

# WOMEN, JOINT FOREST MANAGEMENT AND ENVIRONMENTAL SUSTAINABILITY: EVIDENCE FROM RURAL WEST BENGAL

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Forests are a critical livelihood support system for the rural poor, especially women living in forest fringe area. Rural women are highly dependent on forest resources as it plays an important role in the viability and subsistence of the households. The common forest resources provide them with food, medicine, fodder, firewood, etc. However indiscriminate collection of forest resources leads to degradation of forests. JFM provides the opportunities for the forest dependent people to meet their subsistence requirement. Rural women consider the forest as their source of livelihood and hence are very much concerned about the long term sustainable governance of the forest resources. Based on a primary survey of 300 rural household covering 9 villages in the districts of Bankura and Purulia of West Bengal, we investigated empirically the effect of women's active participation in JFM on forest resource preservation and conservation using Binary Probit Model. Empirical evidence of our study reveals that active participation of women in forest management have a positive impact on the resource related outcomes and protect the forest through greater control of illicit harvesting of forest products and regeneration in the forest. Therefore gender equity in JFM participation improves the sustainability of forest resources.

**Key Words:** Common Property Resources, Subsistence, livelihood, Gender Equity

## INTRODUCTION

The forest resources play an important role in the environmental and ecological security of India. Indiscriminate and massive (approximately 4.3 million hectare) diversion of forest land during 1950-1980 for non-forestry purposes, necessitated the need for conservation and development of the forest resources. This led to the enactment of the Forest Conservation Act, 1980 whose primary objective was to provide a higher level of protection to the forests and to regulate diversion of the forest land in India for non-forestry activities. However there is depletion of the forest resources in view of increasing population pressure and development activities.

More than 200 million people are partially or fully dependent on the forest resources for their livelihood in India. The importance of this natural resource was felt even in the ancient times which can be traced to the ancient text of *Atharva Veda*. Forests are a vital livelihood support system for the rural poor, especially women living in forest fringe area. The common forest resources provide the rural poor with food, medicine, fodder, firewood, etc (Jodha 1985a, 1985b, 1986, 1990; Pasha, 1992; Singh *et al.*, (1996); Iyengar and Shukla, 1999; Beck and Ghosh, 2000). The women collect firewood for domestic as well as for commercial purposes. They collect certain tree barks and medicinal herbs which are used as industrial raw material as well as for medicinal purposes. Empirical evidence from southern districts of Bihar, suggest that rural women collect *mahua* flowers (*Madhuca indica*), *kendu* leaves (*Diospyros melanoxylon*) used in making indigenous cigarettes, mushrooms and *mahua* seeds, tamarind (*Tamarindus indica*) (Rao, 1996). In West Bengal, tribal women gather *sal* (*Shorea robusta*)

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leaves for six months of the years (Poffenberger, 1993). The *Sal* leaves are stitched by hand to make *Sal* plates, which are then sold in the local market. The rural women also sell their collected products like firewood, *Sal* stick (used as tooth brush) and wild vegetables at the local market. Rout *et al.* (2010) opine that collection of Non Timber Forest Product provides employment for the tribal women and they have larger potential for generating employment in future. Generally the men collect forest products only when they are not engaged in agricultural or other off-farm activities. Thus CPR collection for men is a secondary job. However, collection of forest products for rural women living in the forest fringes is always a primary occupation. Thus forest plays a crucial role in their daily lives.

