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## Contribution of Forest Resources to Local People's Income: A Case Study in Cat Tien Biosphere Reserve, Vietnam

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Drawing on the results of the surveys in 3 zones of Cat Tien Biosphere Reserve (CTBR) belonging to 3 provinces in Southern Vietnam, this paper examines the potential and contribution of forest resources to local people's livelihood. The main objectives of this study are to emphasize the variety of forest resources found in the area, to describe their contribution to the local people in 3 different zones of the reserve after the establishment of CTBR in 1998. 84 households were interviewed in 4 hamlets in 2005, 2006 and 2010. Participatory Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA) methods were implemented in order to obtain the information and data.

The paper shows that in spite of the strict regulations on conservation the local people in the surveyed areas have been overusing forest resources for both subsistence and cash income. The findings confirm that the people in the core zone (CZ) and the buffer zone (BZ) still got very high forest resource income (FRI), whilst the residents in the transition zone (TZ) were less dependent on the forest resources. Moreover, the income of the residents in the CZ and the BZ increased significantly thanks to the forest resources. All of the well-off and medium households in the CZ got most of their income from forest resources, especially from uphill cultivation of cashew. It is recommended that higher-yielding cashew should be cultivated in areas outside the CZ where Javan Rhinoceros are living; more extension activities of agro-forestry and more participation of the local people involved in forest management and protection are necessary.

**Keywords:** Cat Tien Biosphere Reserve, forest resources, local people, income

### INTRODUCTION

Vietnam forest cover declined dramatically from 50% in 1945 to 20% in 1989, increased from 28.8% in 1998 to 33.2% in 2000 (Sang, 2006). Currently, the national forest cover is about 39.4% (MARD, 2009) of the total country. 36.7% of the forest area is protected in protected areas (Wil *et al.*, 2006). Local people living inside or around them are dependent on available forest resources such as foodstuff, fuel wood, and construction materials. These people are mainly poor minorities and have few other livelihood opportunities, rather than from forest (Swinkels and Turk, 2006).

Cat Tien Biosphere Reserve is the home of about 9,500 people in the CZ and 170,000 residents in the BZ belonging to 11 different ethnic groups; about 30% of the residents are estimated to live in poverty, especially ethnic minorities. About 60–80% of the population has the main source of living from forest resources (CTBR, 2006). Most of the local people within and around CTBR have depended much on forest resources for generations and have caused the major loss of the reserve (Sang *et al.*, 2009). They harvest forest resources for both subsistence

and cash income. Biodiversity in CTBR is endangered mainly by encroachment of forest land, illegal logging, poaching. This results in biological invasions, endangering endemic faunas and floras.

This study demonstrates the importance and value of recognizing the forest resources in the daily lives of the local people, especially ethnic minorities; explores its contribution to their livelihoods so as to be intended to enhance food security, sustainable management and conservation of CTBR.

### MATERIALS AND METHOD

This study was based on 84 households from four hamlets in 3 zones of CTBR. The study was carried out in K'it Hamlet in the CZ; two hamlets in the BZ: Hamlet 4 in Ta Lai Commune, Dong Nai Province and hamlet 3 in Tien Hoang Commune, Lam Dong Province; and Hamlet 6 in the TZ belonging to Madagui Commune, Lam Dong province. The field data were collected in the period from October, 2005 to March, 2006 and in 2010 in the zones of CTBR. This area was chosen as a case study because the forest resources in the reserve continue to be degraded owing to a lot of pressures and a lot of species of plants and animals (especially Javan Rhinoceros) living in the sanctuaries are threatened by the local people. To reflect the status of the role of forest resources in CTBR to local people's income, the research aims at the following criteria to select the study sites: there are natural forests; for the CZ, there are indigenous ethnic minorities living in the surveyed hamlet; local residents depend on the forest resources; it is possible to access

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the communities and conduct survey on cultivation and forest management.

To check whether a hamlet had the criteria mentioned above, the first observation and interviews with the local government, local people, and foresters were implemented. Based on these criteria, four hamlets belonging to four communes in two provinces, Dong Nai and Lam Dong, were chosen in three different zones. Selected hamlets were as follows: K'it Hamlet in the CZ, Hamlet 4 of TaLai Commune and Hamlet 3 of Tien Hoang Commune in the BZ; Hamlet 6, of Madagui Commune in the TZ. The random sampling method was used to choose sample households. In total, 84 households were interviewed by using the questionnaire with long discussions.

