Buffer zone income dynamics for the sub-district producer community: Implications for rural off-farm income, income inequality and the development of household agriculture.

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Abstract

This paper explores the role of buffer zones in household welfare in Zimbabwe by using primary household level data collected between November and December 2010 from communities that share boundaries with Nyatana Game Park. The descriptive statistics suggest that the contribution of buffer zone activities to household income may be significant, with a positive correlation to household agricultural income for communities that reside inside or close to the Park. Using the Gini decomposition approach and Lorenz curves, the paper further suggest that buffer zone income may be capable of contributing to more equally distributed incomes for rural communities who share boundaries with Game Parks. The implied message is that buffer zones may provide active livelihood sources capable of financing rural household agriculture and reducing income inequality. However, this potential may not be realized because of the current buffer zone design status (created for local secondary use, not for commercial primary use), restrictive policies, high predation, poorly defined buffer zone boundaries and poor institutional support. Need therefore arises to address current barriers as suggested by regression estimates for correlates of household income. This will promote households' adaptation abilities hence marrying conservation and rural development using positive harvests from buffer zones as incentives for wildlife conservation.

Key words: Buffer zone incomes, income inequality, household agriculture

1. Introduction and background information

Many community managed Game Parks were established with the primary assumption that revenue from ecotourism activities would provide the main livelihood source for the surrounding communities (Muchapondwa, 2003; Fernandez *et al*. 2009). The idea was to involve the masses of rural communities as active partners so as to marry conservation and development by using the positive benefits (revenue) from Game Parks as incentives for surrounding communities to conserve wildlife (Gadgil and Rao, 1994, 1995). Buffer zones were therefore seen as secondary livelihood sources for complementing local requirements of surrounding communities.

The low and sometimes missing revenue from Game Parks, amid a growing number of the sub-district producer communities, may have turned community game farming into a high risk livelihood source. Due to the agro-ecological locations of most Game Parks (regions IV and V), crop farming is also very risky and unreliable for surrounding communities (Child, 1995). With this, the sub-district producer community seems to be responding to distress diversification strategies in response to "push" and "pull" factors.

Buffer zones that were initially created as a secondary livelihood source have been turned into primary livelihood sources which send "pull" signals to even secondary and tertiary sub-district producer communities. Recent studies suggest that the rural poor are dependent on forest resources for sustaining their livelihoods [Millennium Ecosystem Assessment (MEA), 2005]. A forest-poverty linkage model has therefore emerged as a possible safety net, and a path out of poverty (Cavendish, 2003; Vedeld *et al*. 2004; Fisher, 2004; Narain *et al*. 2005; Kabubo-Mariara, 2008; World Bank, 2008).

Other studies, however, suggest that the potential benefits that the poor can derive from forests are not obvious and/or always positive (Beck and Neshmith, 2001; Campbell *et al*. 2001; Shively, 2004; Adhikari, 2005). The literature, therefore, suggests a two way causal relationship between buffer zone and

poverty (Kabubo-Mariara, 2008). Angelsen and Wunder (2003) argue that a forest may be a poverty trap rather than a safety net due to the low returns of most non-timber forest products, poor physical infrastructural development in rural areas and missing markets. MEA (2005) further acknowledges that many developing countries have not effectively used forest resources in support of development efforts due to the widespread corruption of the political and economic elites in the forest sector.

More questions than answers surround the potential of buffer zones to address the livelihoods of rural communities who share boundaries with such ecosystems. In addition, the actual income benefits that rural poor communities can derive from buffer zones are questionable given that most developing countries prohibit the commercial sale of forest produce. Adhikari (2005) notes that while the poor may attempt to minimise risk by using forest resources to mitigate the shortfalls in consumption, the rich may be interested in enhancing their incomes through the commercial trade of these resources, when there are good market opportunities.

Locked up in risk community game farming and crop farming, rural communities may have been "pushed" out of such activities targeting buffer zones as their only hope due to lucrative opportunities (grazing land and several extractable buffer zone natural resources), although its potential in this regard is highly debated in literature. This study analyses the buffer zone income dynamics for the sub-district producer community with the implicit objective of understanding communities` dependence on buffer zones (forests). It focuses specifically on the implications for rural off-farm income, income inequality and the development of household agriculture.

2. Problem statement

Most community managed game parks have failed to provide consistent and meaningful primary livelihood sources for surrounding communities (Child, 1995; Patel, 1998; Hasler, 1999; Muchapondwa, 2003). This may have forced communities to consider buffer zones that were initially created as

secondary livelihood sources for local domestic use. Literature on the subject, however, suggests that the potential of buffer zones (forests) may not be that obvious and/or always positive (Beck and Neshmith, 2001; Campbell *et al*. 2001; Shively, 2004; Adhikari, 2005). The need therefore arises to consider the potential of buffer zones to address livelihoods as primary sources for the sub-district community, given the recent attention to buffer zones amid failing community game farming.

The study analyses the income dynamics for three categories of communities for purposes of understanding contribution of buffer zone incomes. The first group were primary sub-district producer communities with normal limited access to the buffer zone (NLA), who relied strictly on the established buffer zone for a livelihood through harvesting of buffer zone products like fire wood, wild mushroom, reeds and timber. The second group comprised of primary sub-district producer communities with illegal unlimited access to the entire game park (IUA); they relied directly on the entire game park since they were able to illegally establish their accommodation inside the game park and could therefore access resources beyond the established buffer zone, for a livelihood through harvesting game park products. The third group comprised of the secondary sub-district producer community with distanced, normal, limited access to the buffer zone (DNLA), who partially relied on the established buffer zone for a livelihood.

3. Study questions

The study addresses the following research questions:

- What is the level of household reliance on buffer zone environmental incomes?
- What is the distribution of buffer zone environmental incomes between the three different buffer zone user groups from the sample?
- What is the contribution of the buffer zone to income distribution?
- What are the determinants of household income for different buffer zone user groups?

3.1. Study objectives

The general objective of the study was to analyze the buffer zone income dynamics for the sub-district producer community. The specific objectives were structured as follows;

1. To investigate the level of dependence on buffer zone incomes by different user groups as defined by their location.
2. To investigate the distribution of buffer zone incomes between different user groups.
3. To assess the contribution of buffer zone to income distribution.
4. To uncover the correlates of household income for different buffer zone user groups.

The first two objectives were motivated by recent findings which suggest that forests may play a significant role as safety nets that cushion households during periods of hardship as they are capable of reducing rural poverty (Kabubo-Mariara, 2008) and financing rural household agricultural development (World Bank, 2008; Zahonogo, 2011), although not always in ways that are obvious and/or positive (Beck and Neshmith, 2001; Campbell *et al*. 2001; Shively, 2004; Adhikari, 2005).

The third objective was motivated by mixed reporting that surrounds the possible income distribution effect of non-farm activities as acknowledged by Reardon *et al*. (2001). Studies by van den Berg and Kumbi (2006) in Ethiopia, Lanjouw (1998) in Ecuador, Fisher (2004) in Malawi and Kabubo-Mariara (2008) in Kenya indicate that off-farm activities may reduce rural income inequality, while Reardon (1997) finds that off-farm income contributes to increasing inequality in a review of case studies from several countries in Africa (Khan and Riskin, 2001; Elbers and Lanjouw, 2001; Escobal, 2001). In light of the above, the third objective focused on sources of income inequality among different buffer zone user groups, using the Gini decomposition analysis and Lorenz curves.

The fourth objective tried to uncover factors capable of influencing the magnitude of incomes from different major sources within the study area. The motivation, as it were, was based on the assumption

that if forest activities increase household income and reduce poverty and inequality (Kabubo-Mariara, 2008), understanding the correlates of household income may help in the identification of potential entry barriers and constraints.

3.2. Study site

The study was based on data gathered from community managed buffer zones surrounding Nyatana Game Park, in Zimbabwe. One community residing inside the park was considered for purposes of estimating the full potential of game parks in the event that communities are aloud unlimited access to the park. The specific location of Nyatana Game Park is **16^{0}51`08.71`` S: 32$^0$35`11.30`` E** supported by a modified Google Earth map in Figure 1.

