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Summary

The Kyoto Protocol calls for the majority of industrialised and developed countries (Annex-I) to limit their carbon equivalent emissions of GHGs by 5.2% of their 1990 levels. However, if A-I countries are forced to meet their emission reduction targets alone, they would face huge economic impacts due to high marginal costs of their domestic mitigation. Hence, the Protocol designed three flexibility mechanisms, the emissions trading (ET), joint implementation (JI) and clean development mechanism (CDM) to achieve efficiency, keeping in view of the fact that mitigation taking place anywhere will have same environmental effects due to the uniform mixing feature of the greenhouse gases. Of the three only CDM is of interest to the developing countries as it allows transfer of emission reduction units resulting from emission reduction or removal projects (like afforestation and forest preservation) between A-I and NA-I (developing) countries. This paper considers the implications of forest-based climate change mitigation projects. Forest-based climate change mitigation projects (carbon sequestration and carbon conservation) can offer substantial benefits in addition to GHG emission reduction in the form of biodiversity conservation, protect watersheds and soil resources, reduce local air pollution, enhance food production, transfer technology, and contribute to the sustainable development of the host nations. However, the Kyoto protocol requires that CDM project should result in long-term carbon benefits. Viewed from the rural poor and landless' point, they require resilient, sustainable livelihood systems that are flexible in the short term due to dependence on multiple products. This long-term requirement to keep carbon in storage may conflict with the short-term needs of the poor. Predicting the exact impact of carbon offsets on rural livelihoods is difficult because in any one area participants will have different livelihood strategies and thus will have different motivations when faced with a carbon offset scheme. The focus of the paper is to examine the potential implications of the LUCF projects to the rural livelihoods and discuss mechanism through which the LUCF projects would not affect the rural livelihood.

The implementation of the LULUCF projects depends on the availability of land, land tenure, current vegetation status and opportunity cost of land. For the purpose of carbon sequestration, only the forested land or the land that has not been put to use (wasteland or degraded land) can be available for implementing various mitigation possibilities. Of the land that has not been put to use only the degraded forest land and pasture land can be considered for carbon sequestration, because only this land has the potential to be revegetated to conserve soil, moisture and vegetation. However, in India these lands are generally categorised as common property resources (or open access resources). In India the local communities have a tradition of depending on the forest resources for their living as CPRs contribute both directly as well as indirectly to rural livelihoods. Many rural households are extremely vulnerable to unanticipated hardship caused by unemployment, crop failure etc. In times of crisis the CPRs can provide valuable subsistence inputs and income-generating opportunities. If

access to these lands is restricted, there may be direct conflict between local interests and any proposal to establish strict conservation areas. Hence, the projects have to be well-designed to consider the economic viability of communities. Further, CPRs are eligible under CDM as they satisfy all the concerns of additionality, leakage and permanence.

On the positive side, using CPRs for CDM would result in accrual of benefits to whole villages as well as to the individual household. For instance, in addition to the overall increase in income and achieving self-sufficiency, other benefits include lesser incidence or run-off; drought induced crop-resowing and crop failure (due to better management of watershed through natural vegetation and soil working); better water supply (due to management of watersheds) etc. However, the important commodity contradicting the sequestering of carbon is fuelwood and hence the poor can no longer depend on cprs for their fuel use. Secondly, if growing trees for carbon becomes profitable, there may be tendency to grab the CPR land by influential village individuals. The impact on rural people also depends on the kind of institutional arrangement. For instance, restricting the rural people involvement raises the basic equity issue. Higher returns for investors or governments would result in the loss of low productivity options for many. In such cases the contributions of CPRs in terms of sustainable supplies of biomass and stability of farming systems may be permanently lost, and thus accentuate poverty and hunger once CPRs are privatised and converted to fields growing carbon. This would also result in increased scarcity and stress for those depending on CPRs in terms of longer time and distance involved in collecting the same or lesser quantities of CPR products and the loss in sustained grazing. Such micro level issues are likely to be overlooked in the design of CDM projects as the CDM investors may not be completely aware of the institutional dynamics of CPRs. Interventions need to be fairly location-specific and much smaller in scale, but this may push up the transaction cost for the investor making them unattractive. Consequently, relevant and potentially effective initiatives may not prove attractive to the donors due to the 'economies of scale' argument for not handling small- scale interventions. When considering the usage of CPRs for CDM, incorporation of "CPR perspective" is inevitable.

On the contrary, if the CPR lands are not used for CDM projects, despite the inferior options available from CPRs, the rural poor continue to depend on them. This is because the opportunity cost of the poor's labour to harness the inferior options is still lower. Hence, there would be a progressive degradation in CPRs, especially of fuelwood and fodder (because there is no investment in CPRs). This would eventually result in a situation whereby it is not possible to extract anything, implying that the ultimate resource availability is zero. The best way to balance both would be to design the mechanism so as to ensure that both the investing party as well as the host-country and local people are made better-off. The success of the CDM program depends on the magnitude and responsiveness of rural communities to fuelwood use and also availability of other substitution possibilities. For this one should have an idea of the preferences of people and their reflection in terms of the demand, in this case for different kinds of energy.

To analyse the responsiveness of rural people to fuel demand, we used a linear approximation of the almost ideal demand system to estimate the expenditure, own price and cross-price elasticities of different fuels using data on 69,206 rural households. The results show that people are extremely sensitive to the price of fuelwood. This sensitivity of fuelwood demand to price hikes implies that a scarcity of fuelwood supplies could very well have serious welfare implications given that alternative fuels higher up the ladder are not easily available in India. Using CPR or forest lands without consideration of the rural scenario would not only result in conflicts but also extreme hardships to the poor. The only solution to this problem seems to be management of CPRs by user groups both for carbon as well as fuelwood. In such case though the investor’s interest is not maximised but this can be the only win-win situation for the investors, host countries and the local communities. This scenario would be true not only in India but in all the developing countries where poor are dependent on forests for their livelihoods.

Abstract

Clean Development Mechanism (CDM) of the Kyoto allows transfer of emission reduction units from energy efficiency or fuel substitution or land use change projects to Annex-I countries. While the energy efficiency and fuel substitution projects may have macroeconomic implications, landuse change and forestry projects have implications for rural livelihoods. The rural poor and landless require resilient, sustainable livelihood systems that are flexible in the short term due to dependence on multiple products. The Kyoto protocol requires that CDM projects result in long-term benefits related to the mitigation of climate change. This long-term requirement to keep carbon in storage may conflict with the short-term needs of the poor. The objective of this paper is to examine the potential implications of the LUCF projects on the common property lands to the rural livelihoods and discuss mechanism through which the LUCF projects would not affect the rural livelihood. Analysis of cpr data in India revealed that landlessness and backwardness are directly related to the dependence on cprs. On the positive side, cdm results in accrual of benefits to the whole village and to the individual household. On the contrary it may have negative implications as the main commodity contrasting growing carbon on cprs is use of wood for fuel. The exact implication depends on the responsiveness of households to fuel use and the substitution to other fuels. To analyse the responsiveness of rural people to fuel demand, we used a linear approximation of the almost ideal demand system to estimate the expenditure, own price and cross-price elasticities of different fuels using data on 69,206 rural households. The results show that people are extremely sensitive to the price of fuelwood. This sensitivity of fuelwood demand to price hikes implies that a scarcity of fuelwood supplies could very well have serious welfare implications given that alternative fuels higher up the ladder are not easily available in India (cross price elasticities are very low). Using cpr lands without consideration of the rural scenario would not only result in conflicts but also extreme hardships to the poor. The only solution to this problem seems to be management of cprs by user groups both for carbon as well as fuelwood. In such case though the investor's interest is not maximised but this can be the only win-win-win situation for the investors, host countries and the local communities.

