AGRICULTURAL RISK, COMMON FOREST RESOURCES AND RURAL LIVELIHOOD: A MICRO STUDY IN WEST BENGAL, INDIA

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ABSTRACT

The main occupation of the rural householdsin the state of West Bengal, India is agriculture. However in this region there are several types of risks associated with the harvesting of crops such as weather, seasonal flooding, unpredictable soil quality, crop diseases, price shocks and forest pests. Under these circumstances, forest acts as a security especially against crop failure. Based on a primary survey of total 300 households covering 9 villages under Bankura and Purulia districts of West Bengal, India we investigated and analysed the impact of agricultural risks on the collection of common forest products using Count Data Model technique. Empirical evidence of our study reveals that forest products supplement the rural livelihood and acts as safety net for the poor seasonally or during the agricultural crisis.

Key words: Agricultural risk, Livelihood, Common Property Forest Resources, Safety net, Non-Timber Forest Product (NTFP)

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Introduction

Agriculture is the predominant economic activity in the state of West Bengal in India. However there is wide fluctuation in the agricultural productivity in many parts of West Bengal. The problem of fluctuating crop yield can be attributed to vagaries of the weather and land degradation in the form of soil erosion, salinity, water logging, etc. The yield is also affected by outbreak of crop diseases, pests and other hazards like flood, droughts and fire. In our study villages in the districts of Bankura and Purulia in West Bengal, the rural households are heavily dependent on agriculture. These districts have the problem of 'dry land' which have low moisture retaining capacity in the soil, thereby leading to fluctuating crop productivity. Water storage facilities which are the 'lifeline' of irrigation are also lacking in many parts of Purulia and Bankura districts. Crop failure also occurs due to low rainfall. The instability in the crop production raises the agricultural risk which adversely affects the livelihood and income of the rural households and in turn also effects their decision to use high technology in farming, thereby impeding the development process. The fluctuating crop production also affects the price stability. The rural households have to incur costs for smoothening consumption across income shocks. The households therefore look for safety net to mitigate the income shocks.Households having limited credit and insurance facility, extract Non Timber Forest Products (NTFP) which not only reduce their agricultural risk but also help to smooth out their consumption. Hence NTFP has a supporting role in the wellbeing of the rural poor in the form of 'natural insurance'. By collecting NTFP, rural households smooth their income as well as consumption in the period of agricultural shortfall. CPRs are vital resources for the poor primarily because the cost of using the CPRs are low and these involve only human labour as the input.In rural area, Common Property Resources (CPRs) are critical resources for the poor households.

Several literatures have discussed the importance of Common Property Resources as insurance. Pattanayak and Sills (2001) had put forth a positive correlation between collection of NTFP, shortfall in agriculture and the expected agricultural risk. The advantage of Common Property Resources arises because of its superior insurance properties which tend to provide income maintenance to the rural poor (Baland and Francois, 2004). A study on the potential impact of extraction of NTFP on land use choice was carried out by Delacote (2009).

The study revealed that the rural poor collect forest products in order to reduce the agricultural risk. If the agricultural risk is reduced, then the households reduce the size of the safety activity thereby being less dependent on the forest products as compared to agricultural activities. Based on the field survey of 300 riverine rural households in eight villages in Pacaya-Samiria National Reserve (PSNR) in north-eastern Peru, Takasaki *et al*. (2002) analysed their asset holdings during covariate flood and major heath shocks. Gathering of forest products, hunting and fishing are the primary risk coping strategies adopted by the households. The extraction of natural resources as a coping strategy is shaped by local environmental endowments. Based on the survey of 116 Tawahka rural households in Eastern Honduras, McSweeny (2004)observes that the rural poor sell forest products not only to smooth their income but also to meet sudden cash requirements during any health and agricultural crisis.

In Indian context we also observed a positive relationship between agricultural risk and forest resource collection. Jodha (1978) observes that the rural households adopt different adjustment mechanism like reduction in consumption levels, asset depletion & replenishment, periodic out migration and traditional informal cooperation. However, the shortfall in agricultural production is mitigated by collection of common forest products. Dasgupta and Mäler (1994) had emphasised that the common property resources provide the rural poor with partial protection in time of unusual economic stress. In the study of tribal groups of Bihar, Agarwal, (1991) revealed that communally held forests provided the only means of subsistence during income shocks. This natural insurance brings an important twist to the discussion by connecting rural poverty in risky environments with environmental degradation (Dasgupta, 1993; Duraiappah, 1996). During a localised drought in eastern Gujarat, majority of the population who experienced acute shortage of food sold trees to buy food and meet their subsistence (Conroy 1991). The smoothing of the income of the households arising due to agricultural shocks is done by the labour markets allowing the households to shift labour from farm to off-farm employment (Kochar 1999).

In our study area of Bankura and Purulia districts of West Bengal, agricultural activities are subjected to low fertility of soil, scarcity of water and high dependence on weather. This results in wide variability in production and productivity in agriculture. Due to the non-availability of alternate income opportunities, the farmers in the study area fall back on Common Property Resources to mitigate the agricultural risk. Under this circumstance, the objective of our study is to determine how and to what extent the agricultural shortfall affects the collection of forest

products.Another important objective is to examine the inter relationship among agricultural risk, non-timber forest collection and the extent of rural poverty.The rest of the chapter is arranged as follows: Section 2 presents an overview of the primary data and methodology. Section 3 focuses on the nature of agriculture in our study area and dependency of forest community on forest resources. We have discussed Regression results in Section 4. Section 5 gives the concluding remarks of the study.

Data and Methodology

The study is based on primary data collected from field survey on Common Property Resources conducted in Bankura and Purulia district in 2011. We have chosen two blocks viz. Saltora in Bankura district and Santuri in Purulia district. The blocks have been selected purposively 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, Dulaltoraand 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 these villages were in close proximity to the forest area and it was presumed that the collection and dependency on CPRs in these villages are very high.

Majority of the household respondents have listed agriculture as one of their primary sources of income. Paddy is their main crop.The households face agricultural risks which are primarily due to weather risk i.e. rising temperature, erratic rainfall pattern and increase in severity of drought, flood and cyclones.Therefore the rural households having limited credit and insurance facilities have to depend on common property resources at the time of agricultural crisis. These characteristic of the surveyed area makes it an ideal setting for testing the hypothesis on natural insurance.

We have measured agricultural output in terms of rice equivalent production of agricultural crops. We have collected the data on agricultural production for the current year and last two consecutive years to determine the agricultural shortfall and risk. We have also collected the data

on different types of CPR products which are collected by the rural households and the total time spent for the collection of the forest products by each family unit (monthly basis on an average) for the same period. We have used a tabular method to quantify the pattern of agriculture and the relationship between agricultural risk and common property resources in the surveyed area. The importance of CPR as a safety net during agricultural risk has been analysed using count data model technique.