The data collected for the present study is primary as well as secondary in nature. Primary data were collected by a household survey using survey questionnaire and direct interviews. The personal discussions and interviews with members of the households, the traditional and modern village headmen, and technical officials, especially technicians of CTBR, foresters, local authorities, and group discussions were implemented. Information and data on socio-economic profile, education status, occupations, forest resource use, agriculture products, traditional social life and cultivation practice were collected. Secondary data from books, newspapers, statistic reports, maps, statistical year books, official government records, and local administrative systems were used.

The quantitative information obtained through the questionnaire survey was analyzed. The Statistical Package for Social Sciences (SPSS) was used to identify the significant differences among variables (especially analyze the causal relationship among variables) in the local people's socio-economic characteristics and their forest use structures.

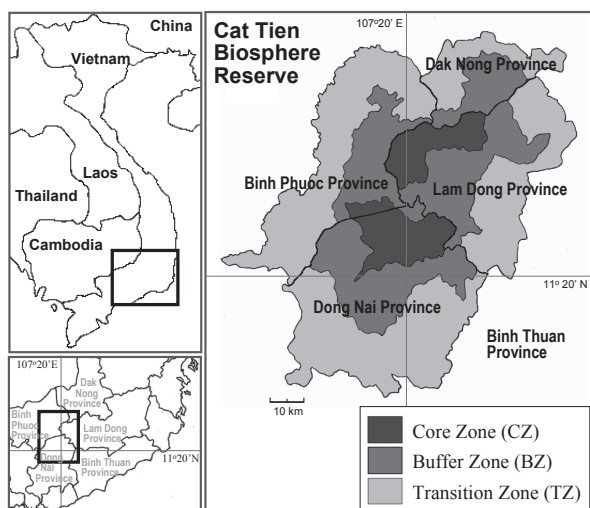


Fig. 1. Study site.

## RESULTS AND DISCUSSION

K'it hamlet is located in Gia Vien Commune, Cat Tien district, Lam Dong Province. The site lies in Cat

Loc area in the CZ with a higher range of precipitous hills. Located inside the living range of Javan Rhinoceros, the hamlet becomes an important place for conservation activities of the reserve. Formerly, there was a group of Chau Ma people living in Da Bo Dam, Gia Vien Communes (Sang *et al.*, 2007). In 1990, they moved to the current area and settled there. At the same year, one family of Kinh people migrated to K'it Hamlet. Between 1991 and 1992, two families of Nung people from the North of Vietnam settled in this area. They have traditional subsistence economy and rely much on forest resources. In the past time, as a custom, shifting cultivation was their major cultivation. But now with the strict control of the reserve, the shifting cultivation is converted to uphill cultivation, mainly cashew plantations and some areas of coffee. They gain high cash income from this kind of cultivation and seem to be accustomed to market economy (Sang, 2006).

Hamlet 4 is located in Ta Lai Commune, Tan Phu District, Dong Nai province; it lies between Dong Nai River and the CZ of CTBR. To its west and north are the borders of the CZ, to the east Dong Nai River, and to the south La Nga Forestry Enterprise. Chau Ma and S'Tieng people have lived here for generations. After 1980, some Kinh people from Mekong Delta or south – east provinces of Vietnam arrived and settled in the area (Sang, 2006). In 1982, the program of fixed cultivation and sedentarisation was implemented; each person in the hamlet was allocated 1,500 m<sup>2</sup> of cultivation land. Before 2003, this area belonged to the CZ. Decision 173/QĐ–TT of August 19<sup>th</sup>, 2003 approved that the hamlet was converted into the BZ (CTBR, 2006).

Lying in Tien Hoang commune, Cat Tien District, Lam Dong Province; Hamlet 3 is located nearby the CZ boundary of the reserve in Cat Loc region and belongs to the BZ. Established at the foot of a high hill range, the site is suitable for cultivation of wet rice. Formerly, the area was covered by the natural forest. In 1986, with the program of development of new economic zones (NEZs), many Kinh families from Ninh Binh Province in the north of Vietnam moved to the site and settled there. At that time, the family income was generated through the exploitation of forest products (Sang, 2006). At that time, the family income was generated through the exploitation of forest products. Their handicrafts include basketry, carpenter and joss-sticks. Recently, with the strict control of forest resources, the economy of the local residents has converted to uphill cultivation, breeding of livestock and poultry, aquaculture and commerce trade.

