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Impacts of the Hara Biosphere Reserve on Livelihood and Welfare in Persian Gulf Peer-reviewed author version

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4 Abstract

5 Despite the importance of biosphere reserves in Iran's livelihood and welfare, the economic significance of Hara Biosphere Reserve has never been comprehensively 6 studied. This study examines the current importance of Hara Biosphere Reserve (HBR) 7 8 in local livelihood and welfare. Using a household survey, data were collected through a 9 questionnaire, key informant interviews and direct observations. Two hundred and fortyfour households were randomly selected from 10 villages through proportional sampling. 10 Results showed that non-environmental income was the first driver of the total income, 11 12 poverty alleviation and narrowing income inequality gap. Park income was the second. The results also showed that excluding park income from total income would 13 significantly increase headcount poverty, widen the poverty gap, and raise the Gini 14 coefficient. Wealthier households had the greatest absolute income from the 15 environment, including forest, fishing and fodder. However, the poorest group had 16 17 smallest absolute income from these sources. Thus, the study demonstrated that wealthier households are responsible for the overharvesting of environmental resources. 18 19 Interestingly, the study showed that wealthier households are more dependent on 20 profitable environmental incomes sources while the poorest are more dependent on nonprofitable ones. 21

Keywords: mangrove forest; environmental income; income inequality; household
 economics; natural resources management.

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1. Introduction

27 Biosphere reserves are unique ecosystems with valuable social and ecological functions. While some conservation systems have focused on conservation goals, biosphere 28 29 reserves seek to protect important ecosystem values, while meeting the livelihood requirements of local residents (Nations 2001). Accordingly, biosphere reserves provide 30 a variety of environmental income sources for local communities. "[E]nvironmental 31 incomes, are incomes (cash or in kind) obtained from the harvesting of resources 32 provided through natural processes not requiring intensive management" (PEN 2007). As 33 34 an example of the environmental income, Cambodia's Tonle Sap biosphere reserve supports fishery for over one million people living in and around it (Bonheur and Lane 35 2002). In Mexico, small-scale fisheries are supported by the biosphere reserve in the 36 37 Gulf of California (Erisman et al. 2015). Biosphere reserves also contribute to animal husbandry by providing livestock feed (Singh et al. 2003). Moreover, they provide a 38 variety of non-timber forest products (NTFPs) such as medicinal plants (Ghorbani et al. 39 40 2012). In addition to environmental incomes, biosphere reserves support a variety of non-environmental income streams like tourism. Tourism generates income for local 41 communities while being environmentally sustainable (Jiang 2009; KC et al. 2015; 42 Surendran and Sekar 2011; Xu et al. 2009). 43

There is now a growing interest in understanding how rural livelihoods depend on natural resources in developing countries. Vedeld et al.'s (2007) meta-study in 17 developing countries showed that environmental incomes derived from forests contributes an average of 22% of the total income of local people. In their study carried out in 24 developing countries, Angelsen et al. (2014) found that environmental incomes account for 28% of the total household income. Moreover, the importance of environmental and non-environmental incomes on reducing poverty and income

51 inequality have been investigated in many developing countries, including South Africa (Thondhlana and Muchapondwa 2014b), Ethiopia (Gatiso and Wossen 2015), Cambodia 52 (Nguyen et al. 2015), Zimbabwe (Cavendish 2000), and Nicaragua (Ravnborg 2003). 53 54 The results of the case studies have varied because of the diversity of social, economic, ecological, and political contexts. Nevertheless, environmental incomes have been shown 55 to contribute to poverty alleviation and to reducing income inequality (Gatiso and 56 57 Wossen, 2015; Thondhlana and Muchapondwa, 2014a). Environmental income is also expected to be a safety net against poverty (Shackleton et al., 2008). Moreover, 58 59 environmental income is a pathway out of poverty (Fisher, 2004) and helps to equalize income (Nguyen et al., 2015). In general, due to the diversity of contexts, the relationship 60 between household livelihood and welfare and the natural ecosystem's goods and 61 62 services needs to be analyzed at the local level. This study investigates the importance of the environmental and non-environmental incomes that come from a biosphere reserve in 63 Iran to the livelihood and welfare of people in its vicinity. 64

For the past 50 years, Iran's environmental degradation or annihilation has been one of 65 the country's most important issues. Many case studies in Iran have found that local 66 livelihoods are driving environmental degradation. For instance, Croitoru and Sarraf 67 (2010) estimated that over the past 57 years deforestation for agriculture, firewood, and 68 charcoal contributed to reducing Iran's forest area from 19.5 to 12.4 million hectares. 69 70 Wood overexploitation, overgrazing, and overhunting were identified as the major threats to Iran's deforestation. In another study, Makhdoum (2008) found local 71 overharvesting and poverty as the main causes of environmental degradation in Iran. It is 72 73 worth noting that these threats are found in all of Iran's ecosystems but at differing levels of intensity (Croitoru and Sarraf 2010). Ghasemi et al.'s (2010) case study in South Iran 74

found that overharvesting of mangroves was placing undue strain on the region'smangrove ecosystem.

Nearly 10% of Iran's population lives in and around forests that they need for survival (Peter 2004), but there is little information about the relationship between household welfare and sources of Iran's environmental and non-environmental incomes. So, given the importance of livelihood drivers in environmental degradation in Iran and the importance of environmental incomes on local livelihood more studies are needed to investigate and quantify the economic value of environmental goods for livelihood and welfare in Iran.

In addition, understanding and analyzing livelihood and welfare can be the first step in 84 limiting environmental degradation. According to Mamo et al. (2007), understanding the 85 86 importance of environmental income and its quantity in the livelihood of local people may work as an input to conservation policy through determining the potential loss to the 87 local people. Thondhlana et al. (2012) also concludes failure to understanding how 88 89 various income sources contribute to local livelihood and welfare may result in designing inappropriate conservation strategies which eventually lead to unsustainable outcomes 90 91 like overuse of resources and conflict. Furthermore, misguided conservation strategies may result in resentment of conservation policy (Anthony 2007), promote illegal 92 93 activities and exacerbate environmental degradation (Hamilton et al. 2000; Watts and 94 Faasen 2009).

In sum, livelihood analysis seems to be the first step in reducing pressure on the environment through its contribution to the design of more effective conservation programs. In the next step, designing more sustainable, adaptive, and long-run conservation policies would reduce conflict between parks and people. In this work, we begin by describing the importance of all incomes that come from one of the most

important biosphere reserves in Iran. We then suggest ways to establish a sustainable park-people relationship. We elaborate on this relationship in the next section.

