Food Policy 102 (2021) 102117

Contents lists available at ScienceDirect

Food Policy

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

Labor force participation of rural women and the household's nutrition: Panel data evidence from SAT India

Nikita Sangwan [a], Shalander Kumar [b,*]

[a] Indian Statistical Institute, New Delhi 110016, Delhi, India
[b] International Crops Research Institute for the Semi-Arid Tropics, Patancheru 502 324, Hyderabad, India

ARTICLE INFO

JEL Classification:
D1
D13
J16
J21

Keywords:
Labor
Bargaining
Dietary diversity
Home-production
Gender

ABSTRACT

This paper investigates the role of women's labor force participation in the household's dietary diversity and the value of home-production. Using unique household panel data from Semi-Arid tropics of India, empirical estimations from a household fixed effects model reveal a positive significant effect of workdays of women on dietary diversity (overall and home-produced) and home-production. Our findings highlight a significant heterogeneity in the effect by type of work—paid and unpaid. The results for paid work are driven by a greater decision-making power emanating from labor force participation of women. Unpaid work, on the other hand, operates through the self-consumption of home-produced goods. We show that correcting for endogenous labor force participation of women leaves our conclusions unchanged. The results suggest that interventions boosting female labor force participation in paid activities are nutrition enhancing for the household and work towards improving women's bargaining power within the household. Moreover, we rule out deleterious effects on health indicators of women despite increased time burden.

1. Introduction

Gender inequality in economic opportunities is considered a major bottleneck in the development process, especially in the context of developing countries. In effect, several global efforts are working towards boosting employment opportunities for women.[1] A greater participation of women in the labor market is expected to relax the budget constraint of the household and empower women by boosting their economic independence. However, this exposes them to more severe time trade-offs (Komatsu et al., 2018; Lele, 1986). Concerns regarding a negative implication of the same on the households' welfare have been raised (Johnston et al., 2018) as the decrease in time devoted to home-production by women is not substituted by an increase in time spent by their male counterparts (Liu, 2007). Therefore, the implications of policies that aim to enhance female labor force participation need critical evaluation.

In this paper, we use novel household-level panel data of rural households from the Semi-Arid Tropics (SAT) of India to analyse the effect of labor force participation of women on the household.[2] Firstly, we examine the impact of female workdays on the household's dietary diversity. It is defined as the number of food groups consumed by a household in a given season in a year. This measure serves as a good proxy for household-level food security (Taruvinga et al., 2013; Ruel, 2003). However, a household may either purchase these food items from the market or produce them for self-consumption. The detailed consumption data provides information on the source of the food items - home-produced and purchased. This allows us to separately examine the effect of female workdays on the overall dietary diversity and home-produced dietary diversity. Second, we look at the effect of female workdays on the value of home-production. Home-production is defined as the real value of consumption goods, food and non-food, that a household produces for self-consumption in a given season in a year. This allows us to develop a better understanding of the overall effect of the time trade-offs faced by women on the household's consumption. Our results indicate a significant positive effect of female labor force participation on both dietary diversity and home-production. Furthermore, we are interested in investigating the heterogeneity in these results by type of work—paid and unpaid. Here, paid work refers to remunerative activities performed in the farm and non-farm sector for wages (either in cash or kind) while unpaid work refers to activities

* Corresponding author.
E-mail addresses: nikita18r@isid.ac.in (N. Sangwan), k.shalander@cgiar.org (S. Kumar).

[1] The Women Work Report of UNDP (Menon et al., 2019), the OECD-ILO-IMF-WBG Report (OECD, 2014) and the World Development Report (Razavi, 2012).
[2] The SAT regions are characterised by highly variable, low-to-medium rainfall and lack of irrigation facilities.

https://doi.org/10.1016/j.foodpol.2021.102117
Received 14 September 2020; Received in revised form 24 May 2021; Accepted 30 May 2021

carried out on the family farm and family livestock care.

The existing literature has identified three main channels through which female labor force participation can influence dietary diversity and home-production - (1) Income effect, (2) Substitution effect and (3) Empowerment/Bargaining power effect. Engagement in the labor market generates a positive income effect as the earned wages relax the budget constraint of the household. The increased liquidity, as a result, allows for the purchase of a more diversified food basket. Maity (2020) finds that increased workdays through public works program translate into higher food expenditure and improved food security. It can also complement agricultural production via increased investment in inputs (Mondal et al., 2021). But the involvement in the labor market may increase the time burden of women. In rural households, women allocate time between paid work (in farm and non-farm activities), unpaid work (on the family farm and family livestock care) and domestic work. Their active involvement in the family farm and livestock rearing is well documented in the literature (Dutta, 2016). Increased participation in paid work generates income for the household but may take away time from unpaid activities that generate goods for self-consumption (Grosch et al., 2006). Moreover, an engagement in paid or unpaid activities may lead to substitution of time from domestic chores. For instance, the study by Mancino (2011) using American Time Use Survey shows that working full-time reduces the time allocated to food preparation by women. Consequently, this paucity of time may have adverse effects on the diversity of food consumed by the household (Komatsu et al., 2018). Therefore, the substitution effect exerts a negative impact on dietary diversity. The final channel of empowerment emanates from the economic independence that comes from the labor force participation of women. This may translate into a greater bargaining power in resource allocation decisions within the household. Studies find that women direct a higher share of resources towards richer nutrients (Pangaribowo et al., 2019). Thus, a greater say of women in the decision-making process will improve the dietary diversity of the household. Kassie et al. (2020) find evidence in support of this positive effect of empowerment on women's dietary diversity in rural Kenya. However, the net impact will depend on which of the three channels dominate.

In addition, the intensity with which these channels operate may depend on the type of employment. The income channel is more likely to dominate in paid work where wages are paid in cash. D'Souza et al. (2020) finds a significant positive impact of non-farm income on dietary quality. The time substitution, on the other hand, is likely to be less binding for unpaid work as women can combine or supervise domestic chores alongside, given both of these activities are majorly carried out within the household premises. This option may not be available for paid work which at times require mobility and entail non-flexible working hours making the trade-off with domestic work more stringent. As expected, we find that an increase in paid workdays is associated with a fall in domestic days while the unpaid days exhibit a significant positive relationship with the domestic days. Empowerment would be more pronounced in paid work carried outside the home or independent from the influence of men (Anderson and Eswaran, 2009). Likewise, Padmaja et al. (2019) show that exposure to information on dietary practices and awareness of eating patterns can play an important role in nutrition enhancement. We, therefore, test for the presence of heterogeneity in our results by type of work—paid and unpaid. The results show that the impact of paid workdays on the overall dietary diversity of the household is more pronounced relative to unpaid workdays. Once we control for the income effect, the impact of paid workdays is significantly larger than unpaid workdays. The estimates for home-produced dietary diversity and home-production indicate a significant heterogeneity by type of work. On expected lines, both of these are increasing significantly more with unpaid work compared to paid work. Paid workdays, on the other hand, display no significant effect over and above the income effect. The presence of this heterogeneity indicates the sensitivity of the results from previous studies to the employment structure and the definition of female employment deployed by them. Our results in consonance with the findings in Komatsu et al. (2018) emphasise the importance of localised context when looking at the responses of nutrition to agricultural interventions.

Finally, in order to understand the underlying mechanisms, we explore the empowerment channel as a possible explanation for the observed results. We find that an increased participation of women in paid work significantly increases the say of women in household decision making. Moreover, in line with Hoddinott and Haddad (1995), we find that the increased bargaining power is also reflected in changes in household expenditure. We observe an increase in the per-capita food expenditure with an increment in the paid and unpaid workdays. This indicates that households in which women do not work have lower per-capita food expenditure. It highlights that enhanced decision-making power of women within the household can be an important driver of improved dietary diversity. Empowered women also have better control over the health choices they make for themselves as well as their children (Holland and Rammohan, 2019; Bloom et al., 2001). We find evidence of a significant improvement in the health indicator of women despite the possibility of deleterious effect from increased time-burden. Thus, empowerment emanating from labor force participation enhances the nutritional intake of the household (Gupta et al., 2019; Santoso et al., 2019) and bolsters food security (Sraboni et al., 2014).

Our work contributes to the literature on multiple fronts. First, it adds to our understanding of how the household's dietary diversity and home-production are affected by female workdays. In contrast to a large number of studies on women's labor force participation and dietary diversity, to the best of our knowledge, the diversity of home-produced food and the value of home-production has not been addressed in literature. This speaks to the agricultural household production literature on the self-consumption of food items produced on the family farm. Second, and importantly, we extend the literature by incorporating heterogeneity by paid and unpaid workdays. The existing literature has largely focused on paid work in isolation due to the paucity of data on unpaid work. Our detailed data allows an investigation of this heterogeneity which is pertinent from a policy perspective. Third, in contrast to existing studies that are restricted to cross-sectional analysis or aggregated geographical areas like State or District, we analyse the changes at the household level. We utilise a household fixed effects estimation strategy that accounts for household-level unobserved heterogeneity. We have year and season fixed effects to allay any concerns of seasonality in consumption and employment. The yearly village trends allow for general trends across villages. Hence, our identification is coming from within-household variation in labor force participation of women, over and above the observed household characteristics and any unobserved shocks that vary by household, season, year or village-specific trends. Finally, we add to the literature on women's agency emanating from labor force participation and their well-being.[3]

From a policy perspective, our findings underscore the nutrition benefits of policies that aim at increasing female employment which is beyond the immediately intended impact.[4] In the Indian context, they emphasise the nutritional gains accruing from public employment programmes targeted at rural areas with special provisions for women such as Mahatma Gandhi National Rural Employment Guarantee Act

[3] Chang et al. (2020) provides a scoping review of women's agency drawing lessons from experimental and quasi-experimental studies.