Located in Madagui Commune, Da Huoai District, Lam Dong Province; hamlet 6 is near the border between Lam Dong and Dong Nai Provinces and 1 km far from the centre of Da Huoai District. This hamlet belongs to the TZ. In 1986, with the program of development of NEZs, many Kinh families from the north of Vietnam were moved to the south; a group of families did not go to the NEZs but settled in this site (Sang, 2006).

### Change of the local people's income structure

Table 1 summarized the average income per capita

**Table 1.** Gross annual income per capita in the period of 7 years

Zones	Agriculture Income	FRI						Other incomes	Total	
		Uphill cultivation	Forest protection	Logging	Hunting & Fishing	NTFPs	Sub total			
CZ	1998	538.78	1468.42	0	103.05	96.95	176.16	1844.58	377.5	2760.86
	2005	312.20	12308.54	122.56	10.98	41.71	97.26	12581.05	44.98	12938.23
	Balance	-32.37	1548.59		-13.15	-7.89	-11.27	1533.78	-47.5	1453.91
	%	-6.01	105.46		-12.76	-8.14		83.15	-12.58	52.66
BZ	1998	948.55	892.19	0	77.14	271.7	330.3	1571.36	214.24	2734.14
	2005	1750.71	4293.46	22.35	9.97	73.48	143.27	4542.52	781.79	7075.02
	Balance	114.59	485.89		-9.6	-28.3	-26.72	424.45	0.52	620.13
	%	12.08	54.46		-12.44	-10.4	-8.09	27.01	0.24	22.68
TZ	1998	1112.77	317.47	0	702.27	202.27	251.59	1473.6	684.55	3270.92
	2005	4211.36	1022.73	102.27	312.5	42.61	277.27	1757.38	3246.82	9215.56
	Balance	442.66	100.75		-55.68	-22.81	3.67	40.54	366.04	849.23
	%	39.78	31.74		-7.93	-11.28	1.46	2.75	53.47	25.96

Note: Unit of the incomes: 1000 VND / head of habitant / year;

Approximate exchange rate in June, 2010: 1 Japanese Yen = 207.18 Vietnamese Dong;

Balance: the mean annual increase of the incomes in amount of 1000 VND and in percentage in the period of 7 years.

**Table 2.** Comparison of average gross income per capita in the period of 7 years

Zones	Pairs	T	Df	Sig. (2-tailed)
CZ	Average gross income per capita 1998 – 2005	-5.248	17	0.000**
BZ	Average gross income per capita 1998 – 2005	-2.683	50	0.010*
TZ	Average gross income per capita 1998 – 2005	-3.951	14	0.001**

Note: \*, \*\* denote significance at level of 0.05 and 0.001

Method: Paired Sample T Test for the income in selected hamlets of three zones between 1998 and 2005.

of sampled households in different hamlets of 3 zones for the period of 7 years. It shows that the gross annual income per capita of all the hamlets in 3 zones jumped significantly between 1998 and 2005 (see table 1 and 2). The increase of the gross annual income per capita was as follows: K'it Hamlet in the CZ 52.66%, the hamlet in the TZ 25.96%, and the hamlets in the BZ 22.68%. It is apparent from the table that the rapid rise of the gross annual income per capita in the CZ was the result of the significant increase of the income from uphill cultivation on the forest land (see table 2). The significant increase of the income from uphill cultivation and agriculture mainly contributed to the rise of the gross annual income per capita in the BZ. In the sampled hamlet of the TZ, the dramatic increase of the gross annual income per capita was the consequence of the rapid rise of other incomes from off-farm activities as well as agriculture (see table 2). In contrast, the income from biological forest resources including activities of logging, collection of non-timber forest products (NTFPs), hunting and fish-

ing annually decreased (see table 1). It means the access of the local residents to biological forest resources has become narrower with every passing day.

### Change of the welfare structure of the sampled households

The wealth of each household was classified into one of the four levels: well-off households (group I), medium households (group II), poor households (group III) and very poor households (group IV). As can be seen from tables 3 and 4, the welfare groups in the CZ between 1998 and 2005 were changed significantly. In 2005 the households in the CZ were richer than themselves in 1998 as their cashew plantations were in the period of fully developed ages after they started planting cashew on the encroached uphill land from 1993 to 1998. All of the well-off and medium households in the CZ got most of their income from forest resources, so the people in the area have become richer with every passing day. But the change of welfare groups was not significant in the BZ and the TZ. Many residents in the BZ have encroached on the uphill land since 1998, so their cashew plantations now are at the young age. Of course, the income per capita from cashew in this area was not high.

