Female Labor Supply in a Household Decision making context:

Evidence from ICRISAT-VDSA villages of India

Aakanksha Melkani

PhD student

Department of Agriculture, Food and Resource Economics

Michigan State University

email: melkania@msu.edu

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Over the last decade, female labor participation[1] in rural India has seen a steep decline from 33.3 percent (2004-05) to 24.7 percent (2011-12) (Rustagi 2013), raising debates over the underlying forces driving this change. Research points to the increasing household income (Abraham 2013) and growing preference towards educational pursuits (Neff, Sen and, Kling 2013) as two main reasons for this decline. Increase in household income along with patriarchal socio-cultural norms, which discourage woman's work outside the house, relieve women from paid work, especially if it was previously undertaken to augment low household incomes. Meanwhile, rural labor markets which traditionally comprised of agriculture, allied and caste based occupations, underwent transformation after the 1990s and now represent a more diverse set of occupations. These include many non-farm occupations such as construction, self-employment in small businesses and, to a lesser extent, regular salaried jobs (Reddy 2013). The benefits of these new and remunerative opportunities in non-farm employment are found to be skewed in favor of the young educated male population of rural India (Eswaran 2009) due to their relative ease of access to information, markets and training.

These national trends which have so far not been tested in a household decision making context. This article is an attempt to fill this gap in literature. The questions of interest in this study are, i) whether a micro level data set reflects the pattern of female labor supply observed at national level?; and, ii) how do labor supply choices of spouse and other family members effect the labor supply of the female. We use longitudinal data from six villages in India collected under the program named Village Dynamics in South Asia (VDSA) of the International Crop Research

Institute of Semi Arid Tropics (ICRISAT) over a span of seven years, corresponding broadly to the period of dramatic change in female employment patterns at national level.

Theoretical background and Hypothesis

We assume that labor supply decisions in our sample are taken in a collective household decision making context. Collective decision making models allow each household member to make his or her autonomous choices and these choices are then negotiated at the household to reach a common decision (Manson and Brown 1980; McElroy and Horney 1981). Apps and Rees (1993) introduced the concept of interpersonal exchange of labor within households which is relevant to our study. This study draws from the model by Carter and Katz (2011) which modifies the collective decision model to suit peasant economies in developing country. It assumes that the household agents are relatively autonomous in resource allocation to goods and activities that pertain to their traditional gender roles (referred to as "separate spheres" by the authors). Individuals in the household try to maximize their utility subject to their expectation of spouse's behavior. Agents within the household can transfer income and labor to each other. Transfer of money occurs from males to females in exchange of which females transfer labor from paid work to household production.

In context of our discussion of employment opportunities in rural India and the theoretical framework by Carter and Katz (2011) we make the specific hypothesis that there will be a trade-off of labor supply between wives and husbands in a household. An increase in male income (through better employment opportunities such as non-farm employment in our model) higher in comparison to female's wage increase would lead to higher monetary transfers from males to females and thus reallocate female's time endowments away from paid work to household activities such as domestic production.

Data

The data used for the study comprises household panel data from six villages of India belonging to the states of Andhra Pradesh and Maharashtra collected between the years 2005 to 2013[2]. The time span corresponds to the one over which a sharp decline in female labor force participation was observed at a national level. This data was collected as a part of the VDSA program (Microdata 2016). Initiated by ICRISAT in 1975 with the purpose of creating a knowledge bank about farming systems, constraints and opportunities facing farmers of the semi-arid tropics. The six villages selected for our study constitute the original villages of the ICRISAT survey. They belong to three districts namely Mahbubnagar (Andhra Pradesh), Akola (Maharashtra) and Solapur (Maharashtra) and broadly represent the agro-climatic sub-regions of semi-arid tropical India. Our sample gauges a total of 678 households across eight years leading to a total sample size of 4508 (panel is not balanced). All currently married adults (>=18 years of age) are included in the sample. Each married female is matched with her spouse using relevant identification codes in the data.