1. Introduction

Human activities are responsible for intensification of green house gas emissions (GHGs) such as carbon dioxide and methane into the atmosphere. It is feared that an increase in GHGs would lead to a rise in the global temperature, sea level rise, increased desertification etc. A 1 – 3% increase in temperature over the next hundred years would have potential dramatic effects on industrial, economic and agricultural sectors of society. More hardest hit are the poorest nations of the world with less capacity to adapt to change and whose people are more directly reliant on the environment for their basic needs. With the objective of stabilising GHGs 'at a level that would prevent dangerous interference with the climate system' the framework convention on climate change (FCCC) was signed at the United Nations Conference on Environment and Development at Rio in 1992. Although recognition has been made that some climate change is inevitable but the conference concluded that adaptation measures are also essential. Since then efforts are being made to lay out the general principles and obligations to guide the future behaviour of the signatory parties. The most significant outcome of such effort is the Protocol signed at Kyoto in 1997.

Article 3 of the Protocol contains the quantified emission limitation and reduction objectives. Article 3(1) is the core obligation within the text. It states "*The Parties included in Annex I shall, individually or jointly ensure that their aggregate anthropogenic CO_2 emissions of the GHGs listed in Annex A*[2] *do not exceed their assigned amounts, calculated pursuant to their quantified emission limitations and reduction commitment inscribed in Annex B and in accordance with the provisions of this Article with a view to reducing their overall emissions of such gases at least 5.2% below their 1990 levels in the commitment period 2008 to 2012.*" (UNFCCC, 1997). However, if A-I countries were forced to meet their emission reduction targets alone, they would face huge economic impacts due to high marginal costs of their domestic mitigation. Hence, the Protocol designed some flexibility mechanisms to achieve efficiency, keeping in view of the fact that mitigation taking place anywhere will have same environmental effects due to the uniform mixing feature of the greenhouse gases. The three flexible mechanisms as defined in the Kyoto Protocol are the Joint Implementation (JI) in Article 6, Clean Development Mechanism (CDM) in Article 12 and Emissions trading (ET) in Article 17 respectively. The emission trading allows the A-I countries to trade emission reduction units that are above or below their emission quotas agreed in the protocol in supplement to domestic actions. The KP approaches JI as that allowing transfer of emission reduction units resulting from emission reduction or removal project among the A-I countries. The CDM allows transfer of emission reduction units resulting from emission reduction or removal projects (like afforestation and forest preservation)

[2] Comprises of majority of industrial countries

between A-I and NA-I (developing) countries (which do not have emission reduction commitments). The mechanism has mainly two objectives namely emission reduction and sustainable development for host NA-I countries. The success of CDM depends on the welfare implications to the developing countries. In what follows we examine the implications of CDM and other mechanisms to both developed as well as developing countries as a result of different mechanisms.

As it is mainly CDM that is of interest to India, the paper considers the implications of CDM. Existing studies on economic impacts of the KP from global perspective reveal that developed countries would significantly reduce the costs of meeting their Kyoto commitments through CDM and other flexibility mechanisms (Manne and Richels, 1999: Bernstein *et al.,* 1999; Ellerman *et al.,* 1998). In this way, the NA countries would also benefit along with the A-I countries. For instance, the studies showed that India and China could gain 1.5 billion US dollars and 6.2 billion US dollars respectively from the trading under the CDM (Ellerman *et al*., 1998). This is true only in a partial equilibrium analysis. However the NA-I countries could suffer due to increased energy prices and negative trade spillover effects, which could be examined only using the general equilibrium framework for the world economy. However, all these models considered the fuel substitution and energy efficiency projects and reflect the impact of the inter-country linkages.

CDM can have macroeconomic implications not only due to inter-country linkages but also because of other linkages at the country level, though small (as CDM is mainly project related). For instance consider the case of a hydropower project. This project would qualify as a CDM candidate only if the total cost of the power system expansion is higher than that in the case without it, implying an increase in the overall system costs. Assuming perfectly competitive markets while modelling the production sectors, the increase in production costs would be passed on to output price of corresponding goods. In the general equilibrium models due to inter linkages between commodity prices, change in the price of a good also cause change in price of other goods too. As a result, a hydropower project under the CDM, for example would cause change in demand and prices not only of electricity but also of other goods considered in the model. This is not acceptable as the NA-I countries do not have any emission reduction obligations. But at the same time the NA-I countries get some revenue due to sale of ERs. The implication to the household depends on how this revenue is redistributed.

While the energy efficiency and fuel substitution projects involve increase in prices in the economy, the projects involving landuse change and forestry can have implications for livelihood as discussed below. Carbon storage is but one of the many goods and services provided by forests that benefit society. The rural poor and landless require resilient, sustainable livelihood systems that are flexible in the short term due to dependence on multiple products. The KP requires that CDM projects result in long-term benefits related to the mitigation of climate change. This long-term requirement to keep carbon in storage may conflict with the short-term needs of the poor. Predicting the exact impact of carbon offsets on rural livelihoods is difficult because in any one area participants will have different livelihood strategies and thus will have different motivations when faced with a carbon offset scheme. The focus of the paper is to examine the potential implications of the LUCF projects on the common property lands to the rural livelihoods and discuss mechanism through which the LUCF projects would not affect the rural livelihood. The scheme of the paper is as follows: Section 2 discusses the importance of CPRs to the people in India and discusses the benefits and costs of considering CDM projects on these lands. Section 3 examines how responsive the rural people are to the fuelwood demand (the main commodity on which rural people are dependent). Section 4 discusses the results and section 5 concludes with implications of the study.