However, lack of rights and responsibilities to control and use the common property resources make them highly vulnerable. Degradation of forest leads to forest produce being available further away from the place of dwelling, thereby increasing the drudgery of the women. Rural women consider the forest as their source of livelihood and hence are very much concerned about the long term sustainable governance of the forest resources. Women consider that the environmental degradation can lead to their reduced supplementary income and community forest management can help to reduce it. Thus any environmental policy should take into account the economic impact of the women and leverage the role of women in the protection and management of the forest resources (Agarwal, *et al.*, 2006). For a sustainable forest management, women should not only have access to the forest and accrue the benefits from it but also the right and authority to take decisions (Giri, 2012). Active participation of women in forest management involving local decision-making have a positive impact on the resource related outcomes and significantly increase the effectiveness of the institution involved in forest governance and protection through greater control of illicit harvesting of forest products and regeneration in the forest (Agarwal, *et al.*, 2006). Women's participation in forest management through *Mahila Mandals* has led to active monitoring, protecting and managing the common forest area (Bingeman, 2003). Jamisolamin (2012) believes that women can play a key role in ensuring environmental protection and conservation provided they are allowed to take decision in the management process. Thus women can play a critical role in the Joint Forest Management for long term sustainability of the scarce natural resources.

Despite the fact that women are the major users of common property resources, their involvement in Joint Forest Management is generally marginal in India. In West Bengal, for instance, there were many complaints from the rural women that the male officials discouraged them from coming to the forest office and also rebuked them if they came in the evening (Narain, 1994). Further, rural women were also excluded from several other activities like water users associations, village councils, etc. (Agarwal, 2001). To regulate illicit grazing and removal of forest products, direct involvement of women in JFM is essential.

Under this backdrop, the objective of our study is to explore the role of women participation in sustainability of the common property resources in the study area. In specific terms the objective of the study are as follows:

- i. To examine the performance of women in JFM committees
- ii. To investigate empirically the effect of women's active participation in JFM on forest resource preservation and conservation.

The study has been presented in seven section source of data and methodology. The third section focuses on the role of women in CPR collection in the study area. The fourth section discusses women's participation in Forest Resource Management. Women's participation in JFM and sustainability in forest resources has been presented in the fifth section. We have discussed Regression results in the sixth section. The seventh section gives the concluding remarks of the study.

## DATA AND METHODOLOGY

The study is based mainly on a primary survey conducted in 2011. Multistage sampling technique has been used for the collection of primary data. We have purposively chosen two economically backward districts of West Bengal viz. Bankura and Purulia since both of them are covered by vast forest area and the rural poor are highly dependent on Common Property Resources for their subsistence.

In order to address the research problem, we have chosen two blocks viz. Saltora in Bankura district and Santuri in Purulia district. The blocks have been selected taking into consideration the dominance of CPR based economic activities. In Bankura district, from Saltora block, we have chosen six villages viz. Panjhoria, Ramjibanpur (Bandhghat), Seolibona, Baldanga, Dulaltora and Tantirdanga. Three villages viz. Jiyathole, Marbediya and Ambari have been selected from Santuri block in Purulia district. The primary survey was carried out in 300 households in 9 villages of Bankura and Purulia districts. The study villages were selected for the survey because they were economically highly backward with majority of the households living below the poverty line. Moreover forests contribute critically to the survival of the rural poor, specially the women. In the surveyed villages, we have collected information from households through complete enumeration method.

We have used a tabular method to quantify the role of women in the collection of common forest products and their participation in JFM in the surveyed area. In order to study the impact of women's participation on sustainability of the forest resources, we have used a binary probit model to examine the determinants of sustainability of forest resources.

In this paper we have tested the following hypothesis :

H<sub>1</sub>: Women's participation in forest management improves the sustainability of the forest resources.

## ROLE OF WOMEN IN CPR COLLECTION IN THE STUDY AREA

Rural women are highly dependent on forest resources as it plays an important role in the viability and subsistence of the households. Every day early morning, groups of women set out towards the forest to collect firewood and several non-timber forest products like fruits, medicines etc. In Table 1 below, we depict the time spent by the household members in CPR collections and the employment days generated thereby. From the Table, we observe that in the study villages in Bankura and Purulia districts, out of total 873 adult members involved in CPR collections in the last 1 month, 485 members are female and 388 are male. This figure implies that the female adult members consider CPR collection as an important household activity as compared to the male adults in the study area. The time involved in CPR collection in the last 1 month in hours for the male and female members shown in the Table. The data reveals that female members of the household spent more time in CPR collections as compared to the male members in all the villages in the study area. The income generated by collection of CPRs by the household members supplement the total household income. In other words, collection of CPRs by the household members is a means of employment. We have depicted the average employment man days generated in collection of CPRs for both adult male and female. One man day is equivalent to 8 hours of work. Thus the average employment man days for male and female is calculated by dividing the time consumed by them in CPR collection by 8 and then dividing it with the number of household members. From the table, we observe that the average employment man days in CPR collection for male and female in the study villages of Bankura district is 8 and 11 man days per month respectively. Similarly, in the study