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103 **1.1. Status of park-people relationship in the area**

Hara biosphere reserve is being managed by two governmental organizations: the Forest, 104 Range and Watershed Management Organization and Department of Environment. This 105 106 area is now under three management systems as national park, international wetland, and biosphere reserve (Zahed et al. 2010). Although it is considered as a national park, park 107 108 authorities and government let people use the park. Biosphere reserve management system enables environmental managers to follow both environmental conservation and 109 local livelihood development goals. Now, Hara Biosphere Reserve supports the 110 111 livelihood of several thousands of people living in rural adjacent areas, directly or indirectly. For example, rural households harvest the leaves and branches of mangrove 112 trees as their domestic animals feed. Moreover, Hara Biosphere Reserve is a place for 113 fishing and supports the livelihood of thousands of fisher households, particularly small-114 scale fisheries. Fisheries in Hara Biosphere Reserve are a profitable activity, because the 115 equipment's necessary for fishing in Hara Biosphere Reserve is less than those necessary 116 for fishing in the sea and the amount of fish is higher in Hara Biosphere Reserve. It is an 117 advantage, especially for small-scale fisheries. Households derive almost all of their 118 119 fishing income from fishing in the Hara Biosphere Reserve. Moreover, Hara Biosphere Reserve supports tourism. Households engage in fishing, subsistence animal husbandry, 120 wage activities and ecotourism. Partly in response to overharvesting, park authorities 121 122 have increased their monitoring in this area and restricted some uses. For example, they have restricted harvesting the leaves and branches of mangrove trees in the Hara 123 Biosphere Reserve. Moreover, entry into fisheries is impermissible in some months of 124

the year. These activities are reasonable from a conservationist standpoint even though they are unpopular with residents. Moreover, direct observation and interview with rural elders reveal that more restrictions, far from reducing overharvesting, have increased the amount of illegal activity in the reserve. For instance, many residents illegally enter the fisheries by bribing the authorities. The challenge in the Hara Biosphere Reserve is the preservation of the value of this important ecosystem without depriving the local population of their livelihood.

This area has the commercial and trading potential to attract more visitors. The 132 133 recreation valuation of Hara Biosphere Reserve is indicative of its economic importance. Since managers and decision makers have neglected the reserve, it there is a need for 134 more facilities for visitors (Dehghani et al., 2010). In fact, because natural assets do not 135 136 trade in ordinary markets, often, they are ignored in policymaking and priority-setting, leading to degradation or depletion of resources. This undermines the functioning and 137 resilience of ecosystems, thus threatening their ability to supply present and future 138 generations. The economic valuation of ecosystem services can be used to enhance 139 public awareness, and it can help policymakers decide how best to allocate resources (de 140 Groot et al., 2012). 141

142

143 **1.2. Objectives**

This study generally aims to explore the importance of HBR in local livelihood and welfare. However, the importance of specific incomes from HBR is also comprehensively investigated. More specifically, this study answers the following questions:

148 1. How important is Hara Biosphere Reserve for the livelihood of different incomegroups?

150	2. To what extent does the Hara Biosphere Reserve contribute to poverty alleviation and
151	to reducing income inequality?
152	3. How does household poverty status influence environmental income from the park?
153	4. How do intra- and extra-household variables influence the income from the park?
154	5. How can a sustainable park-people relationship be practiced in the Hara Biosphere
155	Reserve?
156	
157	2. Material and methods
158	2.1. Study area
159	This study was performed in a high biodiversity hotspot between the Qeshm and Khamir
160	counties in Hormozgan province in southern Iran (Figure 1). About 42,500 people, most
161	of whom have limited education, live in the area. Most of the residents inhabit the coastal
162	area and rely on fishing, subsistence animal husbandry, wage activities and ecotourism.
163	This region is internationally known as Ramsar International Wetland and is part of
164	UNESCO's Man and Biosphere Program (MAB). The area is also one of Iran's most
165	important protected areas (Zarei et al., 2014).
166	Hara Biosphere Reserve is the largest stand of mangrove forests in the Persian Gulf
167	(26°40'-26°59'N, 55°21'-55°52'E). This area is home to two species of mangrove:
168	Avicennia marina and Rhizophora macrunata. A. marina, the predominant species of
169	mangrove in Hara Biosphere Reserve, is locally called Hara. According to Danehkar
170	(1998), the mangrove forest covers 107.00 km^2 in Iran, 85.00 km^2 of which are in the
171	Hara Biosphere Reserve. This area has an arid climate with an average temperature of
172	15°C in winter and 35°C in summer. The average annual rainfall is less than 200mm.
173	Salinity fluctuates between 38 to 50 g/L in the mangrove forest (Zahed et al. 2010). Hara

174	Biosphere Reserve is among the richest ecosystems in the Persian Gulf and hailed	in the
175	Middle East for its "megadiversity" (Ghasemi et al. 2012).	
176	[insert Figure 1]	
177		
178	2.2. Sampling method and data collection	
179	This study was conducted in 10 villages in two counties in the southern and no	orthern
180	parts of the Hara Biosphere Reserve. Villages were selected by simple random sar	npling
181	(Table 1). Both quantitative and qualitative techniques were used to collect data.	In the
182	quantitative survey, a close-ended researcher-designed questionnaire was used to	collect
183	the data from selected households. Data were gathered on socioeconomic character	ristics,
184	income sources, and total income and expenses of the households in 2014. Th	e data
185	include the average income from Hara Biosphere Reserve in 2014.	
186	Before the survey was administered, a pilot study was held to improve the question	nnaire
187	and determine the sample size. Thirty heads of households drawn from the s	ample
188	completed the questionnaires. After the pilot study, the sample size was estimated	at 244
189	households, based on Cochran's formula (Equation 1).	
190		
191	$n = \frac{N(t.s)^2}{Nd^2 + (t.s)^2}$ Equation	n (1)
192	Where:	
193	n = size of sample	
194	N = size of population	
195	t = t student	
196	d = preferred likelihood accuracy	
197	s = standard deviation of population	
198	In this formula, the following assumptions were made: the size of population is 3	,497, t

student is 1.96 (prob. = 0.95), preferred likelihood accuracy is 12%, and standard
deviation of 30 respondents in pilot study is 0.99. The sample size was calculated as
follows:

$$n = \frac{3497(1.96 \times 0.99)^2}{3497(0.12)^2 + (1.96 \times 0.99)^2} = 243.2 \simeq 244$$

