INCOME INEQUALITY AMONG THE SMALLHOLDER IRRIGATION FARMERS: THE CASE OF HAMAMAVHAIRE AND NGONDOMA IRRIGATION SCHEMES IN THE MIDLANDS PROVINCE OF ZIMBABWE

Joseph, B. Chivizhe[1], Francis, T. Mugabe[2] and Reuben,M.J.Kadigi[3]

1 Department of Agricultural Economics and Development, Midlands State University, Gweru, Zimbabwe
2 Chinhoyi University of Technology (CUT) Zimbabwe
3 School of Agricultural Economics and Business Studies-Sokoine University of Agriculture (SUA) Tanzania
E-mail: josephchivizhe@gmail.com

ABSTRACT

Zimbabwe developed smallholder irrigated agriculture initially as a famine relief strategy and later towards alleviation of poverty, employment creation and cushioning the country's semi arid periodic droughts since the beginning of the twentieth century. The study evaluated the effect of smallholder irrigated agriculture on income distribution. A multistage sampling technique was used to select the two study areas of Ngondoma and HamaMavhaire comprising 71and 56 sample respondents respectively. A researcher administered questionnaire for collection of cross-sectional data. HamaMavhaire results show negative disaggregated income (USD 335.38) for the bottom quintile with the top quintile earning 64.07% of total income. Ngondoma results show earnings of 2.94%, and 58.7% of the income earned by the bottom and top quintiles respectively. The finding shows a Gini coefficient of 0.624 for HamaMavhaire and 0.516 for Ngondoma indicating greater income inequality in HamaMavhaire. Disaggregation of total income using the coefficient of variation and the Gini coefficient shows crop income and transfers being consistently inequality reducing sources, while self employment was inequality increasing. Livestock and non-farm income behaved differently being inequality reducing sources under the Gini coefficient and inequality increasing under the Coefficient of variation. However literature recommends Coefficient of variation than Gini coefficient as more meaningful measure.

Keywords: *smallholder irrigation, income inequality, Gini coefficient, coefficient of variation, inequality increasing*

INTRODUCTION

The Organisation for Economic Cooperation and Development (OECD) empirical research shows that inequality affects human capital growth by undermining education opportunities for children from poor socio-economic backgrounds thus lowering social mobility and slowing skills development needed for GDP improvement (Gurria 2014). Contrary to the Gurria finding, Brueckner and Lederman (2015) point that income inequality is beneficial to economic growth in poor countries and bad for advanced economies. The argument is advanced on the basis that this depends on the initial level of GDP per capita. At the 25th percentile of initial income, the predicted effect of a 1% increase in GC on GDP being 2.3%, while at the 75th percentile of initial income the effect was higher that is minus 5.3%.This being in line with the Galor and Zeira (1993) model in Moav (2001) which predicts that the effect of rising inequalities on GDP per capita is negative in relatively rich countries but positive in poor countries. The studies in this discussion were however conducted in Latin American countries.

Results on the study of the income inequality across OECD countries over a period of time (GDP per hour worked ranged between US$ 38.7, in year 2000 to US$46.5 in year 2014) showed a statistically negative effect on growth, thus supporting the findings of this study and further went to say that a 1% increase in inequality lowers GDP per capita by 0.6 to 1.1 %. Higher levels of income inequality can lower GDP per capita regardless of whether the rise in inequality takes place in the lower half or top of the distribution (OECD 2016).

Between 1988 and 2013 global inequality fell from 0.697 to 0.625 measured using the Gini coefficient (World Bank 2016) with European countries recording a Gini coefficient of 0.306, USA 0.372 while the Gini coefficient of China rose from 0.33 to 0.43 with India being at 0.35. A Gini coefficient is a measure of statistical dispersion intended to represent the income or wealth distribution of a nation's residents. It is the most commonly used measure of inequality. The higher the index, the more unequal the distribution of the wealth.

Income inequality affects the pace at which economic growth enables poverty reduction (Ravalion,2004) in FAO (2016).Growth is less efficient in lowering poverty in countries with high levels of income inequality or where the distribution pattern of growth favours the non - poor (FAO, 2016). Inequality remains above average in SSA at 0.44 compared to East Asia at 0.37 and Latin America and Caribbean at 0.48. Lesotho, South Africa and Botswana are the most unequal SSA countries, with Gini coefficients above 0.63, while Niger and Ethiopia have the lowest disparities, with Gini coefficients below 0.35 (CIA. 2014) in Manero (2016). Developed countries have lower inequalities compared to the developing countries, supporting the notion that accelerated growth will not take place in the absence of reduced inequality.

Zimbabwe ranks among the ten most unequal SSA countries with a Gini coefficient of 0.5 in 2006 (CIA, 2014). This is attributed to the legacy of the colonial era, socioeconomic situation and other reforms (Manero, 2016). Studies at Mkoba and Silalabuhwa smallholder irrigation schemes (Manero, 2016) showed scheme level Gini coefficient being higher than national level at Mkoba, (0.6 and 0.5) while Silalabuhwa had a scheme level Gini coefficient of 0.48 and a national level of 0.50.According to Manero, (2016) scheme level Gini coefficients are generally higher than national Gini coefficient levels as there is more disparity among smallholder irrigators than the general population at large, though the Silalabuhwa situation was different. Although income inequalities could be measured through consumption or incomes, this study addresses income inequality as income is more concerned with the value of farm output.

