Impacts of the Hara Biosphere Reserve on Livelihood and Welfare in Persian Gulf

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Abstract

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

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

1. Introduction

Biosphere reserves are unique ecosystems with valuable social and ecological functions. While some conservation systems have focused on conservation goals, biosphere reserves seek to protect important ecosystem values, while meeting the livelihood requirements of local residents (Nations 2001). Accordingly, biosphere reserves provide a variety of environmental income sources for local communities. "[E]nvironmental incomes, are incomes (cash or in kind) obtained from the harvesting of resources provided through natural processes not requiring intensive management" (PEN 2007). As 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 2002). In Mexico, small-scale fisheries are supported by the biosphere reserve in the 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 variety of non-timber forest products (NTFPs) such as medicinal plants (Ghorbani et al. 2012). In addition to environmental incomes, biosphere reserves support a variety of non-environmental income streams like tourism. Tourism generates income for local communities while being environmentally sustainable (Jiang 2009; KC et al. 2015; Surendran and Sekar 2011; Xu et al. 2009).

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

inequality have been investigated in many developing countries, including South Africa (Thondhlana and Muchapondwa 2014b), Ethiopia (Gatiso and Wossen 2015), Cambodia (Nguyen et al. 2015), Zimbabwe (Cavendish 2000), and Nicaragua (Ravnborg 2003). 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 to contribute to poverty alleviation and to reducing income inequality (Gatiso and Wossen, 2015; Thondhlana and Muchapondwa, 2014a). Environmental income is also expected to be a safety net against poverty (Shackleton et al., 2008). Moreover, 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 between household livelihood and welfare and the natural ecosystem's goods and 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 Iran to the livelihood and welfare of people in its vicinity.

For the past 50 years, Iran's environmental degradation or annihilation has been one of the country's most important issues. Many case studies in Iran have found that local livelihoods are driving environmental degradation. For instance, Croitoru and Sarraf (2010) estimated that over the past 57 years deforestation for agriculture, firewood, and charcoal contributed to reducing Iran's forest area from 19.5 to 12.4 million hectares. Wood overexploitation, overgrazing, and overhunting were identified as the major threats to Iran's deforestation. In another study, Makhdoum (2008) found local overharvesting and poverty as the main causes of environmental degradation in Iran. It is 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

found that overharvesting of mangroves was placing undue strain on the region's mangrove 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 limiting environmental degradation. According to Mamo et al. (2007), understanding the 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 local people. Thondhlana et al. (2012) also concludes failure to understanding how various income sources contribute to local livelihood and welfare may result in designing inappropriate conservation strategies which eventually lead to unsustainable outcomes like overuse of resources and conflict. Furthermore, misguided conservation strategies may result in resentment of conservation policy (Anthony 2007), promote illegal activities and exacerbate environmental degradation (Hamilton et al. 2000; Watts and 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.

1.1. Status of park-people relationship in the area

Hara biosphere reserve is being managed by two governmental organizations: the Forest, Range and Watershed Management Organization and Department of Environment. This 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 authorities and government let people use the park. Biosphere reserve management system enables environmental managers to follow both environmental conservation and local livelihood development goals. Now, Hara Biosphere Reserve supports the 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 trees as their domestic animals feed. Moreover, Hara Biosphere Reserve is a place for fishing and supports the livelihood of thousands of fisher households, particularly small-scale fisheries. Fisheries in Hara Biosphere Reserve are a profitable activity, because the equipment's necessary for fishing in Hara Biosphere Reserve is less than those necessary for fishing in the sea and the amount of fish is higher in Hara Biosphere Reserve. It is an advantage, especially for small-scale fisheries. Households derive almost all of their fishing income from fishing in the Hara Biosphere Reserve. Moreover, Hara Biosphere Reserve supports tourism. Households engage in fishing, subsistence animal husbandry, wage activities and ecotourism. Partly in response to overharvesting, park authorities 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 Biosphere Reserve. Moreover, entry into fisheries is impermissible in some months of

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 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 more facilities for visitors (Dehghani et al., 2010). In fact, because natural assets do not 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 resilience of ecosystems, thus threatening their ability to supply present and future generations. The economic valuation of ecosystem services can be used to enhance public awareness, and it can help policymakers decide how best to allocate resources (de Groot et al., 2012).