Empirical Strategy

This section describes the empirical strategy we follow to test the hypothesis. We frame panel data regression models of labor supply of women regressed against relevant individual, household and village level characteristics. The panel data structure helps us control for several important time-invariant characteristics which can affect our dependent variable but have not controlled for through the control variables (for example, socio-cultural norms, individual preferences). Regression equations are estimated separately for total work, farm work and non-farm work. Moreover, labor supply decisions are tested both at the intensive (intensity of work) and extensive (participation in work) margins.

We first describe the strategy followed to test the model at the intensive margin. The independent variable (female's labor supply) is measured as number of days worked in a year. Since a significant proportion of the population does not participate in work, we will have a censored data sample with censoring at zero days of work. Our dependent variable will no longer be linearly related to the independent variables violating an important assumption to be followed for obtaining consistent results through an Ordinary Least Square (OLS) regression. Hence, we follow Heckman (1974) and use a Tobit model instead for solving our problem. Since we have a panel structure to our data, we estimate the Tobit using the Correlated Random Effects (CRE) Tobit method as described by Mundlak (1978) and Chamberlain (1984). In this technique, time variant explanatory variables are averaged over time for each individual entity and are included as regressors in the model. It is assumed that unobserved heterogeneity is a function of these averages and thus by controlling for these averages in the regression we can control for the unobserved heterogeneity. Our model can be represented by the following function:

(1) $E\left(d_{i,t}^{f} \mid d_{i,t}^{m}, I_{i,t}, H_{i,t}, V_{i,t}, y_{1t}, \alpha_{1i}\right) = f\left(\beta_0 + \beta_1 d_{i,t}^{m}, + I_{i,t}\beta_2 + H_{i,t}\beta_3 + V_{i,t}\beta_4 + y_{1t} + \alpha_{1i}\right)$

Here, *i* indexes the individual and *t* indexes the time period, which is year in our case.

We are primarily interested in estimating β_1, the coefficient for $d_{i,t}^{m}$ (work intensity for the spouse, measured in terms of number of days worked in a year). For our hypothesis to be accepted, the coefficient β_1 should be negative and significant. The other explanatory variables are several individual ($I_{i,t}$), household ($H_{i,t}$) and village level ($V_{i,t}$) characteristics which control for other factors that may influence the female's labor supply. The variable y_{1t} represents the year fixed effect and α_{1i} the time invariant unobserved heterogeneity. A detailed description of each of the

explanatory variables is given in table 1.

The strategy followed for testing the model at the extensive model is very similar. The only changes are made in the way the dependent variable (participation of female in work) and major independent variable (participation of spouse in work) are measured. Participation is measured as a binary variable ($p_{i,t}^{f}$ for females and $p_{i,t}^{m}$ for males) which is recorded as one for an individual who participates in any economically productive activity and zero if otherwise. The CRE Tobit is replaced by CRE Probit and the function to be estimated can be represented as follows:

$$(2)\ P\left(p_{i,t}^{f} \mid p_{i,t}^{m}, I_{i,t}, H_{i,t}, V_{i,t}, y_{2t}, \alpha_{2i}\right) = f\left(\delta_0 + \delta_1 p_{i,t}^{m}, + I_{i,t}\delta_2 + H_{i,t}\delta_3 + V_{i,t}\delta_4 + y_{2t} + \alpha_{2i}\right)$$

The hypothesis would again be accepted if the coefficient for participation of spouse (δ_1) is found to be negative and significant.

An important caveat here is that decisions made by a couple within a household can be expected to be endogenous due to simultaneity in decision making. The results from our analysis should be interpreted only as correlations with no argument about causation being made.

Results

We first look at the general trends in employment levels for males and females in our sample. Figures 1 and 2 present the percentage of men and women employed at the farm and non-farm sector in our sample over the years. As opposed to the trends at the national level, farm sector employment does not show any decline in case of either females or males. In fact there is a small consistent increase in percentage employment. Non-farm employment fluctuates much more but

there is no consistent trend here either. Thus, we can say that the patterns observed at the national level are not reflected in our sample.