[4] As pointed out by Verger et al. (2017), household dietary diversity serves as a proxy indicator of household economic access to food and it is individual dietary diversity scores that reflect dietary quality. However, we do not have individual consumption data and are thus constrained to run the analyses at the household level. Our results on dietary diversity combined with the empowerment and health indicator findings are suggestive evidence of improved nutritional intake.

(MNREGA), Swarnjayanti Gram Swarozgar Yojana and National Rural Livelihood Mission (NRLM)[5]. They also inform policies intended to improve the household's economic access to food and health outcomes of the need to mitigate challenges in rural female labor force participation.

We must mention that even with a household fixed effects model and controls for observed household characteristics and annual village trends, the endogeneity in labor force participation of women is not completely ruled out. Therefore, we substantiate our results with multiple Oster bounds (Oster, 2019) and show that our estimates are not likely to suffer from omitted variable bias. We also control for production diversity of the household to address the possibility of a link between production and dietary diversity (Jones et al., 2014). Our results remain unchanged. Furthermore, the labor force participation of both sexes can affect the nutritional intake of the household. We focus on women as they are taking up substantial roles in the farm sector with the migration of men to the non-farm sector (Mahajan, 2019). Moreover, they face acute time trade-offs in simultaneously balancing paid, unpaid and domestic chores whereas men may perform their tasks sequentially (Wodon and Blackden, 2006). Therefore, labor force participation of women, unlike men, can impact dietary diversity through channels other than the pure income effect i.e., substitution and empowerment.

The remainder of the paper is organised as follows: Section 2 describes the data and variable construction. Section 3 explains the estimation strategy. Section 4 discusses the empirical results and robustness checks. Section 5 explores the underlying mechanisms. Section 6 concludes.

2. Data

We use the household-level data of Village Dynamics Studies in South Asia (VDSA) for the period 2009–14.[6] The data covers eighteen villages from the states of Andhra Pradesh, Gujarat, Karnataka, Maharashtra and Madhya Pradesh. These villages are representative of the Semi-Arid Tropics (SAT) of India. In each village, 40 households are surveyed every month by resident field investigators and are represented equally by four categories of operational landholding—labor, small, medium and large.[7] We combine data from the transaction and employment schedules to create a household-season-year level panel. Here, year refers to the agricultural crop year of India, i.e. July-June and the months are classified into seasons as follows—(i) Kharif (July-October), (ii) Rabi (November-March), and (iii) Summer (April-June). Information on the household and individual characteristics are available in the General Endowment Schedule (GES). A household is composed of members who stay together and share food from the same kitchen, including temporary migrants.

The transaction schedule records monthly information on the item-wise quantities of food consumed by the household and expenditure on food and non-food items.[8] The recall period for each of these items is 30-days. This information on food items is generally collected from the wife/daughter/daughter-in-law who is responsible for cooking food. The quantities and expenditures are further disaggregated into the source category—(i) purchased and (ii) home-produced. For our analysis, we consider an overall category (sum of purchased and home-produced) and home-produced category. For each item type, food and non-food, the quantities and expenditures for the overall and home-produced category are summed up to the season-year level for a household. Following existing literature, we measure dietary diversity as the number of different food groups consumed by a household in a season in a year. For instance, if a household consumes food that belongs to 5 food groups in a season of a year, its dietary diversity score will be 5. This provides a better measure of diversity, relative to the quantity of food consumption, as it captures the micro as well as macronutrients. It also serves as a proxy for the food security of the household. Households in our sample consume a maximum of eleven food groups.[9] A household may either purchase these food items from the market or produce them for self-consumption. Therefore, we consider two separate measures of dietary diversity using the source of procurement—(1) Overall Dietary Diversity Score (ODDS) and (2) Home-produced Dietary Diversity Score (HDDS). The value of home-production is defined as the real money value of consumption goods, food and non-food, produced by a household for self-consumption in a given season and year.[10] We also calculate the seasonal real per-capita expenditure incurred by the household for the following categories—food, non-food, education, medical and addiction.[11] For this, we first deflate the nominal seasonal expenditure for each category with CPI-AL and then divide it by the family size.

The employment schedule records monthly information on the labor market participation of the household member. An individual in a rural household can allocate time to paid work (in farm or non-farm activities), unpaid work (on the family farm and family livestock care) or domestic work. Paid work directly generates income while unpaid work generates goods for self-consumption and in some cases for sale in the market. Domestic work includes activities like cleaning, cooking, child care etc. An individual can do multiple jobs and workdays in each of them is reported. Women in our sample perform both paid and unpaid work (42%). Almost all women do domestic work (97%). Data are reported every month on the number of days an individual spends in each of these activities and the earnings from engagement in paid activities. For our analysis, we restrict the sample to the individuals in the working-age group (aged 15–60 years). We measure the monthly paid workdays as the sum of workdays spent in paid farm and paid non-farm activities. Similarly, monthly unpaid days are the sum of self-employment workdays on the family farm and family livestock care. We then sum the monthly paid, unpaid and domestic days across months that belong to a specific season. We also generate a total workdays variable which is the sum of paid and unpaid workdays in a season and year. This gives us employment data at the individual, season and year level. We take a mean of these workdays by gender for a given season and year. This brings the employment data to the household, season and year level for female and male members. Therefore, our analysis is based on the gender category and corresponds to the case of a representative woman and man of the household.

Finally, we use the GES Schedule to construct the measure of decision making by women. This module provides annual information on the role of gender in the decision-making regarding credit, investment, sale of produce, household maintenance, education and marriage of children, and out-migration. It reports the gender of the member of the household

[5] https://nrega.nic.in; https://www.india.gov.in/swarnjayanti-gram-swarozgar-yojana; https://nrlm.gov.in.

[6] The longitudinal household data collected under the VDSA project was funded by Bill & Melinda Gates Foundation.

[7] If a household from the selected sample was not available during the survey period due to out-migration or any other reasons for a long period, then it was replaced with a new household from the village census based on the operational holdings. Operational holding is defined as own land plus leased/shared in minus leased/shared out.

[8] Food items: cereals, pulses, oils, fruits and vegetables, milk and milk products, fish, meat, chicken, the food at the hotel, spices, sugar, tea and other foodstuffs etc. Non-food items: toddy, alcohol, firewood, taxes, cosmetics, education, medical, clothing, travel, ceremonial, and entertainment etc.

[9] Cereals, coarse cereals, oils, pulses, eggs, milk, non-vegetarian (chicken and meat), seafood, sugars, fruits and vegetables and miscellaneous.

[10] We use CPI-AL with the base year 2009–10 to deflate the nominal value. Real value $= \left(\frac{\text{Nominal value}}{\text{CPI-AL}}\right) * 100$.

[11] Expenditure on education consists of the school fee, books, stationery, transport and uniform. Medical expenses include domestic medications and hospital charges (if any). Expenses incurred on alcohol, cigarettes, drugs and other addictive substances comprise the addiction expenditure.

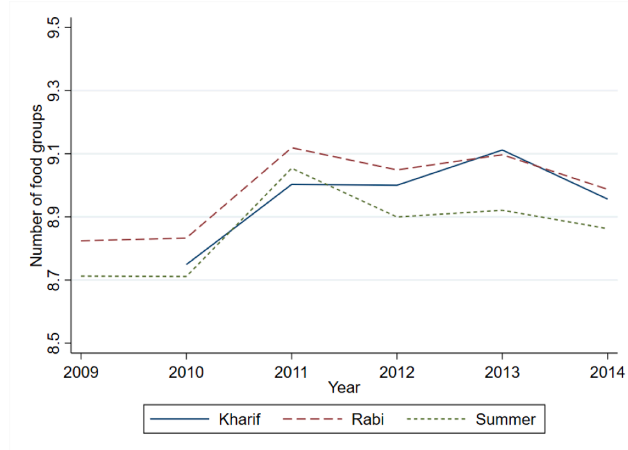
Table 1
Summary statistics.