2. Common Property Resources (CPR) and CDM Projects

Forest-based climate change mitigation projects (carbon sequestration and carbon conservation) can offer substantial benefits in addition to GHG emission reduction in the form of biodiversity conservation, protect watersheds and soil resources, reduce local air pollution, enhance food production, transfer technology, and contribute to the sustainable development of the host nations (see Gundimeda, 2000 for different studies). Implementing these options however depends on the availability of land, land tenure, the current vegetation status and the opportunity cost of land. In what follows we discuss the case of CDM projects through forest expansion (or afforestation). For the purpose of carbon sequestration, the land that has not been put to use (wasteland or degraded land) can be available for implementing various mitigation possibilities (Haripriya, 2001). In India, according to an estimate made by NRSA (1995), nearly 75.5 Mha is referred to as wasteland. This includes degraded forestland as well as crop and other privately owned non-crop land categories and pastureland. However, of the entire wasteland only the degraded forest land and pastureland can be considered for carbon sequestration, because only this land has the potential to be revegetated to conserve soil, moisture and vegetation. However, in India these lands are generally categorised as common property resources (or open access resources). Jodha (1986, p.1169) identifies CPRs as "the resources accessible to the whole community of a village and to which no individual has exclusive property rights. The CPRs that fall under this category include community pastures, community forests, wastelands, common dumping and threshing grounds, watershed drainage and village ponds, rivers, rivulets as well as their bank and beds. Other definitions of CPRs include 'resources in which a group of people have co-equal user rights, specifically rights that exclude the use of those resources by other people. Individual's membership in the group of co-owners is typically conferred by membership in some other group, generally a group whose central purpose is not the use or administration of the resource (per se), such as village, tribe etc (Ostrom 1990; Bromley and Cernea 1989)'. In India the local communities have a tradition of depending on the forest resources for their living as CPRs contribute both directly as well as indirectly to rural livelihoods. Many rural households are extremely vulnerable to unanticipated hardship caused by unemployment, crop failure etc. In times of crisis the CPRs can provide valuable subsistence inputs and income-generating opportunities. If access to these lands is restricted, there may be direct conflict between local interests and any proposal to establish strict conservation areas. Hence, the projects have to be well-designed to consider the economic viability of communities.

However, for CPRs to be eligible for CDM they should address the concerns of additionality, leakage, permanence, and baselines or without project case and carbon inventorying, monitoring and verification. Additionality means that the project must demonstrate that the activities leading to carbon benefits are additional to a 'business-as-usual' scenario. Some of the tests for the evidence of additionality of the project are: financial additionality - evidence that project activities are stimulated by investments or funding beyond that normally available; technological additionality - evidence that project activities have resulted from the removal of technological barriers; and institutional additionality - evidence that project activities go beyond the scope of national programs or regulations (Brown *et al*. 2000). Leakage implies projects must demonstrate that anticipated carbon benefits do not suffer an unexpected loss due to displacement of activities in the project area to areas outside the project that result in carbon emissions. A unique feature of these LUCF projects is the possibility of reversal of carbon benefits either due to natural disturbances or due to lack of reliable guarantees. This feature is named in the KP as 'Permanence'. In order to qualify for CDM the project should demonstrate this feature of permanence or strategies have to be identified. In addition to this a baseline scenario need to be developed showing what would have happened to the land without the project (in this case the fate of the CPR lands without the project) along with proper design of carbon inventory, monitoring and verification program (ibid).

In order to examine if the CPRs are eligible under the CDM a brief description of the importance of CPRs and their condition is necessary. Several studies have shown that CPRs are critical to sustainable livelihood strategies of the poor in India (see for instance, Jodha 1990 1985a, b, 1986; Iyengar and Shukla, 1999; Beck and Ghosh, 2000). Jodha sketched a broad picture of contributions made by various CPRs; ranging from direct visible contributions in terms of supplying physical items like food, fibre, fodder, fuel, timber etc. to less valuable gains implied by sustainability of farming systems, renewable resource supply, drought period maintenance etc. From Jodhas' various studies on arid and semi-arid regions in India, the following implications can be drawn: 1) CPRs contribute between 12 - 25% of the poor household income; 2) the poorer the households, the more important the contribution of CPRs and 3) CPRs contribute to rural equity because they are accessed more by the poor than by the rich. Chen's (1991) case study of a Gujarat village shows that the poor collect 70% of their fuel and 55% of their fodder requirements from CPR's. She also notes that there has been a gradual decline in CPR's in the village over the last thirty years, mainly through privatisation and that conflict over CPR's increases in times of crisis. Beck (1994) in a similar study notes that CPR constituted between 19 and 29% of household income of very poor villagers and he also notes that conflict over CPRs is central to poor household's experience of poverty. The studies on CPRs are scattered and it is difficult to get a national picture.

The only source, which gives a national scenario on CPRs, is the National Sample Survey Organisation (NSSO). The NSS in its 54th round (1998) has estimated CPR land per household at the state level. The estimates indicate that CPR land constitutes 15% of the total geographical area in India. Based on the estimates the states can be classified into three groups (see Table 1).

Table 1: Estimated CPR Land in Different States

State/UT	Percentage of CPR area to total geographical area	Estimated CPR area (00 ha)
Rajasthan	32	127,094
Gujarat	27	39,165
Madhya Pradesh	22	79,715
Sikkim	14	213
Kerala	13.9	5,392
Mizoram	13.9	3,137
Himachal Pradesh	12	3,404
Tamil Nadu	12	15,129
Uttar Pradesh	12	31,705
Karnataka	11	17,505
Maharashtra	11	33,174
Meghalaya	11	2,487
Orissa	11	17,487
Andhra Pradesh	9.2	20,546
A & N Islands	9	57
Bihar	8.3	12,627
Nagaland	8	1,301
Assam	7.1	1,613
Jammu and Kashmir	5.1	1,133
Haryana	3	1,221
Arunachal Pradesh	2.2	1,874
West Bengal	2	3,186
Manipur	1.9	430
Punjab	1	490
Tripura	1	77

Source: NSSO (1999)

The three groups shown in the table are: 1) States where the CPR land area is low, being less than or around 5% of the geographical area. Punjab and Haryana fall in this category. These two states are at an advanced level of agricultural development and are characterised by a large percentage of land under private ownership; 2) States where CPR land fall in the range of 5 - 15%. Most of the states excepting Gujarat, Madhya Pradesh and Rajasthan fall under this category; 3) Above 15% - Gujarat, Rajasthan and Madhya Pradesh fall under this category. Rajasthan has 32% of land under CPRs, followed by Gujarat with 27% and Madhya Pradesh with 22%. The NSSO data also reports that around 45% of all rural households in India collect fuelwood from cpr lands and 45% report some collection in the form of fuelwood, fodder, katha, Lac, edible products etc. mainly for consumption (see Table 2).

From Table 2 it can be seen that a majority of the households are dependent on CPRs for fuelwood, fodder, timber, thatching materials, leaves and other products. Only 1% of the people who collect fuelwood report sale of fuelwood. The average quantity of fuelwood collected varies from state to state with all India average of 500 kg (NSSO, 1999). However, the average value of the products is not very high. The value provided by the CPRs at present is very low because complete quantification made by CPRs is not easy. Further the value may be underreported. At present, due to degradation of CPRs, they do not offer high returns to the users. It is only the rural poor with limited alternative means of income who depend more on the low pay-off options offered by CPRs (Jodha, 1986). Moreover, the importance of CPRs is not only economic; they are central to many cultural and social activities of poor rural women and men.

It is surprising to see from Table 2 that in regions where the percentage of CPR land in proportion to the geographic area is higher than 25% like in Gujarat and Rajasthan, the proportion of people depending on CPRs is less than other regions. This may be due to underreporting of data or it may be because that CPRs in these areas have degraded to an extent that they do not give returns to the people.