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:

1. How important is Hara Biosphere Reserve for the livelihood of different income groups?

2. To what extent does the Hara Biosphere Reserve contribute to poverty alleviation and to reducing income inequality?

3. How does household poverty status influence environmental income from the park?

4. How do intra- and extra-household variables influence the income from the park?

5. How can a sustainable park-people relationship be practiced in the Hara Biosphere Reserve?

2. Material and methods

2.1. Study area

This study was performed in a high biodiversity hotspot between the Qeshm and Khamir counties in Hormozgan province in southern Iran (Figure 1). About 42,500 people, most of whom have limited education, live in the area. Most of the residents inhabit the coastal area and rely on fishing, subsistence animal husbandry, wage activities and ecotourism. This region is internationally known as Ramsar International Wetland and is part of UNESCO's Man and Biosphere Program (MAB). The area is also one of Iran's most important protected areas (Zarei et al., 2014).

Hara Biosphere Reserve is the largest stand of mangrove forests in the Persian Gulf (26º40´-26º59´N, 55º21´-55º52´E). This area is home to two species of mangrove: *Avicennia marina* and *Rhizophora macrunata*. *A. marina*, the predominant species of mangrove in Hara Biosphere Reserve, is locally called Hara. According to Danehkar (1998), the mangrove forest covers 107.00 km^2 in Iran, 85.00 km^2 of which are in the Hara Biosphere Reserve. This area has an arid climate with an average temperature of 15˚C in winter and 35˚C in summer. The average annual rainfall is less than 200mm. 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 northern
180 parts of the Hara Biosphere Reserve. Villages were selected by simple random sampling
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 characteristics,
184 income sources, and total income and expenses of the households in 2014. The 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 questionnaire
187 and determine the sample size. Thirty heads of households drawn from the sample
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 (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:

$$n = \frac{3497(\,1.96\times0.99\,)^2}{3497(0.12)^2 + (\,1.96\times0.99\,)^2} = 243.2 \simeq 244$$

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 fishing[1], the relationship between the people and the park, and the measure of some local scales such as Tang.[2]

[insert Table 1]

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).

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 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 costs. Fishing income was calculated by asking heads of household about ways of 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 related costs. Tourism income was calculated by deducting the gross value of tourism income in the previous year from related fuel and labor costs. Non-park environmental income is derived from environmental resources outside of the Hara Biosphere Reserve. Fodder is the only source of income in this category. Local people harvest and store fodder from rangelands in spring and use it year-round.[4] Net fodder income was calculated like other sources of income. NEI is comprised of wage, social grants, 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 all household members in Iran and income from social institutions paid to vulnerable 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.

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

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

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

259 Where P_1 is the poverty gap index, z is the poverty line, and G_i is the difference between
260 the poverty line and household income.

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

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

Where G is the Gini coefficient, Xi is the cumulative percentage of the population in class i and X_(i+1) is the cumulative percentage of population in class i+1,Y_i is the cumulative percentage of income in class i and Y_(i+1) is the cumulative percentage of income in class i+1.

Another inequality index is decile dispersion ratio which is a simple but widely used method to assess income inequality. It presents the ratio of the income of the richest 10 percent to the income of the poorest 10 percent.

Multiple regression analysis was used to estimate the effects of selected explanatory variables on the PI. The selection of intra- and extra-household explanatory variables (Table 2) were based on theories discussed in other studies. In line with those studies, we hypothesized a negative relation between age and education of the household head with the PI. We also expected the level of the PI to increase with total income. In sum, the following five hypotheses were formulated and tested in this study:

H1: There is a negative relation between age and education of the household head with the PI.