Agricultural Risks and Forest Product Collection: The Conceptual Framework

CPRs play a vital role to the rural livelihood and act as safety net for the rural poor in the period of agricultural crisis. Here we primarily focus on the livelihoods of agricultural households who live very close to publicly owned tropical forest and collection of non-timber forest products is a means to smooth their income and consumption.

In poor forest economy, forest collection appears to be a shock absorption mechanism especially under the situation of crop failures. The poor inhabitants move to the forest for the collection of NTFP. However, in the good harvesting period, they intend to generate surplus (savings) which act as an insurance for mitigating the future agricultural risk.

Household maximises utility (u) subject to the production constraint, time constraints and budget constraints. Solving this maximising problem using the lagrangian method, we can describe household forest collection in a reduced form of labour demand equation (following Pattanayak & Sills, 2001).

$$N_F^d = n\ \ P_N \,|\, \xi, X, H_C, F$$

where P_N = Opportunity cost of time as measured by off-farm wages in a complete market

ξ = Agricultural risks

X = Exogenous income

H_C = Household characteristics

F = Forest quality

Demand is downward sloping in P_N which reflects the opportunity cost of time and the response to off-farm opportunities will be conditional upon ξ, X, H_C and F. There is a positive correlation between forest collection labour and agricultural risks.

The extraction of forest products depend on the factors relating to household and village characteristics i.e. family size, age, education, own land, livestock unit, distance between forest and houses, etc. as well as agricultural risk and shortfall of that year.The reduced form of labour demand equation $N_F^d = n\ P_N \left| \xi, X, H_C, F \right.$ allows us to test the signs and significance of the coefficients. Our intention is to examine the impact of agricultural risk on the collection of forest products. To capture the impact of agricultural risk on CPR collection, we shall consider the Count Data model.

The Empirical Specification: The Count Data Model

The Forest Collection Labour is measured by the number of major forest collection trips during the survey year. As the number of trips to collect forest products is a non-negative, integer valued variable, we have applied Count Data Model using STATA computer software package. In our survey area, majority of the households collect forest products. However in the case of wealthier households, they are not themselves involved in forest collection trips. Therefore we observed zero trip for few households in Bankura and Purulia districts.

As the count model very often detect over dispersion or variance greater than the mean, it is easier to estimate the parameter with maximum likelihood techniques.First we have applied Poisson Regression model. The common alternative of Poisson regression model is negative binomial.

In the case of our survey data, some households take zero trip to the forest. Thus the number of zeros may be inflated and the number of household taking zero trip cannot be explained in the same manner as the number of households taking more than zero trip. A Standard Negative Binomial model would not distinguish between these two processes, but a zero inflated model allows for and accommodates this complication. To analyse such type of data set, a Zero Inflated Negative Binomial model should be considered. A Zero Inflated Negative Binomial model assumes that zero outcomes is due to two different processes (Greene, 2003). In our case the two

processes are that the household taking the trip to collect CPR versus not taking any trip. If not taking any trip, the only possible outcome is zero. If taking trips to collect CPR, it is then a count process. In Zero Inflated Negative Binomial model we use the logistic distribution for the first stage and Binomial distribution for the second stage. Here we have explained whether a household takes any trips, as well as additional variables likely to explain whether a household correctly reports whether it takes any trips. The expected count is expressed as a combination of the two processes:

E (to take a trip) = $prob$ (not take any trip)*0 + $prob$ (take any trips)* $E(y = x|$ take any trip)

The Count Data Model is specified as follows:

$$FCL = \alpha_0 + \alpha_1 AGEHEAD + \alpha_2 SQAGEH + \alpha_3 FAMSIZE + \alpha_4 AVRSCH + \alpha_5 LIVESTOCK + \alpha_6 FORESTDIST + \alpha_7 AGRSHLFALL + \alpha_8 AGRIRISK + \alpha_9 WAGE + \in$$

where FCL (Forest Collection Labour) is dependent Variable which is measured by the number of major forest collection trips during the survey year. Here α_0 is the constant, α_i are constant coefficients associated with the explanatory variables and $\in$ is the random disturbance term.

Explanatory variables, their description and expected correlations of the dependent and independent variables are given in Table 1 below:

TABLE 1

Variable Name	Variable Description	Expected sign
Dependent Variable 1. *FCL*	Forest Collection labour which is measured by the total number of major forest collection trips during the survey year	
Explanatory Variables 1. *AGEHEAD*	Age of household head (in years)	+
2. *SQAGEH*	Square age of household head which is a measure of experience in collecting CPR	+
3. *FAMSIZE*	Average number of population of the household (Size of the family)	+

4. *AVRSCH*	Education which is measured by the average years of schooling (no. of years) of household	-
5. *LIVESTOCK*	No. of livestock owned by the household converted into animal units which is a measure of wealth	-
6. *FORESTDIST*	Distance of the CPR field from the residence of the household (Km) as measure of forest quality	-
7. *AGRSHTFALL*	Agricultural shortfall which we measure from the actual agricultural production in terms of rice (Kg) in the survey year and Mean agricultural production in one normal year, i.e. $\frac{(\text{Actual Agri. Prod.} - \text{Mean Agri. Prod.}) \times 100}{\text{Actual Agri. Prod}}$	+
8. *AGRIRISK*	Coefficient of variation of agricultural production over the last 5 years is a measure of agricultural risk	+
9. *WAGE*	Annual Wage income of the household (in Rs)	-