We now discuss the results of the regressions which are presented in tables 1 and 2. Table 1 presents the results of the analysis at the intensive margin and summarizes the impact of several individual, household and village level characteristics on the number of days worked by a female. We observe that the spouse's work intensity has a positive and significant ($p<0.001$) impact on the female's work intensity. Spouse's days worked on farm also increased female's involvement ($p<0.001$) in farm work but had no impact on her non-farm work. On the other hand, a spouse's increased work days on non-farm occupations increased female's involvement in both farm ($p<0.05$) and non-farm ($p<0.001$) activities. This goes against our initial hypothesis of trade-off of labor between females and males. Rather there seems to be a complementary relation between labor decisions of couples.

However, we do observe substitution between farm and non-farm work when we look at the impact of household typologies on female's work intensity. Household typologies are variables constructed by summing the number of other household members (apart from self and husband) involved in farm and/or non-farm work. An increased number of household members working on farm increases the female's participation in farm too. Whereas, additional number of household members working in non-farm decreases the female's work intensity. A similar trend is observed for farm work intensity for females. Female's number of days worked on farm increases with increase in number of other household members working on farm and decreases with the number of members participating in non-farm work. However, the pattern is reversed in case of non-farm work intensity of females. Female's work intensity on non-farm activities negatively related to number of household members working on farm and positively with number of household

members participating in non-farm employment. Such household typologies have been used as "peer effects" influencing household decisions by many authors, such as for schooling of children (Bobonis and Finan 2009) and retirement plan decisions (Duflo and Saez 2002). Rahut et al. (2015) apply this approach in determining non-farm employment in Bhutan.

We also observe, surprisingly, that wages have no significant impact on female's labor supply at the intensive margin in both farm and non-farm sectors. Female's participation in all kinds of paid employment increases with age though at a decreasing rate (the coefficient of the quadratic term is negative and significant). Years of education is negatively related to work intensity although its impact is significant only in case of non-farm employment. There can be two explanations to this observation. On one hand, it can be argued, as by Neff, Sen and, Kling (2012) and Rustagi (2013) that more and more women are opting out of paid employment to extend their years of education. On the other hand, Kannan and Raveendran (2012) and Bhaumik (2013) argue that the females withdrawing from workforce may not be the same as those pursuing education. Other factors such as socio-cultural norms in rural India may discourage women's work outside the household (Abraham 2013). Thus, with increasing prosperity oh household we may observe more women getting educated but not entering the job market.

In fact, a study of our sample for the distribution of women across different educational classes indicates that the latter maybe a more relevant explanation. From our data for the year 2013, we find that as many as 36 percent women were illiterate, 22 percent were educated only up to primary grade, 15 percent up to middle school and another 16 percent up to high school. Since the sample consists of only adult women (age more than or equal to 18 years) there is very small percentage of women who would be pursuing any kind of education. Thus, we can conclude that preference for education is not a reason for withdrawing from job markets in our sample.

Social stratification in form of castes and tribes is a defining factor for socio-economic status in rural India. In our data, this type of social stratification is transformed into three categories: firstly "Forward castes" which can be considered the most privileged class; secondly "Backward castes", which are generally lower in socio-economic status and lastly "Scheduled castes and tribes" which are historically known to be the most disadvantaged group. We observe that belonging to a backward caste or schedules caste/tribe has a large positive and significant relation with women's farm work. However, its impact on non-farm work was significant only for the backward classes. Greater participation in labor force by women identifying with less privileged social castes was also reported by Mammon and Paxson (2000).

Other factors with significant correlations with female work intensity are dependency ratio and distance of household from market. More number of dependents is related with women devoting more time on farm and overall labor supply but its impact on nonfarm work is negative and insignificant. The distance of household from nearest market reduces women's overall work supply and the reduction is larger in non-farm activities. However, the opposite is observed in case of farm employment, where distance from market increases female's work intensity. The reasons of these observations are evident. The distance from market reduces access to several employment opportunities in the non-farm sector. The cost and inconvenience of travel, especially if women have several care-giving responsibilities within household, maybe much larger. Thus, distance from market will reduce their labor supplied to the non-farm sector and increase it in the farm sector which can be accessed within the village community. The number of children below the age of 13 has a negative but insignificant impact on women's contribution to work.