H2: The level of the PI increases when the total income increases.

H3: The farther a household is from the part, the lower its PI?

H4: Household with higher labors and more livestock are expected to harvest more from the park.

H5: Those villages that have road access to the Hara Biosphere Reserve harvest more from it.

[insert Table 2]

3. Results and Discussion

3.1. Socio-economic characteristic of sample households

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 all of their heads are male. Although the number of large stocks (cow and camel) and 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, roughly 49% of households have at least one type of stock. However, most stocks (70%) 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.

3.2. Households' income sources and dependency

3.2.1. The most common and uncommon sources of income

Local people depend for their living on a variety of environmental and non-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 shows that many local people have more income from resources use activities including fishing and forest than non-resources use activities like tourism. The lack of tourism was mainly because of the area's underdeveloped tourism infrastructure. Only four villages -- Taable, Soheili, Haftrangoo, and Laft -- have income from tourism. Among all the NEI sources, nearly all households (97%) receive income from social grant and only 7% from 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% of the respondents. As Table 4 shows, NEI is an income source for 99% of the sample, PI for 71%, and NPEI 27%.

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

342 Social grant was the third main source of income whose relative and absolute importance
343 was higher for the poorest group. This group received the most income from social
344 grants. Farm, forest, handicraft and remittance were the other important sources of
345 income. The share of farm income in the total income was 4%. Although the amount of
346 agriculture income was not notable, mainly because of water scarcity, many households
347 keep livestock. Most of the livestock feed were came from gathered around rangelands
348 and the leaves and branches of mangrove trees from the Hara Biosphere Reserve. The
349 study shows that households with higher farm income (wealthier households) harvest
350 more from fodder and forest resources. However, poor households are more dependent
351 on these resources. As shown in Table 3, rich group has more than twice the income
352 from forest and fodder than does the poorest group, but the poorest group is more
353 dependent on forest (3%) and fodder income (1%).
354 Like Soltani et al. (2014), we found that the poor group has highest dependency on
355 forest and fodder sources of income. In line with our findings, many studies such as
356 those by Cavendish (2002), Vedeld et al. (2007), Babulo et al. (2009) and Kamanga et al.
357 (2009) also showed that the poor group was more dependent on forest income than the
358 wealthier group. Given the highest relative importance of forest income for the
359 livelihood of poor households, the study demonstrates that restrictions on harvesting
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
362 income ranging from 3% in the low-income to 2% in high-income group. This is at the
363 lower boundary of dependency ranges reported from other developing countries like
364 Nepal (12-31%) (Rayamajhi et al. 2012), Malawi (7-12%) (Kamanga et al. 2009), and
365 Guatemala (9-28%) (Prado Córdova et al. 2013). In a case study in two villages in
366 Zagros (Iran), Soltani et al. (2014) found much higher dependency on forest income (23-

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).

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 livestock feed like foliage, straw, bran. However, key informants reported several difficulties which prevented local cooperatives from working as intended. First, these cooperatives were established only in a few large villages like Taabl. Accordingly, many 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 villagers, there was little or no difference between cooperatives and the market prices of the livestock feed. Thus, more investment in providing lower-price livestock feed and distributing the cooperatives to small villages like Lashteghan, Guran, and Durbani can protect the livelihood of the poorest households and environmental sustainability at the same time.

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 livelihood strategies (Rakodi 1999; Serrat 2008). Moreover, access to assets and capital 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 have less access to livelihood assets (Table 5). Poor people have lower access to livestock, saving, and labor than do people who are not poor. Moreover, education of 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 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 various assets reduce their abilities to overcome the entry barriers of more profitable economic activities. Thus, they pursue more easy-entry and less capital intensive livelihood options including simple labor, remittances, social grants, and handicrafts.