	Obs	Mean	Std. Dev.	Definition
Panel A: Dependent Variables				
Dietary Diversity Score:				
Overall (ODDS)	12,375	8.93	1.32	Total food items
Home(HDDS)	12,375	2.38	1.58	Home-produced food items
Home-Production	12,375	593.19	1048.08	Real value of home-produced goods (in INR)
Expenditure (per-capita):				
Total	12,375	905.11	1112.88	Total expenditure (in INR)
Food	12,375	418.40	208.11	All food items (in INR)
Non-food	12,375	486.71	1039.19	All non-food items (in INR)
Education	12,375	57.53	424.19	Education (in INR)
Medical	12,375	56.57	266.59	Medical and health purposes (in INR)
Addiction	12,375	42.40	50.40	Addiction/toxicating items (in INR)
Decision-making by women:				
Credit	11,887	0.04	0.20	Credit
Investment	9,848	0.03	0.17	Investments
Sales	10,101	0.03	0.17	Sale of household produce
Education	11,664	0.06	0.23	Education of children
Maintenance	12,369	0.27	0.44	Household maintenance
Panel B: Workdays				
Female:				
Total	12,375	44.13	34.51	Total female workdays
Paid	12,375	26.03	33.44	Female paid workdays
Unpaid	12,375	18.10	24.79	Female unpaid workdays
Domestic	12,375	43.52	31.99	Female domestic workdays
Male:				
Total	12,375	63.59	36.11	Total male workdays
Paid	12,375	45.12	38.35	Male paid workdays
Unpaid	12,375	18.46	28.89	Male unpaid workdays
Domestic	12,375	9.18	11.53	Male domestic workdays
Panel C: Household characteristics				
Children	12,375	1.33	1.41	Number of children
Working Female	12,375	1.72	0.87	Number of working age women
Working Male	12,375	1.92	0.91	Number of working age men
Education	12,375	6.12	3.12	Years of education (>14 year members)
Durables	12,375	11282.51	22111.68	Endowed value of durables (in INR)
Assets Index	12,375	−0.21	0.86	PCA Index of endowed buildings
Production diversity	12,375	2.50	2.14	Annual number of crops cultivated
Market Distance	12,375	13.75	6.38	Distance from the market (in kms)
Women wages	12,375	343.45	1533.04	Unconditional real wages (in INR) of women
Men wages	12,375	1232.27	4956.04	Unconditional real wages (in INR) of men
Lag Men wages	11,997	1237.41	4998.86	1 year lagged unconditional men wages (in INR)

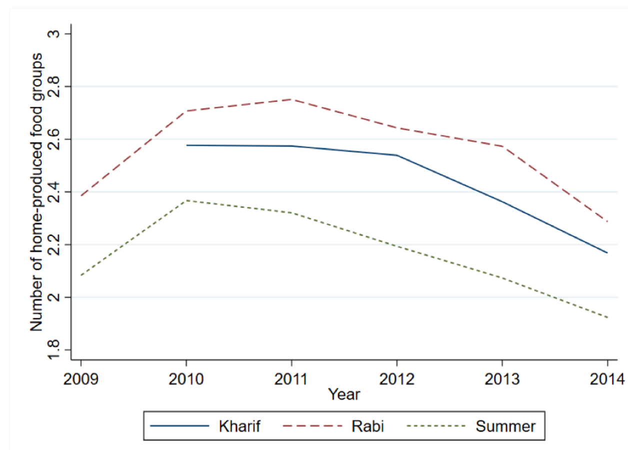
Source: VDSA micro level data (2009–14).

(Male, Female or Both) who influence the decision making in a given year. For each of these domains of decision making, we generate an indicator variable of women decision-making that takes a value of one if female members are independently making that decision and zero otherwise.

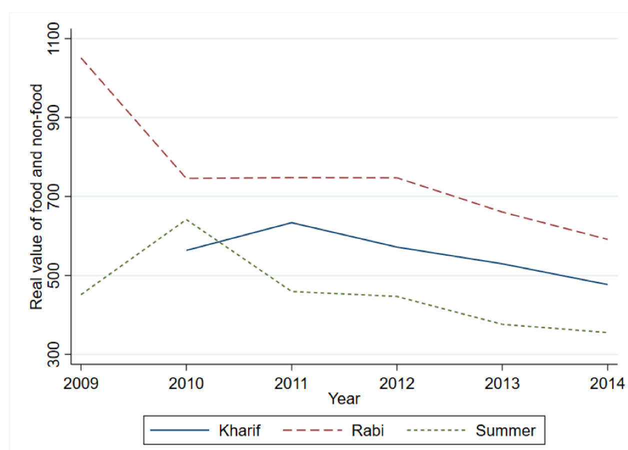
We have a total of 13,149 observations at the household-season-year level from 832 households surveyed across the three seasons over the period 2009–2014. We exclude the Kharif season of 2009 from our analyses as employment data is missing for the initial months of July-September due to a delay in the initiation of data collection. This leaves us with 12,375 observations. We cannot have a balanced panel



a: Overall Dietary Diversity



b: Dietary Diversity of Home-produced food



c: Vale of home-production

Fig. 1. Trends in dependent variables. *Source:* VDSA micro level household data (2009-2014).

here as new households will enter or exit based on their demographic composition as and when they have members in the working-age population (aged 15–60 years). We check the robustness of our results to a balanced sample of households that are observed throughout.

Table 1 reports the summary statistics. Panel A lists the dependent variables. The ODDS ranges from 5 to 11 and has an average of 8.93. The HDDS lies in the range of 0–8 and has a mean value of 2.38. The average

a(i): Paid Workdays: Female a(ii): Unpaid Workdays: Female a(ii): Domestic Workdays: Female

b(i): Paid Workdays: Male b(ii): Unpaid Workdays: Male b(ii): Domestic Workdays: Male

Fig. 2. Trends in workdays by gender. *Source:* VDSA micro level household data (2009-2014).

home-production per season is approximately 593 INR (Indian Rupee). Fig. 1 depicts the annual trends in these dependent variables by season. The overall dietary diversity has increased since 2009 and stabilised at almost nine food groups. In contrast, the home-produced dietary diversity and the value of home-production are on a downward trend for all the seasons since 2010.[12] The per-capita seasonal expenditure on food and non-food items are 409 and 476 INR, respectively. The per-capita seasonal expenditure on education and medicines are similar in magnitude, about 57 INR. All expenditures are in real terms. We also have annual data on the gender of the household member making decisions on various domains relevant for the household—credit, investment, sale of produce, education of children and household maintenance. The share of women decision making is marginal in all these domains relative to that of men. In all these domains, the highest influence of women is observed in household maintenance (27%).

Panel B lists the employment statistics by gender. The total workdays are higher for men (60.58) than women (42.29). The paid workdays for women (25.33) are less than men (43.42) by almost half while the unpaid workdays are similar in magnitude for both the sexes. Domestic work is disproportionately performed by women. Fig. 2 depicts the annual trends in the workdays of women and men by season.[13] The workdays (paid, unpaid and domestic) have been stable over the years for all the seasons. This indicates that the selection of women into employment types may not be a major concern. The workdays for men and women exhibit similar trends. The figure graphically depicts that women are bearing a disproportionate burden of domestic chores while men invest most of their time in paid work.

Panel C summarises household characteristics. Each household is composed of 1–2 children (aged below 15 years) and two working-age male and female members each on average. The average years of education roughly correspond to the primary level of education (6 years). We use Principal Components Analysis (PCA) on the ownership of assets endowed to a household to construct an Assets Index.[14] We use annual data from the cultivation schedule to construct our measure of production diversity. It is the total number of crops a household cultivates in a year.[15] A household that did not cultivate any crop in a given year is assigned a value of zero. In our sample, a household cultivates about 2–3 crops on an annual basis. The mean unconditional seasonal earnings of women (343 INR) are just a quarter of that of men (1,232 INR).[16] Conditional on working in paid work, women earn 1926 INR per season while men earn 4227 INR.[17] The seasonal earnings of women are sufficient to meet the food requirements of all the household members. This indicates that the labor force participation of women will have a substantial income effect on the household.

3. Estimation strategy

We first estimate the marginal effect of an additional day of work by women using a household fixed-effects (FE) model. Our equation of interest being:

$$y_{hvst} = \alpha_0 + \alpha_1 \text{Total Workdays}_{hvst} + \delta_0 X_{hvst} + H_h + S_s + T_t + V_v{*}t + \epsilon_{hvst} \quad (1)$$

where h is an index for the household, v indexes village, s indexes season and t indexes year. y_{hvst} is the dependent variable for household h in village v in season s in year t where $y = \{$ODDS, HDDS, Home-Production, Decision-making, Expenditure$\}$. ODDS (Overall Dietary Diversity Score) is the count of different food groups that a household consumes and is a good proxy for food security. A rural household can

[12] The observed level differences across the seasons are due to the variation in the number of months that are classified into seasons (4 for Kharif, 5 for Rabi and 3 for Summer). This will not be a concern in the analysis as our estimation strategy examines the effect within a season, not across seasons.

[13] Again, the observed level differences across the seasons will not be a concern in the analysis as we examine the effect within a season.

[14] PCA was taken over the ownership of bathroom, cooking gas, drinking water well, electricity, residential house, water connection and toilet.

[15] The type of crops may have a better association with the nutritional intake but our objective here is not to examine the nutritional impacts of production diversity but to check the robustness of our results to controlling for this channel. In addition, the type of crops cultivated by a household in our sample doesn't vary for a given season over the analysis period.

[16] These are unconditional earnings i.e. the earnings are assigned a value of zero for an individual who is not employed. The earnings are in real terms.

[17] The difference between their wages is due to engagement in different job types. While men are employed on the farm, in non-farm and salaried jobs women are majorly involved in low-paying farm work.

Table 2
Effect of women's workdays on overall dietary diversity.