villages in Purulia district, the average employment man days in CPR collection for male and female are 6 and 8 man days per month respectively. We notice that the female adult members are involved in CPR collections to a much larger extent as compared to the male members. Further, the female members generate higher employment man days through CPR collections as compared to the male members in the household.

**Table: 1, Women and CPR Collection in Last one Month of the Date of Survey**

| District      | Name of village | No. of HouseHolds | No. of Adults involved in CPR Collection |        |       | No. of Children involved in CPR Collection |        |       | Time involved in CPR Collection in last 1 month (Hour) |        |       | Average Employment mandays Per member Per month in CPR collection |        |       |
|---------------|-----------------|-------------------|--|--------|-------|--|--------|-------|--|--------|-------|---|--------|-------|
|               |                 |                   | Male                                     | Female | Total | Male                                       | Female | Total | Male   | Female | Total | Male  | Female | Total |
| Bankura       | Panjhoria       | 26                | 32                                       | 34     | 66    | 0  | 0      | 0     | 1610   | 4069   | 5679  | 6   | 15     | 11    |
|               | Ramjibanpur     | 20                | 26                                       | 24     | 50    | 0  | 0      | 0     | 1828   | 2764   | 4592  | 9   | 14     | 11    |
|               | Seolibona       | 54                | 74                                       | 84     | 158   | 26   | 0      | 26    | 4412   | 7080   | 11492 | 7   | 11     | 9     |
|               | Baldanga        | 7                 | 9  | 8      | 17    | 0  | 0      | 0     | 615  | 740    | 1355  | 9   | 12     | 10    |
|               | Dulaltora       | 18                | 20                                       | 38     | 58    | 3  | 0      | 3     | 1350   | 2252   | 3602  | 8   | 7      | 8     |
|               | Tantirdanga     | 25                | 31                                       | 35     | 66    | 5  | 0      | 5     | 1911   | 2776   | 4687  | 8   | 10     | 9     |
| Purulia       | Jiyathole       | 81                | 103                                      | 146    | 249   | 2  | 0      | 2     | 5306   | 10521  | 15827 | 6   | 9      | 8     |
|               | Marbediya       | 25                | 35                                       | 44     | 79    | 2  | 0      | 2     | 1620   | 2565   | 4185  | 6   | 7      | 7     |
|               | Ambari          | 44                | 58                                       | 72     | 130   | 8  | 0      | 8     | 2070   | 4320   | 6390  | 4   | 8      | 6     |
| Bankura Total |                 | 150               | 192                                      | 223    | 415   | 34   | 0      | 34    | 11726  | 19681  | 31407 | 8   | 11     | 9     |
| Purulia Total |                 | 150               | 196                                      | 262    | 458   | 12   | 0      | 12    | 8996   | 17406  | 26402 | 6   | 8      | 7     |
| Grand Total   |                 | 300               | 388                                      | 485    | 873   | 46   | 0      | 46    | 20722  | 37087  | 57809 | 7   | 10     | 8     |

Source: Field Survey, 2011

Note: The Average Employment man days for male and female Per member Per month is calculated by dividing the time spent by them in CPR collection by 8 (One man day is equivalent to 8 hours job) and then dividing it again with the number of household members