[insert Table 3]

[insert Table 4]

[insert Table 5]

3.3. Composition of cash and subsistence incomes

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 incomes are completely cash while the forest and fodder incomes are entirely 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 from leaves and branches of mangrove trees to sell them to their neighbors. These households declined to complete the questionnaires. Other income sources, such as fishing, farm and handicraft have a combination of cash (respectively, 85%, 67% and 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.

[insert Figure 2]

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

3.4.1. Poverty analysis

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, NEI, and NPEI. The NEI is found as the first driver of poverty alleviation in the area. 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 alleviation is highest for the middle-income group (an increase in HPI from 7% to 86%). Park income plays a significant role in the poverty alleviation of the area. Excluding the PI will increase the HPI for the middle by 21% and for the rich income groups by 33%. 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 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.

[insert Table 6]

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]

3.4.2. Inequality analysis

The results shown in Table 8 demonstrate that the total Gini coefficient among the rich (0.268) households is more than among the middle (0.201) and the poor (0.218). Within 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 inequality moderator for the high- and the middle-income groups. However, for the 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 smallest changes in the Gini coefficient when forest income is excluded. In contrast, 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 households (0.146 unit) much more than among the middle (0.093 unit) and poor ones (0.06). As the Lorenz curve illustrates (Figure 3), access to NEI has the most equalizing effect on the sample (reducing the Gini coefficient from 0.773 to 0.339). The NEI decreased inequality among the poor, the middle-income and the rich by 0.466, 0.500 and 0.492 units, respectively. When the PI is eliminated from total income, inequality among all the income group increases, but most of all for the rich.

[insert Table 8]

[insert Figure 3]

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

491 in Table 9, 10% of the richest people earned respectively 666 times more income from
492 NEI, 299, 25 times more income from PI and NPEI, than did 10% of the poorest.
493 The same pattern was seen among specific income sources. The greatest income
494 inequality among PI sources was seen within fishing income (283) compared to non-
495 profitable sources like forest (57) and tourism (14). In addition, considerable income
496 inequality was seen between 10% of the poorest and richest households in profitable
497 NEIs including wage (12 times) and farm (128 times). However, this gap was smaller in
498 non-profitable NEI sources like handicraft (8 times) and remittance (1%). One possible
499 explanation for this is that poorest households are less capacitated (Table 5), especially
500 in profitable wage incomes.
501 [insert Table 9]
502
503 **3.5. Determinants of park income**
504 Using SPSS software, a multivariate linear regression was estimated to determine the
505 relationship between the PI as the dependent variable and age of HH, education of HH,
506 household labor, livestock, saving, having access road to the park, poverty status,
507 household distance to the park and village distance to the park as the independent
508 (explanatory) variables. Both intra- and extra-household variables were chosen in the
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
511 national studies and theories to investigate the relationship among livelihood, welfare,
512 and environment in Hara Biosphere Reserve. The variance inflation factor for the
513 regression coefficients was equal to 1, showing no multi-collinearity among variables.
514 Furthermore, to give a clearer picture about co-linearity, the correlation matrix which
515 shows correlation among independent variables is presented in Table 10. As the table

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

[insert Table 10]

Although the model is completely significant, there is a weak relationship between selected variables and PI ($F = 5.70$; $P \leq 0.000$, $R^2 = 0.18$). According to the regression analysis, among the predictor variables only five variables including education of HH, livestock, saving, poverty status, and household distance to the park were significantly 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 effect on PI. As we expected, the model yielded a positive and significant effect between household poverty status and PI (P=0.07, b=974086.13) (Table 11). It means that non-poor households harvest more from Hara Biosphere Reserve and can therefore be considered the main income group that is responsible for the environmental degradation in the area. In line with our findings, Soltani et al. (2014) found that poor households are not responsible for higher resources use and forest degradation in Zagros, Iran. This finding contradicts previous studies by Makhdoum (2008) and Croitoru and Sarraf (2010) that cited poverty as the main cause of environmental degradation in Iran. We also found that household savings had a positive and significant effect on PI ($P \leq 0.05$, b=0.057). This may support the former result. The results of regression model also indicated a positive relation between livestock and PI ($P \leq 0.05$, b=262397.94). This is because local people who own livestock harvest the leaves and branches of mangrove trees from the park to use as fodder.