Table 2. Proportion of People (out of 1000) depending on CPRs for different Products in different zones

Zone	Timber	Fuel wood	Fodder	Other leaves	Thatching materials	Fruits	Bamboo /cane/reeds	Tendu leaves	Medicinal plants	Edible oil seeds
WHm	338	880	741	704	191	45	32	14	42	2
Ehm	294	704	346	360	391	323	483	70	233	35
LG	157	571	163	371	97	32	64	102	87	14
MG	114	524	374	397	349	149	217	107	63	44
TG	21	305	131	71	124	55	40	14	30	0
UG	0	402	221	146	135	103	23	0	44	0
CHg	366	879	312	598	376	501	332	408	221	275
Ehg	156	756	342	349	402	293	163	392	99	77
WHg	100	492	346	189	207	155	116	132	18	20
DP	151	643	322	315	302	202	166	98	90	25
EG	174	573	283	314	225	222	292	68	85	30
WC	201	687	461	350	266	332	267	115	252	24
GC	75	503	356	313	169	201	96	97	66	41
TD	0	140	47	0	85	0	0	0	0	0
Isl	595	936	234	757	861	351	842	88	407	0
All	192	656	342	372	286	246	203	179	112	73
	Honey	Other Edible Products	Lac	Non-edible oil seeds	Gums and Resins	Fibres and flosses	Tans and dyes	Bee-wax	Animals and birds	Katha
WHm	40	31	8	2	18	0	2	4	20	2
Ehm	295	85	47	2	54	41	22	163	298	18
LG	145	40	0	2	21	0	0	51	78	0
MG	116	55	44	11	47	32	52	68	127	46
TG	39	14	0	2	2	0	0	16	39	0
UG	34	63	0	2	2	0	0	34	34	0
CHg	178	246	88	93	86	101	34	66	256	6
Ehg	202	69	43	23	62	32	45	111	103	33
WHg	118	36	17	10	59	10	0	6	61	6
DP	225	40	31	17	76	65	25	104	173	16
EG	202	38	7	9	63	22	0	112	222	0
WC	247	95	21	15	82	30	0	173	167	0
GC	127	56	46	2	89	0	28	34	46	0
TD	0	0	0	2	2	0	0	0	0	0
Isl	440	185	158	2	92	0	0	230	401	0
All	167	83	36	25	60	38	21	77	146	12

Source: NSSO (1999)

Further from Table 3 it can be seen that it is mainly the rural labour and people with landholdings less than 1 ha that are mainly dependent on CPRs for collecting the fuelwood and they do so mainly for own consumption rather than for sale. Despite the contribution made by CPRs to the livelihood of rural poor, these resources have remained one of the most neglected areas in development planning in India. Further, a number of welfare and development interventions have had severe negative side affects on CPRs. In the last five years itself, around 833,000 ha (around 2%) of the CPR land has been lost (NSSO, 1997). Such decline in CPRs have also been noted by earlier studies like Chen (1991), Pasha (1992) etc. Jodha (1986) in a survey of 82 villages in 7 states in dry tropical west and south India found that the poor households are losing access to CPRs, the extent and decline between the mid-1950s and 1980s was between 26% and 52%. Jodha identifies the primary factors behind the degradation of CPRs as undeclared regressive state policies, encouraging privatisation and neglect of CPRs.

The poor in India continue to depend on CPRs because the opportunity cost to poor to harness these resources is still lower. Though there are other ways of coping strategies adopted by poor (like ready acceptance of inferior options, illegal loping of trees etc), the dominant response of the rural people would be to grab CPR areas and over-exploit their production potential. This would result in further environmental degradation at the village level and rapid decline of whatever cushion rural people have through CPRs. Finally this would induce increased marginalisation and pauperisation of the poor. Increasing the productivity of CPRs would require huge investments, to which the key obstacles being absence of fiscal tradition to patronise such community resources, long gestation period and complex transaction costs associated with resource allocation to CPRs and invisibility of gains (Jodha, 1992).

It is clear that the government does not have access to the necessary resources to improve the state of CPRs unless financed by some external source. Hence, the additionality component (both financial additionality and institutional additionality) of the KP is satisfied. Leakage prevention however cannot be guaranteed but can be prevented if the projects are carefully designed taking into account the demand for products or resources (e.g., agricultural land, timber, fuelwood) contributing to the land-use change. The issue of permanence can also be addressed through strategies such as establishment of contingency carbon credits, insurance, and mixed portfolio of projects (Brown et al., 2000). However, LUCF carbon-offset projects cannot be a permanent solution, but rather as a means to postpone emissions and buy time to develop and implement policies and measures requiring longer lead times. The other criteria can also be taken care of through proper project design. Hence, the CPR lands are eligible for the CDM projects.

Table 3 - Proportion (Per 1000) of households reporting Collection/Sale of fuelwood from CPR by category of households for each climatic zone.

Zone	Category of household reporting collection					Category of household reporting sale				
	Rural Labour	*Others with land possessed (ha)*				Rural Labour	*Others with land possessed (ha)*			
		<0.20	0.20-0.5	0.50-1.00	1.00 or more		<0.20	0.20-0.5	0.50-1.00	1.00 or more
WHm	759	447	447	764	532	6	5	9	7	
Ehm	442	333	333	441	415	78	17	32	34	19
LG	476	255	255	217	160	3	6	-	2	-
MG	496	285	285	171	122	5	6	2	5	1
TG	391	281	281	200	114	1	3	-	-	-
UG	429	204	204	86	50	3	-	8	-	-
Ehg	810	463	463	666	670	34	50	52	36	18
CHg	609	312	312	349	365	30	8	20	9	3
WHg	733	330	330	474	402	6	-	-	-	1
DP	751	436	436	561	499	11	4	6	2	5
EG	604	298	298	380	314	14	9	24	5	1
WC	336	108	108	278	434	9	8	8	10	6
GC	753	307	307	558	388	2	2	-	3	-
TD	212	89	87	143	70	22	-	-	126	3
Isl	715	408	408	734	799	-	-	-	-	-
All	597	298	298	372	330	14	9	11	10	4

The arguments above favour revegetating CPR lands under CDM. On the positive side, this would result in accrual of benefits to whole villages as well as to the individual household. For instance, in addition to the overall increase in income and achieving self-sufficiency, other benefits include lesser incidence or run-off; drought induced crop-resowing and crop failure (due to better management of watershed through natural vegetation and soil working); better water supply (due to management of watersheds) etc. As discussed before, rural people depend on CPRs mainly for fuelwood, thatching materials, timber, fodder and other products. While collecting other products may still be possible with proper mechanism design, the important commodity contradicting the sequestering of carbon is fuelwood. Sequestration of carbon and burning of carbon are contradictory, which need to be considered. Secondly, if growing trees for carbon becomes profitable, there may be tendency to grab the CPR land by influential village individuals. Such phenomena have been reported by some of the earlier studies on CPRs (Agarwal 1995; Iyengar and Shukla, 1999; Arnold and Stewart, 1991; Jodha, 1985a, Jodha 1986, Jodha 1992). The impact on rural people also depends on the kind of institutional arrangement. For instance, privatisation restricting the rural people involvement raises the basic equity issue. Higher returns for investors or governments would result in the loss of low productivity options for many. In such cases the contributions of CPRs in terms of sustainable supplies of biomass and stability of farming systems may be permanently lost, and thus accentuate poverty and hunger once CPRs are privatised and converted to fields growing carbon. This would also result in increased scarcity and stress for those depending on CPRs in terms of longer time and distance involved in collecting the same or lesser quantities of CPR products and the loss in sustained grazing. Such micro level issues are likely to be overlooked in the design of CDM projects as the CDM investors may not be completely aware of the institutional dynamics of CPRs. Interventions need to be fairly location-specific and much smaller in scale, but this may push up the transaction cost for the investor making them unattractive (see Gundimeda and Yan, 2002). Consequently, relevant and potentially effective initiatives may not prove attractive to the donors due to the 'economies of scale' argument for not handling small- scale interventions. When considering the usage of CPRs for CDM, incorporation of "CPR perspective" is inevitable.