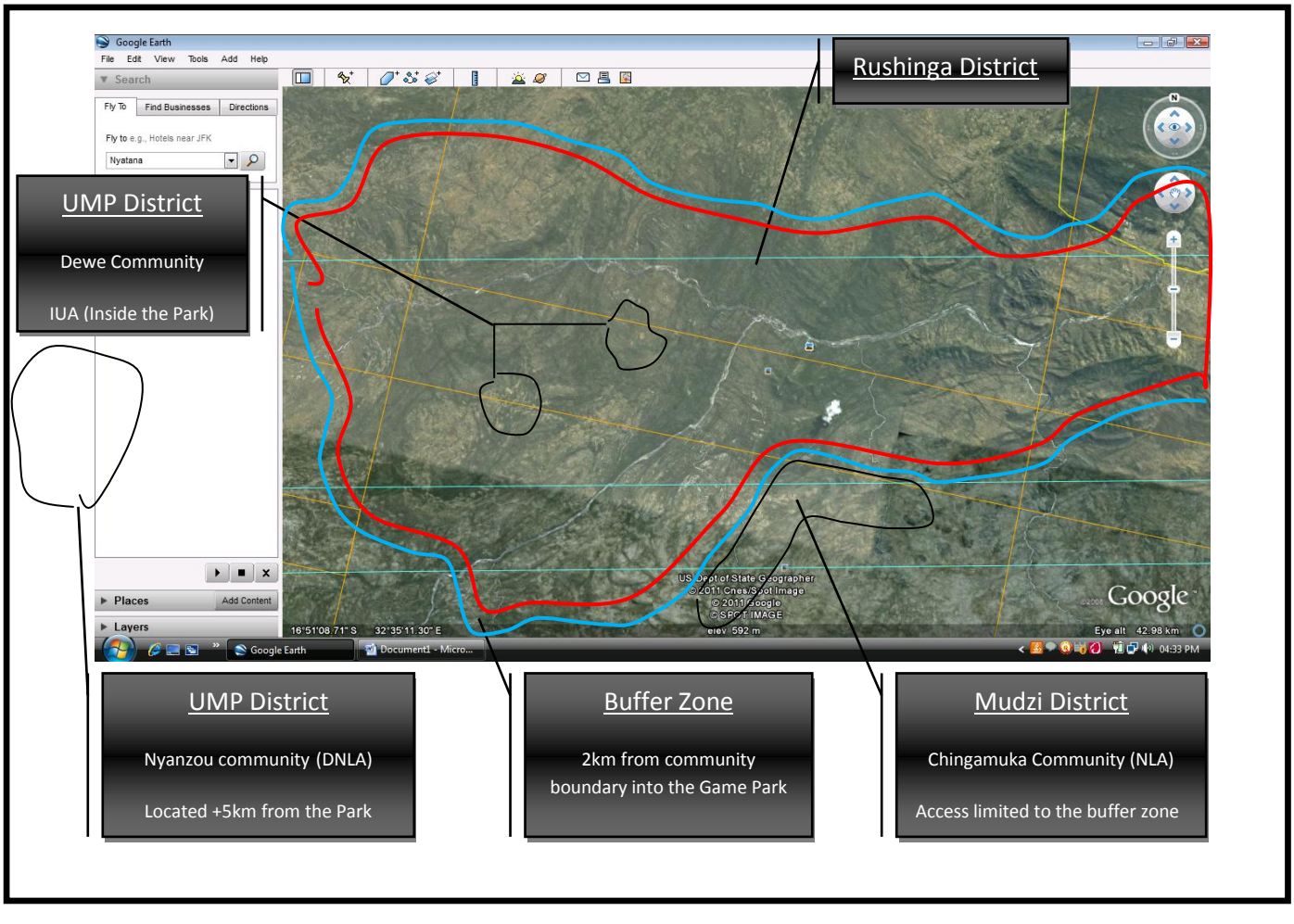

Figure 1: Study location map (Nyatana Game Park)

3.3. Sampling and data collection procedure

The survey was conducted in November and December 2010. The study employed a multi-stage sampling technique with stratified and random components. Samples were drawn from three communities, namely those who were: illegally residing inside the game park (IUA - 20), legally residing outside the game park within 3km from the buffer zone (NLA - 50), and legally residing outside the game park beyond 3km from the buffer zone (DNLA - 50).

Initially, purposive stratified systematic sampling was employed with community characteristics (location), as the basis for sampling. Participation in income generating activities and the income derived from them was assumed to vary in relation to the distance away from the buffer zone. From each of the three groups of communities each community was selected using a simple random sampling technique. Finally, households were further randomly selected for enumeration. Three districts surround the Nyatana Game Park, namely UMP, Mudzi and Rushinga. From the three districts, all three categories of communities (IUA, NLA and DNLA) were present. However, the illegal unlimited access group (IUA) was more pronounced in UMP and Rushinga districts.

From the UMP district, specifically from Dewe and Masunzwa communities, several households were illegally residing inside the Nyatana Game Park. This was also true for the Rushinga district. Figure 2 illustrates how communities were grouped for sampling purposes so as to include the levels involved from the district down to household level. From the created groups (IUA, NLA and DNLA) based samples in level I, one community was randomly selected for the purpose of drawing households for interviews. For the IUA group, Dewe community from the UMP district was randomly chosen, Chingamuka from Mudzi for the NLA and Nyanzou from UMP for the DNLA group.

The actual sample survey yielded 120 households, 20 from the IUA, 50 from the NLA and 50 from the DNLA group. Due to the practical difficulties of interviewing illegal households, the study only managed to interview 20 respondents from the IUA group. A detailed questionnaire was used to collect the

required data and probed household socio-economic characteristics, income sources and buffer zone collection activities. Household data was also augmented by focus group discussions from each of the sampled villages, for the purpose of understanding community shared norms and values with respect to buffer zone incomes. This was mainly done to gather group consensus for it was feared that households may misrepresent themselves, for fear of prosecution because the sale of forestry produce was illegal.

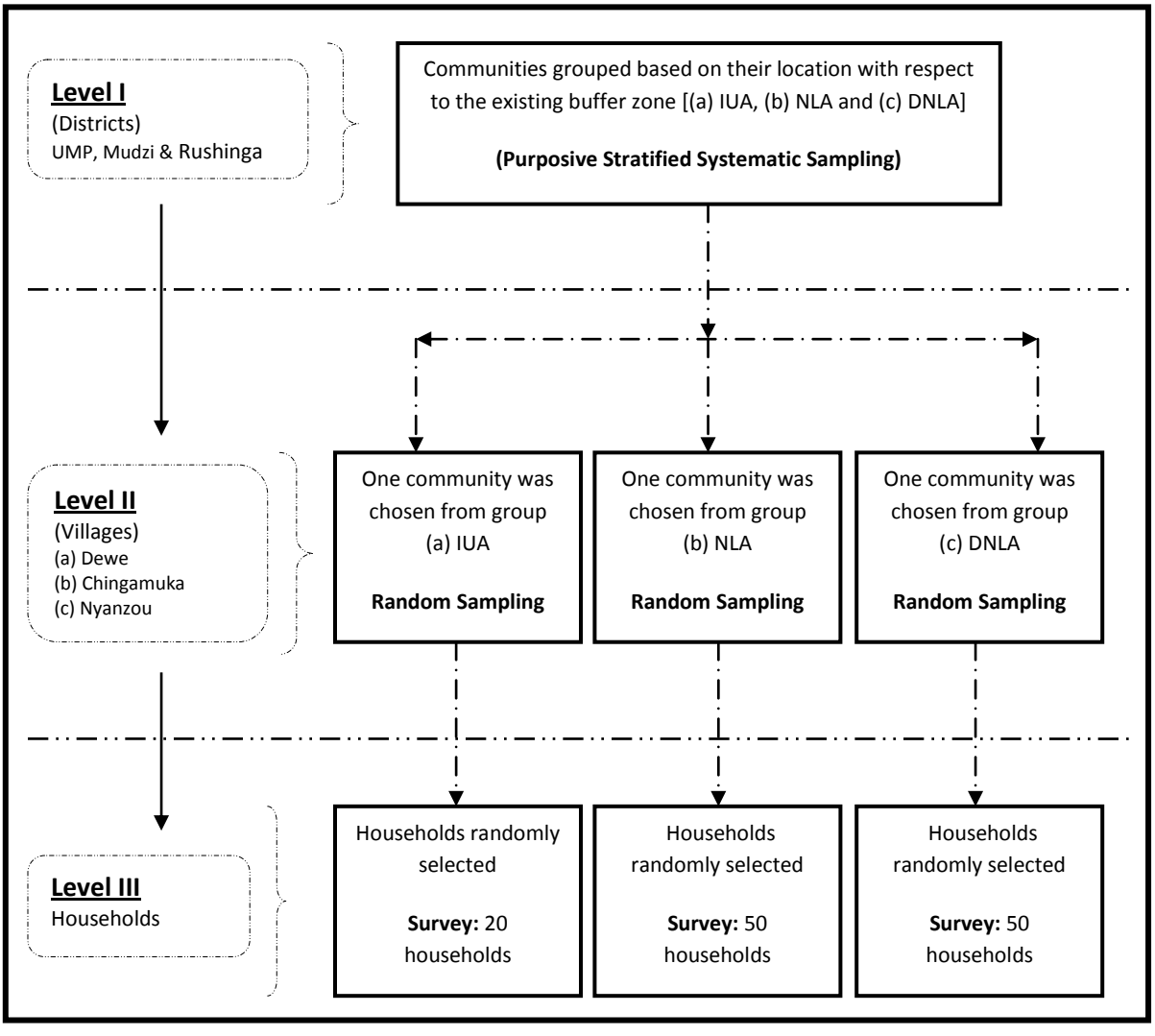

Figure 2: Sampling procedure

4. Literature review

This section reviews the literature presented on the relative importance of off-farm activities to household incomes, with special reference to societies that share boundaries with community managed Game Parks or common pool forest areas. The concepts reviewed here include issues on the potential of non-farm activities in rural areas as livelihood and income sources; the potential of forests (buffer zones) in rural areas as livelihood and income sources; the contribution of non-farm incomes to household agriculture development and the contribution of non-farm activities to household income equality.