	Main Specification			Robustness Checks			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Total Workdays	0.0023**						
	(0.0010)						
Paid Workdays		0.0032***	0.0031***	0.0032***	0.0032***	0.0034***	0.0035***
		(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0009)
Unpaid Workdays		0.0019**	0.0014*	0.0019**	0.0017**	0.0020**	0.0022**
		(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0009)
Observations	12,375	12,375	12,375	12,375	12,375	11,990	10,013
R-squared	0.8362	0.8366	0.8387	0.8366	0.8367	0.8359	0.8375
p-val[Paid = Unpaid]		0.15	0.06	0.14	0.09	0.11	0.2
Controls	✓	✓	✓	✓	✓	✓	✓
Household FE	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓
Season FE	✓	✓	✓	✓	✓	✓	✓
Village yearly trends	✓	✓	✓	✓	✓	✓	✓

Source: VDSA micro level household data (2009–2014).
Note: The dependent variable and the Workdays (Total, Paid and Unpaid) are in log terms using IHS transformation. Column (1) reports the effect of total workdays while Column (2) reports the effect of paid and unpaid workdays. Column (3) controls for the per-capita food expenditure. In Columns (4)-(6), we report the results of robustness checks. Column (4) controls for per-capita total expenditure, Column (5), controls for production diversity as measured by the number of crops cultivated by a household in a year, Column (6) restricts to a balanced panel to check for sample selection and Column (7) controls for lagged men wages. The row 'p-val[Paid = Unpaid]' reports the p-value of the test of difference in the coefficient of paid and unpaid workdays. Controls include time-variant household characteristics—demographics (number of children, working-age women and working-age men), average education level of the household (for members above 14 years of age), distance from the nearest market, interaction of endowed assets and wealth with year fixed effects, real seasonal men wages and domestic workdays of men. Standard errors clustered at the household level in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

purchase food items or produce them for self-consumption, therefore, we consider the HDDS (Home-produced Dietary Diversity) separately to bring out the time trade-off and the effect of labor force participation of women on the household's diet. Additionally, we also examine the effect on the value of Home-production. This provides an insight into the effect of female labor force participation on the food as well as the non-food front as the home-production includes the value of home-produced food and non-food items. Decision-making captures annual information on the role of gender in decisions regarding credit, investment, sale of produce, children's education and maintenance of the house. It is an indicator variable that takes a value of one if women of the household are independently making decisions over each of these domains and zero otherwise. Expenditure is the per-capita real expenses on food items and non-food items (education, medical and addiction).

As defined above, Total Workdays$_{hvst}$ are the mean workdays of the working-age woman, or the number of days worked by a representative woman, in household h, in village v, season s and year t. We transform the dependent variable and our variable of interest (Total Workdays$_{hvst}$) using Inverse Hyperbolic Sine (IHS) transformation. This transformation is defined at zero and the regression coefficients can be interpreted as percentage changes.[18]. The coefficient α_1 is the percentage change in the dependent variable associated with a percentage increase in the average workdays of women. X_{hvt} controls for time-variant household characteristics.[19] Since we want to focus on women, we control for the earnings and domestic days of men. This helps to rule out the income effect from wages of male members of the household as well as the substitution for women's domestic work by them. H_h accounts for household-level heterogeneity, season fixed effects (S_s) allay concerns of seasonality and T_t is year fixed effects. The village-specific annual time trends ($V_v{*}t$) allow for general trends in the dependent variable over time. This accounts for any unobserved time-variant variables that vary at the village level. It allows us to control for trends in price levels which may vary annually at the village level.

We use a household fixed effects (FE) model as our unit of analysis is the household. This also takes care of the potential bias in ordinary least squares (OLS) regression as we are able to control for household-level unobserved heterogeneity. Hence, for identification, we exploit the within-household variation in labor force participation of women, over and above the observed household characteristics and any unobserved shocks that vary by season, time or annual village trends.

Next, we examine the heterogeneity in this impact by the type of work–paid and unpaid. We use the following specification:

$$y_{hvst} = \beta_0 + \beta_1 \text{Paid Workdays}_{hvst} + \beta_2 \text{Unpaid Workdays}_{hvst} + \delta_1 X_{hvst} + H_h + S_s + T_t + V_v{*}t + \epsilon_{hvst} \quad (2)$$

where Paid Workdays$_{hvst}$ (Unpaid Workdays$_{hvt}$) is the mean paid (unpaid) workdays of women in household h, in village v, in season s and year t. Here, paid workdays refer to employment in activities that earn wages while unpaid refers to self-employment in family farm and family livestock care activities. Here again, we transform the dependent as well as the independent variable of interest (paid and unpaid workdays) using the IHS transformation. The coefficients β_1 and β_2 capture the percentage change in the dependent variable associated with a one per cent increase in the paid and unpaid workdays, respectively. We are interested in the difference between the two coefficients i.e. the differential in the marginal effect of paid and unpaid work. The controls are the same as the previous specification. Standard errors in both these specifications are clustered at the household level since the workdays are defined at the household level.

We corroborate our findings with multiple robustness checks. First, we control for the total seasonal expenditure of the household i.e., the sum of food and non-food expenditure in a season, as households may diversify on the non-food front. This is to check if the observed results are over and above the income effect on the food and non-food items.

[18] The transformation is given by $logy = ln(y + (y^2 + 1)^{1/2}$ (Burbidge et al., 1988).

[19] Household composition (number of children, working-age men and women in the household), average years of education (for members above 15 years of age), the endowment of durables interacted with year dummies, assets index interacted with year dummies, wages earned by men, domestic days of men and distance from the market.

Table 3
Effect of women's workdays on home-produced dietary diversity.

	Main Specification			Robustness Checks			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Total Workdays	0.0139**						
	(0.0058)						
Paid Workdays		0.0073	0.0070	0.0074*	0.0073*	0.0067	0.0064
		(0.0045)	(0.0045)	(0.0045)	(0.0042)	(0.0046)	(0.0052)
Unpaid Workdays		0.0301***	0.0292***	0.0301***	0.0233***	0.0291***	0.0273***
		(0.0052)	(0.0052)	(0.0052)	(0.0049)	(0.0052)	(0.0056)
Observations	12,375	12,375	12,375	12,375	12,375	11,990	10,013
R-squared	0.7512	0.7527	0.7530	0.7528	0.7586	0.7533	0.7530
p-val[Paid = Unpaid]		0	0	0	0	0	0
Controls	✓	✓	✓	✓	✓	✓	✓
Household FE	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓
Season FE	✓	✓	✓	✓	✓	✓	✓
Village yearly trends	✓	✓	✓	✓	✓	✓	✓

Source: VDSA micro level household data (2009–2014).
Note: The dependent variable and the Workdays (Total, Paid and Unpaid) are in log terms using IHS transformation. Column (1) reports the effect of total workdays while Column (2) reports the effect of paid and unpaid workdays. Column (3) controls for the per-capita food expenditure. In Columns (4)-(6), we report the results of robustness checks. Column (4) controls for per-capita total expenditure, Column (5), controls for production diversity as measured by the number of crops cultivated by a household in a year, Column (6) restricts to a balanced panel to check for sample selection and Column (7) controls for lagged men wages. The row 'p-val[Paid = Unpaid]' reports the p-value of the test of difference in the coefficient of paid and unpaid workdays. Controls include time-variant household characteristics—demographics (number of children, working-age women and working-age men), average education level of the household (for members above 14 years of age), distance from the nearest market, interaction of endowed assets and wealth with year fixed effects, real seasonal men wages and domestic workdays of men. Standard errors clustered at the household level in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Table 4
Effect of women's workdays on value of home-production.

	Main Specification			Robustness Checks			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Total Workdays	0.0700***						
	(0.0219)						
Paid Workdays		0.0256*	0.0218	0.0267*	0.0256*	0.0191	0.0186
		(0.0155)	(0.0156)	(0.0155)	(0.0153)	(0.0159)	(0.0177)
Unpaid Workdays		0.0739***	0.0626***	0.0744***	0.0637***	0.0661***	0.0736***
		(0.0158)	(0.0159)	(0.0157)	(0.0157)	(0.0160)	(0.0174)
Observations	12,375	12,375	12,375	12,375	12,375	11,990	10,013
R-squared	0.7404	0.7407	0.7470	0.7417	0.7422	0.7420	0.7396
p-val[Paid = Unpaid]		0	0.01	0	0.01	0	0
Controls	✓	✓	✓	✓	✓	✓	✓
Household FE	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓
Season FE	✓	✓	✓	✓	✓	✓	✓
Village yearly trends	✓	✓	✓	✓	✓	✓	✓

Source: VDSA micro level household data (2009–2014).
Note: The dependent variable and the Workdays (Total, Paid and Unpaid) are in log terms using IHS transformation. Column (1) reports the effect of total workdays while Column (2) reports the effect of paid and unpaid workdays. Column (3) controls for the per-capita food expenditure. In Columns (4)-(6), we report the results of robustness checks. Column (4) controls for per-capita total expenditure, Column (5), controls for production diversity as measured by the number of crops cultivated by a household in a year, Column (6) restricts to a balanced panel to check for sample selection and Column (7) controls for lagged men wages. The row 'p-val[Paid = Unpaid]' reports the p-value of the test of difference in the coefficient of paid and unpaid workdays. Controls include time-variant household characteristics—demographics (number of children, working-age women and working-age men), average education level of the household (for members above 14 years of age), distance from the nearest market, interaction of endowed assets and wealth with year fixed effects, real seasonal men wages and domestic workdays of men. Standard errors clustered at the household level in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Second, we control for production diversity of the household to take care of any possible link between production and dietary diversity. Third, we control for lagged men wages instead of contemporaneous men wages. This takes care of any concern of endogeneity in the current wages. Fourth, we restrict the analysis to a balanced panel of households that are observed throughout to rule out systematic attrition in the sample. Fifth, we show that our results are not driven by endogenous labor force participation using multiple Oster bounds. Sixth, we cluster the standard errors at the village-season level to take into account any possible correlation in shocks that may affect consumption and employment within a village for the same season. Finally, we run the specification for paid and unpaid workdays separately to allay any concerns of multi-collinearity between these two independent variables of interest. Our results are robust to all these checks.