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

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

[insert Table 11]

4. Conclusions and Policy Implications

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

566 contributor to the total income, poverty reduction and narrowing income inequality. The
567 study also contributes to the literature on environmental protection. Although some
568 studies identified poverty as the main driver of environmental degradation in Iran
569 (Makhdoum 2008), our study showed that the wealthiest households harvest more from
570 the Hara Biosphere Reserve than the poorest. Moreover, the wealthiest households are
571 more likely to be engaged in high-return activities like fishing. Therefore, they are
572 mainly responsible for the depletion of the Hara Biosphere Reserve's environmental
573 resources. Poorest households had lower absolute environmental income and are engaged
574 more in low-return environmental activities like forestry. Thus, the poorest people should
575 not be accused of the high resource use that causes environmental degradation (Nguyen
576 et al. 2015). Indeed, the households with less trained and capacitated members will not
577 be able to be engage in profitable activities. On the other hand, they have less access to
578 financial, physical, natural, social and human capital so their livelihoods —such as
579 handicrafts and fodder harvesting – require less equipment. Improving access to more
580 livelihood capital enables the households to participate in more profitable environmental
581 activities like fishing. Moreover, greater access to resources and equipment enables them
582 to harvest more from Hara Biosphere Reserve.
583 We have presented some policy interventions for reducing park-people conflict and
584 environmental sustainability in the Hara Biosphere Reserve. First, more restrictions
585 should be imposed to reduce wealthy households' illegal activities and over-harvesting in
586 the area. This policy would reduce the pressure on the Hara Biosphere Reserve and
587 protect the environmental income from the Hara Biosphere Reserve for the poor
588 households. At the same time, more attention should be paid to the development of non-
589 resources use livelihood options like wage and tourism. The results of the study
590 demonstrated that tourism income has much less importance in local livelihood than

591 resources use activities like fishing and forestry. To increase the non-resources,
592 employment and development efforts should facilitate investment in NEI activities.
593 Expanding and diversifying rural livelihood options toward those activities that are less
594 dependent on environmental resources harvest is considered a suitable conservation
595 policy in developing countries (Illukpitiya and Yanagida 2008; Mamo et al. 2007)
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
598 reduction over resources use by providing alternative income sources. In short, poverty
599 reduction programs in the area should concentrate on increasing activities like tourism
600 that generate income for local communities while protecting environmental
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
604 harvesting of environmental resources in the area by providing alternative income
605 sources to poorer households. The potential importance of tourism in environmental
606 sustainability and local development has been proven in developing countries like
607 Turkey (Açıksöz et al., 2015). However, Livelihood activities that consume
608 environmental resources should also be considered in designing poverty reduction plans.
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
611 results have found that poorest people are not able to engage in high-return activities.
612 One possible explanation would be their lack of access to human capital. In our study,
613 only a few households had education beyond the elementary level. Lower capacity of
614 poorest people to participate in high-return activities or to operate commercial
615 enterprises due to their lack of human capital has been reported in many areas of Iran

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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753

Table 1.

Study Villages, Distance to Hara Biosphere Reserve and the Size of Sample for Each 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)
Household labor	Productive household members (16-65 years)	(Ellis 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)	-