To make a proper distribution of the sample in the selected villages, proportional allocation sampling was used (Table 1). Beside the quantitative measurement and to make a triangulation, a qualitative survey was held in each area by interviewing key informants and elders. Three to six informants and elders were interviewed in each village. They were interviewed about the village's main livelihoods, local methods of fishing¹, the relationship between the people and the park, and the measure of some local scales such as Tang.²

210

202

[insert Table 1]

211

212 **2.3. Data analysis**

Subsistence and non-subsistence incomes from all income sources were aggregated to calculate the total income. To calculate net income, all costs such as the cost of labor, purchased inputs, and transportation were included in. The cost of household labor was excluded, because of difficulties in identifying labor shadow prices (Campbell et al. 2002). All the incomes were calculated by Toman (one dollar is about 3500 Tomans) and adjusted to per capita income through the Oxford scale (OECD 2005). The scale is based on the age of household members and assigns a value of 1 to the first household member,

¹ Different methods were used for fishing by households in each rural area. The main methods are Moshta, Jal, Gargor, Net, Angle.

² Households gather leaves and branches from the mangrove forest from Hara Biosphere Reserve in packages called Tang. Each Tang is about 19kg.

about 0.7 to each additional member between the ages of 16 and 65, and about 0.5 to
each child under 16 (Ellis 2000b).³

To explore the economic importance of Hara Biosphere Reserve to local livelihoods, poverty reduction and reducing the inequality gap, all of a household's income sources were aggregated into three types: park income (PI), non-park environmental income (NPEI), and non-environmental income (NEI).

226 PI includes forest, fishing, and tourism income. Forest income is the sum of the cash and subsistence incomes of non-timber forest products (NTFPs) harvested from 227 228 mangrove forests inside Hara Biosphere Reserve. Forest income was calculated by multiplying the total volume of NTFPs and market price per unit volume minus related 229 costs. Fishing income was calculated by asking heads of household about ways of 230 231 fishing, volumes and types of fish and shrimp harvested in each way and multiplying volumes to related prices in the last year. At the end, gross value was deducted from 232 related costs. Tourism income was calculated by deducting the gross value of tourism 233 income in the previous year from related fuel and labor costs. Non-park environmental 234 income is derived from environmental resources outside of the Hara Biosphere Reserve. 235 Fodder is the only source of income in this category. Local people harvest and store 236 fodder from rangelands in spring and use it year-round.⁴ Net fodder income was 237 calculated like other sources of income. NEI is comprised of wage, social grants, 238 239 remittance, handicraft, and farm income. Wage income includes all kinds of wage, also governmental jobs. Social grants are composed of the governmental cash subsidy paid to 240 all household members in Iran and income from social institutions paid to vulnerable 241 242 households. Farm income is the aggregate of livestock and agriculture incomes. Net

³ For example, the total income of a household per year was divided into its adult equivalent value (computed based on the Oxford scale).

⁴ This amount of fodder does not support all fodders which they need to feed their livestock during a year. So, they provide their needs from market and Hara Biosphere Reserve.

livestock income was calculated for three livestock species: camel, cattle and goat.
Livestock income is calculated as the sum of the sales and consumption of livestock and
their products such as milk and the current value of livestock. Given the area's water
scarcity, agriculture was not a common activity and mainly took the form of dry farming.
In some villages, a few households that engaged in illegal activities, and had almost the
highest income, declined to answer our questions. These households were excluded from
the study.

In the poverty analysis section, the head count and the poverty gap indices were used 250 251 to determine the poverty effect of various income sources. The head count poverty index determines the percentage of people living at below the poverty line. The national 252 poverty line in rural areas -- 269,000 Toman per capita per month -- was used as the 253 254 poverty line (Research and Training Institute for Management and Planning, 2015). The greatest virtue of this index is its simplicity. Another index which was used for poverty 255 analysis is the poverty gap index which measures depth of poverty. The formula of the 256 poverty gap index is shown in Equation (1). 257

258 (1)ation Equ
$$P_1 = \frac{1}{N} \sum_{i=1}^{N} \frac{G_i}{Z}$$

Where P₁ is the poverty gap index, z is the poverty line, and G_i is the difference between
the poverty line and household income.

In the inequality analysis section, the Gini coefficient combined with the Lorenz curve and the decile dispersion ratio was used. The Gini coefficient is a confirmed method for income inequality assessment and is used in several studies (Shorrocks 1982; Singh and Dey 2010; Thondhlana and Muchapondwa 2014a). The Gini coefficient formula is shown in Equation (2).

266 $G = 1 - \sum (X_{i+1} - X_i)(Y_{i+1} + Y_i)$ Equation (2)

267	Where G is the Gini coefficient, Xi is the cumulative percentage of the population in
268	class i and X_(i+1) is the cumulative percentage of population in class i+1,Y_i is the
269	cumulative percentage of income in class i and $Y_{(i+1)}$ is the cumulative percentage of
270	income in class i+1.
271	Another inequality index is decile dispersion ratio which is a simple but widely used
272	method to assess income inequality. It presents the ratio of the income of the richest 10
273	percent to the income of the poorest 10 percent.
274	Multiple regression analysis was used to estimate the effects of selected explanatory
275	variables on the PI. The selection of intra- and extra-household explanatory variables
276	(Table 2) were based on theories discussed in other studies. In line with those studies, we
277	hypothesized a negative relation between age and education of the household head with
278	the PI. We also expected the level of the PI to increase with total income. In sum, the
279	following five hypotheses were formulated and tested in this study:
280	H1: There is a negative relation between age and education of the household head with
281	the PI.
282	H2: The level of the PI increases when the total income increases.
283	H3: The farther a household is from the part, the lower its PI?
284	H4: Household with higher labors and more livestock are expected to harvest more from
285	the park.
286	H5: Those villages that have road access to the Hara Biosphere Reserve harvest more
287	from it.
288	[insert Table 2]
289	
290	3. Results and Discussion
291	3.1. Socio-economic characteristic of sample households