Table 5
Effect of women's workdays on their decision-making.

Domains of Decision-making:	Credit (1)	Investment (2)	Sales (3)	Children's Education (4)	Maintenance of house (5)
Paid Workdays	0.0022*	0.0025**	0.0031**	0.0024	0.0053**
	(0.0012)	(0.0011)	(0.0014)	(0.0016)	(0.0025)
Unpaid Workdays	−0.0020	−0.0005	0.0012	0.0013	0.0012
	(0.0016)	(0.0015)	(0.0016)	(0.0017)	(0.0026)
Observations	4,179	3,436	3,526	4,100	4,360
R-squared	0.5971	0.5027	0.4856	0.4900	0.6025
p-val[Paid = Unpaid]	0	0.05	0.23	0.58	0.18
Controls	✓	✓	✓	✓	✓
Household FE	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓
Village yearly trends	✓	✓	✓	✓	✓

Source: VDSA micro level household data (2009–2014).
Note: All dependent variables are binary indicators with a value of one if women independently make decision in that domain and zero otherwise. All workdays (Paid and Unpaid) are in log terms using IHS transformation. The row 'p-val[Paid = Unpaid]' reports the p-value of the test of difference in the coefficient of paid and unpaid workdays. Controls include time-variant household characteristics—demographics (number of children, working-age women and working-age men), average education level of the household (for members above 14 years of age), distance from the nearest market, interaction of endowed assets and wealth with year fixed effects. Standard errors clustered at the household level in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Table 6
Effect of women's workdays on household expenditure (per-capita).

Categories	Food (1)	Non-food (2)	Education (3)	Medical (4)	Addiction (5)	Fuel/Energy (6)
Paid Workdays	0.0073**	−0.0292***	0.0169	−0.0574***	−0.0345***	−0.0030
	(0.0031)	(0.0063)	(0.0185)	(0.0133)	(0.0105)	(0.0048)
Unpaid Workdays	0.0170***	−0.0068	0.0273	−0.0237	0.0018	0.0043
	(0.0030)	(0.0066)	(0.0194)	(0.0151)	(0.0116)	(0.0047)
Observations	12,375	12,375	12,375	12,375	12,375	12,375
R-squared	0.7883	0.5303	0.5870	0.4129	0.7005	0.7289
p-val[Paid = Unpaid]	0.01	0	0.64	0.04	0.01	0.19
Controls	✓	✓	✓	✓	✓	✓
Household FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Season FE	✓	✓	✓	✓	✓	✓
Village yearly trends	✓	✓	✓	✓	✓	✓

Source: http://vdsa.icrisat.ac.in/VDSA micro level household data (2009–2014).
Note: All dependent variables and workdays (Paid and Unpaid) are in log terms using IHS transformation. The row 'p-val[Paid = Unpaid]' reports the p-value of the test of difference in the coefficient of paid and unpaid workdays. Controls include time-variant household characteristics—demographics (number of children, working-age women and working-age men), average education level of the household (for members above 14 years of age), distance from the nearest market, interaction of endowed assets and wealth with year fixed effects, real seasonal men wages and domestic workdays of men. Standard errors clustered at the household level in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

4. Estimation results

4.1. Overall dietary diversity

Table 2 reports the estimates of the effect of women's labor force participation on the overall dietary diversity (ODDS). Column (1)-(3) show the results from our main specification. Column (1) lists the coefficient α_1 of Eq. 1 and Columns (2)-(7) capture the heterogeneity in type of work (β_1 and β_2 of Eq. 2). We find that an increase in workdays of women by a per cent improves the dietary diversity of the household by 0.0023% (Column (1)). The coefficient, although small in magnitude, is precisely estimated. A plausible reason for the small magnitude is the low variation observed in the dietary diversity measure. The results in Column (2) show that paid, as well as unpaid workdays, have a significant positive effect on the ODDS of the household. A percentage increase in the paid workdays increases the dietary diversity by 0.0032% while unpaid work has an effect of 0.0019%. The coefficient for paid workdays is larger in magnitude but not statistically different from unpaid workdays. This increase in ODDS can be a pure income effect from the wages earned by women that are utilised for the purchase of more food varieties. To test this, we control for the per-capita food expenditure in Column (3). We find that the observed significant positive effect of paid and unpaid workdays are over and above the income effect. This shows that the gain in dietary diversity is not driven by a pure income effect. Additionally, the gap in the magnitude of the two coefficients becomes significant (at a 10% level of significance).

4.2. Dietary diversity of home-produced food

Table 3 reports the marginal effect of women's labor force participation on home-produced dietary diversity (HDDS). We find that a percentage increase in total workdays of women increases the HDDS by 0.0139% (Column (1)). Interestingly, we do not find any negative effect of paid workdays on the dietary diversity of home-produced food as has been argued in some of the existing studies. In fact, the coefficient is positive although not significant (Column (2)). Unpaid workdays have a significant positive effect of 0.03%. This effect is over and above the income effect as the coefficient for unpaid workdays remains positive and significant in Column (3) where we control for per-capita food expenditure. In both, Column (2) and (3), we find a significant heterogeneity by the type of work. These findings indicate that increased participation of women in unpaid activities adds to the nutritional intake of the household via an improvement in the HDDS. This can result from the self-consumption of food items produced by unpaid work i.e. from the family farm or family livestock. A key takeaway from these results is that despite additional time burden resulting from increased days of work in paid as well as unpaid activities the dietary diversity of home-produced food does not experience any negative effect. On the contrary, it has a positive effect, over and above the income effect.

4.3. Value of home-production

The above results show that the engagement of women in the labor market enhances the dietary diversity of the household. This rules out any negative substitution effect on the food front. But the time constraint may still exert a cost on the household production which includes food as well as non-food items produced for self-consumption and sale on the market. In Table 4, we report the marginal effects of women's labor force participation on the value of home-production. Column (1) shows a positive and statistically significant effect of total workdays. An increase in workdays of women by a per cent increases the value of home-production by 0.07%. Column (2) brings out the heterogeneity in the type of work. Surprisingly, even for home-production paid work exhibits no negative effect. In fact, the coefficient is positive and significant (at a 10% level of significance). An increase in the paid workdays by a per cent increases home-production by 0.03%. On expected lines, the value of home-production increases significantly with an increase in unpaid workdays. An increase in the unpaid workdays of women by a per cent improves the dietary diversity of the household by 0.07%. The differential between paid and unpaid work is statistically significant (at a 1% level of significance).

4.4. Robustness checks

4.4.1. Per-capita total expenditure

Our results show that ODDS is increasing with workdays and this effect is over and above the pure income effect from a higher food expenditure as the estimates continue to remain significant even after we control for the per-capita food expenditure of the household. But the income effect may operate through diversification to the non-food items by the household. For instance, the household may invest in time-saving cooking equipment. Therefore, we run our main specification controlling for the per-capita total expenditure of the household. The results for our three dependent variables (ODDS, HDDS and Home-production) are reported in Column (4) of Table 2, Table 3 and Table 4, respectively. The sign and magnitude of the estimated effect remain similar to our main specification. Thus, our results reflect a positive impact of female labor force participation over and above the income effect.

4.4.2. Production diversity

In a rural setup, households are consumers as well as producers. One can argue that there exists a link between production diversity and dietary diversity (Chegere and Stage, 2020). We show that controlling for this association leaves our conclusions unchanged. We use the number of crops cultivated by a household in a year as our measure of the production diversity of the household. Column (5) of Table 2, Table 3 and Table 4 report the regression coefficients for ODDS, HDDS and Home-production, respectively. We find that production diversity has a significant positive effect on all three variables of interest. The coefficients continue to remain significant even after we control for production diversity. Thus, our results are not driven by production diversity and are robust to its inclusion.

4.4.3. Sample selection

We restrict our sample to a balanced panel of households observed for each season from 2009 to 2014 (excluding Kharif in 2009). This reduces the sample size to 10,013 observations and is unique at the household-season-year level. The regression results for the dependent variables are reported in Column (6) of Table 2, Table 3 and Table 4, respectively. We find that our results are similar to the main specification. Therefore, our results are not driven by the systematic attrition of the sample.

4.4.4. Lagged men wages

In our main specification, we control for the earnings of the male members to focus on the role played by female members. But, the contemporaneous earnings may suffer from an endogeneity bias. Therefore, we run a specification that controls for lagged men wages. The regression results are reported in Column (7) of Table 2, Table 3 and Table 4, respectively. Our results remain the same qualitatively with a marginal increase in the magnitude of the coefficients (β_1 and β_2) of ODDS. While the magnitude for the HDDS and home-production reduce marginally.