## WOMEN'S PARTICIPATION IN FOREST RESOURCE MANAGEMENT

Government of India (GoI) had launched the Joint Forest Management programme in 1990 in order to conserve, protect the forest and also rejuvenate the degraded ones. JFM was initiated for sharing of products, responsibilities, control and decision making authority over forest lands between the local community and the forest department. JFM provided the opportunities for the forest dependent people to meet their subsistence requirement. It provided the users a stake in the forest benefits and a role in planning and management for sustainable development of the forest. However, due to social, economic and cultural constraints, participation of women in JFM program is limited. The lack of participation by women greatly reduced their opportunity to share information and knowledge. Further it also prevents them to voice their opinions. Thus several activities could negatively impact on both women and their use of the forests. Further, women's concerns weren't heard at JFM meetings, mainly due to the fact that men always decided the timing of the meetings. Even when women were physically present at meetings their views weren't heard and only the opinion of the men are taken into account (Patricia, *et al.*, 1998). While, the women are interested in ensuring increased and sustained availability of NTFPs, the men are generally interested in maximising monetary returns. The poor involvement of women also meant that the choice of species for planting in JFM areas was often decided by men, who chose cash profits over fuel and fodder yields. This reduced women's involvement and interest in the JFM program. In several cases information about the provisions, rules and responsibilities of JFM program are not communicated to the women folk.

The Forest Department staffs also do not make efforts to understand women's point of view and push them for active participation in the JFM program. The views of the women are not considered. For the women, participation in JFM meeting means loss of wage. No provisions are made for the security of the women taking active part in the JFM program. Women normally collect firewood from the forest and the forest department staffs often prohibit such activities in the protected areas. Since no alternatives are made for women who depend on the firewood for their income, they easily become resentful of JFM (Pathak, 2000).

In Table 2, we have depicted the participation in the Joint Forest Management in the study villages in 2010.

**Table: 2, Participation of Household Members of Study area in JFM**

| District             | Name of village | No. of Household members participation in JFM (2008) |           | No. of Household members participation in JFM (2009) |           | No. of Household members participation in JFM (2010) |            | No. of members involved in planning & decision making (2010) |           | No. of members involved in Implementation (2010) |           | No. of members involved in Benefit sharing (2010) |           | No. of members involved in Evaluation (2010) |          | No. of non-active members in JFM (2010) |           |
|----------------------|-----------------|--|-----------|--|-----------|--|------------|--|-----------|--|-----------|---|-----------|--|----------|---|-----------|
|                      |                 | Male   | Female    | Male   | Female    | Male   | Female     | Male   | Female    | Male   | Female    | Male  | Female    | Male   | Female   | Male                                    | Female    |
| Bankura              | Panjhoria       | 25   | 5         | 28   | 7         | 36   | 11         | 15   | 5         | 7  | 2         | 5   | 2         | 2  | 0        | 7                                       | 2         |
|                      | Ramjibanpur     | 9  | 0         | 10   | 2         | 12   | 2          | 8  | 2         | 0  | 0         | 0   | 0         | 2  | 0        | 2                                       | 0         |
|                      | Seolibona       | 36   | 10        | 42   | 12        | 51   | 18         | 23   | 12        | 10   | 0         | 10  | 4         | 4  | 0        | 4                                       | 2         |
|                      | Baldanga        | 3  | 0         | 3  | 0         | 4  | 0          | 3  | 0         | 0  | 0         | 0   | 0         | 0  | 0        | 1                                       | 0         |
|                      | Dulaltora       | 16   | 8         | 21   | 10        | 25   | 14         | 12   | 8         | 5  | 3         | 7   | 2         | 0  | 0        | 1                                       | 1         |
|                      | Tantirdanga     | 24   | 11        | 30   | 12        | 42   | 20         | 15   | 12        | 10   | 2         | 8   | 4         | 2  | 0        | 7                                       | 2         |
| Purulia              | Jiyathole       | 91   | 23        | 102  | 31        | 128  | 47         | 77   | 30        | 20   | 7         | 15  | 7         | 10   | 0        | 6                                       | 3         |
|                      | Marbediya       | 16   | 2         | 18   | 5         | 22   | 8          | 15   | 4         | 2  | 1         | 4   | 1         | 0  | 0        | 1                                       | 2         |
|                      | Ambari          | 34   | 15        | 41   | 18        | 55   | 25         | 20   | 10        | 12   | 4         | 12  | 8         | 5  | 0        | 6                                       | 3         |
| <b>Bankura Total</b> |                 | <b>113</b>   | <b>34</b> | <b>134</b>   | <b>43</b> | <b>170</b>   | <b>65</b>  | <b>76</b>  | <b>39</b> | <b>32</b>  | <b>7</b>  | <b>30</b>   | <b>12</b> | <b>10</b>                                    | <b>0</b> | <b>22</b>                               | <b>7</b>  |
| <b>Purulia Total</b> |                 | <b>141</b>   | <b>40</b> | <b>161</b>   | <b>54</b> | <b>205</b>   | <b>80</b>  | <b>112</b>   | <b>44</b> | <b>34</b>  | <b>12</b> | <b>31</b>   | <b>16</b> | <b>15</b>                                    | <b>0</b> | <b>13</b>                               | <b>8</b>  |
| <b>Grand Total</b>   |                 | <b>254</b>   | <b>74</b> | <b>295</b>   | <b>97</b> | <b>375</b>   | <b>145</b> | <b>188</b>   | <b>83</b> | <b>66</b>  | <b>19</b> | <b>61</b>   | <b>28</b> | <b>25</b>                                    | <b>0</b> | <b>35</b>                               | <b>15</b> |