On the contrary, if the CPR lands are not used for CDM projects, despite the inferior options available from CPRs, the rural poor continue to depend on them. This is because the opportunity cost of the poor's labour to harness the inferior options is still lower. Hence, there would be a progressive degradation in CPRs, especially of fuelwood and fodder (because there is no investment in CPRs). This would eventually result in a situation whereby it is not possible to extract anything, implying that the ultimate resource availability is zero. Also, decrease in fodder availability from the common lands would result in change in the livestock composition. As the benefits provided by the CPRs are not visible, their degradation also become invisible. The cost of abolishing CPRs, in terms of foregone opportunities for gains to the poor, would be too high to be compensated by other means. Those households owning land will be little affected as they can grow some trees in their lands to cater to the fodder and fuel requirements. The best way to balance both would be to design the mechanism so as to ensure that both the investing party as well as the host-country and local people are made better-off.

In the simple case assuming that the system is well designed and local people continue to have right over the CPR lands and they can get products like nuts, fruits, fodder etc based on some well-defined rules. But the basic commodity, which they cannot get as it contrasts with carbon sequestration, is the use of wood as fuel, if the investor's interest of growing carbon has to be maximised. The success of the CDM program depends on the magnitude and responsiveness of rural communities to fuelwood use and also availability of other substitution possibilities. In the Indian context, it is especially important as still seventy eight percent of the rural people and thirty percent of the urban population is dependent on fuelwood and chips as their main fuel. This dependence on fuelwood in rural areas is likely to continue for a long time though contribution of wood fuels in especially urban areas will follow a downward trend (Saxena, 1997). This trend is likely to continue for some more time though it will take a downward shift in rural areas. Hence it is important to examine the quantitative use and value of firewood and other biogenic fuels in rural livelihood system.

Where the rural people are heavily dependent on fuelwood, in such places carbon sequestration/conservation cannot be achieved in isolation without fuelwood/integrated landuse management or energy substitution policies. This involves designing project component to address the unsustainability of both the supply and demand sides of fuelwood through the management of community forests and the promotion of other substitution possibilities to displace the use of fuelwood. For this one should have an idea of the preferences of people and their reflection in terms of the demand, in this case for different kinds of energy. Knowing the responsiveness of people to fuel demand (or elasticities) helps in structuring different substitution policies. For example, the potential for a kerosene subsidy to decrease fuelwood use and resulting deforestation is indicated by the cross-price elasticity of demand for fuelwood with respect to price of kerosene. An advantage of integrating fuelwood use with carbon sequestration is that the use of such biofuels alleviates the critical issue of maintaining the biotic stocks over a long time and also lessens the conflicts. Of course, how to design such successful livelihood interaction is an issue, which would be discussed later. In the next section we examine how responsive the rural people are to the fuelwood demand.

3) How responsive are rural people to fuelwood demand?

To find out the responsiveness of rural people to fuel demand it is useful to know the demand for fuel in rural India. Some attempts have been made earlier to analyse the fuel demand in India. These attempts ranged from large-scale macro-planning exercises to local household case studies. Some macro estimates include attempts made by the ESI (Energy Survey of India) Committee (1965), The FPC (Fuel Policy Committee) (1974), The WGEP (Working Group on Energy Policy) 1979, The ABE (Advisory Board on Energy) (1985), EDSG (The Energy Demand Screening Group) (1986), The Rajadhyaksha committee of power sector planning (Gadgil, Sinha and Pillai, 1989) and the Planning Commission (1998). However, the major interest of these studies was to examine the impact of the energy requirements from their particular points of interest and duties. The main limitation of all the studies at macro level was that the projections were made only taking into account the population growth rate, increase in GDP, urbanization and technological advancements. Even the estimates vary widely. The fundamental problem with macro studies is that although macro factors can influence energy consumption patterns indirectly, the actual determinants of household energy consumption are found at the household level. Aggregate fuel demand is made up by the day-to-day decisions at the household level. These decisions are affected by budget and time constraints of the household, their opportunity costs of time, the relative accessibility of fuels (relative prices) as well as social and cultural factors. Given such a perspective, it is obvious that it is e.g. not only GDP growth that matters but also its distribution.

Several other estimates on consumption of biofuels were attempted mostly for rural regions in addition to the macro estimates (Joshi *et al.* (1992), IREP exercise (of the planning commission of the Government of India) etc. Though the surveys of fuel wood consumption at the regional level are an improvement over the macro level studies as the fuel consumption mix was different for different agroclimatic zones, the estimates give only consumption per capita for rural areas. A third group of studies examined the consumption of fuelwood in different agroclimatic zones and seasons by different income groups, size of households, landholdings, type of profession, agroclimatic zones, season, accessibility of forests etc (see Gundimeda and Köhlin, 2001). While some studies concentrated on the variation in consumption of fuelwood in groups with different income and landholdings, other studied the consumption in different seasons. The studies are scattered across the country and it is very difficult to make meaningful projections for policy analysis. The fourth stream of models, the household models are developed based on the argument that it is unrealistic to assume that peasant households collect a given amount of fuelwood irrespective of the local conditions which shape the private cost structure of fuels. As fuelwood collection is subject to the same labor, land and natural resource constraints as other household activities, including agricultural production, it cannot be analysed in isolation (Dewees, 1989). The only study, available in India that used household model, is by Heltberg *et al.* (2000), who analysed the links between forest scarcity and household energy consumption in villages bordering Sariska Tiger Reserve in Rajasthan. The study mainly focused on the substitution of fuels from the forests and commons and the private domain. However, based on this study alone we cannot conclude anything for our study.

So in this paper an attempt has been made to estimate the demand for fuels in rural areas. As discussed earlier the NSSO has done a survey on the extent of CPR use in India and gave the magnitude and value of collection of different products by population size class of the village and type of household. However, the data is only at state level. In order to analyse the household response to fuel we need a detailed pattern of household fuel use. The only comprehensive survey available on fuel patterns is on the consumption of important commodities in India. The data comprises information collected from around 69,206 rural households and 46,148 urban households, which covered the entire country (26 states and 6 union territories). Such surveys are carried out every five years but the present study uses the data from the 50th round (for the year 1993-94). The survey includes detailed information on demographic characteristics, household assets and expenditure on different commodities. We grouped the data on common property resource use in India with that of the consumption of commodities data in rural areas to analyse the fuel consumption patterns in different cluster of villages. As the NSSO data provides information on the quantities of fuel that is collected, this takes care of the extent of dependence on CPRs by the households.