4.1. The potential of non-farm activities in rural areas as livelihood and income sources

Several authors acknowledge that while many households in rural areas are involved in farm activities, many get the bulk of their incomes from non-farm activities and, recently, the latter has been viewed as an important pathway out of rural poverty (Reardon, 1997; Bryceson and Jamal, 1997; Rosenzweig, 1988; Kimhi, 2000; Ellis, 2000; Barrett *et al*. 2001; Lanjouw, 2001; Ruben and van den Berg, 2001; de Janvry and Sadoulet, 2001; Haggblade *et al*. 2007; World Bank, 2008; Chikwama, 2010; Zahonogo, 2011). With special reference to developing countries, between one third and half of rural households are reported to generate their income from non-farm sources with a share of income between 20% and 70% of the total household income (Rosenzweig, 1980; Benjamin, 1992; Rizov *et al*. 2000; Adams, 2001).

Research conducted by ICRISAT in Burkina Faso over the 1981 to 1985 periods seems to suggest that between 26% and 57% of the total household income come from non-farm activities (Reardon *et al*. 1992). Zahonogo (2002) notes that recent studies in the same zones seem to suggest that non-farm income may represent between 22% and 40% of the total household income. Contrary, studies in Latin America, specifically from Bolivia, have noted that agricultural production is still the most important source of income (Comisión Europea, 2000; Jimenez and Lizarraga, 2003).

4.2. Potential of forests (buffer zones) in rural areas as livelihood and income sources

Tropical forests have also been reported to provide significant livelihood sources, cash incomes and vital safety nets in times of need (Hegde and Enters, 2000; Godoy *et al*. 2000; Pattanayak and Sills, 2001). Earlier, Cavendish (2000) suggested that since forests represent a basket of highly differentiated goods and services, more empirical evidence examining forest dependence, in a robust analytical framework, is necessary. As a result, recent studies have focused on the poverty-forest-link and the contribution of forests and other common pool resources (Vedeld *et al*. 2004). These studies argue that, other than being a safety net and gap-filler, forest income may be part of household livelihood diversification strategies capable of representing a significant income source (Cavendish, 2000; Angelsen and Wunder, 2003; Pattanayak *et al*. 2004; Takasaki *et al*. 2004; Stifel, 2010) with an average contribution of 22% (Vedeld *et al*. 2004) and possibly 30% (Fisher, 2004).

4.3. Contribution of non-farm incomes to household agriculture development

Some previous studies suggest that earnings from farm and off-farm activities may be positively correlated (Haggblade *et al.* 1989; Hazell *et al*. 1991) through unlocking constraints on credit and liquid assets required for agricultural production, hence boosting agricultural competitiveness (World Bank, 2008). In situations where there are no credit constraints, Zahonogo (2011) suggests that the non-farm income may become a determinant in the rural households' strategy for farming investment. This observation has attracted considerable attention from policymakers and rural development agencies for policy targeting towards improving agricultural performance in developing countries (Bernstein *et al*. 1992; Cater, 1997; Ellis, 2000; Barrett *et al*. 2001; Lanjouw *et al*. 2001; Chikwama, 2010). Contrary to this interesting development, some studies argue that the expansion of the rural off-farm sector may have adverse effects on the development of household agriculture (Lipton, 1980; Low, 1986; Ellis; 1998). As previously noted by Lanjouw (2001), there is still no consensus on the exact direction of influence between rural off-farm activities and household agricultural development.

4.4. Contribution of non-farm activities to household income equality

The distributional role of non-farm activities to household income equality, from rural areas, is still controversial. To a larger extent, the direction of influence is affected by the types of non-farm activities involved and the capacity of different households to access such activities. Quite a number of studies suggest that non-farm income may be more unequally distributed than farm incomes (Shand, 1987; Reardon and Taylor, 1996; Leones and Feldman, 1998; Barham and Boucher, 1998; Khan and Riskin, 2001; Elbers and Lanjouw, 2001; Escobal, 2001).

Contrary to this commonly shared conclusion, a significant number of studies share the view that non-farm incomes may contribute to more equally distributed incomes in rural areas, especially when the proportion of non-farm income in relation to total income increases (Chinn, 1979; Stark *et al*. 1986; Adams, 1994, 1999; Adams and He, 1995; Lachaud, 1999). Fisher (2004), based on a study of economic reliance on forests and its impact on the welfare of low-income households in rural Malawi, notes that forest income reduced measured income inequality by 12%. Similar findings were recently shared by Kabubo-Mariara (2008), based on a study of forest dependence and household welfare in Kenya. Kabubo-Mariara (2008) notes that forest incomes from the study area contributed a small proportion (4%) to total income inequality. These results are in agreement with previous conclusions which suggest that forests contribute to more equally distributed incomes (Cavendish, 2000, 2003; Angelsen and Wunder, 2003; Fisher, 2004).

General conclusions from the reviewed literature are therefore varied. Firstly, the literature suggests that non-farm activities contribute significantly to rural incomes (World Bank, 2008; Chikwama, 2010; Zahonogo, 2011) and diversification into non-farm activities, therefore, seems to be the norm (Barrett *et al*. 2001) especially among agricultural households whose livelihoods are vulnerable to climatic uncertainties (Stifel, 2010). Secondly, several studies suggest a positive correlation between non-farm

incomes and the development of household agriculture (Haggblade *et al.* 1989; Hazell *et al*. 1991; World Bank, 2008), although some studies suggest a negative correlation (Lipton, 1980; Low, 1986; Ellis; 1998).

The literature suggests that forests and other common pool resources also contribute significantly to rural household incomes (Godoy *et al*. 2000; Pattanayak and Sills, 2001; Vedeld *et al*. 2004; Kabubo-Mariara, 2008). Regardless of the reported potential of forests and common pool natural resources, the Millennium Ecosystem Assessment (2005) notes that many developing countries have not effectively used forest resources to support rural development. The problem, from an African perspective, seems to emanate from lack of more accurate and adequate data compared to other regions (Sale, 1981; Campbell, 1996; Cavendish, 2000; Fisher 2002; Campbell and Luckert, 2002; Kaimowitz, 2002). Thirdly, literature also suggest that forests may contribute to more equally distributed incomes (Cavendish, 2000, 2003; Angelsen and Wunder, 2003; Fisher, 2004), although other studies show that the reverse may also be true (Khan and Riskin, 2001; Elbers and Lanjouw, 2001; Escobal, 2001).

5. Methods of analysis

The study analyses the income dynamics of sub-district producer communities defined by three distinct buffer zone user groups: (a) illegal unlimited access users (IUA), (b) normal limited access users (NLA) and (c) distanced normal limited access users (DNLA). Four working hypotheses were addressed, as follows; firstly, the illegal unlimited access users (IUA) are more dependent than the normal (NLA) and the distanced (DNLA) normal limited access users on buffer zone resources; secondly, location is an important determinant of buffer zone incomes; thirdly, buffer zones contribute to more equally distributed incomes; and fourthly, buffer zone dependence (income) is conditioned by other household heterogeneities (gender, household-head education and household-head age).

In order to test the above hypotheses, the study employed both descriptive and econometric research methods. The estimation of buffer zone dependence by different user groups and the distribution of

buffer zone incomes was done using descriptive statistics in the form of tables, frequencies, graphs and percentages. With respect to the contribution that the buffer zone makes to income distribution and inequality dominance, the study adopted the Lorenz curve and Gini index, as follows;

5.1. The Lorenz curve

The Lorenz curve maps the cumulative income share on the vertical axis against the cumulative distribution of the households on the horizontal axis. If each household had the same income, the income distribution curve would be straight. This is the line of total equality. The further away the Lorenz curve is from the line of total equality, the greater the inequality. Following Duclos and Araar (2006), the Lorenz curve can be illustrated as shown in equation 1.

$$L(P) = \frac{\int_0^P Q(q)dq}{\int_0^1 Q(q)dq} = \frac{1}{\mu}\int_0^P Q(q)dq \quad \text{.....1}$$

Where;

- The numerator sums incomes from the bottom P: proportion (poorest 100P %) of the population.
- The denominator sums incomes from all the population.