292 The mean age of the sample is 40.75 ± 13.13 and the mean years of the education of the household members is 6.67 ± 3.08 . The average size of the households is 5.48 ± 2.43 and 293 all of their heads are male. Although the number of large stocks (cow and camel) and 294 295 small stock (goat) among the sample varies (approximately between 0-4 and 0-10 respectively), the mean number of this stock is very low (0.34 and 1.52). Nevertheless, 296 roughly 49% of households have at least one type of stock. However, most stocks (70%) 297 298 are small. The mean area of palm groves for each household is 0.22 ha. The palm groves are the only kind of agriculture income that comes mainly from dry farming. 299

300

301

3.2. Households' income sources and dependency

302 3.2.1. The most common and uncommon sources of income

303 Local people depend for their living on a variety of environmental and non-304 environmental incomes (Table 3). Among all kinds of park income, more households engaged in fishing (63%) than forest (36%) and tourism (15%). More interestingly, it 305 shows that many local people have more income from resources use activities including 306 fishing and forest than non-resources use activities like tourism. The lack of tourism was 307 mainly because of the area's underdeveloped tourism infrastructure. Only four villages --308 Taable, Soheili, Haftrangoo, and Laft -- have income from tourism. Among all the NEI 309 310 sources, nearly all households (97%) receive income from social grant and only 7% from 311 remittance. Social grants are a cash subsidy paid by the government to all household members. Fodder income as the only type of NPEI was an income source for only 27% 312 of the respondents. As Table 4 shows, NEI is an income source for 99% of the sample, 313 314 PI for 71%, and NPEI 27%.

315

316 3.2.2. Importance of various incomes among income groups

317 Wage income, with a contribution to 56% of the total income, was the main income source for households. Wage income was more important for the middle-income group 318 (60%) although wealthier households had more absolute income from wage labor. In 319 320 general, wealthier households had more absolute income from all income sources than the poorest group, except for social grants and remittances (Table 3). Fishing income was 321 the second most important source of income, contributing to 21% of the total income. 322 323 More interestingly, we found that the wealthier income group has a higher absolute and relative income from fishing while the poorest group has the lowest. As discussed by 324 325 Thondhlana and Muchapondwa (2014a), wealth might be tied to the area's environmental resources harvest. It is possible that wealthier households with greater 326 access to financial and physical capital can harvest more from environmental resources 327 328 than other groups (Uberhuaga et al., 2012). Members of wealthier households can pay bribes to access closed fisheries and afford better equipment. This finding is consistent 329 with other studies in developing countries such as Nepal (Adhikari, 2005), Vietnam 330 (Mcelwee, 2008), Bolivia (Uberhuaga et al., 2012), Ethiopia (Thondhlana and 331 Muchapondwa, 2014a), and Cambodia (Nguyen et al., 2015) where wealthier households 332 were more dependent on environmental income. These households are placing the most 333 pressure on fishing resources. Moreover, strict limits on fishing activities in the months 334 335 when fishing is permitted will have a stronger negative effect on affect the livelihood of 336 wealthier households. However, interviews with the key informants revealed that many of rich households harvest fish in permissible months by bribing the authorities. 337 Overfishing by wealthier households adversely affect the livelihoods of other income 338 339 groups, depletes in the fishing resources and leads to environmental degradation and biodiversity loss. So, policy makers and environmental administrative must be more 340 attentive to overfishing in the Hara Biosphere Reserve. 341

Social grant was the third main source of income whose relative and absolute importance 342 was higher for the poorest group. This group received the most income from social 343 grants. Farm, forest, handicraft and remittance were the other important sources of 344 income. The share of farm income in the total income was 4%. Although the amount of 345 agriculture income was not notable, mainly because of water scarcity, many households 346 keep livestock. Most of the livestock feed were came from gathered around rangelands 347 348 and the leaves and branches of mangrove trees from the Hara Biosphere Reserve. The study shows that households with higher farm income (wealthier households) harvest 349 350 more from fodder and forest resources. However, poor households are more dependent on these resources. As shown in Table 3, rich group has more than twice the income 351 from forest and fodder than does the poorest group, but the poorest group is more 352 353 dependent on forest (3%) and fodder income (1%).

Like Soltani et al. (2014), we found that the poor group has highest dependency on 354 forest and fodder sources of income. In line with our findings, many studies such as 355 those by Cavendish (2002), Vedeld et al. (2007), Babulo et al. (2009) and Kamanga et al. 356 (2009) also showed that the poor group was more dependent on forest income than the 357 wealthier group. Given the highest relative importance of forest income for the 358 livelihood of poor households, the study demonstrates that restrictions on harvesting 359 360 leaves and branches of mangrove trees have a more negative effect on the livelihood of 361 the poor group. As shown in Table 3, forest income accounts for up to 2% of the total income ranging from 3% in the low-income to 2% in high-income group. This is at the 362 lower boundary of dependency ranges reported from other developing countries like 363 Nepal (12-31%) (Rayamajhi et al. 2012), Malawi (7-12%) (Kamanga et al. 2009), and 364 Guatemala (9-28%) (Prado Córdova et al. 2013). In a case study in two villages in 365 Zagros (Iran), Soltani et al. (2014) found much higher dependency on forest income (23-366

47%) than in our finding. One possible explanation would be the lower market price of
leaves and branches of mangrove trees as the main sources (89%) of forest income
compared to other NTFPs reported by Soltani et al. (2014).

370 To reduce the dependency of poorest people on leaves and branches of mangrove trees, environmental managers have formed local cooperatives that provide other kinds of 371 livestock feed like foliage, straw, bran. However, key informants reported several 372 difficulties which prevented local cooperatives from working as intended. First, these 373 cooperatives were established only in a few large villages like Taabl. Accordingly, many 374 375 local people who live in small villages have no access to these cooperatives. Second, although the goal of these cooperatives is provide cheap livestock feed for the poorest 376 villagers, there was little or no difference between cooperatives and the market prices of 377 378 the livestock feed. Thus, more investment in providing lower-price livestock feed and 379 distributing the cooperatives to small villages like Lashteghan, Guran, and Durbani can protect the livelihood of the poorest households and environmental sustainability at the 380 same time. 381

Tourism income from Hara Biosphere Reserve had the lowest share of the total income (>1%) compared to other park incomes (Table 3). More investment in tourism infrastructure development like more transportation routes from other areas of Iran to the Hara Biosphere Reserve, more paved roads, guesthouses, medical and health clinics and other facilities would attract more tourists and generate more income for local people without depleting natural resources.