In the first step we grouped the households in different regions in India into different homogeneous groups. At first, the households are clustered into different income groups and only the low-income groups are considered, as it is mainly the rural poor who are dependent on CPRs for collection. In the next stage, the households are regrouped into four clusters based on the per capita availability of CPR land, percentage area of forests to the total geographical areas (as a proxy for availability of the resource), reduction in CPR lands (as a measure of degradation), percentage of population dependent on CPRs for collecting fuelwood and share of fuelwood in the total fuel expenditure (as a measure of dependence on CPRs and fuelwood). Using these homogeneous groups we aim to examine if the people with high CPR access are as responsive as the people with low access to CPRs. What kind of variations are observed or observable at different levels of forest availability and dependence? Answers to these are not easy to come by as grouping of households taking into account all the four factors mentioned above is a complex problem both statistically and interpretational. The above grouping can be achieved using the well-known statistical clustering technique (see Chopra et al., 1990 for the technique). In this study a four-cluster pattern, for the pooled sample is estimated.

For the purpose we used the method of K-means clustering. Based on this, we identified four clusters. Cluster 1 consists of the states Andhra Pradesh, Assam, Gujarat, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Orissa and Tamilnadu. Cluster 2 comprises of the states Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Andaman and Nicobar Islands, where the per capita CPR land, forest area, dependence on CPR lands and the share of fuelwood in total fuel consumption are considerably higher. As these states are comparatively less developed compared to other states, the reduction in CPR land is lesser compared to other clusters. Cluster 3 consists of hill states in Northeast comprising of Sikkim and Tripura and the rest of the states Bihar, Haryana, Kerala, Punjab, Rajasthan, Uttar Pradesh and West Bengal are classified under one cluster. Cluster 1 needs maximum concern as both the reduction in CPR land as well as the dependence on CPRs is higher. It may be surprising that Rajasthan (relatively less developed) and Punjab fall in one cluster. However, as the clustering of groups is also based on the share of fuelwood in total fuel consumption, it is not surprising given the fact that Punjab is agriculturally well developed and the rural people may be depending on the agricultural residues (though agricultural lands are not classified as CPRs but sometimes it is difficult to exclude people using the by-products). The cluster means and coefficients of variation in respect of relevant variables are compared between clusters. Table 4 provides the number of observations and means of the variables considered for grouping.

From Table 4, it can be inferred that states which are less developed and where CPR land per capita is higher (lower population pressure), the decline of the CPR area is less (exception is cluster 3, which are mainly hill states). Various reasons can be attributed for this. One reason may be that these states are isolated (clusters 3) and located in bio-physically less favourable environments and hence protection of CPRs is stronger. Other reason may be that market forces less affect these states and hence traditional norms in usage of CPR land may be still prevalent. In such states, it is easier to organise 'user groups' thus lowering the transaction costs. In both these clusters the communities have fuller knowledge and an active concern about the CPRs. Clusters 1 and 3 also are comprises of more tribal population.

Table 4: Means and Number of observations falling under different Clusters

	Mean					
Cluster	**Per capita CPR land**	**% forest to the geographical area**	**Reduction in CPR land/CPR land**	**% of people (collecting fuelwood from cprs**	**Share of fuelwood in total fuel consumption expenditure**	**Number of households**
1	0.33	21.50	3.63	69.84	0.67	16966
2	0.86	78.25	1.05	80.33	0.78	1301
3	0.08	51.80	0.00	48.64	0.77	650
4	0.25	12.05	3.93	49.27	0.47	14722

3.2. Estimation of Fuel Demand

In the next step, we estimated the fuel demand for different clusters using the household data published by NSSO (1994). Without going into the technical details, the model can be briefly discussed as follows. In the first step a household allocated budget on fuel and non-fuel commodities and in the second stage he allocates expenditure on different categories of fuel. For the first stage an Engel model (relation between consumption and income) is used to analyse the allocation of total expenditure on fuel and non-fuel. In the second stage a linearised version of the almost ideal demand systems (LA-AIDS) suggested by Deaton and Muellbauer (1980) is used (see Gundimeda and Köhlin, 2002 for technical details). For analysis we clubbed clusters 2 and 3 into one cluster 2. In rural areas around 88% use fuelwood, 44% use dung, 67% use kerosene, 3% use LPG, 41% use electricity and 4% use other fuels like charcoal, coal and gobar gas. Thus, we considered the following commodity groups for rural areas: dung, fuelwood, kerosene, and electricity.

Demand functions for these fuel categories should ideally be based on a non-separable utility maximizing household model such as those used by (Cooke, 1998; Heltberg, 2000). Although the data is at household level, it still has limitations, e.g. in the availability of ancillary resource variables. We therefore considered a reduced form specification that draws as far as possible on the variables provided by the relevant literature, given the limitation of the data set. All available and relevant fuel prices are of course included. The household characteristics include total household expenditure, household size, expecting economies of scale in fuel consumption, caste (whether backward or forward caste); occupation (whether self employed, (for rural further distinguished to self-employed in agriculture or non-agriculture), agricultural labourer, casual labourer or other professions), as proxies for taste, life-style and opportunity cost of time. Finally, the resource characteristics are reflected by ownership of land. SAS was used to estimate the demand systems for the different clusters. Table 5 provides the summary statistics for the corresponding prices, expenditure on fuels and the demographic variables we used in the LA-AIDS model for all clusters together.

4 . Results and Discussion

From Table 5 it can be seen that cluster 2 has relatively higher percentage of scheduled castes and tribes compared to other clusters 1 and 3. Here as discussed earlier dependence on CPRs is also higher as most of them are landless and belong to self-employed in non-agriculture or unemployed category (around 68%). Clusters 1 and 3 more or less have similar percentage of backward castes and higher proportion of agricultural labourer and self-employed in agriculture. Cluster 1 has less share of fuelwood in total consumption compared to clusters 2 and 3. This clearly shows that landlessness and backwardness are directly related to the dependence on CPRs. The regression estimates also behaved very well with high significant levels and expected signs. Most variables were significant at the 1% level throughout the different sub-samples. The significance of these coefficients suggests that demands were responsive to prices, income and demographic variables. We are omitting the details on these parameters, as own-price and cross-price elasticities are more relevant for our analysis.

Table 6 gives the expenditure elasticities of different kinds of fuels. From table 6 it can be seen that the expenditure elasticity of fuelwood is positive and greater than one indicating that they are luxuries. But this is contrary to what we know about fuelwood that it is a necessity. This anomalous observation is because of the fact that fuelwood is collected free in rural areas and hence there is a tendency to consume high quantities. Dung and kerosene have expenditure elasticities between zero and one indicating that they are necessities. Expenditure elasticity of electricity however is negative and less than zero implying an inferior good. This result is also because of the fact that in India electricity is not used for cooking but only for lighting. Rural people treat electricity as inferior good because of the unreliable power supplies. This can also be seen from the fact that less than 10% of the people use electricity in all the clusters.