4.4.5. Selection on unobservables

Even with the household fixed effects model and controlling for an extensive set of household characteristics and yearly village trends, there might remain some endogeneity due to unobservables. To address this issue of selection on unobservables we employ the method proposed by Oster (2019). This approach establishes bounds to the true value of parameters i.e. '*Beta*.' Calculating these bounds on beta requires fixing the value of R_{max}, the maximum R-squared that can be achieved, and the relative importance of unobservables to observables which is captured by '*Delta*'. We test the sensitivity of our results to multiple specifications and report the corresponding Oster bounds in Appendix Table A.4. Panel A of the table assumes that observables are as important as unobservables (i.e. $Delta = 1$) and considers the standard case of $R_{max} = 1.3{*}\overline{R}$ to calculate a bias-adjusted treatment effect bound on '*Beta*'. Here, $\overline{R}$ is the R-square from the estimated regression. In Panel B and C of the table, we impose stricter bounds. Panel B uses $Delta = 1$ and $R_{max} = 1.4{*}\overline{R}$. Panel C has $Delta = 1.5$ i.e. unobservables are 50% more important than observables and $R_{max} = 1.3{*}\overline{R}$. The last panel of the table reports the value of *Delta* that would reduce the coefficient value (*Beta*) to zero and generate the same R-squared ($\overline{R}$) value. For all statistically significant estimates from our main specification, the bounds do not include zero for any of the three panels. Also, the value of *Delta* that would produce no effect is very high (Panel D). This provides evidence that our results are not driven by the endogenous participation of women in the labor market. This warrants that our estimates are unlikely to suffer from omitted variables bias.

4.4.6. Clustering at the village-season level

In Appendix Table A.5, we cluster the standard errors at the village-season level. This takes into account any possible correlation in shocks that may affect consumption and employment within a village for the same season. We find that our results continue to remain significant even when we cluster the standard errors at the village-season level.

4.4.7. Paid and unpaid workdays in separate regressions

In our main specification, we run the paid and unpaid workdays in the same specification as these two choice variables are determined simultaneously. As a robustness check, we run our specification for paid and unpaid workdays separately to allay any concerns of multicollinearity between these two variables of interest. The regression results are reported in Appendix Table A.6. Our results remain unchanged.

5. Discussion of results

Our results show that the labor force participation of women has a significant positive impact on dietary diversity (overall and home-produced) and the value of home-production. Paid workdays significantly improve the overall dietary diversity but have no significant effect on home-produced dietary diversity. This could result from a positive income effect as the earnings from paid work can relax the budget constraint and thereby increase the consumption of more varieties of food items. But, as discussed above, the observed positive effect is over and above the pure income effect. In other words, there are alternative channels that give rise to the observed positive effect, in addition to the income channel. The unpaid workdays, on the other hand, directly contribute to the production of home-produced food and non-food items that result in a significantly higher home-produced dietary diversity and value of home-production. This feeds back into improving the overall dietary diversity of the household.[20]

One possible mechanism that can explain the observed effect is the role of women in household decision making. Economic independence of women emanating from their labor force participation may translate into a greater bargaining power in the resource allocation decisions of the household. Studies show that women direct a higher share of resources towards richer nutrients (Pangaribowo et al., 2019). This would result in improved dietary diversity and nutritional outcomes. In Table 5, we find evidence in support of this channel. The decision-making by women in various domains is positively associated with paid workdays. We find a positive relationship between the number of paid workdays and the likelihood of women making decisions in the domains of credit, investment, sale of produce and maintenance of the house. Contrary to paid workdays, unpaid workdays do not exhibit a significant effect on decision-making within the household.[21] We expect this increased bargaining power to reflect in other household decisions also. Table 6 lists the different types of household expenditures (per-capita). We find that an increase in paid workdays, as well as unpaid workdays, result in significantly higher per-capita food expenditure (Column 1). The increase in food expenditure is more pronounced for unpaid workdays. The non-food expenditure, on the other hand, is falling significantly with paid workdays. This fall is driven by a reduction in the expenditure on medical and addiction items. We do not find a corresponding fall for the unpaid workdays. Also, there is no change in expenditure on education or fuel for both, paid and unpaid workdays. Thus, on expected lines, we find resources being directed towards food and away from addictive substances which are majorly consumed by men. The fall in medical expenditures also indicates a better nutritional status that may result from increased dietary diversity. This supports the mechanism of increased say of women contributing to better nutritional outcomes for the paid workdays of women. Even for unpaid workdays the coefficient on medical expenditure is negative although imprecisely estimated. Therefore, paid as well as unpaid activities can enhance the dietary diversity of the household but the channels through which they operate are different.

One expects the time trade-off from labor force participation of women to crowd out the domestic days of work i.e. exhibit a negative substitution effect. In Appendix Table A.1, we bring out this trade-off. The total workdays do not affect domestic workdays. But, there exists considerable heterogeneity between paid and unpaid work.[22] Increased participation in paid work crowds out domestic work. An increase in paid workdays by a per cent reduces domestic workdays by 0.15% (Column 4). Conversely, unpaid workdays are positively related to domestic work. A one per cent increase in the unpaid workdays is associated with 0.28% higher domestic days (Column 4). This positive association is possibly resulting from the fact that unpaid work is performed on the premises of the household and can be combined with domestic work. Paid work on the other hand may require mobility and entail non-flexible working hours making the trade-off more stringent. Therefore, paid work leads to substitution of time away from domestic work while unpaid work complements domestic work.

This raises the natural question of whether the improved dietary diversity of the household is at the cost of women's well-being. We investigate how the heavier work burden on women impacts their health. In Appendix Table A.2, we examine the effect of paid and unpaid workdays on three health indicators of female members of the household. Column (1) reports the effect on the mean number of days the female members of the household report being seriously ill in a given season and year. We expect this to capture short-term impacts on health. We also try to capture the effect on the longer-term health in Column (2) and (3) where the dependent variable is the proportion of female members (aged 15 years and above) that fall in the underweight or overweight category, respectively.[23] We find a significant reduction in the number of days female members reported being seriously ill for paid as well as unpaid workdays (Column (1)). We find no effect on the proportion of underweight and overweight women. Our results align with those of van den Bold et al. (2020). They find no adverse effects on the nutrition of women despite the increased time burden in Burkina Faso. Similarly, we find no pernicious effect of labor force participation of women on their health outcomes.

6. Conclusions

In this paper, we examine the role of women's labor force participation on the overall dietary diversity, the home-produced dietary

[20] One can expect the unpaid workdays (the sum of workdays spent on the family farm and livestock) to have a higher relevance for the farm households. It is the household characteristic of ownership of farm and livestock that determines the opportunity for a woman to do unpaid work. Therefore, we test for heterogeneity in the observed effect between farm and non-farm households. In Appendix Table A.3, we interact the paid and unpaid workdays with an indicator for farm households. A household is classified as a farm household if at the start of the survey the household was sampled as a small, medium or large landholding group depending on their operational landholdings. We do not find a significant differential in the effect of paid and unpaid workdays between the farm and non-farm households on the ODDS and value of home-production. We find that the effect of unpaid workdays on home-produced dietary diversity is lower for farm households. This reflects the fact that farm households would already have a higher dietary diversity coming from the farm produce therefore an increment in unpaid workdays may not change the dietary diversity while for the non-farm households it can add additional food groups to their diet.

[21] We find no significant change for both, paid and unpaid workdays, in the decision-making over the following domains—the marriage of children, own labor or other inputs used on the farm (fertilizers, fodder, labor, land, livestock, machinery, pesticides or seeds). The results are skipped for brevity and are available on request.

[22] We run the specification for paid and unpaid workdays separately in Column (2) and (3), respectively, to allay any concerns of multicollinearity. Then run both together in Column (4), our preferred specification, as the decision on paid, unpaid and domestic days is being taken simultaneously.

[23] Body Mass Index (BMI) $= \frac{\text{Weight (in kg)}}{\text{Height}^2 \text{ (in m)}}$. Underweight category: BMI $<$ 18.5 and overweight category: BMI $\geqslant 25$ and $\leqslant 29.9$ (https://www.ncbi.nlm.nih.gov/books/NBK541070/). The data required to calculate BMI is available annually from 2010 onwards. The dependent variable in Column (1) and the workdays are IHS transformed.

diversity and the value of home-production in order to clearly bring out the time trade-offs faced by women. For this purpose, we utilise novel household panel data from the Semi-Arid tropics of India. Our results show a positive effect of female labor force participation on all three variables of interest and rules out any adverse effects despite an increased burden on the time of women. Interestingly, we find significant heterogeneity in this effect by type of work—paid and unpaid. This heterogeneity may explain the lack of consensus observed in the existing literature on the effect of labor force participation of women. It indicates that the effects being captured by previous studies are sensitive to the employment structure of the region and the definition of women's employment deployed by them. Thus, a region-specific study becomes pertinent from the policy perspective. We find suggestive evidence that the positive effect of paid workdays on the household's dietary diversity is driven by an improved say of women in the decision-making process of the household. And it is the self-consumption of home-produced goods that explains the observed positive effect of unpaid workdays. Our study also extends the literature on women's agency. We find that the labor force participation of women not only improves the household's dietary diversity but also enhances women's agency and improves their health indicators despite a heavier burden of work.