Source: Field Survey, 2011

From Table 2, we observe that the participation of the female members in JFM is 65 in Bankura district and 80 in Purulia district which is very low as compared to the male members. However the participation of the female members in JFM has increased during the last 3 years in both the districts. Majority of the household members actively participating in the JFM are involved in the planning & decision making stage only. The number of members involved in implementation, benefit sharing and evaluation is very low. It is also observed that there are a sizeable number of household members who are not active participants in the JFM and therefore they are not active members. Participation of the female members is restricted to the planning and decision making stage only.

## WOMEN'S PARTICIPATION IN JFM AND SUSTAINABILITY IN FOREST RESOURCES

From our study area, we have observed that women members spent more time in CPR collection as compared to their male counterpart and female headed household depend more on CPR collections as compared to the male headed households to supplement their household income. Hence forest degradation affects the women member badly and thus they are very much concerned about forest resource sustainability. Therefore we have assumed that active participation of women member in JFM have a positive impact on sustainability of forest resources. However, sustainability of forest

resources also depends on some socio-economic variables like sex ratio, female headed household, female literacy, per capita cattle unit, dependency ratio, market pressure and imposition of fine on CPR rule breakers.

As women are major users of forest resources, they should involve themselves in planning, decision making and implementation of the forest conservation programme. Participation of women in JFM includes reforestation work and protection of plantation, freely grazing livestock and illicit removal of forest products. Hence sustainability of forest resources depends on active participation of women in JFM. In addition to examining the importance of women's participation in JFM, we have also considered some demographic factors such as family size, sex ratio, gender gap in education, male headed household etc. and market pressures. We have also examined their influence on forest conservations.

In this section we have identified these factors within rural household and villages determining the sustainability of forest resources through econometric analysis to give an understanding between active participation of women in JFM and sustainability of forest resources (*SFOREST*).

### Sustainability of Forest Resources

*SFOREST* = *f* (Family size, Sex ratio, Active participation of women in JFM, Gender gap in education, Number of male household head, market pressures)

We have used a Binary Probit regression model to examine the determinants of sustainability of forest resources.

Our Specified model is:

$$SFOREST = \alpha_0 + \alpha_1 SEXR + \alpha_2 FHEAD + \alpha_3 FLIT + \alpha_4 DEPR + \alpha_5 PCATTLE + \alpha_6 WACTPM + \alpha_7 DISM + \alpha_8 PUNSHM + \epsilon \dots\dots\dots(1)$$

Here the dependent variable is, *SFOREST*.