The study area

Two smallholder irrigation schemes in the districts of Chirumhanzu and Kwekwe of the Midlands Province of Zimbabwe constitute the study area.

Table 1: Distribution of smallholder irrigation schemes in the Midlands Province

District	Number of schemes	Total Area (ha)	Numberof irrigators	Average Plot Size (ha)
Chirumhanzu	9	213.6	586	0.37
Gokwe North	0	0	0	0.0
Gokwe South	2	7.2	37	0.2
Gweru	6	162.5	696	0.2
Kwekwe	7	349.3	1154	0.3
Zvishavane	2	48.4	110	0.44
Mberengwa	4	120	223	0.5
Shurugwe*	4	79	18.1	

* Only two schemes operating

Source: DoID (2011)

Chirumhanzu district has nine operational schemes in normal seasons. In bad seasons (drought) all schemes get affected, even those that normally have all year round water supplies. HamaMavhaire irrigation scheme (located 19^0 42' 20" south latitude and 30^0 32' 20" east longitude) was selected for the study as it has an overhead irrigation system with one hectare plots which are much bigger than the comma hectare schemes found in the majority of the smallholder schemes nationwide, while Kwekwe district has six operating schemes under normal rainfall seasons. Ngondoma irrigation scheme (located 18^0 25' 19.16" south latitude and 29^0 25'03.57" east longitude was selected for the study because of it having a variety of plot sizes ranging between 0.1ha to 1ha all under surface/flood irrigation system. Figure 1 shows the Midlands Province administrative districts.

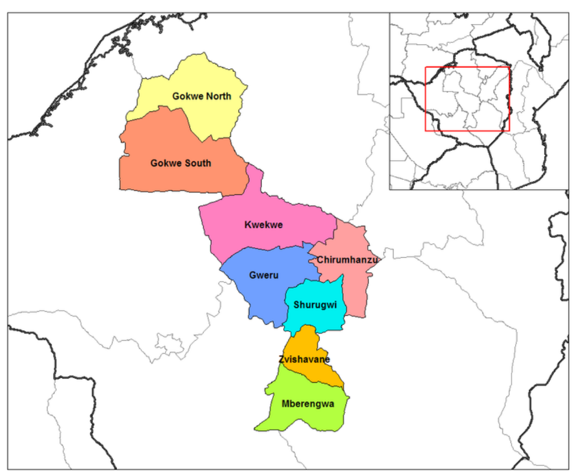

Fig 1: Administrative Districts of the Midlands Province

Source: DoiD (2013)

METHODOLOGY

Data collection

This study used cross-sectional primary (own survey) data collected between the 4th of May in year 2013 and the 20th May 2014, and secondary data (including time series, and sectoral).

Semi-structured interviews, informal discussions and secondary data

Based at the household level, a detailed questionnaire was administered to seventy-six households at Ngondoma and fifty-one households at HamaMavhaire totalling 127 households. The Cochran's (1977) sample size formula for continuous data was used in the calculation.

$no = (t)^2 *(s)^2/d^2 = (1.96)^2 (1.167)^2 / (7*0.03)^2$……………(1)

where;

t = value for selected alpha level 0.025 in each tail = 1.96

s = estimate of standard deviation = 1.167 (7/6)

d = acceptable margin of error (0.03) for mean being estimated = 0.21

Where sample size exceeds 5% of population, which was the case in our situation, the Cochran's (1977) correction formula is used to correct for final sample size. The correction formula;

n = no/1 + no/pop=118/1 +118 /201 for Ngondoma irrigation scheme

118/ (1+118/205 =74.89 (sample size) rounded off to 75.

118 / (1+ 118 /96) = 52.93 rounded off to 53 as sample size for HamaMavhaire irrigation scheme

The questionnaire sought to elicit a set of information that would help analyse the level of agricultural productivity, incomes and income inequality. The questionnaire encompassed aspects of crop production area, level of inputs, outputs, prices, as well as quantities produced, sold and consumed domestically, quantities in store and produce received or given in-kind, other sources of income. Table 1 shows the distribution of smallholder irrigation schemes in the Midlands Province. The plot sizes of less than 2ha conform to smallholder irrigation as defined in the smallholder irrigation literature (FAO, 2001; FAO, 2008; International Water Management Institute, 2002 and Conway, 2011).

Income Distribution among smallholder irrigation farmers

This specific objective concerning income inequality was measured using the two interlinked methods, the Lorenz curve and the Gini coefficient. In the Lorenz curve, two columns, one for the cumulative farmer's incomes against the other on the cumulative farmer population was drawn in ascending order (Bakare, 2012). The values of the cumulative income was plotted on the Y- axis (0 - 100) while those of the cumulative share of people were on the X- axis (0 - 100) all starting from point of origin. The plotted values will be the basis for drawing the Lorenz curve (Jurkatis and Strehl, 2013). A line of absolute equality was drawn at 45^0 angles from the point of origin to the right hand corner of the rectangle. The further away the Lorenz curve is from the absolute line, the more unequal the distribution becomes. Income inequality was calculated using a formula that draws from the different income sources.