This study shows that NEI that contributes 75% to the total income is the primary source of income in the area (Table 4). Similarly, Uberhuaga et al. (2012), Misbahuzzaman and Smith-Hall (2015) found the highest contribution of NEI to the local livelihood in their studies. However, Yemiru et al. (2010) and Melaku et al. (2014) have shown the highest

importance of environmental incomes in local livelihood in many low-income areas. The
PI is the second main source of income for the sample, accounting for 24% of total
household income. The NPEI does not appear to be an important income source for most
households. Among income groups, the share of NEI for the richest households is the
lowest, at 67%. However, at 32% the share of the PI is the highest for the richest
households. For the middle group, the opposite is true.

Access to livelihood assets influence a household's ability to adopt a variety of 398 livelihood strategies (Rakodi 1999; Serrat 2008). Moreover, access to assets and capital 399 400 varies among poverty classes. In this regard, comparison of household socio-economic features among two poverty classes (poor and non-poor) revealed that poor households 401 402 have less access to livelihood assets (Table 5). Poor people have lower access to 403 livestock, saving, and labor than do people who are not poor. Moreover, education of 404 household HH among poor group was extremely low. This especially reduces a household's ability to adopt more profitable activities like wage income. Moreover, a 405 406 non-poor household's access to capital like a large amount of cash savings enables it to invest in profitable wage and fishing activities. In short, poor people's lower access to 407 various assets reduce their abilities to overcome the entry barriers of more profitable 408 economic activities. Thus, they pursue more easy-entry and less capital intensive 409 livelihood options including simple labor, remittances, social grants, and handicrafts. 410

- 411[insert Table 3]412[insert Table 4]
- 413
- 414

415 **3.3.** Composition of cash and subsistence incomes

17

[insert Table 5]

416 If the total household income is divided between cash and subsistence incomes, about 88% of the total income will be cash (Figure 2). The wage, remittance and social grant 417 incomes are completely cash while the forest and fodder incomes are entirely 418 419 subsistence. It is important to note that households harvest fodder and forest mainly for their uses not for selling although a small number of poorest people was seen to harvest 420 from leaves and branches of mangrove trees to sell them to their neighbors. These 421 422 households declined to complete the questionnaires. Other income sources, such as fishing, farm and handicraft have a combination of cash (respectively, 85%, 67% and 423 424 59%) and subsistence (respectively, 15%, 33% and 41%) incomes.

Among the main groups of the income source, the NPEI (or fodder) was completely subsistence while a major share of the PI (82%) and NEI (95%) for sample households was in cash. Considering the highest share of the cash income to the total PI, the local users of the Hara Biosphere Reserve can be described as "regular cash users." In contrast, Prado Córdova et al. (2013), who investigated the importance of the forest income in local livelihood in Guatemala, described local users as "regular subsistence users" of environmental resources.

As illustrated in Figure 2, the rich households earn more cash income than the poor from both NEI and PI. The poorest households have more subsistence income than the moderate and richest households from the PI and NEI. The higher subsistence income of the poorest people from PI may indicate that PI supports the consumption of poorest households without necessarily lifting them out of poverty.

437

[insert Figure 2]

438

439 **3.4.** Importance of various income sources in poverty and inequality alleviation

440 **3.4.1. Poverty analysis**

441 Approximately 20% of the population are below the poverty line (Table 6). Analyzing by income groups revealed that poor group had 100% poverty count with or without PI, 442 NEI, and NPEI. The NEI is found as the first driver of poverty alleviation in the area. 443 444 Eliminating the NEI from the total household income increases the poverty headcount index (PHI) from 20% to 86% of the sample. The significance of the NEI in poverty 445 alleviation is highest for the middle-income group (an increase in HPI from 7% to 86%). 446 Park income plays a significant role in the poverty alleviation of the area. Excluding the 447 PI will increase the HPI for the middle by 21% and for the rich income groups by 33%. 448 449 Without NPEI, the HPI will change much less. The results indicate that the poverty alleviation role of the NEI among the middle group is the most but for the PI, this role 450 451 among the rich group is the most.

The study demonstrates the importance of PI in poverty reduction although this importance has not yet been considered in Iran's poverty assessment plans. This miscalculation may result in underestimation of rural household income and in inappropriate interventions (Jodha 1986; Mamo et al. 2007). Moreover, the importance of NEI sources in poverty alleviation indicates that poverty reduction programs in the area should concentrate on increasing NEI labor opportunities, especially wage income.

458

[insert Table 6]

459

The analysis of the poverty gap shows, while the poverty depth was 5% for the sample, it has been 16% within the poor, 1% within the middle-income and 0% within the high-income groups (Table 7). When the PI and NEI sources are excluded, the poverty gap index will generally widen for the poor. The NPEI does not. It seems that the NEI affects the poverty gap index the most and its effects are most pronounced for middle- and high-income groups.

[insert Table 7]

467

468 **3.4.2. Inequality analysis**

The results shown in Table 8 demonstrate that the total Gini coefficient among the rich 469 (0.268) households is more than among the middle (0.201) and the poor (0.218). Within 470 471 the sample, the wage, fishing and social grant groups have the most income-equalizing effect although their equalizing values are different. Wage income is the first income 472 inequality moderator for the high- and the middle-income groups. However, for the 473 474 poorest households, social grant is the first income inequality moderator. Forest income has a greater income equalizing effect within the poor group but the rich group shows the 475 smallest changes in the Gini coefficient when forest income is excluded. In contrast, 476 477 fishing income is a better income equalizer for well-off than for middle- and low-income households. Excluding fishing income increases income inequality among rich 478 households (0.146 unit) much more than among the middle (0.093 unit) and poor ones 479 (0.06). As the Lorenz curve illustrates (Figure 3), access to NEI has the most equalizing 480 effect on the sample (reducing the Gini coefficient from 0.773 to 0.339). The NEI 481 decreased inequality among the poor, the middle-income and the rich by 0.466, 0.500 482 and 0.492 units, respectively. When the PI is eliminated from total income, inequality 483 among all the income group increases, but most of all for the rich. 484

485

- [insert Table 8]
- [insert Figure 3]
- 487

486

The results of decile dispersion ratio (DDR) indicate that poorest households cannot earn enough from profitable income sources including NEI and PI (Table 9). However, much less income inequality was seen in a low profitable income source like NPEI. As shown in Table 9, 10% of the richest people earned respectively 666 times more income from
NEI, 299, 25 times more income from PI and NPEI, than did 10% of the poorest.