On the policy front, our findings underscore the nutritional benefits of employment policies designed with special provisions to enhance women's employment such as the Mahatma Gandhi National Rural Employment Guarantee Act (NREGA), Swarnjayanti Gram Swarozgar Yojana and Swarna Jayanti Shahari Rojgaar Yojana, which is beyond the immediately intended consequences. They also inform policies intended to improve the economic access to food and health outcomes of the need to mitigate challenges in improving rural female labor force participation through institutional, technological, financial and market interventions.

We must mention that even with a household fixed effects model and controls for observed household characteristics and annual village trends, the endogeneity in labor force participation of women is not completely ruled out. But this study is able to take care of any selection at the household level. A robustness check with multiple Oster bounds on the estimated coefficients warrants that our estimates are unlikely to suffer from omitted variable bias. Studies in the future that make use of individual-level panel data can help to build more nuance in the labor and nutrition connection. There might also be concerns about measurements errors due to recall bias in days worked and consumption. In an experimental study in Ghana, Gaddis et al. (2019) found this bias is linked to the cognitive burden of recalling past events and has a strong educational gradient. The data used in our analyses were collected every month by resident field investigators. Since the field investigators were staying in the same village as the surveyed households and had become more aware of the social-economic systems the chances of measurement errors would have been minimised. However, the concerns about measurements errors due to recall bias in workdays and consumption may not be fully ruled out but are expected to be low as data is collected every month.

CRediT authorship contribution statement

Nikita Sangwan: Conceptualization, Methodology, Software, Validation, Formal analysis, Data curation, Writing - original draft, Writing - review & editing, Visualization. **Shalander Kumar:** Conceptualization, Writing - review & editing, Supervision.

Acknowledgement

We thank Bharat Ramaswami, Farzana Afridi, Kanika Mahajan, Monishankar Bishnu, Sonia Bhalotra and three anonymous reviewers and the editor for their valuable comments. We also thank Uma Lele, Digvijay Negi, Sugat Chaturvedi, Pranav Mimani, and participants at the ISD-MIND Seminar (Hyderabad) for their suggestions. Elias Khan Patan extended exceptional data assistance. Nikita acknowledges financial support from Jim and Wendy Ryan Endowment fund and Shalander acknowledges funding from CGIAR Research Program on Grain Legumes and Dryland Cereals 1 . Longitudinal house-hold data collected with financial support from Bill and Melinda Gates Foundation is well acknowledged.

Appendix A

See Tables A.1–A.6

Table A.1
Effects of women's labour force participation on Domestic workdays.

	(1)	(2)	(3)	(4)
Total Workdays	−0.0180			
	(0.0151)			
Paid Workdays		−0.2221***		−0.1527***
		(0.0114)		(0.0102)
Unpaid Workdays			0.3306***	0.2836***
			(0.0154)	(0.0153)
Observations	12,375	12,375	12,375	12,375
R-squared	0.5652	0.6079	0.6405	0.6592
Controls	✓	✓	✓	✓
Household FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
Season FE	✓	✓	✓	✓
Village yearly trends	✓	✓	✓	✓

Source: http://vdsa.icrisat.ac.in/VDSA micro level household data (2009–2014).
Note: All dependent variables and workdays (Paid and Unpaid) are in log terms using IHS transformation. Controls include time-variant household characteristics—demographics (number of children, working-age women and working-age men), average education level of the household (for members above 14 years of age), distance from the nearest market, interaction of endowed assets and wealth with year fixed effects, real seasonal men wages and domestic workdays of men. Standard errors clustered at the household level in parantheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Table A.2
Effect of women's workdays on their health indicators.

	Seriously Ill Days (1)	Underweight (2)	Overweight (3)
Paid Workdays	−0.0228***	0.0001	0.0003
	(0.0074)	(0.0028)	(0.0018)
Unpaid Workdays	−0.0154**	−0.0032	0.0016
	(0.0069)	(0.0033)	(0.0022)
Observations	12,375	2,903	2,903
R-squared	0.5310	0.7228	0.7254

(*continued on next page*)

Table A.2 (*continued*)

	Seriously Ill Days (1)	Underweight (2)	Overweight (3)
p-val[Paid = Unpaid]	0.2	0.38	0.62
Mean (Y)	1.52	0.25	0.14
Controls	✓	✓	✓
Household FE	✓	✓	✓
Year FE	✓	✓	✓
Season FE	✓		
Village yearly trends	✓	✓	✓

Source: VDSA micro level household data (2009–2014).
Note: Dependent variable in Column (1) and workdays (Paid and Unpaid) are in log terms using IHS transformation. Seriously Ill Days in Column (1) is the mean number of days female members report being seriously ill in a season. Column (2) and (3) report the proportion of female adult members in the household (aged 15 and above) that fall in the underweight (Body Mass Index (BMI)<18.5) and overweight category (BMI⩾25 & BMI⩽29.9), respectively. BMI is calculated using the height and weight data available annually from 2010 onwards. Mean (Y) is the mean of the dependent variable. Controls include time-variant household characteristics—demographics (number of children, working-age women and working-age men), average education level of the household (for members above 14 years of age), distance from the nearest market, interaction of endowed assets and wealth with year fixed effects, real seasonal men wages and domestic workdays of men. Standard errors clustered at the household level in parantheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Table A.3
Heterogenous effect of women's workdays by farm and non-farm households.

	Overall Dietary Diversity (1)	Home-produced Dietary Diversity (2)	Value of Home Production (3)
Paid Workdays × *Farm*	−0.0006	0.0126	−0.0582
	(0.0018)	(0.0097)	(0.0427)
Unpaid Workdays × *Farm*	−0.0019	−0.0296*	−0.0407
	(0.0021)	(0.0164)	(0.0568)
Paid Workdays	0.0037**	−0.0020	0.0679
	(0.0015)	(0.0086)	(0.0418)
Unpaid Workdays	0.0034*	0.0546***	0.1062*
	(0.0019)	(0.0156)	(0.0569)
Observations	12,375	12,375	12,375
R-squared	0.8366	0.7532	0.7410
Estimate Paid (*Farm* = 1)	0.0031**	0.0106	0.0097
Estimate Unpaid (*Farm* = 1)	0.0015	0.025	0.0655
Controls	✓	✓	✓
Household FE	✓	✓	✓
Year FE	✓	✓	✓
Season FE	✓	✓	✓
Village yearly trends	✓	✓	✓

Source: VDSA micro level household data (2009–2014).
Note: All dependent variables and workdays (Paid and Unpaid) are in log terms using IHS transformation. '*Farm*' indicates households classified as farm (small, medium and large) group on the basis of operational holding at the start of the survey. Controls include time-variant household characteristics—demographics (number of children, working-age women and working-age men), average education level of the household (for members above 14 years of age), distance from the nearest market, interaction of endowed assets and wealth with year fixed effects, real seasonal men wages and domestic workdays of men. Standard errors clustered at the household level in parantheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Table A.4
Robustness checks: oster bounds.

	Overall Dietary Diversity (1)	Home-produced Dietary Diversity (2)	Value of Home Production (3)
	Panel A: Delta = 1 and Rmax = 1.3× R^2		
Paid Workdays	(0.0022, 0.0032)	(0.0038, 0.0073)	(0.0093, 0.0256)
Unpaid Workdays	(0.0019, 0.0019)	(0.0232, 0.0301)	(0.0552, 0.0739)
	Panel B: Delta = 1 and Rmax = 1.4× R^2		
Paid Workdays	(0.0019, 0.0032)	(0.0025, 0.0073)	(0.0035, 0.0256)
Unpaid Workdays	(0.0019, 0.0019)	(0.0207, 0.0301)	(0.0483, 0.0739)
	Panel C: Delta = 1.5 and Rmax = 1.3× R^2		
Paid Workdays	(0.0017, 0.0032)	(0.0019, 0.0073)	(0.0004, 0.0256)
Unpaid Workdays	(0.0019, 0.0019)	(0.0194, 0.0301)	(0.0447, 0.0739)
	Panel D: Beta = 0		
Paid Workdays	388	602	318
Unpaid Workdays	7250	87	108
Observations	12,375	12,375	12,375
R-squared	0.2279	0.1550	0.1386
Controls	✓	✓	✓
Household FE	✓	✓	✓
Year FE	✓	✓	✓
Season FE	✓	✓	✓
Village yearly trends	✓	✓	✓

Source: VDSA micro level household data (2009–2014).
Note: Oster bounds are estimated using 'psacalc' command in Stata based on Oster (2019). All dependent variables and workdays (Paid and Unpaid) are in log terms using IHS transformation. Controls include time-variant household characteristics—demographics (number of children, working-age women and working-age men), average education level of the household (for members above 14 years of age), distance from the nearest market, interaction of endowed assets and wealth with year fixed effects, real seasonal men wages and domestic workdays of men. Standard errors clustered at the household level in parantheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Table A.5
Robustness Checks: Village-Season clustering of standard errors.