761 HH (household head).

762 Table 3.

763 *Income Sources, Absolute and Relative Income across Income Groups*

Income source	Households who receiving income sources (%)	All households (244)		Income groups						ANOVA test (F)
				Poor (77)		Middle income (122)		Rich (45)		
		Abs	Rel	Abs	Rel	Abs	Rel	Abs	Rel	
Forest	36	116097	2	93016a	3	100904a	2	196782b	2	3.434**
Fishing	63	1340572	21	544904a	17	961447a	16	3729900b	29	12.831***
Tourism	15	87962	<1	50360	2	101785	2	114831	<1	1.346
Fodder	27	52912	<1	39866a	1	46533a	<1	92530b	<1	2.591*
Wage	67	3542148	56	1352256a	41	3588829b	60	7162738c	56	35.383***
Social grants	97	820863	13	889232	27	782837	13	806969	6	.985
Farm	35	228039	4	94999a	3	227666	4	456698b	4	3.683**
Handicraft	55	121036	2	87447a	3	141715b	2	122447	1	3.097**
Remittances	7	46398	<1	115357a	4	19989b	<1	0b	0	6.331***
Total		6,356,029	100	3,267,435a	100	5,971,706b	100	12,682,897c	100	105.761***

764 Abs (Absolute incomes)

765 Rel (Relative incomes)

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

767 a, b, c, LSD test; Different letters show significant differences across quantiles ($p <$

768 0.05).

769 Table 4.

770 *Absolute and Relative Importance of Income Sources in Local Livelihood*

Main income source groups	Households receiving income sources (%)	Mean household income per capita per year (dependency %)	Absolute income (Relative income)			ANOVA test (F)
			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***

771 PI (Park income)

772 NPEI (Non-Park Environmental income)

773 NEI (Non-Environmental income)

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

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

776 0.05).

Table 5.

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

Variables	Poverty status		p-value
	Poor	Non-poor	
Age of HH	43.35	39.55	.035
Education of HH	5.26	6.86	.012
Household labor	2.39	2.84	.003
Livestock	1.29	2.12	.016
Saving	428571.43	3128742.51	.050
Household distance to the park	2384.42	2811.98	.039

The significance threshold is set at .05

780 Table 6.

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

782 *Groups*

Income groups	Poverty head count index (%) for different income sources			
	Total income	Without PI	Without NPEI	Without NEI
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

783

784 Table 7.

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

Income groups	Poverty gap index (%) for different income sources			
	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

786

Table 8.

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

Income excluded source		Income Groups			
		Sample	Poor	Middle	Rich
Gini Coefficient when each income source excluded	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
	Wage	0.496	0.302	0.430	0.593
	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.

792 *Decile Dispersion Ratio for All Income Sources*

Income sources		Mean income	Decile dispersion 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 income sources	PI	1,544,632	299
	NPEI	52,912	25
	NEI	4,758,484	666
	Total income	6,356,029	10

793

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

** Correlation is significant at the 0.01 level.

* Correlation is significant at the 0.05 level.

Table 11.

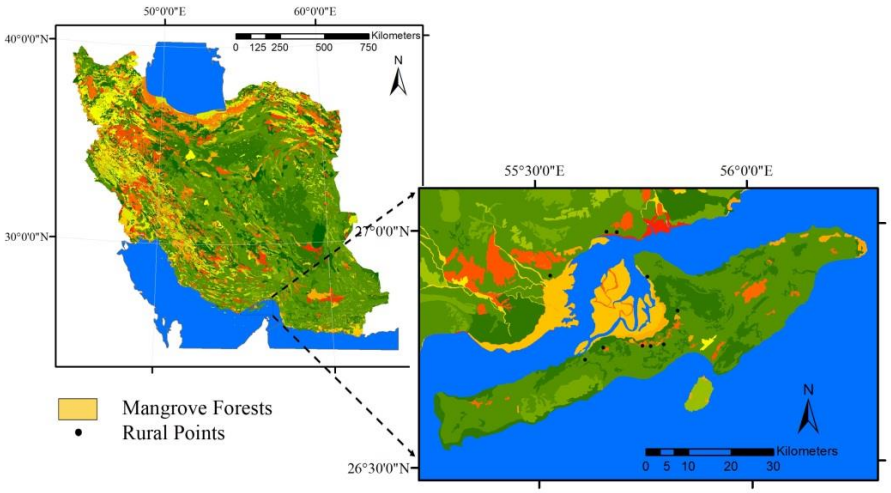
Results of Multivariate Linear Regression of PI against Inter- And Intra-Household Variables

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

HH (household head).