Duclos and Araar (2006) further suggest that the Lorenz curve can be used for testing inequality dominance. If the Lorenz curve say LBZ (P) of a distribution BZ is everywhere above the Lorenz curve LAG (P), distribution AG is more unequal than distribution BZ. Thus, all the inequality indices that obey the Pigou-Dalton principle should indicate that inequality in AG is higher than inequality in BZ.

5.2. Decomposition of income inequality

The Gini coefficient is a measure of statistical dispersion most prominently used as a measure of inequality of income distribution or the inequality of wealth distribution. It is defined as a ratio with

values between 0 and 1. A low Gini coefficient indicates more equal income distribution, while a high Gini coefficient indicates more unequal distribution. A value of 0 corresponds to perfect equality (everyone having exactly the same income) and 1 corresponds to perfect inequality (where one person has all the income, while everyone else has zero income) (van den Berg and Kumbi, 2006).

The decomposability of income inequality allows inequality to be partitioned either over subpopulations or sources (Adams, 1999). In this technique, total inequality is divided into a weighted sum of inequality by various income sources (for example, non-farm and agricultural income) and it encompasses source decomposition of the Gini coefficient. The Gini coefficient is frequently used for the analysis of the distribution of income because it can be decomposed by income source; this illustrates the effects of alternative income sources on total income equality. In their recent study, van den Berg and Kumbi (2006) used a similar approach to obtain estimates of the contribution of selected sources of income on inequality in Oromia, Ethiopia. Their analysis follows the common expression for the Gini coefficient (G) for the distribution of total income within the group and is defined as in equation 2:

$$G = \frac{2\,\mathrm{cov}[Y, F(Y)]}{\mu} \quad \text{.....2}$$

Where;

- cov*[Y, F(Y)]* is the covariance of total income (Y with mean μ) with its cumulative distribution (F).

5.3. Equation of income

The analysis considered setting simple linear equations to estimate the reduced form models of household income from different sources. Conceptually, it is possible to think of a number of variables, which could influence household income. The variables could be location based (e.g. distance from

buffer zone – IUA, NLA and DNLA groups), human capital related (e.g. education and level of access to extension by household) or socio-economic related variables (e.g. household size, age and gender). The analysis of income employed here also included a location dummy variable to capture the location endowments important for household income generation. In order to identify the determinants of household income, from different sources, this study estimated the income determination function for the year 2010. The total income equation was estimated using OLS for all the different categories of incomes separately. The general model of all the estimated equations, following an approach by Pindyck and Rubinfeld (1991), can be written as shown in equation 3 for each category of income:

$$Y_j = \beta_0 + \beta_i X_i + u \quad \text{.....3}$$

Where;

y_j = the dependent variable representing income earned from each income category, explained by,

b_i = the vector of parameters and

X_i = the vector of exogenous explanatory variables with

b_0 = the constant term and

u = the error term.

6. Definition and measurement of variables

In this section the study explores the impact of several household characteristics that may influence incomes for households which rely on the buffer zone. These included: household size, gender of household-head, age of household-head, education of household-head, arable land size (plot size), Livestock Units, access to extension by households and distance to buffer zone.

Household size

Household size, as measured by the number of adult household members, was expected to have a positive influence on buffer zone incomes, based on the generic understanding that buffer zone activities may be labour intensive (Gunatilake *et al*. 1993; Shively, 2004). A similar positive influence was also expected with respect to self-employment as rural households respond to "push" factors (high risk and lack of access to credit) which may push households into non-agricultural activities, in this case self employment, and "pull" factors such as higher returns to labour that could be obtained from working off the farm (Reardon, 1998; Lanjouw and Lanjouw, 2001; Sanchez, 2005). Effectively, a negative influence was therefore expected with reference to agricultural income.

Household-head gender

Gender was included to test whether there was a significant difference between the incomes of male headed households and female headed households. A negative association was expected with respect to buffer zone incomes based on the conventional understanding that women may participate more actively in common pool gathering resources than men (Narain *et al*. 2005). A positive influence was expected with respect to self-employment based on "push" and "pull" factors.

Household-head age

The age of the household, as measured by its number of years, was expected to uncover the extent to which labour allocation changes over the life span of the household-head, as suggested by Adhikari (2005). Earlier studies suggest a positive association between age and incomes based on the fact that age may mean experience in managing common resources and the accumulation of capital (Kabubo-Mariara, 2008). In contrast, other studies suggest a negative association, specifically with respect to buffer zone incomes, for older households which may have less time and physical strength to engage in

forest activities (Kohlin and Parks, 2001; Vedeld *et al*. 2004). Either a positive or a negative influence was therefore conjectured for all the main sources of income from the study area.

Household-head education

Education was expected to be negatively related to agricultural and buffer zone incomes and positively related to self employment. Previous studies noted that education may be expected to influence the extraction of fewer forest resources because education normally opens up alternative employment opportunities which are capable of diverting households from subsistence agriculture and gathering activities (Vedeld *et al*. 2004; Shively and Pagiola, 2004).

Land size

Land size, as measured in hectares of arable land, was expected to positively influence incomes generated from agriculture; households with a larger plot size were expected to spread agronomic risk through crop diversity and rotations made possible by the larger plot size. This scenario was expected to negatively influence buffer zone participation and the resultant incomes from that source. Alternatively, previous studies suggest a positive influence based on the understanding that forests may be seen as important sources of intermediate products that serve as input in the farming system (Fisher, 2004; Adhikari, 2005). Livestock Units (LUs) for key bovine species (cattle, sheep and goats) from the study area was one of the factors also expected to positively influence agricultural incomes as a result of "sweet *velds*" common in agro-ecological regions IV and V.

Access to extension

Extension was expected to positively influence income from agriculture and self employment. A negative influence was expected with reference to incomes from the buffer zone, based on the current restrictive legal framework that prohibits the commercial harvesting of forest produce. Previous studies, however, suggested that institutions may be an important source of relevant information, including

information on policy changes that directly affect forest communities (Gaspert *et al*. 1999; Adhikari, 2005).

Distance to buffer zone

Distance to buffer zone was expected to negatively influence incomes from agriculture (livestock) and buffer zone resources. Households who live closer to the buffer zone were expected to have a more secure and accessible supply of buffer zone products regardless of the existence or absence of allocation rules (Varughese and Ostrom, 2001). On the same note, households that live closer to the buffer zone (IUA and NLA) were further expected to have more secure access for grazing their livestock in comparison to their distant counter parts (DNLA). The risks generic in farm activities were, therefore, expected to push the DNLA group out of agricultural activities into non-farm activities (self-employment) and thereby positively influencing incomes from self-employment. Table 1 summaries the description, measurement and expected signs for the considered variables.

Table 1: Variables hypothesized to affect household income

Variable	Description	Unit	Expected Sign		
			Buffer	Agric	Self Em
1. Household size	Number of adult family	Number	**+**	**-**	**+**
2. Household gender	Household head gender	0 = F; 1 = M	**-**	**-**	**+**
3. Household age	Age of household head	Years	**-/+**	**+**	**+**
4. Household education	Highest level of education achieved	0 = U; 1 = P; 2 = S; 3 = T	**-**	**-**	**+**
5. Arable land size	Estimate of arable farming area	1 = < 0.5ha; 2 = 0.5 - 2.5ha; 3 = > 2.5ha	**-/+**	**+**	*****
6. Livestock units	Number of livestock units owned	1 = < 2LUs; 2 = 2 - 3LUs; 3 = > 3LUs	*****	*****	**+**
7. Access to extension	Household`s access to extension	1 = Poor; 2 = Fair; 3 = Good	**-**	**+**	**+**
8. Distance to buffer zone	Location of respondents with respect to buffer zone	IUA = 1; NLA = 2; DNLA = 3	**-**	**-**	**+**

Key:

- *: Influence could not be established *a priori*

- Household gender: F = Female; M = Male
- Household Education: U = Uneducated; P = Educated to primary level; S = Educated to secondary level; T = Educated to tertiary level
- Distance to buffer zone: IUA = Illegal Unlimited Access group (Inside the Park); NLA = Normal Limited Access group (0 – 5km from the buffer zone); DNLA = Distanced Normal Limited Access group (> 5km from the buffer zone).

7. Results and discussion

This section presents the research findings. Firstly, the study presents descriptive statistics for all sampled households. For the purpose of addressing the first and second objectives, a detailed descriptive analysis of data was conducted to explore the nature of household income sources and household income shares by source and buffer zone user groups. To achieve the third objective, the study used the Gini index and Lorenz curves to uncover the contribution of buffer zones to income distribution. Finally, using econometric results, the study estimated the correlates of household incomes from different main income sources within the study area.