Table 2 summarizes female's participation (extensive margin) in farm, non-farm and overall work in relation to the participation of her spouse and several other individual, household

and village level characteristics. The results are almost the same as in case of the previous analysis of intensive margin with few differences. The most important difference is the responsiveness of farm sector and overall employment to female wages which is positive and significant ($p<0.001$). This is in accordance to the well-established fact of higher responsiveness of work participation to wages compared to work intensity for married women (Kimmel and Kneister 1998; Blundell et al. 2011). The impact of education on work participation is insignificant on any of the three categories. Dependency ratio also does not impact participation in non-farm sector while distance of market becomes insignificant for the farm sector.

Discussion

This study shows that in contrast to the dramatic changes in female's work participation being observed after the year 2000 in rural India at the national level the trend for our sample has remained somewhat stable. In particular, the importance of females in the farm economy has remained strong and participation has been increasing. A slight downward trend could only be observed for females in non-farm sectors.

The regression results reject our hypothesis of trade-off of labor between spouses and rather suggests a complimentary relation of labor supply by men and women. Further, the results reveal that factors such as education and wages are not the driving factors of women's labor supply decisions. Rather, constraints on the household such as higher dependency ratio, belonging to lower social caste and distance from markets (and thus inaccessibility to remunerative employment) are positively related to women's increased work participation and time devoted to work, especially farm work.

These results are in line with the findings of Klassen and Janneke (2012) who performed a similar study for urban India found that employment for less educated women was driven by

necessity rather than opportunity. On a similar line, Padmaja et al. (2014) use the VDSA dataset to compare the different roles males and females play under differing resource endowments and conclude that women have a greater role to play in risk prone agriculture such as under drought conditions and uncertain availability of irrigation water.

Limitations of the study

A major limitation of this study is that it does not address the endogeneity that is expected in this analysis due to the simultaneity of decisions made by couples. The challenge in addressing this problem is identifying valid instruments which vary adequately over time so that they can be incorporated into the panel structure. Future development of this research will aim at identifying such instruments so that conclusions can be made about the causal relationship of spouse's labor decisions on the female.

Another possible area of concern is the attrition in the panel which has not been addressed. We expect this problem to minimally impact our data since the VDSA data collection procedure incorporates mechanisms to maintain a similar representative sample of households throughout the period of data collection.

Conclusion and Policy implications

This article emphasizes that household characteristics can play very important role in determining female labor supply in developing countries, even more important than wages and education. Women are driven to farm work where household endowments are low and dependents are more. Increased participation of men and other household members in non-farm employment maybe a factor influencing female's withdrawal from labor market. However, we do not yet have enough evidence to conclude. Further work in this direction can throw light upon what could be the

different implications on women in developing economies undergoing transformation from farm based rural economy to urbanized economy with larger non-farm sector.

Footnotes

1. The National Sample Survey reports "Labor Force Participation" as the number of persons in the labor force per 1000 persons. Persons in the labor force include those employed and those not employed but capable of work and seeking employment

2. The data for 2007 has been included because of large number of missing values

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Table 1: Description of variables used in the empirical analysis