It is clear that the significant change of welfare groups in the CZ was the result of the great annual increase of the income from forest (105.5% of the annual increase of total income per capita) (see table 1).

### Income from forest resources

According to the bar chart (figure 2), K'it Hamlet of the CZ had the highest forest income in its total income (97.2%) and the hamlet in the TZ the lowest (19.1%). The BZ had 64.4% of total income. It is very easy to see the significant difference in the percentage of forest income in the total income between the TZ and two other zones. Most of the income of the residents in the CZ and

the BZ came from forest resources. The people in the CZ were the most dependants on the forest resources. On the contrary, the people in the hamlet of the TZ did not depend much on the forest resources, but their economy based on both agriculture and off-farm activities.

With regard to the different levels of dependence on forest resources, the figure in table 5 varied much among hamlets of the zones as well as different welfare groups. When considering more than 40% of household income coming from forest resources, the highest one was in the CZ–100%–followed by the BZ–50.9%–and, finally, the TZ–13.4%. This implies that levels of dependence on forest resources of three zones were significantly different and the population in the TZ did not depend much on the forest resources.

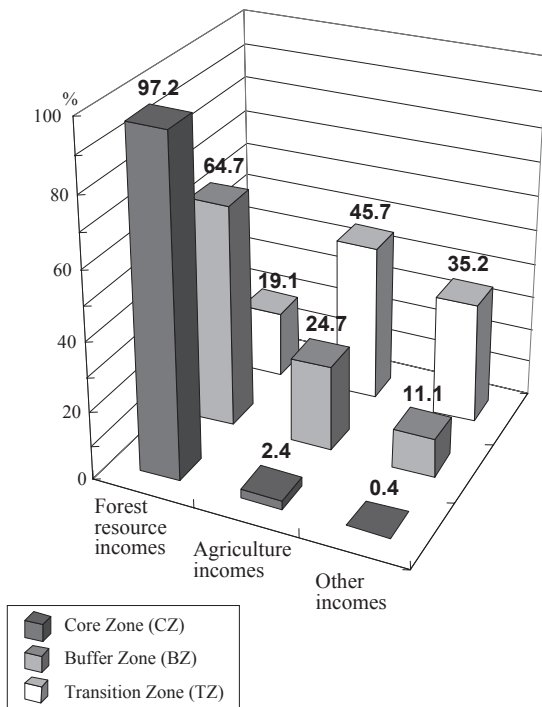


Fig. 2. Rate of the FRI and others to the total income per capita in 2005.

Concerning the welfare groups related to percentage of FRI in the total income (see table 5), in 2005 all the well-off households in K'it Hamlet of the CZ (50% of the sample population of the hamlet) had more than 80% of

Table 3. Distribution of welfare groups of the sampled households

Number of households of different welfare groups in 2005						
Zones	Groups	I	II	III	IV	Total
CZ	I	2	0	0	0	2
	II	1	1	0	0	2
	III	4	1	0	0	5
	IV	3	1	3	2	9
		10	3	3	2	18
BZ	I	5	0	2	1	8
	II	2	0	2	2	6
	III	1	1	1	4	7
	IV	1	3	3	23	30
		9	4	8	30	51
TZ	I	2	0	2	0	4
	II	3	1	0	0	4
	III	0	0	2	0	2
	IV	0	3	0	2	5
		5	4	4	2	15
Total	I	11	4	4	3	22
	II	6	4	3	4	17
	III	5	3	0	9	17
	IV	8	4	7	9	28
		30	15	14	25	84

Table 4. Change of the welfare groups of the sampled households in the period of 7 years

Zones	Z	Asym.sig (2- Tailed)
CZ	-3.223	0.001**
BZ	-0.026	0.979
TZ	-1.303	0.193

Note: Statistic Test: Wilcoxon Signed-Ranks Test.  
\*, \*\* denotes significance at 0.05 and 0.001 level