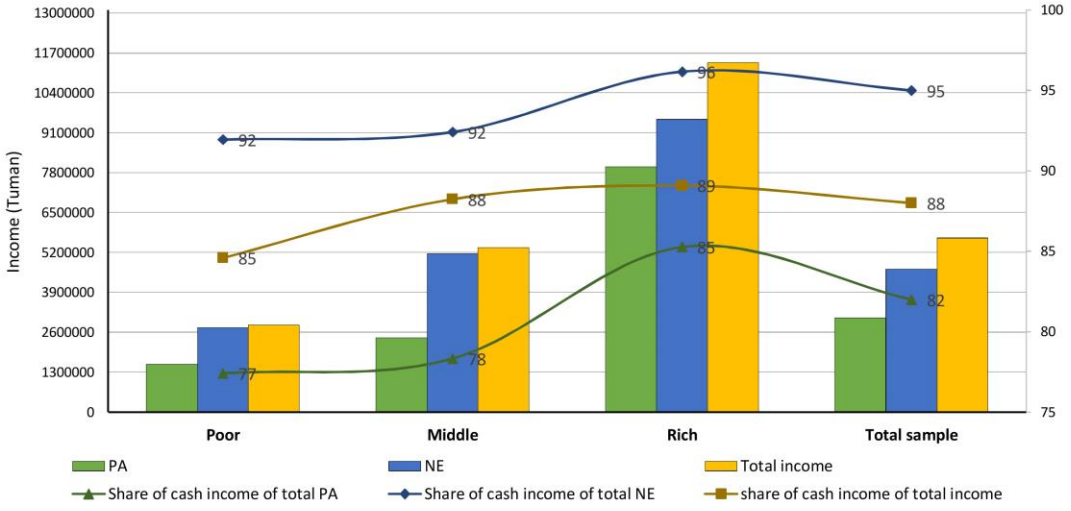
***, **, and * significant at 0.01, 0.05, and 0.1.

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



807

808 *Figure 1*. Location of the study area.



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

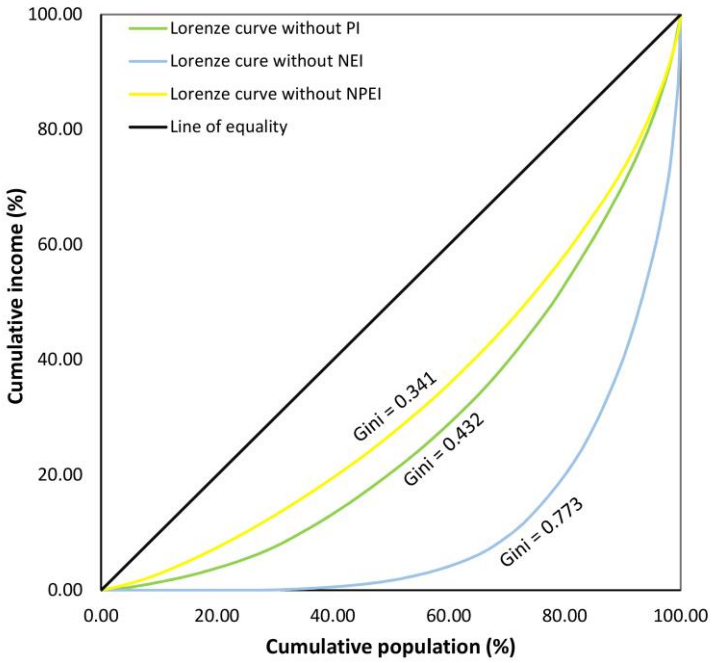

Figure 3. Lorenz curve and Gini changes, excluding NEI, PI and NPEI.