Sustainability is measured on the basis of the data collected in the village survey from three different variables:

- i. Regulate illicit grazing
- ii. Control the extensive removal of forest products
- iii. Regenerate the allotted forest

All these three variables is a dichotomous variable where we coded 'Yes' response as '1' and a 'No' response as '0'. To construct the sustainability of forest index, we have created a dummy variable that takes the value of '1' if all the three variables related to forest sustainability have value '1' and otherwise have value '0'. Thus if the responses to all the three variables were 'Yes', the value of sustainability of forest index would be '1'. If one of the variables were coded as '0', the value would be '0'.

The Explanatory variables are defined in Table 3 below:

**Table: 3, Description of Variables in Binary Probit Model**

| Explanatory variables | Description   | Expected Sign |
|-----------------------|---|---------------|
| <i>SEXR</i>           | Sex Ratio i.e. ratio of the female to male in the household   | +             |
| <i>FHEAD</i>          | Female Headed Household<br><i>FHEAD</i> =1, if the household head is female<br><i>FHEAD</i> =0, if the household head is male   | +             |
| <i>FLIT</i>           | Female Literacy rate i.e. number of years of schooling of the female members of the household   | +             |
| <i>DEPR</i>           | Dependency Ratio which indicates the employment condition of the household i.e. proportion of number of non-working members to the total number of family members in the household  | –             |
| <i>PCATTLE</i>        | Per Capita cattle unit which is the ratio of cattle unit to the family size i.e. 1 cattle unit= 1 bullock /cow or 4 goats or 4 pigs or 100 chicken /hens/ducks  | –             |
| <i>WACTPM</i>         | Number of women member actively participating in the Joint Forest Management. Active participation of women implies they participate in meetings of the forest protection committees; they are involved in planning, decision making and implementation of the forest conservation programme. | +             |
| <i>DISM</i>           | Distance to the closest market (in km); i.e. measure of market pressures by variation in distance from markets  | +             |
| <i>PUNSHM</i>         | Punishment against violation of CPR rules<br><i>PUNSHM</i> =1, if the JFM committee impose fines on members who break CPR rules<br><i>PUNSHM</i> =0, if no fine is imposed on members who violates CPR rules  | +             |

Here  $\alpha_0$  is constant and  $\alpha_i$  ( $i = 1, 2, \dots, 8$ ) are the coefficients associated with the explanatory variables and  $\epsilon$  is the random disturbance term.

## RESULTS AND DISCUSSIONS

We have tested this regression equation using household level data collected through field survey in Bankura and Purulia districts in West Bengal. We have estimated the regression equation by binary probit model using EViews 7 economic software. The results of our analysis are presented in Table 7.5 and Table 7.6.



**Table: 4, Determinants of Forest Sustainability**

| <b>(Bankura District)</b>                            |             |            |             |        |
|--|-------------|------------|-------------|--------|
| Dependent Variable: SFOREST                          |             |            |             |        |
| Method: ML - Binary Probit (Quadratic hill climbing) |             |            |             |        |
| Sample: 1 150; Included observations: 150            |             |            |             |        |
| Covariance matrix computed using second derivatives  |             |            |             |        |
| Variable   | Coefficient | Std. Error | z-Statistic | Prob.  |
| C  | -6.426145   | 2.913384   | -2.205732** | 0.0274 |
| SEXR   | 3.186774    | 1.712963   | 1.860387*** | 0.0628 |
| FHEAD  | -0.056348   | 1.350760   | -0.041716   | 0.9667 |
| FLIT   | 1.043060    | 0.603126   | 1.729421*** | 0.0837 |
| DEPR   | -2.701982   | 2.273579   | -1.188427   | 0.2347 |
| PCATTLE  | 0.623331    | 1.037894   | 0.600572    | 0.5481 |
| WACTPM   | 1.062673    | 0.595308   | 1.785081*** | 0.0742 |
| DISM   | -0.440801   | 0.646270   | -0.682069   | 0.4952 |
| PUNSHM   | 3.724002    | 1.624603   | 2.292254**  | 0.0219 |