The same pattern was seen among specific income sources. The greatest income 493 494 inequality among PI sources was seen within fishing income (283) compared to nonprofitable sources like forest (57) and tourism (14). In addition, considerable income 495 inequality was seen between 10% of the poorest and richest households in profitable 496 NEIs including wage (12 times) and farm (128 times). However, this gap was smaller in 497 non-profitable NEI sources like handicraft (8 times) and remittance (1%). One possible 498 499 explanation for this is that poorest households are less capacitated (Table 5), especially in profitable wage incomes. 500

[insert Table 9]

502

501

503

3.5. Determinants of park income

Using SPSS software, a multivariate linear regression was estimated to determine the 504 relationship between the PI as the dependent variable and age of HH, education of HH, 505 household labor, livestock, saving, having access road to the park, poverty status, 506 household distance to the park and village distance to the park as the independent 507 (explanatory) variables. Both intra- and extra-household variables were chosen in the 508 509 regression model. The intra- and extra-household independent variables were based on a 510 review of the local, national, and international literature. We focused on local and national studies and theories to investigate the relationship among livelihood, welfare, 511 and environment in Hara Biosphere Reserve. The variance inflation factor for the 512 regression coefficients was equal to 1, showing no multi-collinearity among variables. 513 Furthermore, to give a clearer picture about co-linearity, the correlation matrix which 514 shows correlation among independent variables is presented in Table 10. As the table 515

517

shows, there is no significant correlation among explanatory variables. Therefore, multicollinearity is not a problem in the regression model.

518

519

[insert Table 10]

Although the model is completely significant, there is a weak relationship between 520 selected variables and PI (F = 5.70; P<0.000, $R^2 = 0.18$). According to the regression 521 analysis, among the predictor variables only five variables including education of HH, 522 livestock, saving, poverty status, and household distance to the park were significantly 523 524 affected PI. However, other variables such as age of HHs, household labor, having an accessible road to the park, and village distance to the park did not have a significant 525 effect on PI. As we expected, the model yielded a positive and significant effect between 526 527 household poverty status and PI (P=0.07, b=974086.13) (Table 11). It means that nonpoor households harvest more from Hara Biosphere Reserve and can therefore be 528 considered the main income group that is responsible for the environmental degradation 529 in the area. In line with our findings, Soltani et al. (2014) found that poor households are 530 not responsible for higher resources use and forest degradation in Zagros, Iran. This 531 finding contradicts previous studies by Makhdoum (2008) and Croitoru and Sarraf 532 (2010) that cited poverty as the main cause of environmental degradation in Iran. We 533 also found that household savings had a positive and significant effect on PI (P<0.05, 534 535 b=0.057). This may support the former result. The results of regression model also indicated a positive relation between livestock and PI (P<0.05, b=262397.94). This is 536 because local people who own livestock harvest the leaves and branches of mangrove 537 538 trees from the park to use as fodder.

539 Some evidence has shown that higher education results in lower resources use due to out 540 migration and the increased opportunity costs of labor (e.g. Phillips, 1994 cited in

562	4. Conclusions and Policy Implications
561	
560	[insert Table 11]
559	who live in villages with higher distance to the park may arrive at different results.
558	examine the role of Hara Biosphere Reserve in the livelihood and welfare of households
557	study were less than 7 km from the Hara Biosphere Reserve. Thus, other studies that
556	the park and PI. It is worth noting that all the villages that were randomly selected in this
555	households. In addition, there was no significant relation between a village's distance to
554	the Hara Biosphere Reserve. This could also explain the location of wealthier
553	humidity near the park. In addition, there were more road, schools, and health farter from
552	Hara Biosphere Reserve, were farther from the park because of the higher amount of
551	al. 2004). This is because wealthier households that have the highest income from the
550	more income from the park than those that are closer (Abebaw et al. 2012; Pattanayak et
549	the park and PI (P \leq 0.01, b=706.93). This means that households far from the park have
548	showed a positive and statistically significant relationship between household distance to
547	harvest the park's environmental resources. More interestingly, regression analysis
546	the study area, well-educated HHs were more likely to perform wage labor than to
545	b=-210739.82). It means that HHs with higher education harvest less from the park. In
544	a negative and statistically significant relation between education of HH and PI (P \leq 0.01,
543	2005; Nguyen et al. 2015; Thondhlana et al. 2012). In line with former group, we found
542	capacity to harvest more environmental resources as a good source of income (Adhikari
541	(Adhikari et al. 2004; Uberhuaga et al. 2012). However, education may increase the

4. Conclusions and Policy Implications

The study has investigated the economic importance of one of Iran's most important 563 biosphere reserves. Incomes derived from the Hara Biosphere Reserve have a crucial role 564 in local livelihood and welfare. However, non-environmental income was the first 565

566 contributor to the total income, poverty reduction and narrowing income inequality. The study also contributes to the literature on environmental protection. Although some 567 studies identified poverty as the main driver of environmental degradation in Iran 568 (Makhdoum 2008), our study showed that the wealthiest households harvest more from 569 the Hara Biosphere Reserve than the poorest. Moreover, the wealthiest households are 570 more likely to be engaged in high-return activities like fishing. Therefore, they are 571 mainly responsible for the depletion of the Hara Biosphere Reserve's environmental 572 resources. Poorest households had lower absolute environmental income and are engaged 573 574 more in low-return environmental activities like forestry. Thus, the poorest people should not be accused of the high resource use that causes environmental degradation (Nguyen 575 et al. 2015). Indeed, the households with less trained and capacitated members will not 576 577 be able to be engage in profitable activities. On the other hand, they have less access to financial, physical, natural, social and human capital so their livelihoods --such as 578 handicrafts and fodder harvesting - require less equipment. Improving access to more 579 livelihood capital enables the households to participate in more profitable environmental 580 activities like fishing. Moreover, greater access to resources and equipment enables them 581 to harvest more from Hara Biosphere Reserve. 582

We have presented some policy interventions for reducing park-people conflict and 583 environmental sustainability in the Hara Biosphere Reserve. First, more restrictions 584 585 should be imposed to reduce wealthy households' illegal activities and over-harvesting in the area. This policy would reduce the pressure on the Hara Biosphere Reserve and 586 protect the environmental income from the Hara Biosphere Reserve for the poor 587 588 households. At the same time, more attention should be paid to the development of nonresources use livelihood options like wage and tourism. The results of the study 589 demonstrated that tourism income has much less importance in local livelihood than 590