Nature of Agriculture in the Study Area

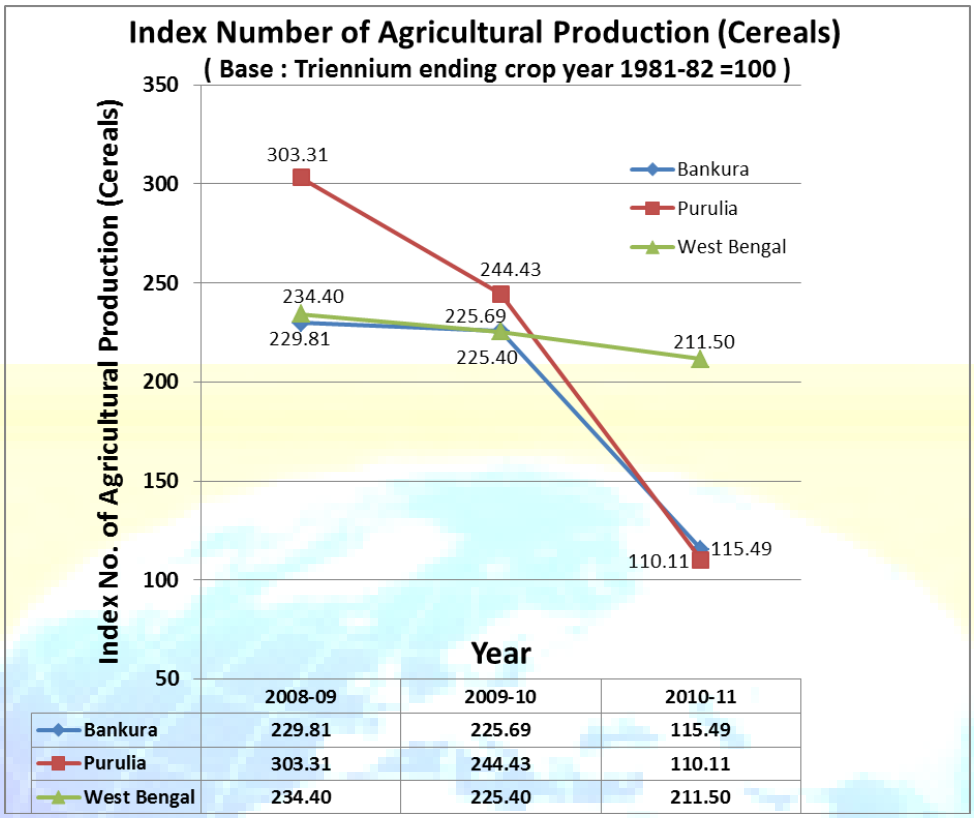
The study has been conducted in two districts of West Bengal.Bankura district is part of the Burdwan Division in the state of West Bengal with an area of 688200 hectare. It has primarily two Agro Climatic Zones, viz. undulating red & lateritic zone and Vindhyan Alluvial Zone. Agriculture in this zone is mainly dependent on rain. In this region more than one crop is harvested by utilizing canal irrigation and ground water. Agriculture accounts for almost 70 percent of the district's income. Most of the farmers are small & marginal. A vast area of Bankura district is not cultivable due to undulation of land. However, some land is fertile and due to availability of sufficient water from canal or deep tube wells, cultivation is done. Bankura district has a net cultivable land of around 4.3 lakhs hectare and around 4.47 lakhs cultivators. The principal crop of Bankura district is paddy, wheat, oil seeds and vegetables. Agriculture is largely dependent on the vagaries of monsoon. Drought constitutes a major hazard in the district.

Agriculture is the main source of livelihood in the district of Purulia. About 70 per cent of the total agricultural holdings belong to small and marginal farmers. Most rural households practice subsistence farming under adverse and riskyenvironmental conditions. The natural resource base can be characterized as poorly suited toagriculture due to climatic, water resource, and soil conditions.Due to the topography of the districts, the rivers Kanshabati, Damodar and Dwarakeshwar flowing provide little irrigation facilities. Soil erosion and erratic and scanty rainfall are the major stumbling block in successful irrigation in the district. Irrigation is mainly done through with the help of tanks and *bundhs*, which are embankments of accumulated run-off rain water. Cultivation is predominantly done on a single crop. Paddy is the main crop of the district. Besides paddy, maize, sugarcane, groundnut and pulses are other important crops grown in this district.

The agricultural production in Bankura and Purulia districts vis a vis the state of West Bengal for the year 2008-09, 2009-10 and 2010-11 is illustrated in Figure 1 below:

FIGURE 1

Index Number of Agricultural Production (Cereals)
(Base: Triennium ending crop year 1981-82 =100)



Source: Bureau of Applied Economics and Statistics, Government of West Bengal

The agricultural production (cereals) have been depicted in terms of Index number with a base of Triennium ending crop year 1981-82=100. As is evident from the figure above, the production of cereals has shown a downward trend for the years 2008-09, 2009-10 and 2010-11 in the districts of Bankura and Purulia. Similar trend in production of cereals is also observed in the state of West Bengal. The drastic lowering of production of cereals during the period 2010-11 in the districts of Bankura and Purulia can be attributed to meager rainfall during the said period. It is further observed that during the year 2010-11, the production of cereals in Bankura and Purulia is much lower as compared to that for the State average. This is primarily due to the fact that compared to other districts; Banakura and Pululia are dependent entirely on rainfall for cultivation.

Table 2 illustrates the land ownership pattern in the surveyed villages in the district of Bankura and Purulia.

TABLE: 2

Land Ownership Pattern

		BANKURA	PURULIA	TOTAL
1	No. of Households	150	150	**300**
2	Total area of lease in land (Hectare)	28.47	7.09	**35.56**
3	Total area of lease out land (Hectare)	0.28	0.27	**0.55**
4	Total area of ownland (Hectare)	14.48	35.49	**49.97**
5	Total area of operated land (Hectare)	42.66	42.31	**84.98**

Source: Field Survey, 2011

The total area of 'lease in' land for the 300 surveyed households of Bankura and Pululia district is 28.47 hectare and 7.09 hectare respectively which is in sharp contrast to the area of 'own land' which is 14.48 hectare and 35.49 hectare respectively (Table 2). The above data shows that the households in the surveyed villages of Bankura are poor and therefore they have very meagre land of their own. Theses households have to 'lease in' the land for cultivation and meet their ends. The households in the surveyed villages of Purulia seem to be better off as compared to the surveyed villages of Bakura. These households have comparatively larger 'own land' and therefore the area of 'leased in' land is less.

The land ownership pattern for the own land in the surveyed villages of Bankura and Purulia has been illustrated in Table 3 below. Here we have considered different size class based on the area of the own land. The different size class used are i) 0 hectare i.e. landless farmers ii) 0-0.25 hectare iii) 0.25-0.50 hectare iv) 0.50-0.75 hectare v) 0.75-1.0 hectare vi) above 1.0 hectare.

TABLE 3

Land Ownership Pattern (Own Land)

BANKURA

Size Class (in hectare)	No. of holdings	Percentage of holding	Cummulative percentage of holdings X_t	Area of own land (Hectare)	Pecentage of area	Cummulative percentage of area of own land Y_t	Gini Coefficient
0	66	44.0	44.0	0.00	0	0.0	0.527067773
0 - 0.25	70	46.7	90.7	9.83	68.0	68.0	
0.25 - 0.50	13	8.7	99.3	4.13	28.6	96.5	
0.50 - 0.75	1	0.7	100	0.50	3.5	100	
0.75- 1.0	0	0	100	0.00	0	100	
> 1.0	0	0	100	0.00	0	100	
Total	**150**	**100**		**14.46**	**100**		

PURULIA

Size Class (in hectare)	No. of holdings	Percentage of holding	Cummulative percentage of holdings X_t	Area of own land (Hectare)	Pecentage of area	Cummulative percentage of area of own land Y_t	Gini Coefficient
0	10	6.7	6.7	0.00	0.0	0.0	0.330582934
0 - 0.25	89	59.3	66.0	13.91	39.2	39.2	
0.25 - 0.50	41	27.3	93.3	13.80	38.9	78.0	
0.50 - 0.75	5	3.3	96.7	2.88	8.1	86.1	
0.75- 1.0	3	2.0	98.7	2.80	7.9	94.0	
> 1.0	2	1.3	100	2.12	6.0	**100**	
Total	**150**	**100**		**35.51**	**100**		