Variable Name	**Category**	**Mean**	**SD**	**Description**
Farm days	Individual	107.5	95.7	Number of days worked by female in own farm and/or as hired farm labor in a year (includes any work related to livestock)
Non-farm days	Individual	36.9	88.3	Number of days worked by female in any non-farm economic activity in a year
Total work days	Individual	144.4	117.2	Number of days worked by female in any economic farm and non farm activity in a year
Participation in farm work	Individual			Binary variable recorded as 1 if female participates in any kind of farm work and 0 if otherwise
Participation in non farm work	Individual			Binary variable recorded as 1 if female participates in any kind of non-farm work and 0 if otherwise
Participation in work	Individual			Binary variable recorded as 1 if female participates in any kind of work and 0 if otherwise
Spouse's farm days	Individual	143.6	133.95	Number of days worked by spouse on own farm and/or as hired farm labor.
Spouse's non-farm days	Individual	109.3	136.23	Number of days worked by spouse in non-farm sector
Spouse's work days	Individual	252.9	125.3	Number of days worked by spouse in any kind of economic activity
Spouse's participation in farm work	Individual			Binary variable recorded as 1 if spouse participates in any kind of farm work and 0 if otherwise
Spouse's participation in non-farmwork	Individual			Binary variable recorded as 1 if spouse participates in any kind of non-farm work and 0 if otherwise
Spouse's participation in work	Individual			Binary variable recorded as 1 if spouse participates in any kind of work and 0 if otherwise
Age	Individual	39.17	13.43	Age of female, years
Age squared	Individual			Square of age of the female, controls of non-linear relation of dependent variable with age
Education	Individual	3.96	4.26	Years of schooling
Number of children	Individual	0.64	0.95	Number of children below the age of 13
Dependency Ratio	Household	.57	.67	Ratio of the number of dependent household members (members aged

				less than 14 and more than 65 years of age) by the total number of members in household
Land owned by Household	Household	6.10	6.96	Land owned by household, acres
Land area irrigated	Household	2.9	4.46	Land owned and under assured irrigation, acres
Caste	Household			Dummy for caste of household 1= Backward caste 2= Forward caste (base case) 3= Scheduled castes/ Scheduled tribes/ Nomads
Household farm typology	Household	2.33	1.78	Number of household members, excluding self, engaged in farm work
Household non-farm typology	Household	1.32	1.32	Number of household members, excluding self, engaged in non-farm work
Distance from market	Household	10.91	2.53	Distance of household from nearest market measured in km
Real farm wages for male	Village	21.70	5.89	Mean wages prevailing in village for male farm workers, deflated by consumer price index for rural workers at 1986-87 prices (Rs)
Real farm wages for females (Rs)	Village	30.84	13.26	Mean wages prevailing in village for female farm workers, deflated by consumer price index for rural workers at 1986-87 prices (Rs)
Real non-farm wages for males (Rs)	Village	13.13	4.51	Mean wages prevailing in village for male non-farm workers, deflated by consumer price index for rural workers at 1986-87 prices (Rs)
Real non-farm wages for females	Village	16.75	5.46	Mean wages prevailing in village for female non-farm workers, deflated by consumer price index for rural workers at 1986-87 prices (Rs)
Rainfall in June month, mm	District	84.15	54.60	Rainfall received in month of June measured in mm

Table 2: Regression of Work intensity (Number of days worked per year) of female on individual, household and village level characteristics (Model 1)

Independent variables	Work Intensity	Farm work Intensity	Non-farm Work intensity
No of days worked by spouse	0.2***		
	(0.02)		
No. of days worked by spouse on farm		0.2***	0.1
		(0.02)	(0.07)
No. of days worked by spouse on non farm		0.1**	0.38***
		(0.03)	(0.07)
No. of hh members (excluding self)	10.4***	12.7***	-6.9**
working on farm	(1.17)	(1.04)	(3.18)
No. of hh members (excluding self)	-10.2***	-9.4***	14.6***
working on non farm	(1.58)	(1.48)	(3.77)
Female farm wages at constant (1986-87)	0.8	1.0	1.1
prices	(1.25)	(1.04)	(3.10)
Female non farm wages at constant (1986-	-0.01	-0.7	1.03
87) prices	(0.88)	(0.74)	(2.33)
Age	23.8***	18.2***	20.7***
	(2.03)	(1.70)	(4.48)
Age squared	-0.2***	-0.2***	-0.2***
	(0.01)	(0.01)	(0.03)