	Overall Dietary Diversity (1)	Home-produced Dietary Diversity (2)	Value of Home Production (3)
Paid Workdays	0.0032***	0.0073	0.0256**
	(0.0010)	(0.0047)	(0.0119)
Unpaid Workdays	0.0019**	0.0301***	0.0739***
	(0.0008)	(0.0056)	(0.0160)
Observations	12,375	12,375	12,375
R-squared	0.8366	0.7527	0.7407
p-val[Paid = Unpaid]	0.11	0	0
Controls	✓	✓	✓
Household FE	✓	✓	✓
Year FE	✓	✓	✓
Season FE	✓	✓	✓
Village yearly trends	✓	✓	✓

Source: VDSA micro level household data (2009–2014).
Note: All dependent variables and workdays (Paid and Unpaid) are in log terms using IHS transformation. The row 'p-val[Paid = Unpaid]' tests for the difference in the coefficient of paid and unpaid workdays. Controls include time-variant household characteristics—demographics (number of children, working-age women and working-age men), average education level of the household (for members above 14 years of age), distance from the nearest market, interaction of endowed assets and wealth with year fixed effects, real seasonal men wages and domestic workdays of men. Standard errors clustered at the village level in parantheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Table A.6
Robustness Checks: Paid and Unpaid workdays in separate specifications.

	Overall Dietary Diversity		Home-produced Dietary Diversity		Value of Home Production	
	(1)	(2)	(3)	(4)	(5)	(6)
Paid Workdays	0.0028***		−0.0000		0.0076	
	(0.0008)		(0.0043)		(0.0142)	
Unpaid Workdays		0.0006		0.0273***		0.0572***
		(0.0007)		(0.0050)		(0.0142)
Observations	12,375	12,375	12,375	12,375	12,375	12,375
R-squared	0.8383	0.8379	0.7511	0.7528	0.7458	0.7466
Controls	✓	✓	✓	✓	✓	✓
Household FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Season FE	✓	✓	✓	✓	✓	✓
Village yearly trends	✓	✓	✓	✓	✓	✓

Source: VDSA micro level household data (2009–2014).
Note: All dependent variables and workdays (Paid and Unpaid) are in log terms using IHS transformation. Controls include time-variant household characteristics—demographics (number of children, working-age women and working-age men), average education level of the household (for members above 14 years of age), distance from the nearest market, interaction of endowed assets and wealth with year fixed effects, real seasonal men wages and domestic workdays of men. Standard errors clustered at the household level in parantheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

References

Anderson, Siwan, Eswaran, Mukesh, 2009. What determines female autonomy? Evidence from Bangladesh. J. Dev. Econ. 90 (2), 179–191.
Bloom, Shelah S., Wypij, David, Gupta, Monica Das, 2001. Dimensions of women's autonomy and the influence on maternal health care utilization in a north Indian city. Demography 38 (1), 67–78.
Burbidge, John B., Magee, Lonnie, Robb, A Leslie, 1988. Alternative transformations to handle extreme values of the dependent variable. J. Am. Stat. Assoc. 83 (401), 123–127.
Chang, W., Díaz-Martin, Lucía, Gopalan, A., Guarnieri, E., Jayachandran, S., Walsh, C., 2020. What Works to Enhance Women's Agency: Cross-Cutting Lessons From Experimental and Quasi-Experimental Studies. J-PAL Working Paper.
Chegere, Martin J., Stage, Jesper, 2020. Agricultural production diversity, dietary diversity and nutritional status: Panel data evidence from Tanzania. World Dev. 129, 104856.
D'Souza, Alwin, Mishra, Ashok K., Hirsch, Stefan, 2020. Enhancing food security through diet quality: The role of nonfarm work in rural India. Agric. Econ. 51 (1), 95–110.
Dutta, Swati, 2016. The Extent of Female Unpaid Work in India: A Case of Rural Agricultural Households. Asia-Pacific Popul. J. 31 (2), 75–90.
Gaddis Isis, Siwatu Gbemisola Oseni, Palacios-Lopez Amparo, Pieters Janneke. 2019. Measuring farm labor: survey experimental evidence from Ghana. World Bank Policy Research Working Paper No. 8717.
Grosch, James W., Caruso, Claire C., Rosa, Roger R., Sauter, Steven L., 2006. Long hours of work in the US: associations with demographic and organizational characteristics, psychosocial working conditions, and health. Am. J. Ind. Med. 49 (11), 943–952.
Gupta, Soumya, Pingali, Prabhu, Pinstrup-Andersen, Per, 2019. Women's empowerment and nutrition status: The case of iron deficiency in India. Food Policy 88, 101763.
Hoddinott, John, Haddad, Lawrence, 1995. Does female income share influence household expenditures? Evidence from Côte d'Ivoire. Oxford Bull. Econ. Stat. 57 (1), 77–96.
Holland, Cara, Rammohan, Anu, 2019. Rural women's empowerment and children's food and nutrition security in Bangladesh. World Dev. 124, 104648.
Johnston, Deborah, Stevano, Sara, Malapit, Hazel J., Hull, Elizabeth, Kadiyala, Suneetha, 2018. Time use as an explanation for the agri-nutrition disconnect: evidence from rural areas in low and middle-income countries. Food policy 76, 8–18.
Jones, Andrew D., Shrinivas, Aditya, Bezner-Kerr, Rachel, 2014. Farm production diversity is associated with greater household dietary diversity in Malawi: findings from nationally representative data. Food Policy 46, 1–12.
Kassie, Menale, Fisher, Monica, Muricho, Geoffrey, Diiro, Gracious, 2020. Women's empowerment boosts the gains in dietary diversity from agricultural technology adoption in rural Kenya. Food Policy 101957.
Komatsu, Hitomi, Malapit, Hazel Jean, L., Theis, Sophie, 2018. Does women's time in domestic work and agriculture affect women's and children's dietary diversity? Evidence from Bangladesh, Nepal, Cambodia, Ghana, and Mozambique. Food Policy 79, 256–270.
Lele, Uma, 1986. Women and structural transformation. Econ. Develop. Cultural Change 34 (2), 195–221.
Liu, Jieyu, 2007. Gender dynamics and redundancy in urban China. Feminist Econ. 13 (3–4), 125–158.
Mahajan, Kanika, 2019. Back to the plough: Women managers and farm productivity in India. World Dev. 124, 104633.
Maity, Bipasha, 2020. Consumption and time-use effects of India's employment guarantee and women's participation. Econ. Dev. Cult. Change 68 (4), 1185–1231.
Mancino, Lisa, 2011. Who Has Time to Cook?: How Family Resources Influence Food Preparation. DIANE Publishing.
Menon Sneha, Tomy Dona, Kumar Anita. 2019. Female Work and Labour Force Participation in India. UNDP India Women at Work Report.
Mondal, Ripon Kumar, Selvanathan, Eliyathamby A., Selvanathan, Saroja, 2021. Nexus between rural nonfarm income and agricultural production in Bangladesh. Appl. Econ. 53 (10), 1184–1199.
Oster, Emily, 2019. Unobservable selection and coefficient stability: Theory and evidence. J. Bus. Econ. Stat. 37 (2), 187–204.
Padmaja, Ravula, Pramanik, Soumitra, Pingali, Prabhu, Bantilan, Cynthia, Kavitha, Kasala, 2019. Understanding nutritional outcomes through gendered analysis of time-use patterns in semi-arid India. Global Food Sec. 23, 49–63.
Pangaribowo, Evita Hanie, Tsegai, Daniel, et al., 2019. Women's bargaining power and household expenditure in Indonesia: the role of gender-differentiated assets and social capital. GeoJournal 84 (4), 939–960.
Razavi, Shahra, 2012. World development report 2012: Gender equality and development—A commentary. Develop. Change 43 (1), 423–437.
Ruel, Marie T., 2003. Is dietary diversity an indicator of food security or dietary quality? A review of measurement issues and research needs. Food Nutrition Bull. 24 (2), 231–232.
Santoso, Marianne V., Kerr, Rachel Bezner, Hoddinott, John, Garigipati, Priya, Olmos, Sophia, Young, Sera L., 2019. Role of women's Empowerment in child nutrition outcomes: a systematic review. Adv. Nutrit. 10 (6), 1138–1151.
Sraboni, Esha, Malapit, Hazel J., Quisumbing, Agnes R., Ahmed, Akhter U., 2014. Women's empowerment in agriculture: What role for food security in Bangladesh? World Dev. 61, 11–52.
Taruvinga, A., Muchenje, V., Mushunje, A., 2013. Determinants of rural household dietary diversity: The case of Amatole and Nyandeni districts. South Africa. Int J Dev Sustain. 2 (4), 2233–2247.
OECD, ILO, IFM, WBG. 2014. Achieving stronger growth by promoting a more-gender-balanced economy. Report prepared for the G20 Labour and Employment Ministerial Meeting Melbourne, Australia, 10–11 September.
van den Bold, Mara, Bliznashka, Lilia, Ramani, Gayathri, Olney, Deanna, Quisumbing, Agnes, Pedehombga, Abdoulaye, & Ouedraogo, Marcellin. 2020. Nutrition-sensitive agriculture programme impacts on time use and associations with nutrition outcomes. Maternal Child Nutrition, e13104.
Verger, Eric O., Dop, Marie-Claude, Martin-Prével, Yves, 2017. Not all dietary diversity scores can legitimately be interpreted as proxies of diet quality. Public Health Nutrition 20 (11), 2067–2068.
Wodon, Quentin, Blackden, C. Mark, 2006. Gender, time use, and poverty in sub-Saharan Africa. The World Bank.