Table 5. Mean statistics of the Variables used in the Model for Urban and Rural Areas

	Mean		
Cluster group	Cluster1	Cluster2	Cluster3
Number of observations	32654	2394	13023
Household size	5.27	5.27	5.18
Household belongs to forward caste	66.4%	23.6%	60.3%
Household belongs to either schedule caste or tribe	33.6%	76.2%	39.7%
Household is self-employed in agriculture	12%	6.8%	10.7%
Household is an agricultural labourer	33%	9.1%	28.3%
Household is employed as other labourer	7.3%	5.2%	9.9%
Household is employed as self employed in non agriculture	37%	68%	41.5%
Household is employed in other professions	7.2%	10.6%	8.3%
Household owns land	12.6%	6.8%	4.1%
Household belongs to South	25%	0%	9.6%
Household belongs to North-east	0%	94.6%	30.2%
Household belongs to West	31%	0%	39.1%
Household belongs to East	14.3%	0%	0%
Household belongs to North	28.9%	5.4%	2.1%
Price of Dung	0.15	0.12	0.17
Price of Fuelwood	0.04	0.05	0.04
Price of Kerosene	0.11	0.14	0.10
Price of Electricity	0.27	0.24	0.27
Expenditure share of Dung	0.20	0.001	0.07
Expenditure share of Fuelwood	0.52	0.75	0.70
Expenditure share of Kerosene	0.19	0.17	0.14
Expenditure share of Electricity	0.09	0.08	0.08
Expenditure share of fuel consumption	0.078	0.085	0.085
Household mean percapita expenditure	229.9	266.9	233.18

From Table 6 it can be seen that a large number of the estimated cross-price coefficients have significant t values. All estimated own-price elasticities are negative as expected. The estimated real expenditure coefficients are negative and statistically significant indicating that different categories of fuel are necessities for all clusters. Table 6 presents the matrix of uncompensated price and compensated price elasticities. For clusters 1 and 3 only fuelwood and electricity is price elastic, but for cluster 2 all fuels excepting fuelwood are price-elastic. This implies that in almost all clusters people are highly responsive to the prices of fuelwood and electricity. However, the cross-price effects are not very promising in all the clusters as they are very low. This sensitivity of fuelwood demand to price hikes is interesting since it implies that a scarcity of fuelwood supplies could very well have serious welfare implications when alternate fuels are not available. Though this supports in a way the fact that households easily respond to higher prices through substitution to other fuels, it should be viewed from cross price elasticities, which are very low and even negative. This implies that households are affected due to price changes in fuelwood and given the fact that other alternative higher up the ladder are not freely available, they use inferior fuels. This can have very negative welfare implications.

Table 6. Own Price and Cross Price elasticities for all Clusters

	Cluster 1				**Cluster 2**				**Cluster 3**			
	Dung	Fuel wood	Kerosene	Electricity	Dung	Fuel wood	Kerosene	Electricity	Dung	Fuel wood	Kerosene	Electricity
Own price Elasticity	**-0.37** (0.02)	**-1.14** (0.01)	**-0.90** (0.14)	**-1.03** (0.05)	**-3.36** (1.08)	**-0.88** (0.014)	**-1.24** (0.11)	**-3.53** (0.48)	**-0.84** (0.01)	**-1.38** (0.01)	**-0.18** (0.04)	**-2.47** (0.05)
Cross price elasticities*												
Dung	-0.41	1.17	-0.27	-1.00	-3.36	4.27	0.21	-0.64	-0.77	0.83	0.13	1.92
FW	0.115	-0.10	0.05	0.14	0.01	0.13	0.02	-0.12	0.31	-0.51	0.24	0.02
Kerosene	-0.13	0.23	-0.83	0.46	0.002	0.09	-1.22	-1.22	0.13	0.66	-0.10	-0.88
Electricity	-0.81	1.15	0.76	-1.10	-0.01	-1.05	-2.47	-3.52	4.21	0.12	-1.8	-2.49
Expenditure elasticites	0.20	1.29	0.35	-0.13	-0.65	1.06	0.0	-0.07	0.33	1.16	0.40	-0.49

Notes: * - considered compensated price elasticities.

This indicates that if the CPRs are used for the sole purpose of growing carbon, rural people have negative implications. In India, the immediate substitute higher up the ladder is kerosene, which is not easily available in the market, and even LPG is not easily accessible in rural areas. The rural poor view LPG as an extremely luxurious fuel given the high initial costs. Further, given the fact that rural areas do not have uninterrupted power supply, most of the rural poor use kerosene for lighting. In view of this the only affordable and readily available alternatives available to the rural people in India are fuelwood and dung. Using CPR lands without consideration of the rural scenario would not only result in conflicts but also extreme hardships for poor. With no access to CPRs and hence no income opportunities, this would force the rural poor to migrate to nearby towns and seek employment elsewhere. For those who do not migrate it becomes a question of survival for the landless households. Further, this would place such CDM projects under high participant as well as project risk and as at the end the project may not yield beneficial results (see Gundimeda and Yan, 2002 for discussion). This would also push up the transaction costs making the projects unattractive. In such cases design of proper incentive contract would result in win-win-win situation for the investor, host country and the environment. One such incentive contract would be the management of the CPR lands by the user groups. Even while designing the CDM projects, the annual energy requirement met by rural people from fuelwood and agricultural residues have to be incorporated. There is evidence from the grazing lands and hill region of India that sophisticated indigenous systems of management of natural resources have been in place for sometime. One of the most often cited examples is mutually beneficial agreements made between pastoralists and cultivators; after the harvest, pastoralists are invited to graze their cattle for a fixed period on cultivators' land in exchange for cattle manure. There is also a vast literature on the conditions for sustaining the user groups. Based on an extensive review of studies by Wade (1988), Ostrom (1990) and Baland and Platueau (1996) and other studies, Agarwal (2001) summarised the list of critical enabling conditions for sustainability on the commons. Table 7 lists these enabling conditions. They have been classified under four heads: 1) Resource system characteristics; 2) Group characteristics: 3) Institutional arrangements and external environment. Agarwal (2001) considered some interacting elements also. Using these conditions, the conditions satisfied automatically if cprs are used for cdm are marked Y. The success of cdm on cprs depends on how one can satisfy other criteria listed in the table.

However, taking for granted the fact that user groups ensure justice to the rural poor can be little further from ground reality too. Exclusion of the poor from cprs across regions of India is a common feature of the literature (see Beck and Nesmith, 2001 for review of literature) even before they are very profitable. From the literature the exclusion of cprs has been facilitated by a number of processes – liberalization, commodification, marketization and agricultural intensification which have been going on for decades; related to the first point, elites are increasingly cornering cprs previously used by the poor, partly through privatisation or enclosure of formerly "common" lands and partly through refusing access to cprs to which poor people previously had access: while systems of regulation of cpr lands existed in the past, these systems appear to be breaking down: increase in population has led to greater pressure on resources; general degradation of cprs, caused by the factors noted above ((Beck and Nesmith, 2000 for review of literature). Even experiences of Joint Forest Management (JFM) in India are mixed about the benefits to the poor. In JFM the users in the user group (the village forest committees (VFCs)), are allowed to take the fuelwood from the shrubs of inferior species or dry fallen wood free of charge. Otherwise they are charged a user fee and the harvesting is restricted and selective. The VFCs impose fines for the violation of the agreed rules by insiders or outsiders. This introduces a new rights regime that is not consistent with the traditional de-jure or de-facto rights. The income generated from the user fee is deposited in a common village fund managed by the VFC leaders. Very often these funds are used for purposes – such as temple building or community feasting – that offer little by way of compensatory benefit to the poor, but which help to reproduce the cultural and political capital of more influential households (Kumar 2002).