Years of education	-24.1*	-5.3	-51.2*
	(12.6)	(10.73)	(27.90)
Number of children below the age 12	-3.5	0.1	-7.2
	(2.653)	(2.22)	(6.82)
Caste_group = 1, Backward castes	34.6***	22.2***	59.7***
	(4.93)	(4.15)	(12.59)
Caste_group = 3, Scheduled castes, tribes or	12.2***	16.5***	21.5
nomads	(4.67)	(3.88)	(13.52)
Dependency ratio of hh	16.6***	20.9***	-6.475
	(3.68)	(3.06)	(10.40)
Distance from nearest market	-5.7***	3.5***	-33.1***
	(0.91)	(0.77)	(2.41)
Land owned by hh	-0.1	-0.8	1.8
	(1.02)	(0.87)	(2.30)
Irrigated land owned by hh	-0.9	-1.0	0.3
	(0.95)	(0.80)	(2.68)
Rainfall in June	-0.2***	-0.2***	0.04
	(0.05)	(0.05)	(0.15)
Constant	-236.8***	-239.8***	-353.3***
	(24.55)	(20.78)	(59.64)
Observations	4,508	4,508	4,508

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3: Regression of work participation of female on individual, household and village level characteristics

Independent variables	Work participation	Farm Work participation	Non-farm Work participation
Spouse's participation in work	0.698***		
	(0.145)		
Spouse's participation in farm work		0.782***	0.016
		(0.095)	(0.103)
Spouse's participation in non farm		0.153	0.259***
		(0.105)	(0.097)
No. of hh members (excluding self)	0.211***	0.171***	-0.066***
working in farm	(0.017)	(0.019)	(0.022)
No. of hh members (excluding self)	-0.212***	-0.158***	0.115***
working in non farm	(0.022)	(0.025)	(0.025)
Female farm wages at constant (1986-	0.058***	0.054***	0.005
87) prices	(0.019)	(0.019)	(0.019)
Female non farm wages at constant	-0.002	0.009	-0.003
(1986-87) prices	(0.013)	(0.013)	(0.014)
Age	0.198***	0.189***	0.104***
	(0.029)	(0.028)	(0.027)
Age squared	-0.002***	-0.002***	-0.001***
	(0.000)	(0.000)	(0.000)
Years of education	-0.082	0.021	-0.222

	(0.118)	(0.129)	(0.160)
Number of children below the age 12	-0.020	-0.046	-0.037
	(0.038)	(0.038)	(0.042)
Caste_group = 1, Backward castes	0.219***	0.292***	0.338***
	(0.068)	(0.069)	(0.075)
Caste_group = 3, Scheduled castes,	0.129*	0.301***	0.236***
tribes or nomads	(0.067)	(0.068)	(0.080)
Dependency ratio of hh	0.199***	0.239***	-0.012
	(0.052)	(0.052)	(0.062)
Distance from nearest market	-0.049***	0.008	-0.192***
	(0.013)	(0.012)	(0.014)
Land owned by hh	-0.008	-0.015	0.013
	(0.013)	(0.013)	(0.014)
Irrigated land owned by hh	0.000	-0.003	-0.001
	(0.012)	(0.012)	(0.016)
Rainfall in June	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
Constant	-3.349***	-3.847***	-1.512***
	(0.338)	(0.331)	(0.367)
Observations	4,508	4,508	4,508