Table 5. Ratio of local people's dependency on forest resources

Percentage of annual income from forest resources	Zones																			
	CZ (N = 18)						BZ (N= 51)						TZ (N= 15)							
	Total		Welfare groups				Total		Welfare groups				Total		Welfare groups				Total	
	N	%	I	II	III	IV	N	%	I	II	III	IV	N	%	I	II	III	IV	N	%
< 20%	0	0	0	0	0	0	18	35.4	2	5	3	8	7	46.6	3	3	1	0	25	29.7
20-40%	0	0	0	0	0	0	7	13.7	1	1	0	5	6	40.0	3	1	1	1	13	15.5
40-60%	2	11.1	0	0	0	2	7	13.7	2	1	1	3	1	6.7	0	0	1	0	10	11.9
60-80%	1	5.6	0	1	0	0	12	23.5	2	1	5	4	1	6.7	0	0	0	1	14	16.7
> 80%	15	83.3	9	3	3	0	7	13.7	5	0	0	2	0	0	0	0	0	0	22	26.2
Sum	18	100	9	4	3	2	51	100	12	8	9	22	15	100	6	4	3	2	84	100

their income coming from forest resources, followed by medium groups–16.7% (3 households)–and poor households–16.7% (3 households). Medium households who made up only 5.6% (1 household) of the sample households of the hamlet had 60–80% of their income from forest, and 11.1% naming very poor groups–between 40 and 60%. There were not any welfare groups having FRI which was less than 40%. The figures above indicate that all the well–off and medium households in the CZ got most income from forest resources, but a few poor families depend on forest resources at the mean level.

When considering the relationship between the household income coming from forest resources in the total income and the welfare groups in the BZ, all different kinds of households appeared at any levels of FRI. There were not any significant differences among welfare groups in terms of percentage of income from forest resources.

As for the hamlet of the TZ, 86.6% of households did not depend much on forest resources (less than 40% of their income coming from the forest resources) (see table 5). There were 40% (6 households) of well–off households and 26.7% (4 households) of medium groups that had less than 40% of the income from the forest resources. Only 6.7% (1 household) of poor households had 40–60% of the income from the forest resources and 6.7% of very poor groups had 60–80% of the income from forest resources (see table 5). Conversely, there were not any households who had more than 80% of the income from the forest resources. So the local people in the hamlet of the TZ did not depend much on the forest resources in 2005. Of course, they found out other income from other sources.

**Change of the FRI**

The figure 3 shows that the change of FRI between 1998 and 2005 was dramatically in the CZ and the TZ, but slightly in the BZ (see table 6). The rate of FRI to the total income per capita in the sample hamlet in the CZ increased significantly, from 66.8% in 1998 to 97.2% in 2005. This rate in the BZ rose slightly, from 57.5% in 1998 to 64.2% in 2005. In comparison, the rate decreased rapidly in the sample hamlet in the TZ, from 45.1% in 1998 to 19.1% in 2005.

Furthermore, the proportion of the annual increase of FRI to the increase of total annual income per capita in the CZ was very high (105.5%). As can be calculated from tables 1, this rate in the sample hamlets of the BZ was high (68.4%). The sample hamlet in the TZ had only 4.8% ( $40.54 \times 100 / 849.23\% = 4.8\%$ ). This indicates that the income of the residents in the CZ and the BZ

increased significantly thanks to the forest resources, but the contribution of forest resources to the rise of total income in the TZ was very small.

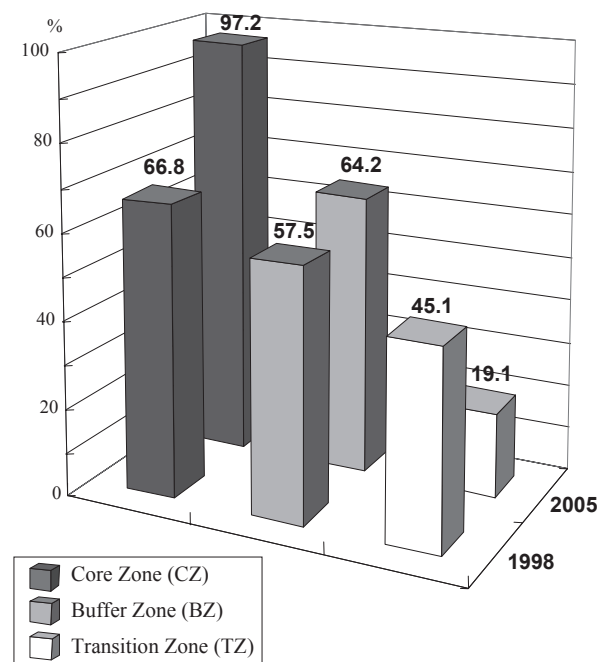
According to table 6, the increase of FRI per capita was significant in the sampled hamlets in the CZ and the BZ, but not in the surveyed hamlet of the TZ.