7.1. Descriptive statistics of all sampled households

Table 2 presents the socio-economic characteristics of all sampled households. The data displays a mean household size of 6, with a minimum of 1 and a maximum of 12. The average age of household-heads was 41, with a minimum of 18 and a maximum of 78.

Table 2: Descriptive statistics of all sampled households

	Household Socio-Economic Characteristics						
	Household Size	Household Head Sex	Household Head Age	Household Head Educ	Plot size	Livestock Units	Extension
N	120	120	120	120	120	120	120
Mean	6.13	.69	41.36	2.20	1.55	2.47	2.23
Median	6.00	1.00	36.00	3.00	2.00	3.00	2.00
Std. Deviation	2.449	.464	15.809	.984	.563	.744	.750
Skewness	-.241	-.841	.396	-1.006	.375	-1.005	-.396
Minimum	1	0	18	0	1	1	1
Maximum	12	1	78	3	3	3	3

The statistics also indicate a high average level of education, which was an average of secondary education for most households. These findings are in line with nationwide statistics based on the 2002 population census. Households had an average plot size of 1.55ha and 2.47 Livestock Units with fair access to extension. The mean and the median did not vary significantly, which implies that there were no major outliers for each household characteristic. In addition, the asymmetry of distribution was both positively and negatively skewed. Age and plot size were positively skewed, while the rest of the characteristics were negatively skewed. Most of the characteristics had skewness values below 1 with the exception of education and livestock units. The statistics, therefore, suggest that the distribution did not differ significantly from a normal symmetric distribution.

7.2. Household incomes by sources

Previous studies suggest that common pool forest resources play a major role in poverty reduction through the diversification of household income sources (Vedeld *et al*. 2004). This section presents the

results of average household incomes and shares of incomes from different activities by different buffer zone user groups. Figure 3 presents household incomes by source and buffer zone user groups.

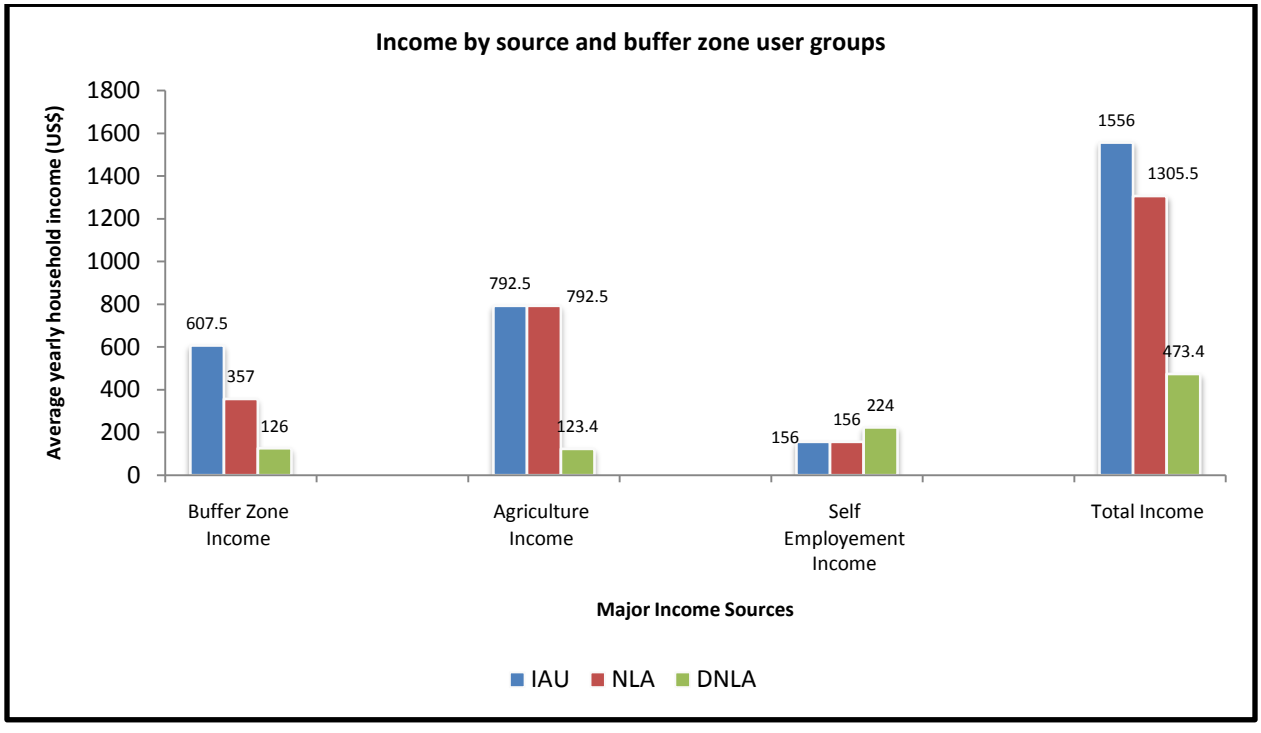

Figure 3: Household incomes by source and buffer zone user groups

The results seem to suggest that the illegal unlimited access group (IUA) and the normal limited access group (NLA) receive the bulk of their income from agricultural activities followed by buffer zone activities and, finally, from activities related to self employment. Contrary to this express trend, the distanced normal limited access group (DNLA) receive the bulk of their income from self employment activities, followed by buffer zone activities and, lastly, by agriculture. To augment the relationship portrayed here, Figure 4 presents income share by source and buffer zone user groups.

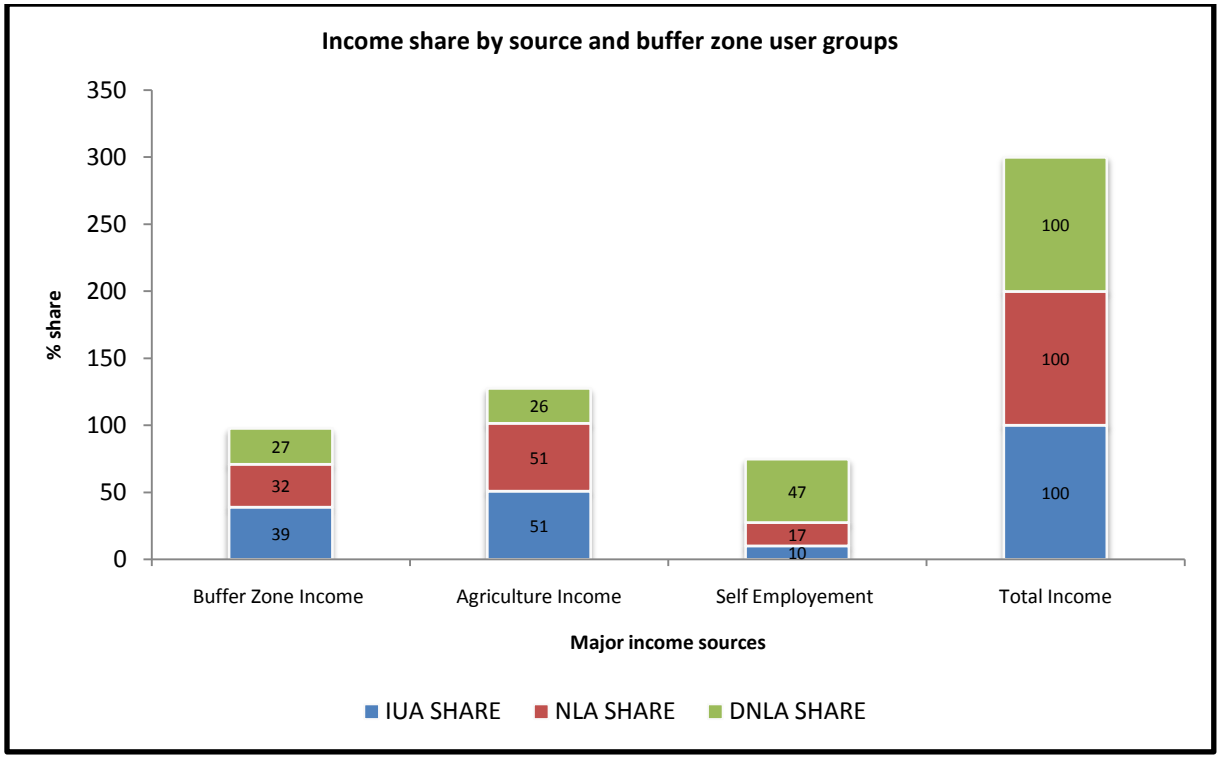

Figure 4: Income share by source and buffer zone user groups

For the IUA group, agriculture contributes 51% share to total income, buffer zone contributes 39% and self employment 10%. With respect to the NLA, group agriculture contributes 51% share of total income, buffer zone 32% and self employment 17%. Effectively, agriculture (mainly livestock) dominates as the main source of income for these two groups. In addition, for the IUA and NLA groups, the results seem to suggest a positive link between agriculture and buffer zone income. From the point of view of livestock production, similar comparable findings were inferred by Fisher (2004) and Adhikari (2005) who suggest that forests may be important sources of intermediate products (grazing land) that serve as inputs in the farming system. Using directional measure of association (Somers` d); the results suggest a positive significant (*p-value* 0.014) link between buffer zone and household income, as shown in Table 3.