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

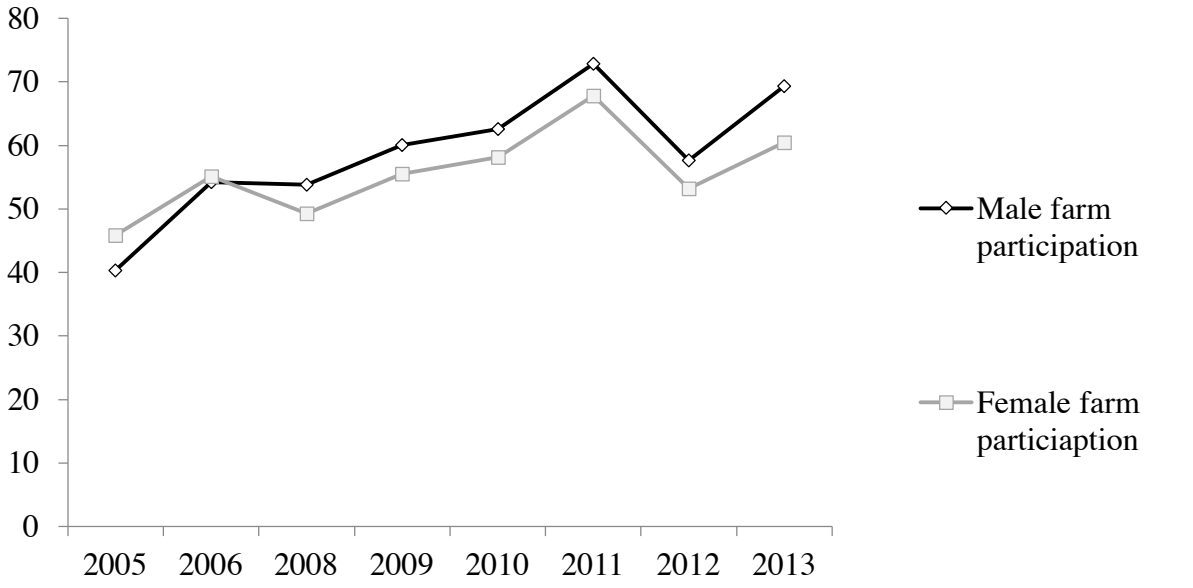

Figure 1: Farm participation (%)
(Rs. at 1986-87 prices)

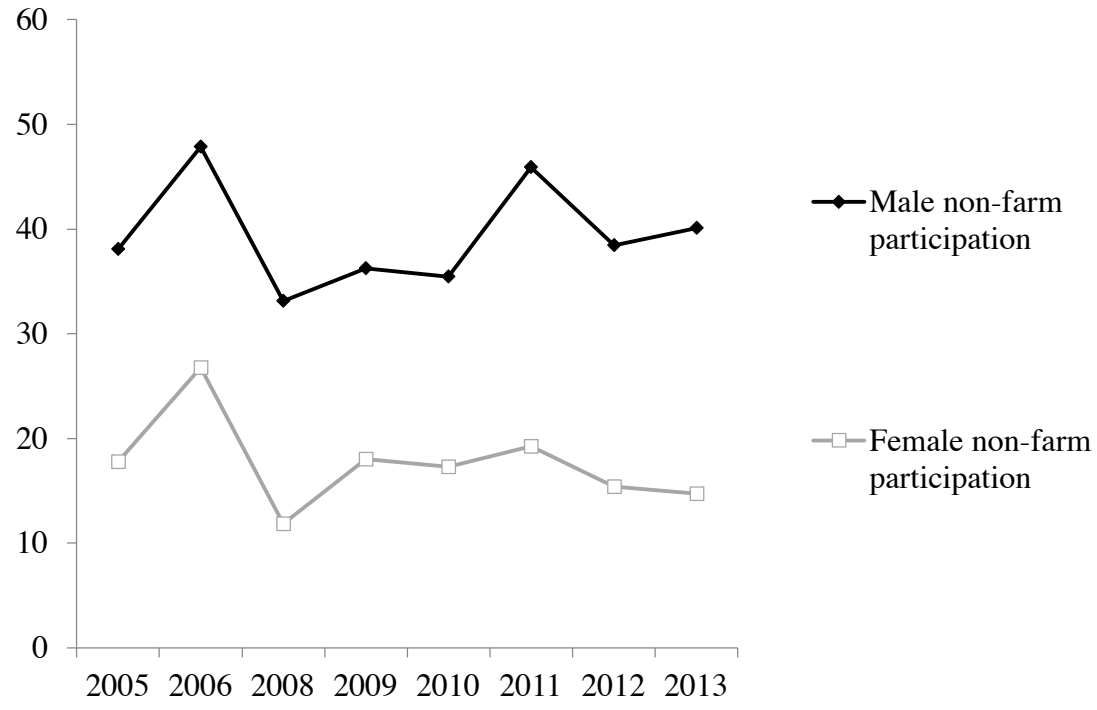

Fig 2: Non-farm participation (%) and real wages
(Rs. at 1986-87 prices)