015. Unpaid work and the economy: linkages and their implications. Indian J. Labour Econ. 58, 1–21.
Howarth, R., 2012. Sustainability, well-being, and economic growth. Minding Nature 5 (2).
IMD, 2020. End of Season Monsoon Report. 2020 SouthESSO. MoES,India Meteorological Department (IMD). https://mausam.imd.gov.in/imd_latest/contents/season_report.php.
IOM, 2007. Discussion Note: Migration and the Environment. Ninety-Fourth Session. MC/INF/288. International Organization for Migration (IOM).
IOM, 2021. International Organization for Migration (IOM) Environmental Migration Portal. Knowledge Platform on People on the Move in a Changing Climate, United Nations (UN).
IPCC, 2014. Climate Change 2014 Fifh Assesment Report. Intergovernmental Panel on Climate Change (IPCC).
Islam, S.N., 2015. Inequality and Environmental Sustainability. DESA Working Paper No. 145 ST/ESA/2015/DWP/145. Department of Economic & Social Affairs of the United Nations, New York, USA.
IWD, 2015. Empowering women farmers to achieve food security and gender equality: an initiative from agriculture to owner laborer, Gajapati district. Institute for Women's development. (IWD), Odisha, India.
Jain, I., Rao, A.D., Jitendra, V., Dube, S.K., 2010. Computation of expected total water levels along the East Coast of India. J. Coast. Res. 26, 681–687.
Jones, L., Boyd, E., 2011. Exploring social barriers to adaptation: Insights from Western Nepal. Glob. Environ. Chang. 21, 1262–1274. https://doi.org/10.1016/j.gloenvcha.2011.06.002.
Kabeer, N., 1999. Resources, agency, achievements: reflections on the measurement of women's empowerment. Dev. Chang. 30, 435–464.
Khyade, V.B., Khyade, S.V., 2016. Indian Women in Agriculture. Int. Acad. J. Econ. 3 (12), 1–8.
Kumar, R., 2005. Constraints Facing Indian Agriculture: Need for Policy Intervention. Indian J. Agr. Econ 60. Jun-March 2005.
Kundu, A., Sarangi, N., 2007. Migration, employment status and poverty: an analysis across urban centres. Econ. Polit. Wkly. 42 (4), 299–306.
Laslett, B., Brenner, J., 1989. Gender and social reproduction: historical perspectives. Annu. Rev. Sociol. 15, 381–404.
Leach, M, Mearns, R., Scoones, I., 1999. Environmental Entitlements: Dynamics and Institutions in Community-Based Natural Resource Management. World Dev. 27, 225–247. https://doi.org/10.1016/S0305-750X(98)00141-7.
Leach, M., Reyers, B., Bai, X., Brondizio, E.S., Cook, C., Díaz, S., Espindola, G., et al., 2018. Equity and Sustainability in the Anthropocene: A Social-Ecological Systems Perspective on Their Intertwined Futures. Global Sustainability e13, 1–13.
Luxton, K., Benzason, M., 2006. Social Reproduction: Feminist Political Economy Challenges Neo-Liberalism. McGill-Queen's University Press, Canada: Montreal.
McGregor, S., 2004. From care to citizenship: calling ecofeminism back to policy. Ethics Environ. 9, 56–84.
Mckenzie, S., Menjívar, C., 2011. The meanings of migration, remittances and gifts: views of Honduran women who stay. Global Networks 1, 63–81.
Merchant, C., 1996. Earth Care: Women and then Environment. Routledge, New York.
Mies, M., Shiva, Y., 1993. Ecofeminism. Zed Press, London.
Mishra, Sweta, 2010. Green warriors: conserving local biodiversity through community conservation initiatives in Orissa, India. Policy Matters 17, 143–172.
Mishra, D., Nayak, P.L., 2014. A study of water pollution in two major rivers in Odisha-Mahandi and Brahamani. Middle-East J. Sci. Res. 22, 1760–1770.
Mishra, D., Sahu, N.C., 2014. Response to farmers to climate change in Odisha: an Empirical Investigation. Int. J. Environ. Sci. 5, 786–900.
Mohapatra, K.K., 2012. Women workers in informal sector in India: understanding the occupational vulnerability. Int. J. Humanit. Soc. Sci. 21, 197–207.
Nayak, S., 2015. Industrial development vs resistance: a study of POSCO project in Odisha. Int. Lett. Social Humanistic Sci. 50, 55–67.
Nelson, J., England, P., 2002. Feminist philosophies of love and work. Hypatia 2, 1–18.
Neumayer, E., Plumpert, T., 2007. The gendered disasters: events on the gender of catastrophic gap in impact life expectancy, 1981-2002. Ann. Assoc. Am. Geogr. 97 (3), 551–566.
NSS, 2020. NSS Report: Time use in India-2019 (January–December 2019). Ministry of Statistics & Programme Implementation, National Service Scheme (NSS).
O'Brien, K., Leichenko, R., Kelkar, U., Venema, H., Aandahl, G., Tompkins, H., Javed, A., Bhadwal, S., Barg, S., Nygaard, L., West, J., O'Brien, K., Leichenko, R., Kelkar, U., Venema, H., Aandahl, G., Tompkins, H., Javed, A., Bhadwal, S., Barg, S., Nygaard, L., West, J., 2004. Mapping vulnerability to multiple stressors: climate change and globalization in India. Glob. Environ. Chang. 14, 303–313. https://doi.org/10.1016/j.gloenvcha.2004.01.001.
Oliver-Smith, A., 2009. Sea Level Rise and the Vulnerability of Coastal Peoples: Responding to the Local Challenges of Global Change in the 21st Century. *Interdisciplinary Security Connections* UNU-EHS.
PAHO, 2010. The Invisible Economy and Gender Inequalities. The Importance of Measuring and Valuing Unpaid Work. Pan American Health Organization, Washington, D.C.
Parreñas, R.S., 2000. Migrant Filipina domestic workers and the international division of reproductive labour. Gend. Soc. 14, 560–580.
Patnaik, U., Das, P.K., 2017. Do development interventions confer adaptive capacity? Insights from rural India. World Dev. 97, 298–312.
PCA-Odisha, 2001. Primary Census Abstract. In: Census of India. Census of West Bengal. Census of Odisha. Directorate of Census Operations, Government of India, New Delhi.
PCA-Odisha, 2011. Primary Census Abstract. In: Census of India. Census of West Bengal Census of Odisha. Directorate of Census Operations, Government of India, New Delhi.
Periodic Labour Force Survey (PLFS), 2021. Data from July 2018-June 2019. Data Processing Division, National Sample Survey Office, 164, Gopal Lal Thakur Road, Kolkata-108, Government of India. http://mospi.nic.in/unit-level-data-periodic-labour-force-survey-plfs-july-2018-june-2019.
Rao, N., 2006. Land rights, gender equality and household food security: Exploring the conceptual links in the case of India. Food Policy 31 (2), 180–193.
Rao, N., Mitra, A., 2013. Migration, representations and social relations: experiences of Jharkhand Labour to Western Uttar Pradesh. J. Dev. Stud. 49, 846–860.
Rocheleau, D., Poats, S.V., 1988. Gender, resource management and the rural landscape: implications for agroforestry and farming systems research. In: Schmink, M., Spring, A. (Eds.), Gender Issues in Farming Systems Research and Extension. Westview Press, Boulder.
Roy, B.C., Mruthyunjaya, Selvarajan, 2002. Vulnerability to climate induced natural disasters with special emphasis on coping strategies of the rural poor in Coastal Orissa, India. In: UNFCC COP8 Conference Organized by the Government of India. Programmes, United Nations Environmental.
Roy, B.C., Selvarajan, S., Mohanty, C., 2004. Vulnerability and Adaptation to Climate Change in Orissa, A Livelihood Analysis, NCAP working paper n° 6. Center for Agricultural Economics and Policy Research. New Delhi, India.
Salgado de Snyder, V.N., 1993. Family life across the border: Mexican wives left behind. Hisp. J. Behav. Sci. 15 (3), 391–401.
Salleh, A., 1997. Ecofeminism as Politics: Nature, Marx and Postmodern. Zed Books, London.
Sangari, K., 2008. Gendered violence, national boundaries and culture. In: Coomaraswamy, R., Perera-Rajasingham, N. (Eds.), Constellations of Violence: Feminist Interventions in South Asia. Women Unlimited, New Delhi, India, pp. 1–33.
Sen, A., 1993. Capability and human well-being Sen A. Capability and well-being. In: Nussbaum, Sen (Ed.), The Quality of Life. Clarendon Press, Oxford.
Sen, A., 1999. Development as Freedom. Oxford University Press, Oxford.
Syvitski, J.P.M., Kettner, A.J., Overeem, I., Hutton, E.W.H., Hannon, M.T., Brakenridge, G.R., Day, J., Vorosmarty, C., Saito, Y., Giosan, L., Nicholls, R.J., 2009. Sinking deltas due to human activities. Nat. Geosci. 2 (October 2009).
Tacoli, C., 2009. Crisis or adaptation? Migration and climate change in a context of high mobility. Environ. Urban. 21, 513–525.
Tompkins, E.L., Vincent, K., Suckall, N., Rahman, R., Ghosh, T., Mensah, A., Anderson, K., Chapman, A., Prati, G., Hutton, C.W., Day, S., Price, V., 2020. Adapting to change: people and policies. In: Nicholls, R.J., Adger, W.N., Hutton, C.