Source: Field Survey, 2011

From Table 3 above, we can infer that 44 percent of the surveyed households in the Bankura district and 6.7 percent in Purulia district have no 'own land'. It can also be observed that 90.7 percent of the surveyed households in the district of Bankura belong to landless and marginal size own land holders (0-0.25 hectare) and they cater to 68 percent of the total own land. There are no large size (>1 hectare) own land holders. This implies that majority of the households have almost equally very small area of own land which indicates that households are extremely poor and have fragmented land. Survey results show that 93.3 percent of the surveyed households in the district of Purulia have 'own land' in the range of 0-0.50 hectare which account for 78 percent of the total own land, whereas only 1.3 percent of the surveyed households belong to large size group (> 1 hectare) having 6 percent of the total own land. The Gini coefficient which shows the degree of inequality in the distribution of 'own land' holding is 0.52 in Bankura district and 0.33 in Purulia district which implies Bankura district has high degree of inequality in the ownership distribution of land owners as compared to Purulia district.

However, the field survey data reveals that majority of the households have almost equally small area of operated land in both the districts.

Agricultural Productivity

Paddy is the main crop cultivated in the study area. Besides paddy, oil seeds and few vegetables are also grown. The surveyed villages are prone to drought; their lands are infertile; and they lack proper irrigation facilities. Hence the villagers cultivate only single crop annually. The agricultural productivity in the surveyed villages in the district of Bankura and Purulia is illustrated in Table 4 below:

TABLE 4

Crop Productivity

District	Block	Name of village	Household category (no. of HH)	Total area of operated land (L) (Hectare)	Total Agricultural Production in 2010 (P) in terms of Paddy (Kg)	Crop Yield (Y) = P / L (Kg/Hectare)
Bankura	Saltora	Panjhoria	26	7.06	14,610	2,069
		Ramjibanpur	20	5.74	12,000	2,091
		Seolibona	54	15.59	34,440	2,209
		Baldanga	7	1.60	3,500	2,188
		Dulaltora	18	6.20	13,720	2,213
		Tantirdanga	25	6.48	13,200	2,037
Purulia	Santuri	Jiyathole	81	20.09	34,680	1,726
		Marbediya	25	8.83	11,074	1,254
		Ambari	44	12.72	20,606	1,620
Bankura Total			**150**	**42.67**	**91,470**	**2,144**
Purulia Total			**150**	**41.64**	**66,360**	**1,594**
Grand Total			**300**	**84.31**	**1,57,830**	**1,872**

Source: Field Survey, 2011

In agriculture, crop yield (Y), is the output of a crop per unit area of land cultivated. The unit by which the yield of a crop is measured is kilogram per hectare.From the Table 4, we observe that in the 6 villages of Bankura the yield ranges from 2037 to 2213 kg/hectare. The average yield in the surveyed villages of Bankura is 2144 kg/hectare. In contrast, in the 3 villages of Purulia the yield ranges from 1254-1726 kg/hectare. The average yield in the surveyed villages of Purulia is 1594 kg/hectare. From the Table we can infer that the average yield of Purulia is lower than that of Bankura. The average yield of the 9 surveyed villages is 1872 kg/hectare, which is significantly low as compared to the state average of 2708 kg/hectare in 2010-11.

Common Property Forest Resources and Rural Livelihood

The rural poor in the study villages are largely dependent on the common property forest resources for their subsistence. Common Property Resources act like a life support for all the households in all the villages in the study area. The rural poor have access to various common property resources like fuel wood, dry leaves, shrubs, dung cakes, etc. which are mainly used for cooking and heating; bamboos, canes, logs from trees, dry leaves are used for construction of houses; shrubs and grasses are used as fodder for the animals; fruits, vegetables, fishes, root, meat from hunted birds and animals are used for consumptions as well as for sale. Few plants and roots are also used for medicinal purposes for curing several ailments. These common property resources are means of subsistence for all the households in the study villages.The economic importance of Non Timber Forest Products in the livelihood of the rural poor can be analysed in two different dimensions: i) The rural poor collect NTFPs for their own consumption which they get it free of cost, but have to pay money if they purchase those products from the market; ii) The rural households collect NTFPs for commercial purposes, which is a source of income for them utilised for various purposes.

Majority of the households in the surveyed villages earn their living through agriculture and wage labour. Due to less than normal rainfall (2010), the production of paddy has been almost one third of that of normal. Common property resources, mainly forest resources, have a critical role in rural livelihood in our study villages. The field survey data reveals that around 19.04 percent of the household income in Bankura district and around 18.11 percent in Purulia district is coming from the CPR based activities. On the other hand, the percentage of the value of CPR consumed to the total monthly consumption expenditure is around 22.29 percent and 20.17 percent in the two districts respectively with an average percentage of 21.28 percent. CPRs play an important role in employment generation. An average household could generate around 116 and 95 employment man days annually from CPR based activities in the study villages of Bankura and Purulia district respectively.In the study villages, the households have very little access to commercial fuels like coal, kerosene, electricity and cooking gas and hence they collect fuel wood from the common forest area. The households gather fuel wood, dung cake for household energy from the CPRs.The household collection of CPRs in the last 1 year in the surveyed villages is shown in Table 5 below:

TABLE 5

Household collection of Common Property Resources in last 1 year (Rs)