Table 7. Critical enabling conditions for sustainability on CPRs

Characteristics	***Whether requirement is met in case cprs are used for growing carbon***
Resource system characteristics	
Small size	Y
Well-defined boundaries	Y
Low level of mobility	Y
Possibilities of storage of benefits from the resource	Y
Predictability	Y
Group characteristics	
Small size	
Clearly defined boundaries	Y
Shared norms	
Past successful experiences – social capital	
Appropriate leadership – young, familiar with changing external environments, connected to local traditional elite	
Interdependence among group members	Y
Heterogeneity of endowments, homogeneity of identities and interests	
Relationship between resource system characteristics and group characteristics	
Overlap between user residential location and resource location	Y
High levels of dependence by group members on resource system	Y
Fairness in allocation of benefits from common resources	
Low levels of user demand	
Gradual changes in levels of demand	
Institutional arrangements	
Rules are simple and easy to understand	
Locally devised access and management rules	
Ease in enforcement of rules	
Graduated sanctions	
Availability of low cost adjudication	
Accountability of monitors and other officials to users	Y
External environment	
Technology	
• Low cost exclusion technology	
• Time for adaptation to new technologies related to the commons	
• Low levels of articulation with external markets	
State	
• Central governments should not undermine local authority	
• Supportive external sanctioning institutions	Y
• Appropriate levels of external aid to compensate local users for conservation activities	Y
• Nested levels of appropriation, provision, enforcement, governance	
Relationship between resource system and institutional arrangements	
• Match restrictions on harvests to regeneration of resources	

Source: Agarwal (2001)

Even concerning the generation of employment for the rural poor due to CDM activities, one needs to exercise a bit of caution. Though, there could have been employment due to plantation, thinning, weeding activities, it is often the case that nonpoor households corner most the of wage work opportunities within their home village, especially when this work is provided by government agencies at an official wage rate that is two to three times the traditional village rates (Kumar, 2002). How to design a suitable institution that ensures equity and fair distribution of benefits is an area of further research and it needs to be location specific.

In case one could successfully form such user groups satisfying the critical enabling conditions for sustainability of cprs, the maximum amount of carbon may not be achievable but this definitely is more sustainable. This is because local people have more knowledge of the species suited for their climatic conditions. Further, by planting the native multipurpose species as per their requirements would result in storing carbon for a long time, rather than planting trees, which grow fast and are not much beneficial otherwise. Communities can indeed be expected to manage a CPR in an effective and uncontested manner, particularly when the resource is confined to a small, well-defined area that is marked by strong de jure tenures. There is now a vast literature, which suggests that suitable institutional frameworks can be designed to secure beneficial outcomes for stakeholders. Linked to this is a growing appreciation that sustainable resource management can go hand-in-hand with poverty alleviation (Jodha, 1986, 1992; World Bank, 2001) and that the effectiveness of government as a resource manager is improved when it shares powers with different user groups. Only in such case can CDM have win-win-win scenario for investors, governments and local people.

5. Conclusions

Developed countries can significantly reduce the costs of meeting their Kyoto commitments through land use and land use change (LULUCF) projects. If Kyoto is ratified, the projects can be implemented on degraded forest lands and pasture land. These lands are eligible under CDM because they satisfy the conditions of additionality, leakage, permanence etc. However, these lands are categorised as common property resources (or open access resources) on which local communities depend for their living directly or indirectly. Using data from the survey carried out by the National Sample Survey Organisation and also other studies, we showed that the poor with limited alternative means of income depend on these low pay-off option offered by cprs for several of their needs. We analysed the data on common property resources of India collected by nsso and found that landless ness and backwardness are directly related to the dependence on cprs. Using cprs for cdm can have two implications. On the positive side, cdm can result in accrual of benefits to whole village as well as to the individual households. However, the main concern raised in this study is that the commodity contrasting sequestering of carbon is the use of these lands as a source of fuelwood. Given the fact that the dependence on fuelwood in rural areas is likely to continue for a long time, carbon sequestration/conservation cannot be achieved in isolation with fuelwood/integrated land use management or energy substitution policies. This involves designing project component to address the unsustainability of both the demand and supply sides of fuelwood and promotion of other substitution possibilities to displace the use of fuelwood. For this we need to know the responsiveness of people to fuel demand.

In order to examine the responsiveness of people to fuel demand, we used the information on consumption of important commodities in India collected by NSSO. The data comprised of 69,206 households and consists of data on demographic characteristics, household assets and expenditure on different commodities. Using an almost ideal demand system proposed by Deaton and Muellbauer (1980) we estimated the expenditure, own price and cross price elasticities for different fuels and for different clusters. We found that for clusters 1 and 3 fuelwood is price elastic excepting cluster 2 (almost close to 1). This implies that in all clusters people are highly responsive to the price of fuelwood. However, the cross-price effects are not very promising in all the clusters as they are very low. This sensitivity of fuelwood demand to price hikes implies that a scarcity of fuelwood supplies could very well have serious welfare implications given that alternative fuels higher up the ladder are not easily available. Using cpr lands without consideration of the rural scenario would not only result in conflicts but also extreme hardships to the poor. The only solution to this problem seems to be management of cprs by user groups both for carbon as well as fuelwood. In such case though the investor's interest is not maximised but this can be the only win-win-win situation for the investors, host countries and the local communities. There has been much research on the conditions for sustainability of commons. However, how to form a successful user group in the context of carbon needs localised analysis and is an issue for further research.

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Glossary of terms

ABE	Advisory Board on Energy
A-I	Annex – I
CDM	Clean Development Mechanism
CHg	Central Plateau and Hills
CPR	Common Property Resources
DP	Southern Plateau and Hills
EC	East Coast Plains and Hills
EDSG	The Energy Demand Screening Group
Ehg	Eastern Plateau and Hills
Ehm	Eastern Himalayas and Brahmaputra Valley
ESI	Energy Survey of India Committee
FCCC	Framework Convention on Climate Change
FPC	Fuel Policy Committee
GC	Gujarat Coast Plains and Hills
GHG	Greenhouse gas emissions
IREP	Integrated Rural Energy Programme
Isl	All Islands
JFM	Joint Forest Management (JFM)
JI	Joint Implementation
KP	Kyoto Protocol
LA- AIDS	Linearised version of the almost ideal demand system
LG	Lower Gangetic Plains
LUCF	Landuse change and Forestry
LULUCF	Landuse, landuse change and forestry
MG	Middle Gangetic Plains
NA- I	Non-Annex 1 countries
NRSA	National Remote Sensing Agency
NSSO	National Sample Survey Organisation
TD	Western Dry Region
TG	Trans Gangetic Plains
UG	Upper Gangetic Plains
VFC	Village Forest Committee
WC	Western Coast Plains and Hills
WGEP	Working Group on Energy Policy
WHg	Western Plateau and Hills
WHm	Western Himalayas