|                       |          |                       |           |
|-----------------------|----------|-----------------------|-----------|
| McFadden R-squared    | 0.922108 | Mean dependent var    | 0.426667  |
| S.D. dependent var    | 0.496250 | S.E. of regression    | 0.133702  |
| Akaike info criterion | 0.226300 | Sum squared resid     | 2.520560  |
| Schwarz criterion     | 0.406938 | Log likelihood        | -7.972472 |
| Hannan-Quinn criter.  | 0.299687 | Deviance              | 15.94494  |
| Restr. deviance       | 204.7058 | Restr. log likelihood | -102.3529 |
| LR statistic          | 188.7609 | Avg. log likelihood   | -0.053150 |
| Prob(LR statistic)    | 0.000000 |                       |           |

|                |    |           |  |     |
|----------------|----|-----------|--|-----|
|                |    |           |  |     |
| Obs with Dep=0 | 86 | Total obs |  | 150 |
| Obs with Dep=1 | 64 |           |  |     |

\*Significant at 1 percent level, \*\* Significant at 5 percent level, \*\*\* Significant at 10 percent level

Source: Estimated by EViews 7 computer software using field survey data of 2011



**Table: 5, Determinants of Forest Sustainability  
(Purulia District)**

|  |  |  |
|--|--|--|
| Dependent Variable: SFOREST                          |  |  |
| Method: ML - Binary Probit (Quadratic hill climbing) |  |  |
| Sample: 1 150  |  |  |
| Included observations: 150                           |  |  |
| Covariance matrix computed using second derivatives  |  |  |

| Variable | Coefficient | Std. Error | z-Statistic | Prob.  |
|----------|-------------|------------|-------------|--------|
| C        | -0.838492   | 0.906073   | -0.925413   | 0.3548 |
| SEXR     | 0.041166    | 0.275027   | 0.149681    | 0.8810 |
| FHEAD    | 1.092519    | 0.528422   | 2.067511**  | 0.0387 |
| FLIT     | 0.404143    | 0.156220   | 2.587015*   | 0.0097 |
| DEPR     | -4.668060   | 1.366426   | -3.416256*  | 0.0006 |
| PCATTLE  | 0.075123    | 0.565857   | 0.132760    | 0.8944 |
| WACTPM   | 1.162318    | 0.450463   | 2.580275*   | 0.0099 |
| DISM     | -0.026964   | 0.276332   | -0.097577   | 0.9223 |
| PUNSHM   | 1.226608    | 0.482273   | 2.543390**  | 0.0110 |

|                       |          |                       |           |
|-----------------------|----------|-----------------------|-----------|
| McFadden R-squared    | 0.792005 | Mean dependent var    | 0.486667  |
| S.D. dependent var    | 0.501497 | S.E. of regression    | 0.202104  |
| Akaike info criterion | 0.408195 | Sum squared resid     | 5.759286  |
| Schwarz criterion     | 0.588833 | Log likelihood        | -21.61462 |
| Hannan-Quinn criter.  | 0.481582 | Deviance              | 43.22924  |
| Restr. deviance       | 207.8375 | Restr. log likelihood | -103.9187 |
| LR statistic          | 164.6082 | Avg. log likelihood   | -0.144097 |
| riProb(LR statistic)  | 0.000000 |                       |           |

|                       |           |           |     |
|-----------------------|-----------|-----------|-----|
| Obs with Dep=0        | 77        | Total obs | 150 |
| <b>Obs with Dep=1</b> | <b>73</b> |           |     |

\*Significant at 1 percent level, \*\* Significant at 5 percent level, \*\*\* Significant at 10 percent level  
Source: Estimated by EViews 7 computer software using field survey data of 2011