Table 3: Directional measure of association

	Value	Approx Sig.
Somers` d	.800	0.014
Buffer zone income : Agricultural income		

These findings may also further suggest the relative importance and potential of buffer zone incomes to finance agriculture. Several studies acknowledge a positive relationship between off-farm and farm income (Haggblade *et al.* 1989; Hazell *et al.* 1991; World Bank, 2008; Zahonogo, 2011). Although respondents cited high income potential from buffer zones, high prohibitive laws were cited as the major challenge which locked incomes from buffer zone activities; this is a possible reason why agricultural incomes seem to dominate for these two groups despite dryness of area.

Lastly, with reference to the DNLA group, agriculture contributes only 26% of the total income followed by the buffer zone with 27% and self employment, as the major contributor, with 47%. These results suggest that agriculture is no longer the main source of income (livelihood source) for most rural people, but rather diversification into other non-farm activities (Ellis, 2000; Barrett *et al*. 2001; Lanjouw, 2001; Ruben and van den Berg, 2001; de Janvry and Sadoulet, 2001; Haggblade *et al*. 2007; World Bank, 2008), in this case buffer zone activities and self employment. Similar recent conclusions were shared by Chikwama (2010) and Zahonogo, (2011) who note that rural off-farm activities may form a significant component of livelihoods in developing countries. Contrary to the suggested positive link between off-farm and farm incomes under the IUA and NLA groups, the results seem to indicate a negative significant (*p-value* 0.014) association between self employment and agricultural income for the DNLA group, as shown in Table 4. These results support earlier findings which argue that the expansion of the rural off-farm sector may have adverse effects on the development of household agriculture (Low, 1986; Ellis, 1998; Kinsey, 2002).

Table 4: Directional measure of association

	Value	Approx Sig.
Somers` d	-.800	0.014
Self Employment Income : Agricultural income		

Based on the above descriptive analysis, the study can therefore loosely infer that, firstly; households which reside close to buffer zones (forest) may have a positive association with off-farm and farm income. This means that they may be more willing to invest their off-farm (buffer zone) income into agricultural activities, thereby promoting the development of household agriculture. Secondly; rural communities which are distanced from projects like Game Parks may be more interested in off-farm livelihood diversification activities (self employment) which negatively affect the development of household agriculture.

7.3. Contribution of buffer zones to income distribution

In this section, the study uses the Gini index and the Lorenz curve to investigate the contribution of the buffer zone to the distribution of income by various sources and buffer zone user groups. Table 5 presents Gini decomposition by income sources and buffer zone user groups. The results suggest that incomes from self employment are grossly unequal across all buffer zone groups, with a Gini index of between 0.46 and 0.50. These findings are not surprising since the respondents were involved (engaged) in different self employment activities which are capable of generating different incomes (Khan and Riskin, 2001; Elbers and Lanjouw, 2001; Escobal, 2001). Similar recent comparable results, with respect to self employment, were reported by Kabubo-Mariara (2008) across different forest user groups, based on a study from rural Kenya.

Table 5: Gini decomposition by income sources and buffer zone user groups

Source of Income	Buffer Zone User Groups		
	IUA Group	NLA Group	DNLA Group
1. Buffer zone Activities	0.18	0.36	0.53
2. Agriculture	0.38	0.33	0.43
3. Self Employment	0.46	0.50	0.49
Total Income	**0.20**	**0.21**	**0.25**

Incomes from agriculture indicated a Gini index between 0.38 and 0.43. These results suggest that the agricultural activities from the study area were generating almost similar incomes, hence an equalizing effect. A slightly higher Gini index for the DNLA group (0.43) may be explained by the dominance of wetland gardens in this group; this was virtually absent from the other two groups (IUA and NLA) due to high invading pressure by game animals.

Incomes from the buffer zone seem to portray a relatively equal distributional effect of income for the IUA and NLA groups (0.18 and 0.36) and gross inequality for the DNLA group (0.53). These findings support the results espoused in the literature, in that forests contribute to more equally distributed incomes (Cavendish, 2003; Fisher, 2004). The decomposition of total income inequality suggests that there may be no huge variations in income inequality across the three buffer zone user groups (0.20 to 0.25), although the IUA group showed a relatively lower Gini index of 0.20.

The equality that exists in the three buffer zone user groups and particularly the distribution of income from each source is reflected in the Lorenz curves presented in Figure 5. The study further tested for inequality dominance between the different buffer zone income sources using the difference in Lorenz curves (Duclos and Araar, 2006). The results suggest that at the lower level of the distribution, there is

more equality among the three sources of income. At the middle level of the distribution, agriculture and buffer zone incomes seem to continue to be equal while self employment incomes seem to be relatively unequal.

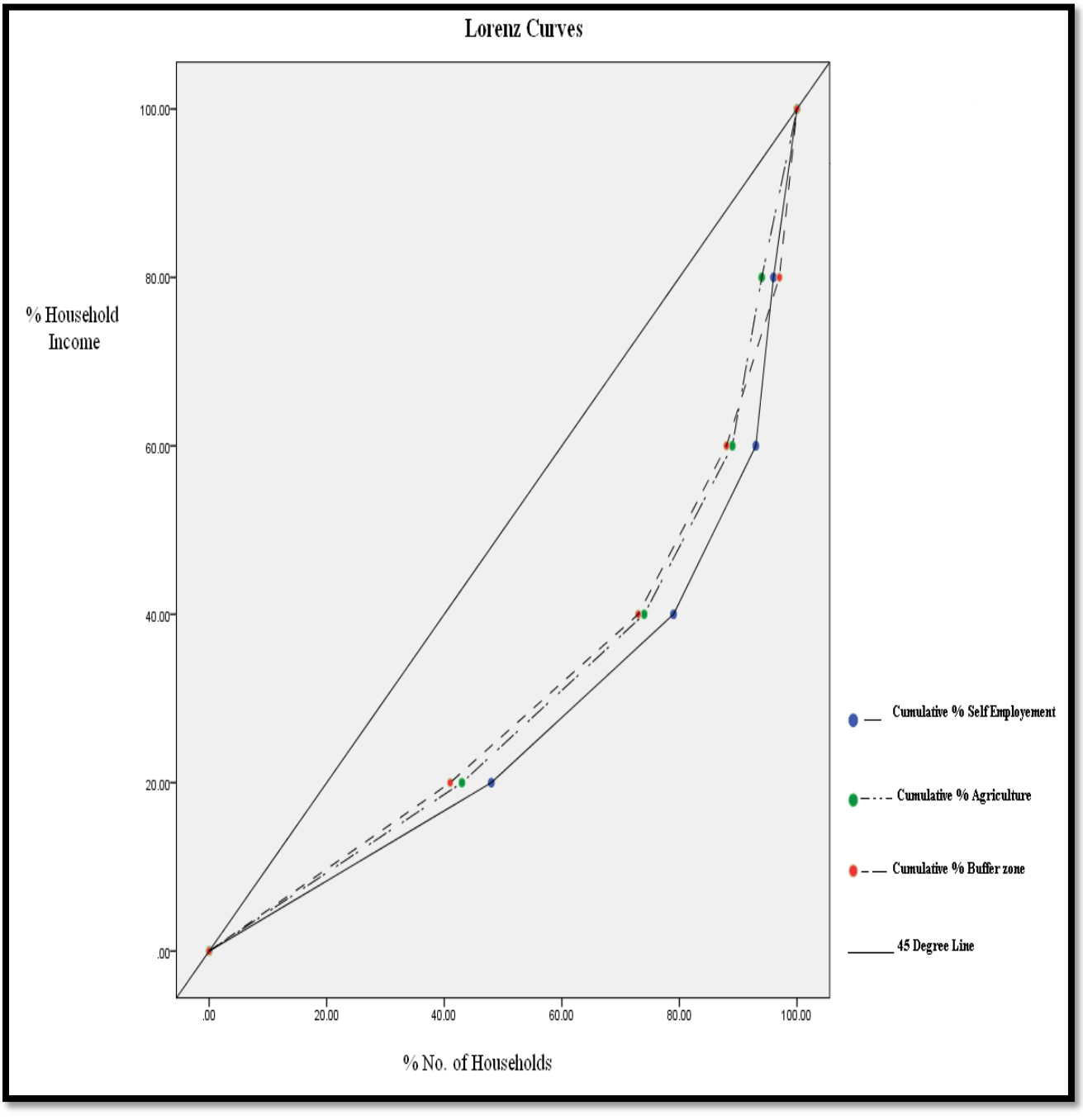

Figure 5: Modified Lorenz curves for income distribution by source of income

These findings further support previous literature that suggests that off-farm income may have an inequality effect to rural household incomes (Escobal, 2001; Kabubo-Mariara, 2008) However, at a higher level of the distribution, the Lorenz curves intersect; this suggests that there may be no inequality dominance.