District	Name of village	Household category (no. of HH)		Value of Fodder collected from Common Property in last 1 year	Value of Fuelwood collected from Common Property in last 1 year	Value of Cowdung collected from common property in last 1 year	Value of Fruits /Vegetables /Flowers /Honey /Herbal Medicine collected from Common Property in last 1 year	Value of Bamboo / *Timber/ Broom /Sal* & other leaves collected from Common Property in last 1 year	Value of Hunted birds/ fish /animals/ snails in last 1 year	Total value collected from CPR in last 1 year
Bankura	Panjhoria	BPL	22	30508	75651	11040	55774	9854	40232	223059
		APL	4	3000	7500	300	4358	1010	2740	18908
		Total	**26**	**33508**	**83151**	**11340**	**60132**	**10864**	**42972**	**241967**
	Ramjibanpur	BPL	15	18200	48975	8520	43500	8040	33020	160255
		APL	5	2905	9250	560	2790	480	1480	17465
		Total	**20**	**21105**	**58225**	**9080**	**46290**	**8520**	**34500**	**177720**
	Seolibona	BPL	47	81320	147850	28440	138949	26740	97400	520699
		APL	7	1428	8563	940	4325	0	1050	16306
		Total	**54**	**82748**	**156413**	**29380**	**143274**	**26740**	**98450**	**537005**
	Baldanga	BPL	7	6240	19000	5700	11130	4340	10900	57310
		APL	0	0	0	0	0	0	0	0
		Total	**7**	**6240**	**19000**	**5700**	**11130**	**4340**	**10900**	**57310**
	Dulaltora	BPL	18	17840	47000	19500	46770	12540	34440	178090
		APL	0	0	0	0	0	0	0	0
		Total	**18**	**17840**	**47000**	**19500**	**46770**	**12540**	**34440**	**178090**
	Tantirdanga	BPL	24	31350	70759	12440	45294	9130	30980	199953
		APL	1	0	2500	0	220	500	0	3220
		Total	**25**	**31350**	**73259**	**12440**	**45514**	**9630**	**30980**	**203173**
Purulia	Jiyathole	BPL	65	80210	192400	17280	102960	20195	106486	519531
		APL	16	32300	43500	2125	8485	2880	4780	94070
		Total	**81**	**112510**	**235900**	**19405**	**111445**	**23075**	**111266**	**613601**
	Marbediya	BPL	**15**	27000	57500	7740	23000	5415	24360	145015
		APL	**10**	11730	26750	625	3860	1800	3640	48405
		Total	**25**	**38730**	**84250**	**8365**	**26860**	**7215**	**28000**	**193420**
	Ambari	BPL	27	41295	96250	6720	33520	10510	36640	224935
		APL	17	26293	54000	520	3937	1925	2560	89235
		Total	**44**	**67588**	**150250**	**7240**	**37457**	**12435**	**39200**	**314170**
Bankura Total		BPL	133	185458	409235	85640	341417	70644	246972	1339366
		APL	17	7333	27813	1800	11693	1990	5270	55899
		Total	**150**	**192791**	**437048**	**87440**	**353110**	**72634**	**252242**	**1395265**
Purulia Total		BPL	107	148505	346150	31740	159480	36120	167486	889481
		APL	43	70323	124250	3270	16282	6605	10980	231710
		Total	**150**	**218828**	**470400**	**35010**	**175762**	**42725**	**178466**	**1121191**
Grand Total		BPL	240	333963	755385	117380	500897	106764	414458	2228847
		APL	60	77656	152063	5070	27975	8595	16250	287609
		Total	**300**	**411619**	**907448**	**122450**	**528872**	**115359**	**430708**	**2516456**

Source: Field Survey, 2011

Forest is not only an important source of income and consumption; it also plays a vital role in the social, cultural and religious life of the rural poor. The use of forest products is evident in the forest communities from their birth to death.

Agricultural Risk and Common Property Forest Resources

CPR extractions play an important role in agricultural risk management. In order to justify the relationship between agricultural risk and CPR extraction, we have collected data on agricultural production for three years 2008, 2009 and 2010 and measured the agricultural shortfall. The fluctuation in agricultural production is observed to have an immediate impact on CPR collection.

The level of agricultural production and collection of CPR in the study area over the three years period is shown in Table 6 below:

TABLE 6

Agricultural Production and CPR collection

District	Block	Name of village	No. of Households	2008			2009			2010		
				Agricultural Production (in Rs)	CPR Collection (in Rs)	Percentage of CPR collection with Agricultural Production	Agricultural Production (in Rs)	CPR Collection (in Rs)	Percentage of CPR collection with Agricultural Production	Agricultural Production (in Rs)	CPR Collection (in Rs)	Percentage of CPR collection with Agricultural Production
Bankura	Saltora	Panjhoria	26	350800	147165	42	380092	162673	43	292200	241967	83
		Ramjibanpur	20	353733	109549	31	316259	126354	40	240000	177720	74
		Seolibona	54	904407	332823	37	869169	387962	45	688800	537005	78
		Baldanga	7	85022	52682	62	86274	62194	72	70000	57310	82
		Dulaltora	18	500178	143366	29	482370	139877	29	274400	178090	65
		Tantirdanga	25	437156	142693	33	358137	167733	47	264000	203173	77
Purulia	Santuri	Jiyathole	81	926560	454379	49	861488	520611	60	693720	613601	88
		Marbediya	25	317280	121972	38	307968	138955	45	221480	193420	87
		Ambari	44	571231	207437	36	537240	237781	44	412120	314170	76
Bankura Total			150	2631296	928278	35	2492301	1046791	42	1829400	1395265	76
Purulia Total			150	1815071	783788	43	1706696	897347	53	1327320	1121191	84
Grand Total			**300**	**4446367**	**1712066**	**39**	**4198997**	**1944138**	**46**	**3156720**	**2516456**	**80**

Source: Field Survey, 2011

The agricultural production is taken in terms of production of rice. The average cost of rice is taken as Rs 20/- per kg. From the Table 6 we can infer that the annual production of rice in the surveyed villages of Bankura district for the year 2008 is around Rs 26.3 lakhs, for 2009 it is around Rs 24.9 lakhs and for the year 2010 it is around Rs 18.2 lakhs. In Purulia district the annual average agricultural production for the year 2008, 2009 and 2010 is around Rs 18.1 lakhs, 17 lakhs and 13.2 lakhs respectively. The agricultural production for the year 2010 is drastically lower than that for the year 2008. This is primarily due to the fact that the rainfall during the year 2010 was much below normal. The percentage of CPRs collection with respect to the agricultural production in the surveyed villages of Bankura district for the year 2008, 2009 and 2010 is 35 percent, 42 percent and 76 percent respectively and for Purulia it is 43 percent, 53 percent and 84

percent respectively . We can therefore conclude that due to low agricultural production in the year 2010, the rural households were compelled to collect more common from property resources as compared to year 2009 and 2008.

The pictorial representation of agricultural production and CPR collection in the study villages of Bankura and Purulia district is shown in Figure 2 & 3 respectively below:

FIGURE 2

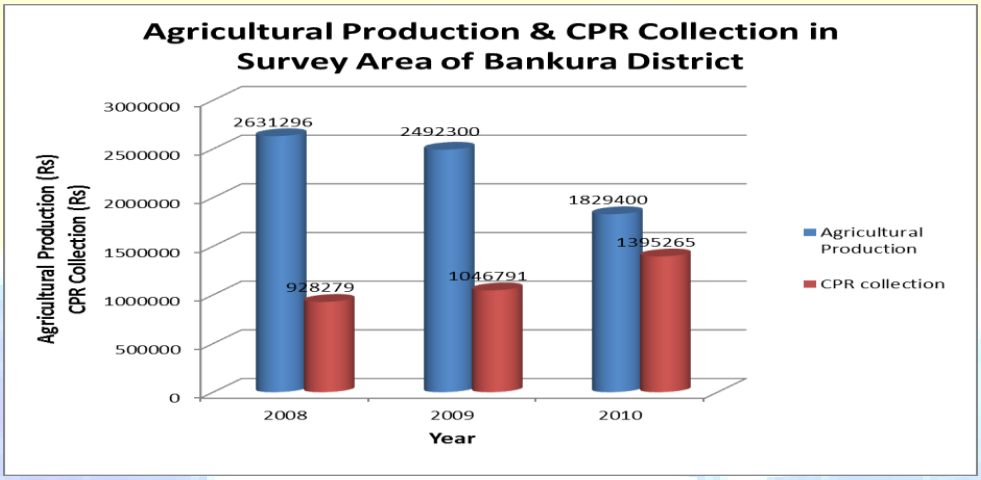
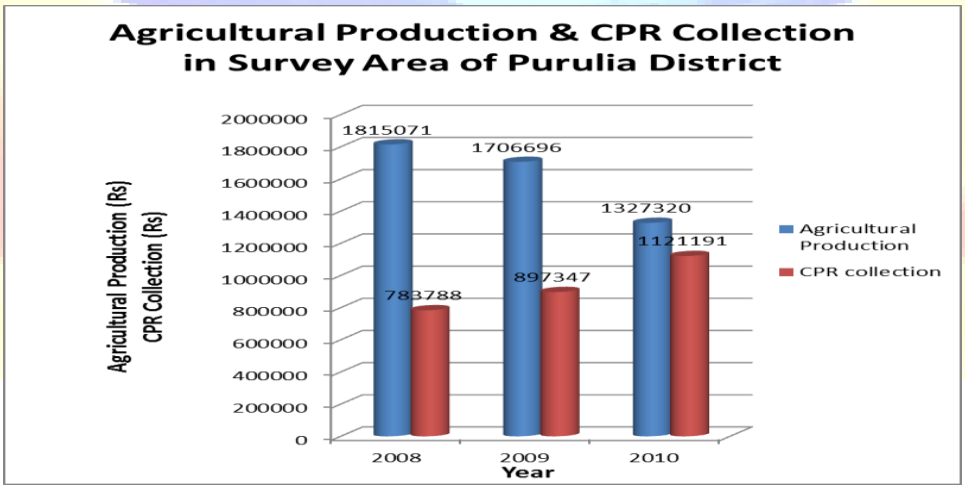


FIGURE 3



In order to establish the critical role of CPR during agricultural crisis, we measured the agricultural shortfallfor the year 2008, 2009 and 2010. Agricultural shortfall is the measure from the actual production (Rs) in terms of rice and the mean agricultural production (Rs) in one

normal year. The level of agricultural shortfall and collection of CPR in the study area over the three years period is shown in Table 7 below:

TABLE 7

Agricultural Shortfall and CPR collection

District	Block	Name of village	No. of Households	2008		2009		2010	
				Agricultural Shortfall (in Rs)	CPR Collection (in Rs)	Agricultural Shortfall (in Rs)	CPR Collection (in Rs)	Agricultural Shortfall (in Rs)	CPR Collection (in Rs)
Bankura	Saltora	Panjhoria	26	(7395)	147165	909	162673	26009	241967
		Ramjibanpur	20	(615)	109549	5619	126354	22119	177720
		Seolibona	54	330	332823	56351	387962	89910	537005
		Baldanga	7	(1050)	52682	1515	62194	5314	57310
		Dulaltora	18	(3885)	143366	12415	139877	25129	178090
		Tantirdanga	25	(2430)	142693	13986	167733	40549	203173
Purulia	Santuri	Jiyathole	81	2205	454379	74071	520611	106073	613601
		Marbediya	25	(3870)	121972	(191)	138955	13246	193420
		Ambari	44	(1215)	207437	10442	237781	45072	314170
Bankura Total			**150**	**(15045)**	**928279**	**90795**	**1046791**	**209032**	**1395265**
Purulia Total			**150**	**(2880)**	**783789**	**84321**	**897347**	**164391**	**1121191**
Grand Total			**300**	**(17925)**	**1712068**	**175116**	**1944138**	**373423**	**2516456**

Source: Field Survey, 2011

Note: The figures in bracket indicate negative shortfall which implies that agricultural production is more than mean.

It is evident from the Table 7 that there was no agricultural shortfall in both districts in the year 2008, since 2008 has been considered as the normal year. However, in the year 2009 and 2010 the agricultural shortfall has shown an increasing trend. In the year 2010, the agricultural production variability resulted in agricultural shortfall of Rs 209032 in Bankura and Rs 164391 in Purulia as compared to the normal year (2008). The Table shows a positive relationship between agricultural shortfall and CPR collection in our surveyed villages over the three years period. It is further observed that even during the period of no agricultural shortfall, household extract CPRs in order to generate surplus income to mitigate future agricultural risk.

The pictorial representation of agricultural shortfall and CPR collection in the study villages of Bankura and Purulia district is shown in Figure 4 &5 respectively below:

FIGURE 4

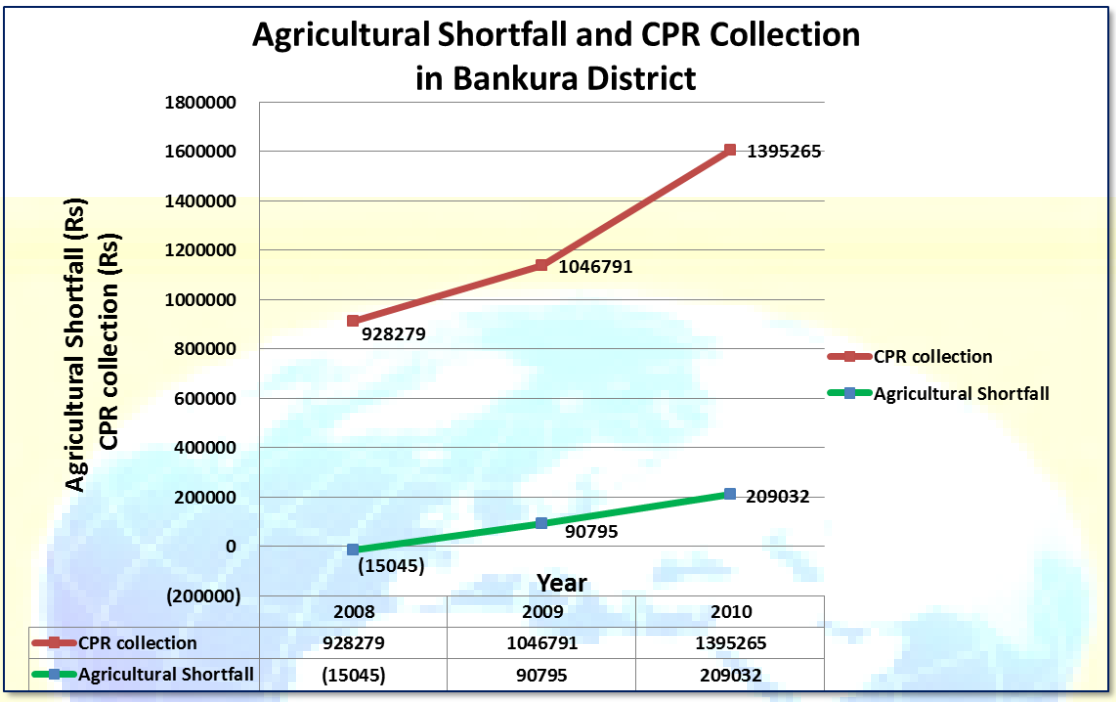
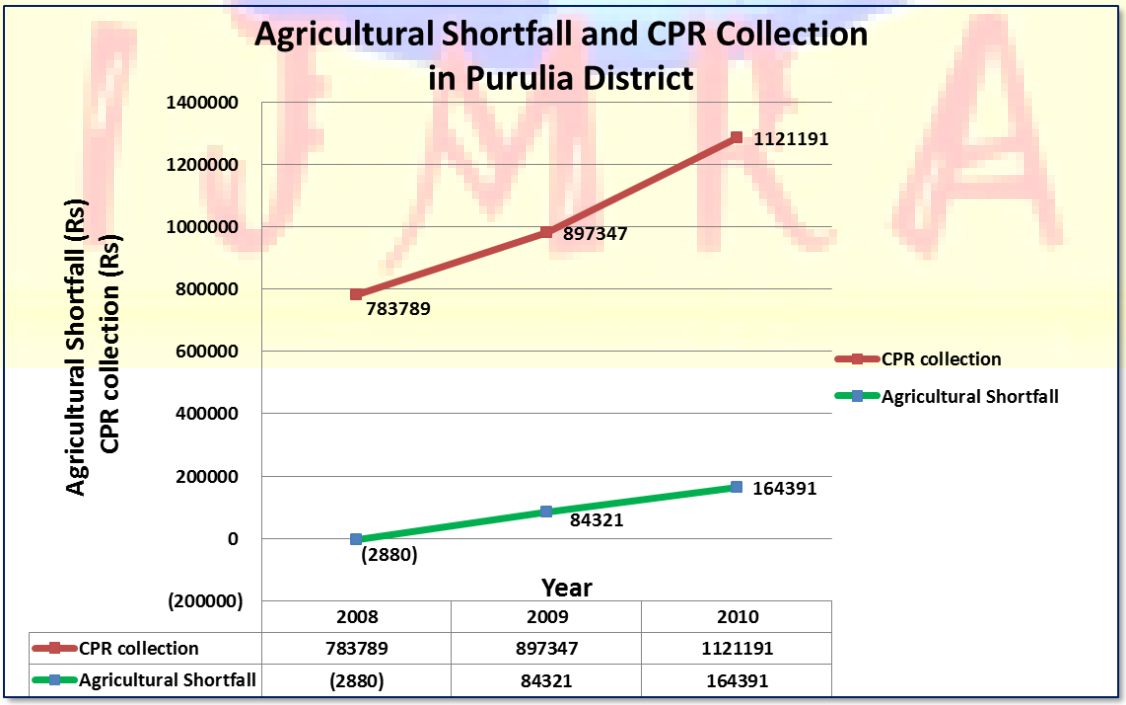


FIGURE 5



Association between Agricultural Shortfall and Forest Resource Extraction: Estimation of Count-Data Model

We have assumed that forest collection labour is determined not only by socio-economic, demographic variable but also by agricultural shock and agricultural risk. We have explained the determinants of forest collection labour through econometric analysis to give an understanding of the impact of agricultural production risk on the extraction of forest products. The regression models have been tested using household level data collected through field survey in Bankura and Purulia district, West Bengal. We have applied Count Data Model using Stata Computer package to determine the frequency of forest collection trips. We have considered Poisson, Negative Binomial and Zero-Inflated Negative Binomial Regression Models to analyse our surveyed data (Detail estimation technique has been explained in the methodological section).

The result for the determinants of forest collection labour is given in the following tables:

TABLE 8

FOREST COLLECTION AS A FUNCTION OF AGRICULTUTAL RISK (BANKURA DISTRICT)

	POISSON REGRESSION				NEGATIVE BINOMIAL REGRESSION				ZERO INFLATED NEGATIVE BINOMIAL REGRESSION			
	No. of Obs.=115				No. of Obs.=115				No. of Obs.=115			
	LR chi2(9) = 1794.06				LR chi2(9) = 33.41				Inflamation model=logit			
	Prob > chi2 = 0.0000				Prob > chi2 = 0.0001				LR chi2(9 = 59.27		Prob > chi2 = 0.0000	
	Log likelihood = -2265.9415		Pseudo R2= 0.2836		Log likelihood = -693.68771		Pseudo R2= 0.0235		Log likelihood = -612.0182			
VARIABLE	Coeffi cient	Std. Error	Z	P>|Z|	Coeffi cient	Std. Error	Z	P>|Z|	Coeffi cient	Std. Error	Z	P>|Z|
AGEHEAD	.0004	.0027	0.16	0.876	-.0060	.0220	-0.27	0.786	.0006	.0122	0.05	0.960
SQAGEH	-.0000	.0000	-1.64**	0.101	.0000	.0002	0.03	0.979	-.0000	.0001	-0.44	0.661
FAMSIZE	-.0415	.0058	-7.12*	0.000	-.0542	.0493	-1.10	0.272	.0051	.0279	0.18	0.856
AVRSCH	-.0340	.0040	-8.38*	0.000	-.0335	.0344	-0.97	0.331	-.0146	.0197	-0.74	0.457
LIVESTOCK	.0231	.0057	4.00*	0.000	-.0423	.0473	0.89	0.371	.0133	.0269	0.49	0.622
FORESTDIST	-.0849	.0089	-9.53*	0.000	-.0731	.0702	-1.04	0.298	-.0203	.0407	-0.50	0.617
AGRSHTFALL	.0013	.0001	13.81*	0.000	.0016	.0010	1.68***	0.093	.0026	.0006	4.64*	0.000
AGRIRISK	.0106	.0008	13.24*	0.000	.0298	.0087	3.48*	0.001	.0070	.0053	1.33**	0.012
WAGE	-.0000	.0000	-3.55*	0.000	-.0000	.0000	-0.34	0.737	-.0000	.0000	-2.05**	0.041
Constant	5.2530	.0757	69.40*	0.000	4.6134	.6477	7.12*	0.000	5.1012	.3689	13.83*	0.000
					Likelihood-ratio test of alpha=0:				Vuong test of zinb vs. standard negative binomial:			
					chibar2(01) = 3144.51		Prob>=chibar2 = 0.000		z= 2.28		Pr>z=0.00112	

*Significant at 1% level, ** Significant at 5% level, *** Significant at 10% level

Source: Estimated by Stata 8 Computer Software using Field Survey Data of 2011

TABLE 9

FOREST COLLECTION AS A FUNCTION OF AGRICULTUTAL RISK (PURULIA DISTRICT)