591 resources use activities like fishing and forestry. To increase the non-resources, employment and development efforts should facilitate investment in NEI activities. 592 Expanding and diversifying rural livelihood options toward those activities that are less 593 594 dependent on environmental resources harvest is considered a suitable conservation policy in developing countries (Illukpitiya and Yanagida 2008; Mamo et al. 2007) 595 596 including Iran (Khalyani et al. 2014; Salehi et al. 2010). In the Hara Biosphere Reserve, 597 this policy may work as a win-win scenario and contribute to park-people conflict reduction over resources use by providing alternative income sources. In short, poverty 598 599 reduction programs in the area should concentrate on increasing activities like tourism that generate income for local communities while protecting environmental 600 601 sustainability. Thus, more investment in tourism infrastructure development would 602 attract more tourists and will provide more income for local people from non-resources 603 use activities. Providing non-resources use labors and tourism might reduce the harvesting of environmental resources in the area by providing alternative income 604 sources to poorer households. The potential importance of tourism in environmental 605 sustainability and local development has been proven in developing countries like 606 Turkey (Açıksöz et al., 2015). However, Livelihood activities that consume 607 environmental resources should also be considered in designing poverty reduction plans. 608 609 We are mindful that environmental resources must not be considered as a panacea to 610 poverty reduction even though they can be complementary sources of income. Our results have found that poorest people are not able to engage in high-return activities. 611 One possible explanation would be their lack of access to human capital. In our study, 612 613 only a few households had education beyond the elementary level. Lower capacity of poorest people to participate in high-return activities or to operate commercial

enterprises due to their lack of human capital has been reported in many areas of Iran 615

614

including the Zagros Mountains (Khalyani et al. 2014; Salehi et al. 2010). Thus, the
capacity of local people should be increase by offering training courses in conjunction
with alternative livelihood activities. Providing alternative employment opportunities
that are not directly related to resources harvest would be a long-run policy that could
reduce park-people conflict and environmental degradation by decreasing dependence on
environmental income.

As a final point, the results of the study can change the common but incorrect belief that the poorest people are responsible for resources degradation. Our findings can assist policy makers and environmental managers in designing more appropriate conservation strategies.

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 insights from Bolivian forest communities. *Forest Policy and Economics* 26:12-21.

754 Table 1.

755 Study Villages, Distance to Hara Biosphere Reserve and the Size of Sample for Each

756 Village

County	Village	Distance to Hara Biosphere Reserve (km)*	Population (N)	Sample (n)
Qeshm	Laft	0.88	952	66
	Durbani	3.42	178	12
	Gavarzin	6.92	397	28
	Guran	1.87	328	23
	Haftrango	4.08	116	8
	Soheili	5.27	366	26
	Taabl	6.37	783	55
Khamir	Chah sahari	1.39	71	5
	Lashteghan	2.69	150	10
	Pohl	2.11	156	11
	Total		3,497	244

^{*}All distance computed based on direct distance from the center of village to Hara

Biosphere Reserve in ArcMap 10.1

759 Table 2.

760 Definition of Explanatory Variables used in Regression Model

Independent variables	Definition	Literature
Age of HH	Age of household head	(Jansen et al. 2006)
Education of HH	Number of years of schooling completed by household head	(Ellis 2000a; Jansen et al. 2006) (Ellis 2000a)
Household labor	Productive household members (16-65 years)	(Emis 2000a)
Livestock	Number of livestock of a household including camel, goat, sheep	(Abebaw et al. 2012; Zenteno et al. 2013)
Saving	Total amount of cash money of a household	(Ellis 2000a; Rayamajhi et al. 2012; Soltani et al. 2012)
Having access road to the park	Does the village has a road that ends to the park?	-
Poverty status	Household's poverty status (poor or non-poor) based on the poverty line	(Thondhlana and Muchapondwa 2014b)
Household distance to the park	Distance from household home to the edge of the park estimated by HH (meter)	
Village distance to the park	Distance from the center of a village to the edge of the park. ArcMap 10.1 was used to calculate all distances (meter)	-
HH (household he	ad).	

Table 3.

763	Income Sources	, Absolute and	Relative Income	e across Income Groups
-----	----------------	----------------	-----------------	------------------------

Households	useholds Income groups						ANOVA		
who receiving	(244)	ioius —	Poor (77)	Middle ir (122	ncome	Rich (4	5)	test (F)
income sources (%)	Abs	Rel	Abs	Rel	Abs	Rel	Abs	Rel	
36	116097	2	93016a	3	100904 a	2	196782b	2	3.434**
63	1340572	21	544904 a	17	961447 a	16	3729900 b	29	12.831****
15	87962	<1	50360	2	101785	2	114831	<1	1.346
27	52912	<1	39866a	1	46533a	<1	92530b	<1	2.591^{*}
67	3542148	56	135225 ба	41	358882 9b	60	7162738 c	56	35.383***
97	820863	13	889232	27	782837	13	806969	6	.985
35	228039	4	94999a	3	227666	4	456698b	4	3.683**
^a 55	121036	2	87447a	3	141715 b	2	122447	1	3.097**
¹ 7	46398	<1	115357 a	4	19989b	<1	0b	0	6.331***
	6,356,02 9	10 0	3,267,4 35a	100	5,971,7 06b	100	12,682,8 97c	10 0	105.761
Abs (A	bsolute inc	comes)							
Rel (Re	elative inco	omes)							
	Households who receiving income sources (%) 36 63 15 27 67 97 35 4 55 1 7 Abs (A Rel (Re	Households who receiving income sources (%) All housel (244) 36 Abs 36 116097 63 1340572 15 87962 27 52912 67 3542148 97 820863 35 228039 1 7 46398 63 6,356,02 9 Abs (Absolute income content) 9	Households who receiving income sources (%) All households (244)	Households who receiving income sources (%) All households (244) Poor (Abs Rel Abs 36 116097 2 93016a 63 1340572 21 544904 a 63 1340572 21 544904 a 15 87962 <1	Households who receiving income sources (%) All households (244) Poor (77) Abs Rel Abs Rel 36 116097 2 93016a 3 63 1340572 21 a 17 15 87962 <1	Income growing (244) Income growing (244) Poor (77) Middle in (122 norme growing (244) Poor (77) Middle in (122 income growing (244) Abs Rel Abs 36 116097 2 93016a 3 100904 a 63 1340572 21 544904 17 a a a 15 87962 <1	Income groups Income groups who (244) Poor (77) Middle income (122) income Abs Rel Abs Rel Abs Rel Abs Rel 36 116097 2 93016a 3 100904 a 2 a 2 63 1340572 21 544904 a 17 a 961447 a 16 15 87962 <1	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $

*** and ** and * indicate 1%, 5% and 10% level of significance, respectively. a, b, c, LSD test; Different letters show significant differences across quantiles (p <

0.05).