Considering all the groups that the study tried to uncover in relation to the contribution of various income sources to inequality, Table 6 presents a depiction of the decomposition of income inequality based on income sources, buffer zone user groups and all buffer zone user groups combined.

Table 6: Gini decomposition of income inequality by income source and buffer zone user groups

Source of Income	Buffer Zone User Groups			
	IUA Group	**NLA Group**	**DNLA Group**	**All Groups**
1. Buffer zone Activities	0.18	0.36	0.53	0.47
2. Agriculture	0.38	0.33	0.43	0.51
3. Self Employment	0.46	0.50	0.49	0.49
Total Income	**0.20**	**0.21**	**0.25**	**0.33**

Results suggest that, on average, buffer zone incomes contribute a small proportion to total income inequality compared to other income sources. This relationship is more pronounced for the IUA (0.18) and NLA (0.36) groups than the DNLA (0.53) group. These findings support previous conclusions which suggested that forests contribute to more equally distributed incomes (Angelsen and Wunder, 2003; Cavendish, 2000; Kabubo-Mariara, 2008). An overall Gini index of 0.33 (total income) for all buffer zone user groups may therefore suggest that buffer zones contribute to more equally distributed incomes for rural communities who share boundaries with Game Parks.

Finally, the study tested for inequality dominance between the different buffer zone user groups based on total household incomes. Lorenz curves, for the distribution of incomes, further suggest that there may be no major differences in inequality between the three buffer zone user groups. Figure 6 presents modified Lorenz curves for total household incomes by buffer zone user groups.

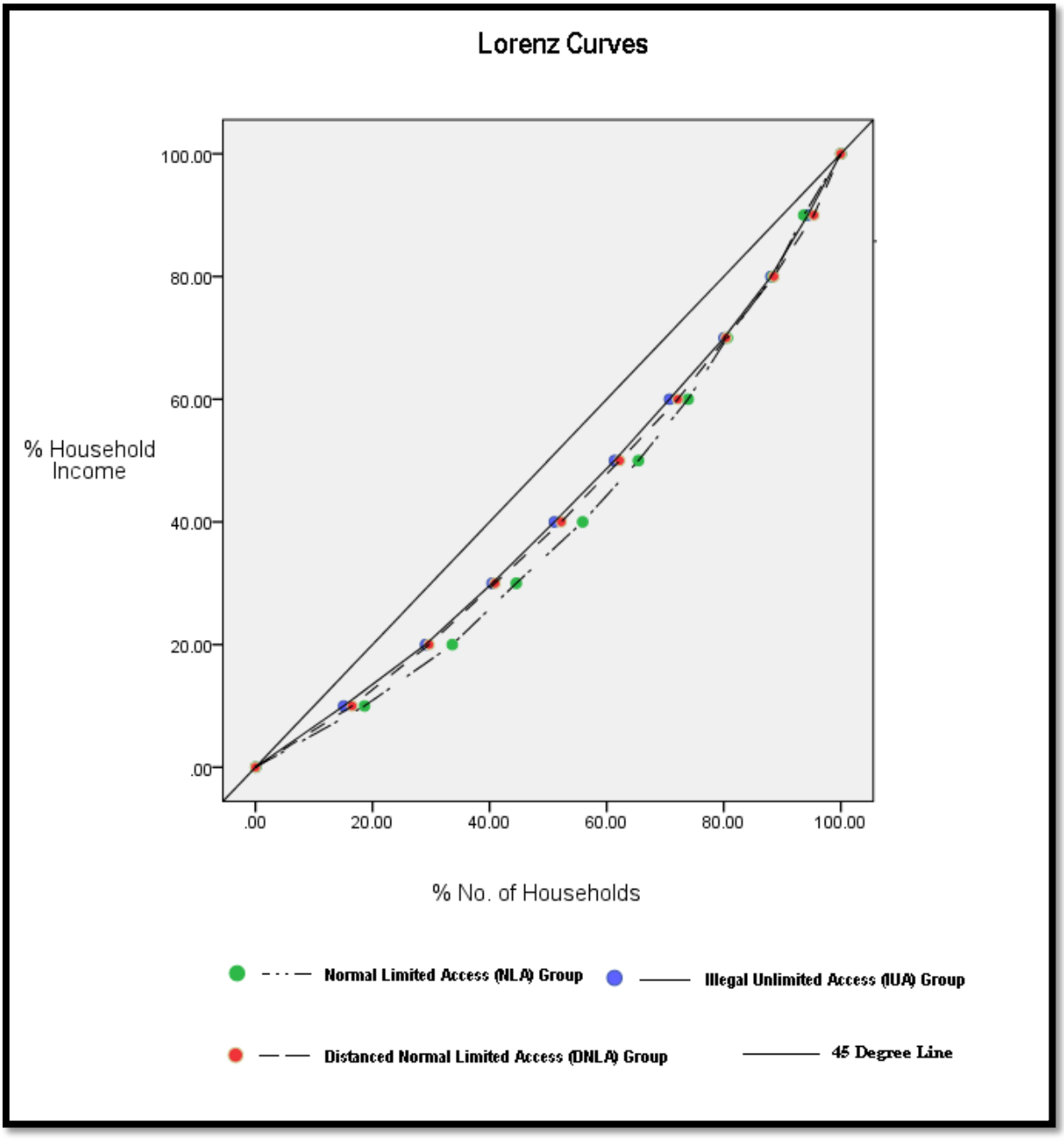

Figure 6: Modified Lorenz curves for total household incomes by buffer zone user groups

Figure 6 seems to suggest that at the lower and middle level of the distribution, there is more inequality among the NLA group than the other groups. Moreover, at all levels of the distribution, the Lorenz curves seem to suggest that there is more equality among the IUA and DNLA groups than the NLA group. Finally, at higher levels of the distribution, the Lorenz curves intersect which suggests that there may be no inequality dominance.

The results, therefore, suggest that there is no inequality dominance among the different buffer zone user groups. Similar results were also shared by Kabubo-Mariara (2008) in his study of forest user groups from rural Kenya.

7.4. Econometric results

In this section, the study estimated the correlates of household incomes from different categories deemed to be key sources of incomes from the study area. This analysis was done primarily to uncover characteristics that are critical to determining whether a household will obtain income from various livelihoods sources considered. Effectively, four equations were estimated as follows; (a) total income equation, (b) agricultural income equation, (c) self employment equation and (d) buffer zone income equation.

Total income was defined as all earned net income obtained from the three income sources. Agricultural income was defined as the sum of crop and livestock net incomes. Self employment was defined as net income from all activities (entrepreneurship activities in the agricultural, processing, service provision, mining and manufacturing sectors) regardless of sectorial classification, and which households engage in away from their own farms in exchange for wages (Barrett *et al*. 2001). Buffer zone income was defined as all earned net income from flora and fauna extracts from the buffer zone.

The results, as presented in Table 7, were estimated using OLS in SPSS version 19.0. OLS was used because all the respondents reported positive incomes from all four sources of incomes.

Table 7: Correlates of household incomes from different main income sources

Predictor Variables		Reported main income sources from the study area			
		Total Income	**Agricultural Income**	**Self Employment Income**	**Buffer zone Income**
Constant	β_0	(2111.094) [9.215]**	(952.202) [5.156]**	(188.881) [2.336]*	(970.011) [9.509]**
1. House hold size	β_1	-0.037 [-0.564]	0.072 [0.977]	-0.125 [-1.274]	-0.132 [-2.025]*
2. Household head gender	β_2	0.25 [.0.385]	0.005 [0.073]	-0.167 [-1.716]	0.135 [2.092]*
3. Household head age	β_3	-0.50 [-0.775]	0.004 [0.060]	0.032 [0.320]	-0.138 [-2.103]*
4. Household head education	β_4	-0.019 [-0.315]	-0.080 [-1.183]	0.195 [2.167]*	-0.017 [-0.282]
5. Arable land size	B_5	0.144 [2.209]*	0.166 [2.231]*	0.173 [1.745]	-0.030 [-0.459]
6. Livestock units	B_6	-0.013 [-0.188]	0.081 [1.019]	-0.241 [-2.285]*	-0.032 [-0.455]
7. Access to extension	B_7	0.116 [0.411]	0.072 [0.222]	0.045 [1.047]	-0.088 [-0.308]
8. Distance to buffer zone	B_8	-0.885 [-3.139]**	-0.777 [-2.406]*	-0.283 [-0.659]	-0.618 [-2.170]*
a) Number of Observations		120	120	120	120
b) F		24.896	15.678	2.897	24.128
c) Sig. F		0.000	0.000	0.006	0.000
d) R^2		0.642	0.5156	0.173	0.635

Notes: ** and * indicates significance at 0.01 and 0.05 probability level respectively; t-value in square brackets [] and un-standardized B coefficient in round brackets () for the constant.