	POISSON REGRESSION				NEGATIVE BINOMIAL REGRESSION				ZERO INFLATED NEGATIVE BINOMIAL REGRESSION			
	No. of Obs.=123				No. of Obs.=123				No. of Obs.=123			
	LR chi2(9) = 5537.03				LR chi2(9) = 103.55				Inflamation model=logit			
	Prob > chi2 = 0.0000				Prob > chi2 = 0.0000				LR chi2(9) = 54.42		Prob > chi2 = 0.0000	
	Log likelihood = -1949.7648		Pseudo R2= 0.5868		Log likelihood = -724.67487		Pseudo R2= 0.0667		Log likelihood = -605.0434			
VARIABLE	Coeffi cient	Std. Error	Z	P>|Z|	Coeffi cient	Std. Error	Z	P>|Z|	Coeffi cient	Std. Error	Z	P>|Z|
AGEHEAD	0.0071	0.0026	2.71*	0.007	0.0086	0.0219	0.39	0.695	0.0029	0.0105	0.28	0.782
SQAGEH	-0.0001	0.0000	-3.78*	0.000	-0.0002	0.0002	-0.67	0.505	-0.0001	0.0001	-0.44	0.659
FAMSIZE	0.0362	0.0035	10.44*	0.000	0.0940	0.0346	2.72*	0.007	0.0276	0.0155	1.78***	0.075
AVRSCH	-0.0294	0.0042	-7.06*	0.000	-0.0695	0.0345	-2.02**	0.044	-0.0133	0.0174	-0.76	0.446
LIVESTOCK	-0.0059	0.0035	-1.66*	0.098	-0.0372	0.0333	-1.12	0.265	0.0004	0.0158	0.02	0.981
FORESTDIST	-0.7177	0.0163	-44.12*	0.000	-1.1101	0.1268	-8.75*	0.000	-0.4932	0.0688	-7.17*	0.000
AGRSHTFALL	0.0000	0.0000	0.22*	0.825	0.0002	0.0004	0.40	0.690	0.0001	0.0002	0.74***	0.058
AGRIRISK	0.0128	0.0007	17.96*	0.000	0.0360	0.0088	4.08*	0.000	0.0094	0.0036	2.60*	0.009
WAGE	-0.0000	0.0000	-4.73*	0.000	-0.0000	0.0000	-2.24**	0.025	-0.0000	0.0000	-0.65	0.515
Constant	5.9812	0.0633	94.53*	0.000	6.1501	0.5241	11.73*	0.000	5.7847	0.2535	22.82*	0.000
					Likelihood-ratio test of alpha=0:				Vuong test of zinb vs. standard negative binomial:			
					chibar2(01) = 2450.18 Prob>=chibar2 = 0.000				z= 3.21 Pr>z=0.0007			

*Significant at 1% level, ** Significant at 5% level, *** Significant at 10% level

Source: Estimated by Stata 8 Computer Software using Field Survey Data of 2011

From the above Tables 8 and 9, we have observed that the results are consistent for most of the variables in both the districts. However our choice of the best model is Zero Inflated Negative Binomial model (ZINB). To compare the negative binomial and ZINB model, we apply the Vuong statistic. The Vuong test compares the ZINB model with a standard Negative Binomial model. A significant Z test indicates that the Zero Inflated Negative Binomial model is better. Hence we have turned to the estimated results of ZINB model. We have detected that the association between forest collection trips and age of the household (*AGEHEAD*) would be positive and Square age of the household head (*SQAGEH*) be negative. In our analysis of both the districts, we have observed the same result. The coefficients on age and the Square of age imply that households with older heads normally take more trip on forest collection except the oldest household. Household's accumulated knowledge about the local forest make it easier for them to take more trips and collect huge amount of forest products. Almost all the household members in the study area collect CPRs. Hence the larger the family size (*FAMSIZE*) the more is the forest trip for the collection of CPR products. Education (*AVGSCH*) i.e. the average years

of schooling of the household has a negative impact on forest collection trips in both the districts which indicated that households who are better educated get better job opportunities and therefore are less interested in collecting CPR during agricultural crisis.

We expected wealthier household i.e. household with larger size of livestock (*LIVESTOCK*) to spend less time in extraction of forest products, but from the regression analysis we can observe that household with larger size of livestock take more trip to gather fodder to feed animals and to collect fuel wood for preparing the concentrated food for the animals. So we can infer that poor as well as wealthier households are responsible for excessive extraction of forest products which ultimately results in environmental degradation.

We have observed that forest distance (*FORESTDIST*) i.e. the distance between the residence and the common forest area has a negative impact on forest collection trips. From our study area, we infer that household who live nearer to the common forest area extract more CPR and hence generate more income from it and thus help to mitigate agricultural crisis. Household who live farther away from the forest area are unable to smooth their income and consumption by collecting CPR products during agricultural shock.
In line with our expectation, wage income is negatively related with forest collection labour. The result is statistically significant in Bankura district, but insignificant in Purulia district. In fact households who have a sufficient wage income are less interested in forest collection trip.

The key findings of our regression results indicate that the coefficients on agricultural risk parameters (*AGRIRISK*) and shock parameter (*AGRSHTFALL*) are positive and significant in both Bankura and Purulia district, which suggest that household with greater agricultural shortfall and risk are likely to take more forest collection trips. This result supports our hypothesis that CPR product is used by rural households as a safety net during the time of agricultural crisis. Thus CPRs help to mitigate agricultural risk by smoothening the income and consumption of the rural poor.

Conclusion

In this study we investigated the impact of agricultural risk on the collection of common forest products based on the survey of total 300 households in the villages of Bankura and Purulia. Most of the households in the surveyed area are very poor. Agriculture is their main occupation and therefore they depend on nature for any agricultural activities. There are several agricultural risks associated such as adverse weather, seasonal flooding, unpredictable soil quality, crop diseases, price shocks, etc. The rural poor have limited credit and insurance facility and therefore they extract forest products not only to reduce their agricultural risk but also help to smooth their income. As per the surveyed data of 150 households in 6 villages of Bankura district, the percentage of CPR extraction with agricultural production for the year 2008, 2009 and 2010 is 32 percent, 41 percent and 76 percent respectively. Similarly, based on the surveyed data of 150 households in 3 villages in Purulia district, the percentage of CPR extraction with agricultural production for the year 2008, 2009 and 2010 is 39 percent, 51 percent and 80 percent respectively. Hence due to lower agricultural production in the year 2010 in the districts of Bankura and Purulia, the percentage of CPR collection with agricultural risk is very high. In our count data model of survey data from Bankura and Purulia districts, we have observed that forest collection labour is positively related to both agricultural shortfall and agricultural risk.Hence CPRs supplement the rural livelihood and acts as safety net for the poor seasonally or during the agricultural crisis.

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