W., Hanson, S.E. (Eds.), Deltas in the Anthropocene (pp. 201–222). Springer International Publishing. https://doi.org/10.1007/978-3-030-23517-8_9.
UNGA, 2005. 2005 World Summit Outcome, Resolution A/60/1, adopted by the General Assembly on 15 September 2005. United Nations General Assembly.
Vincent, K., 2007. Uncertainty in adaptive capacity and the importance of scale. Glob. Environ. Chang. 17, 12–24.
Vörösmarty, C.J., Syvitski, J., John, D.A.Y., De Sherbinin, A., Giosan, L., Paola, C., 2009. Battling to save the world's river deltas. Bull. At. Sci. 65, 31–43.
Warren, K., 1987. Feminism and ecology: making connections. Environ. Ethics 9, 3–20.
WESS, 2013. World Economic and Social Survey 2013. Sustainable Development Challenges. E/2013/50/Rev. 1 ST/ESA/344. Department of Economic and Social Affairs of the United Nations, New York, USA.
Zimmerer, K., Carney, J., Vanek, S., 2015. Sustainable smallholder intensification in global change? Pivotal spatial interactions, gendered livelihoods and agrobiodiversity. Curr. Opin. Environ. Sustain. 14, 49–60.

## Further-reading

Singh, R., Patel, S.K., Tiwari, A.K., Singh, G.S., 2021. Assessment of flood recession farming for livelihood provision, food security and environmental sustainability in the Ganga River Basin. Current Res. Environ. Sustain. 3, 100038.