769 Table 4.

Absolute and Relative Importance of Income Sources in Local Livelihood

Main income	Households receiving	Mean household income per capita -	Absolute	e income (Relativ	e income)	ANOVA – test (F)
source groups	income sources (%)	per year (dependency %)	Poor	Middle income	Rich	
PI	71	1,544,632 (24)	688,280 a (21)	1,164,136 a (19)	4,041,514 b (32)	13.224***
NPEI	27	52,912 (1)	39,866 a (1)	46,533 a (<1)	92,530 b (<1)	2.519^{*}
NEI	99	4,758,484 (75)	2,539,290 a (78)	4,761,037 b (80)	8,548,853 c (67)	54.861***
Total	-	6,356,029 (100)	3,267,435 a (100)	5,971,706 b (100)	12,682,897 c (100)	105.761***
	DI/D 1 '	`				

771 PI (Park income)

772 NPEI (Non-Park Environmental income)

773 NEI (Non-Environmental income)

*** and ** and * indicate 1% and 5% and 10% level of significance, respectively.

a, b, c, LSD test; Different letters show significant differenced across income groups (p <

776 0.05).

777 Table 5.

Comparison of Household Features among Poverty Classes (poor and non-poor)

	Povert	ty status		p-value
ŀ	Poor	N	on-poor	
4	3.35		39.55	.035
	5.26		6.86	.012
	2.39		2.84	.003
-	1.29		2.12	.016
428	571.43	31	28742.51	.050
23	84.42	2	811.98	.039
threshold	is	set	at	05
	I 4 428 23 threshold	Povert Poor 43.35 5.26 2.39 1.29 428571.43 2384.42 threshold is	Poverty status Poor N 43.35 5.26 2.39 1.29 428571.43 312 2384.42 2 threshold is set	Poverty status Poor Non-poor 43.35 39.55 5.26 6.86 2.39 2.84 1.29 2.12 428571.43 3128742.51 2384.42 2811.98 threshold is set at

780 Table 6.

Head Count Poverty Index with and without PI, NPEI, and NEI among the Three Income

Groups

	Povert	Poverty head count index (%) for different income sources					
Income groups	Total	Without PI	Without NPEI	Without NEI			
	income						
Sample (n=244)	20	42	21	86			
The Poor	100	100	100	100			
Middle Income	7	28	8	86			
The Rich	0	33	0	64			

784 Table 7.

	Poverty gap index (%) for different income sources						
Income groups	Total income	Without PI	Without NPEI	Without NEI			
Sample (n=244)	5	20	6	71			
Poor	16	31	16	78			
Middle Income	1	14	1	70			
Rich	0	20	0	60			

Poverty Gap Index with and without PI, NPEI, and NEI among Income Groups

787 Table 8.

788 The Gini Coefficient for Different Income Groups When Each Income Source Is
789 Excluded

Income excluded source -		Income Groups					
		Sample	Poor	Middle	Rich		
Gini Coefficient	Forest	0.344	0.228	0.205	0.271		
	Fishing	0.402	0.278	0.294	0.414		
	Tourism	0.344	0.226	0.205	0.273		
	Fodder	0.341	0.222	0.203	0.270		
when each	Wage	0.496	0.302	0.430	0.593		
income source excluded	Social grants	0.398	0.332	0.237	0.297		
	Farm income	0.347	0.224	0.219	0.276		
	Handicraft	0.344	0.222	0.203	0.271		
	Remittances	0.346	0.249	0.201	0.268		
Gini Coefficient for total income		0.339	0.218	0.201	0.268		

791 Table 9.

Income sources		Maan income	Decile dispersion	
		Mean meome	ratio	
Specific income sources	Forest	116097	57	
	Fishing	1340572	283	
	Tourism	87962	14	
	Fodder	52912	25	
	Wage	3542148	12	
	Social grants	820863	2	
	Farm income	228039	128	
	Handicraft	121036	8	
	Remittances	46398	1	
General	PI	1,544,632	299	
income	NPEI	52,912	25	
sources	NEI	4,758,484	666	
	Total income	6,356,029	10	

792 Decile Dispersion Ratio for All Income Sources

Table 10.

Correlation Matrix

Variables	Age of HH	Education of HH	Household labor	Livestock	Saving	Having access road to the park	Poverty status	Village distance to the park
Age of HH	1							
Education of HH	-	1						
	.060							
Household labor	.043	029	1					
Livestock	.042	039	.015	1				
Saving	.070	.016	.094	.016	1			
Having access road	.080	009	.059	.052	066	1		
to the park								
Poverty status	-	.016	.018	.015	.092	063	1	
	.013							
Village distance to	-	.038	.006	.096	.078	.035	.014	1
the park	.025							

** Correlation is significant at the 0.01 level.
* Correlation is significant at the 0.05 level.

Table 11. 799

Results of Multivariate Linear Regression of PI against Inter- And Intra-Household 800

Variables 801

Independent variables	Estimates (b)	Std. Error	Beta	Sig.
Constant	1847104.92	1639692.67		
Age of HH	-27777.98	24272.52	-0.095	0.254
Education of HH	-210739.82	65478.78	-0.255***	0.001
Household labor	-125804.06	235283.62	-0.037	0.593
Livestock	262397.94	108079.56	0.172^{**}	0.016
Saving	0.057	0.023	0.149^{**}	0.015
Having access road to the park (1= have, 0= do not have)	-114521.84	873787.21	-0.009	0.896
Poverty status (1= not poor, 0 = poor)	974086.13	534654.16	0.118*	0.070
village distance to the park	-211.92	227.22	-0.097	0.352
Household distance to the park	706.93	271.38	0.277^{***}	0.010

802

HH (household head). ***, **, and * significant at 0.01, 0.05, and 0.1. 803

Regression model summary: n = 244; R squared = 0.18; Adjusted R squared = 0.15; df = 804 243; F = 5.70; $P \le 0.01$. 805





Figure 1. Location of the study area.





Figure 2. Share of cash income between income groups and total sample.





Figure 3. Lorenz curve and Gini changes, excluding NEI, PI and NPEI.