**Importance of uphill cultivation income in the total FRI**

As can be seen from figure 4, most of the income from forest resources of the residents in the CZ and the BZ came from uphill cultivation. Most of the residents cultivate cashew (*Anacardium occidentale*) on uphill land. This shows that uphill cultivation has become a crucial activity of these people. The figure in the TZ was only 58.2% and the rest came from forest biological resources. It indicates that the people in this zone were difficult to access to the forest land resources, so they collected NTFPs for handicraft products and gain much income from this activity.

**Income from the activity of the forest protection**

Before 2001, there was not the activity of forest protection in the surveyed area. Recently, forest protection has been an activity of the local people within and around the reserve. To compare the income from forest protec-



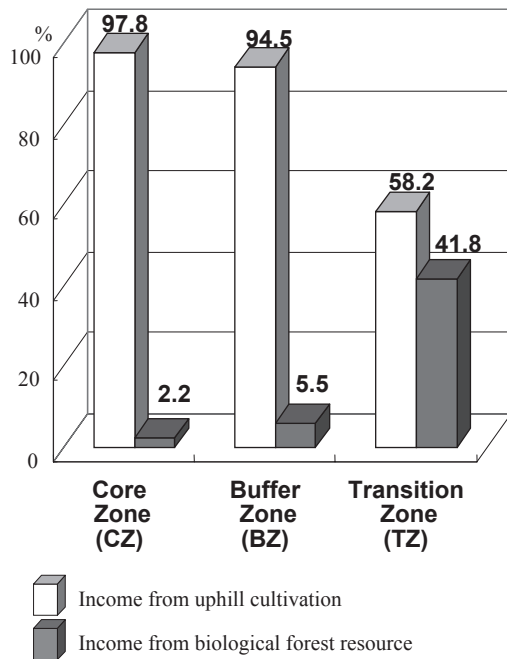
**Fig. 3.** Change of the FRI to the total income per capita.

**Table 6.** Comparison of average gross FRI per capita in the period of 7 years

Zones	Pairs	T	Df	Sig. (2-tailed)
CZ	Average gross FRI per capita 1998 – 2005	-5.212	17	0.000**
BZ	Average gross FRI per capita 1998 – 2005	-2.031	50	0.048*
TZ	Average gross FRI per capita 1998 – 2005	-0.103	14	0.898

Note: \*, \*\* denote significance at level of 0.05 and 0.001.

Method: Paired Sample T Test for the income in 1998 and 2005.



**Fig. 4.** Rate of the income from uphill cultivation to the total FRI per capita.

tion activity with the total FRI capita, the rate of this income was very small in the area: the CZ 0.97% ( $122.56 \times 100 / 12581.05 \% = 0.97\%$ ), the BZ 0.49%, and the TZ 5.82% (calculated from table 1). This could not encourage the local people in the activity of forest protection.

## CONCLUSIONS

It appears from the results that CTBR is naturally endowed with great variety of forest resources on which the local people in the CZ and BZ depend heavily (see figure 2). The resources have been contributing very much to the livelihood of the local people in the CZ and BZ of the reserve, especially richer households (see table 5). The income of the residents in these two zones has increased significantly thanks to the forest resources, but the contribution of forest resources to the rise of total income in the TZ has been very small (see figure 3 and table 6).

The local people in the CZ and BZ have low education levels, are isolated from outside world and lack of alternatives for their livelihood (Sang, 2006); so they must overuse the forest resources for their basic need as well as getting rich (see tables 3 and 4). Their dependency on forest resources causes a lot of negative impacts on CTBR through over exploitation of the resources and encroachment of forest land (Sang, 2006). The findings also confirm that cultivation of cashew on the bare hills contributes both considerable income to the local residents and more green cover for the conservation purpose. Higher-yielding cashew with appropriate techniques should be cultivated in areas outside the CZ; more extension activities of agro-forestry and more participation of the local people involved in forest management

and protection are necessary.

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