With reference to the overall fit of the models, R^2 suggests that the weighted combination of predictor variables was jointly significant in explaining each of the dependent variables. R^2 test statistic for buffer

zone incomes, self employment incomes, agricultural incomes and total incomes were 0.635, 0.173, 0.531 and 0.642, respectively.

Household size, gender and age were statistically significant in influencing income from buffer zone activities. However, the study did not uncover any significant influence of these factors with reference to self employment, agricultural or total income. Education and Livestock Units were significant in influencing income from self employment. Land size was also significant in explaining income from agriculture and total income. Distance to buffer zone, as expected, was also significant in explaining income from buffer zone activities, agriculture and total income. The study did not uncover any significant influence of extension on any of the income sources.

The results suggest that a one standard deviation positive change in household size, holding other predictor variables constant, may yield a decrease of 0.132 standard deviations for buffer zone incomes. The implied message seems to be that, for every increase in participation in buffer zone activities by larger households, incomes from buffer zone activities may decline. These results contradict earlier studies which suggest a positive association, with forest dependence viewed as a labour and time allocation activity (Shively, 2004; Kabubo-Mariara, 2008).

The results obtained from the study area suggest that the available buffer zone resources which are capable of generating income may be scarce and limited to such an extent that the actual income benefits from buffer zone activities may be too low to attract the assumed labour benefits of larger households in gathering common pool resources. Effectively, larger household sizes may be better-off trading their labour elsewhere where incomes are more definite.

With reference to gender, the results suggest that a one standard deviation change in favour of male-headed households holding other predictor variables constant may result in an increase of 0.135 standard deviations for buffer zone incomes. These findings seem to suggest that for every increase in

participation in buffer zone activities, by male-headed households, incomes from buffer zones may increase. However, previous comparable studies seem to suggest otherwise, based on the generic understanding that women may participate more in common property resources than men (Narain *et al*. 2005).

From the study area, reported major buffer zone activities were labour intensive, highly risky from predation (collection of fire wood and construction timber for resale) and highly prohibited by law, thus making participation in buffer zone activities a more male environment.

For a one standard deviation positive change in age of household head holding other predictor variables constant, the results suggest a decrease in income from buffer zones by 0.138 standard deviations. These results imply a negative association between age and income from buffer zones. Vedeld *et al*. (2004) and Kohlin and Parks (2001) note a similar negative association when they argue that older people may have less time and physical strength to engage in forest activities. In contrast, Kabubo-Mariara (2008) notes a positive association suggesting that young households may be more willing to venture into cropping than forest gathering.

As expected, a one standard deviation positive change in the level of education, holding other predictor variables constant was found to increase income from self employment by 0.195 standard deviations. The results suggest a positive association between income from self employment and level of education. Similar results were also shared by Sanchez (2005) who argues that basic literacy may be important for carrying out activities which range from production to services and manufacturing.

Plot size was positively correlated to income from agriculture and total income. The results suggest that a one standard deviation positive change in the plot size, holding other predictor variables constant, may increase income from agriculture and total income by 0.166 and 0.144 standard deviations, respectively. Comparable results were also inferred by Kabubo-Mariara (2008). These findings suggest that a larger plot size may enable households to perform better agronomic practices, like crop diversity

and rotations which are capable of boosting agricultural incomes. The observed positive correlation may mean potential of multiple cropping and crop rotations capable of hedging against crop failure and price fluctuation risks.

With reference to Livestock Units and income from self employment, a negative association was confirmed. The results suggest that a one standard deviation positive change in Livestock Units, holding other predictor variables constant, may decrease incomes from self employment by 0.241 standard deviations. These results seem to suggest that the more Livestock Units that a household keeps, the less likely it would be prepared to venture into self employment activities. Respondents with large Livestock Units cited better returns from livestock sales but high labour requirements to look after large Livestock Units which normally grazed in the Game Park with a high risk of predation (from elephants and lions). The observed negative association may therefore be due to that fact that households with smaller Livestock Units would be more willing to trade their labour in self employment activities to supplement their incomes.

Distance to the buffer zone was negatively related to buffer zone income, agricultural income and total income. The results suggest that a one standard deviation positive change in distance to buffer zone holding other predictor variables constant may decrease incomes from buffer zone, agriculture and total incomes from all sources by 0.618, 0.777 and 0.888 standard deviations, respectively. In comparable studies, Varughese and Ostrom (2001) and Kabubo-Mariara (2008) also observed a negative relationship between distance to forest and forest incomes; they suggested that households closer to a forest may have a more secure and accessible supply of forest produce. Risk “push” factors generic to agricultural activities may have forced the DNLA group out of agricultural activities (Sanchez, 2005; Stifel, 2010) in pursuit of “pull” factors common in non-farm activities (Reardon, 1998; Lanjouw and Lanjouw, 2001; Haggblade, 2007), in this case self-employment with a 47% share of total income for this group.

8. Conclusions

Firstly, the study wanted to uncover the distribution and contribution of buffer zone incomes to family welfare of different user groups. The results from the study area suggest that, for the IUA and the NLA groups, agricultural income followed by buffer zone income and self employment may be the major income sources, in that order. For the DNLA group, the results suggest that self employment followed by buffer zone and, finally, by agricultural income may be the major sources of income. The study also investigated the level of dependence on buffer zone resources by different user groups. The results suggest a high dependence on buffer zone income by the IUA and the NLA groups, with possibilities of financing household agriculture. For the DNLA group, which was taken as proxy to a typical rural community, the results suggest that buffer zone dependence was low with self-employment as the major livelihood source which negatively affected the development of household agriculture.

Effectively communities residing closer to the buffer zone (IUA and NLA groups) had higher incomes compared to their distanced counterparts (DNLA group). This was possibly due to the positive association noted between buffer zone income and agriculture income for the IUA and NLA groups. The negative association suggested between self-employment income and agriculture income for the DNLA group may also explain their comparatively lower incomes.

With respect to the contribution of the buffer zone to income distribution, the results suggest that buffer zones may be capable of contributing to more equally distributed incomes for rural communities who share boundaries with Game Parks. Lastly, the study estimated the correlates of household incomes from different main income sources from the study area. The results suggest that household size and age may negatively influence income from buffer zone activities, while gender may have a positive effect. This may also be true for education and livestock units with respect to the income gained from self employment, the former positively and the latter negatively related. The results further suggest that land size may also be positively significant to explain income from agriculture and total

income. With reference to distance from the buffer zone, the results suggest a negative influence with respect to income from buffer zone activities, agriculture and total income.

9. Study insights and policy issues

The study suggests the following policy issues; Firstly, Game Parks with active buffer zones may be capable of generating significant income sources for rural communities who share boundaries with such Game Parks (primary sub-district producer community). Of interest in this regard, is the positive association suggested by the study between buffer zone incomes and agricultural incomes. This may imply that buffer zone incomes may be capable of funding the development of household agriculture. For full exploitation of the "buffer zone – livelihood *cum* agricultural linkage", several constraints that inhibit participation of women, elder households and larger household sizes should be addressed given the negative correlation between these three variables with respect to buffer zone income.

Secondly, for households far from Game Parks, which could be taken as a proxy representation to typical rural dwellers, livelihood diversification into off-farm activities like self-employment may be the copping strategy and dominant income source. To enhance self-employment opportunities policies targeting tertiary education may be considered given the positive correlation between education and self-employment income. Unfortunately, a negative association may be possible between self-employment incomes and agricultural incomes, implying off-farm income diversification may have adverse effects on the development of household agriculture.

Thirdly, incomes from the buffer zone may have a relatively equal distributional effect on total incomes for rural communities (Cavendish, 2003; Fisher, 2004). This may imply that public policies which foster access to incomes from such sources may have the potential to address inequality.

Fourthly, the available buffer zones may have been poorly defined, with high access limitation to surrounding communities. This scenario may negate its potential as a possible livelihood source capable

of financing household agriculture. Lastly, the dominance of buffer zone incomes by young and male household heads may suggest that the high risks (poor problem animal control) and inhibitory laws (Communal Lands and Forestry Produce Act – that restrict commercial utilization of forestry produce) could further negatively affect its potential.

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