From the above tables 4 & 5, we observe that in most of the cases, the results are consistent. However, in some cases we have got contradictory results. As expected, Sex Ratio (*SEXR*) has been found to have a positive influence on Sustainability of forest resources in Bankura and Purulia district. As the number of female members in the family increases relative to the male members, the Sex Ratio increases. Since the women are mainly involved in collection of forest products, the forest degradation affects them badly and they are more conscious about forest conservation. Therefore we observe that there is a positive relation between Sex Ratio and sustainability of forest resources. Our result is significant in Bankura district but insignificant in Purulia district. In the case of female headed households (*FHEAD*), we noticed positive relation with sustainability of forest resources as female members are more interested to improve forest quality. In line with our expectation, we have observed positive and significant result in Purulia district. However, the impact is negative and insignificant in Bankura district.

The regression results shows a positive relationship between female literacy (*FLIT*) and sustainability of forest resources. As expected we observe that the coefficient of female literacy has positive and significant impact on sustainability of forest resources in both the districts. In fact educated female members understand the importance of forest conservation. Hence with increase in female literacy the probability of forest sustainability also increases.

In line with our expectation, Dependency Ratio (*DEPR*) is found to be negative in case of forest resource conservation. As dependent member increases in the family, burden on the forest products increases which ultimately decreases the probability of forest resource sustainability. The result is significant in Purulia district and insignificant in Bankura district.

From the regression analysis, we observe that there is a positive relationship between per capita cattle unit (*PCATTLE*) and sustainability of forest resources. In fact, household with higher per capita cattle unit collect more fodder to feed animals and require higher quantity of fuel wood to prepare concentrated food for the animals. Hence there is a negative relation between the two. However, in contrary to our expectation, we have observed positive but insignificant results in both the districts. It may be possible that household having large number of cattle become more conscious about forest conservation for the survival of their livestock. In the case of distance to the closest market (*DISM*) we assume that when markets are nearer, the motivation for extraction of forest resources is much greater. Contrary to our expectation, *DISM* has a negative impact on sustainability of forest resources in both the districts suggesting that as distance to markets decreases; control of forest degradation is more prominent. This can be explained by the fact that as distance to market decreases, the probability of inspection of Government officials to monitor the forest protection committee increases. As expected, punishment against CPR rule breakers (*PUNSHM*) has positive and significant impact on forest resource sustainability in both the districts. In fact, if forest protection committee imposes fine on rule breakers, illegal extraction of CPR products is controlled.

The most important finding of this study is impact of active participation of women member in JFM (*WACTPM*) on sustainability of forest resources and the result has been found to be positive and significant in both the districts. Greater and effective involvement of women member in planning, decision making and implementation activities improve the forest quality. Since the women are involved in collection of NTFPs like firewood and fodder which is their means of subsistence and also a source of income, they are more likely to prevent illegal harvesting of the forest products. It is also observed that men who are engaged in patrolling the common forest find it difficult to apprehend women who involve in indiscriminate use of the forest resources. Thus the patrol team should consist of both men and women.

The results advocate that gender equity in participation in JFM enhances sustainable governance of the forest resources.

## CONCLUSION

Our study has investigated the impact of women's active participation in JFM on sustainability of forest resources in our surveyed villages of Bankura and Purulia districts in West Bengal. The result of the survey indicates that female members generate higher employment man days through CPR collection in comparisons with male members of the household. Despite the fact that the women are the major users of the common property resources, their involvement in Joint Forest Management is negligible. We have estimated the impact of women's active participation in JFM on sustainability of forest resources through binary probit model using EViews 7 economic software. The most important finding of this study is the positive and significant impact of active participation of women member in JFM on sustainability of forest resources in both the districts, which is consistent with our hypothesis. Hence, women are more concerned about the improvement of regeneration of forest resources. Further women should participate in patrolling the forest with male guards and thus prevent illegal extraction of forest resources in a better way. Therefore we conclude that gender equity in JFM participation improves the sustainability of forest resources.

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