An advantage of the Gini coefficient is that it satisfies the four principles considered to be reliable inequality measures (Poverty manual, 2005) namely;

(i) The transfer principle that involves the transfer of income between individuals of different levels being considered as inequality increasing irrespective of transfer size.

(ii) Secondly the scale of independence which states that the value of inequality measure should not change if the general income level changes by a fixed amount.

(iii) Thirdly the identity of the income recipient for the value determination of the inequality measure does not matter (anonymity principle) and

(iv) Finally the population principle, meaning that the inequality measure should not be influenced by the size of the population. It is more of a ratio analysis than an average measure type.

Gini Coefficient and Gini decomposition

Gini coefficient is a measure of statistical dispersion. It is intended to represent the distribution of a nation's or population's income. It is the most commonly used measure of inequality. Its values range from 0 to 1; with 0 being perfect equality and 1 perfect inequality. The Gini coefficient is calculated as the ratio of the area between the Lorenz curve and the absolute equality line, divided by the total area under the 45^0 line. Gini = A / (A+B). This formula is related to the Lorenz curve.

Since the Gini coefficient is based on the ratio of the areas under the Lourenz curve, and bearing in mind that A+B

= 0.5, the formula will be;

Gini coefficient = A/0.5 = 2A= 1-2B.

It is important to note that the literature suggests several formulae for calculating the Gini coefficient (Beggs, 2015; Beggs, 2017).

Sometimes the entire Lorenz curve is not known and only the values at certain intervals are given. In that case, the Gini coefficient can be approximated by using various techniques for interpolating the missing values of the Lorenz curve. If (X_k, Y_k) are the known points on the Lorenz curve, with the X_k indexed in increasing order $(X_{k-1} < X_k)$, so that

- X_k is the cumulative proportion of the population variable, for k = 0,…..,n, with $X_0 = 0$, $X_n = 1$.
- Y_k is the cumulative proportion of the income variable, for k = 0,…,n, with $Y_0 = 0$, $Y_n = 1$.

$$G_1 = 1 - \sum_{K=1}^{n} (X_k - X_{k-1})(Y_k + Y_{k-1}) \qquad (2)$$

Total incomes can be arranged in ascending order to generate a plot of the cumulative proportions of income against the cumulative proportions of households, which becomes the Lorenz curve of total income. Similarly, the cumulative proportions of income from a specific source can be plotted against the cumulative proportions of households, arranged in ascending order of the total income, to obtain the concentration curve of that income source. It is important to note that, the Lorenz curve always lies below the egalitarian (45^0) line whereas the concentration curve may lie above the egalitarian line. This happens when income from a particular source accrues to the poor households (http://en.wikipedia.org).

Coefficient of variation and Gini coefficient approaches on income distribution

The qualitative analysis of poverty using the measures presented in the previous sub-section was complemented with quantitative analysis of the impact of irrigated agriculture on income distribution using the Coefficient of variation (CV) and Gini coefficient (GC) approaches. Corresponding to the Coefficient of variation (CV), the following decomposition - adopted from Adam (1994), was used:

$$\sum w_i c_i = 1,\ w_i = \mu_i / \mu,\ c_i = \rho_i\, [(\sigma_i / \mu_i) / (\sigma / \mu)] \quad \textbf{…….. (3)}$$

Where,

$w_i c_i$ = the factor inequality weight of the ith source in overall inequality;

μ_i = the mean income from the ith source;

c_i = the relative concentration coefficient of the ith source in overall inequality;

ρ_i = the correlation coefficient between the ith source and total income, and

σ_i = the covariance involving the ith income source.

According to Adam (1994) the following formula can be used for the decomposition corresponding to the Gini coefficient:

$$\sum w_i g_i = 1,\ w_i = \mu_i / \mu,\ g_i = R_i {*} (G_i / G),\ R_i = cov(y_i, r) / cov(y_i, r_i) \quad …………….. (4)$$

Where,

$w_i g_i$ = the factor inequality weight of the i-th source in overall inequality;

g_i = the relative concentration coefficient of the i-th source in overall inequality;

G_i = the Gini coefficient of the i-th source of income;

y_i = series of income from the i-th source;

r_i = series corresponding ranks;

G = total income Gini coefficient, and

R = correlation ratio.

The two decomposition techniques (the CV and GC) were purposely used in this study to pinpoint the contribution of different sources of income to total inequality.

This is useful because conventionally, most studies have often attempted to evaluate the distributional impact of certain types of income sources by merely comparing the size of distribution of that particular income with that of the total rural income as a whole. Because it neglects the twin issues of income weights and covariance between income sources, any approach, which merely compares the size distribution of one particular income with that of total income (percentage), is likely to arrive at erroneous conclusions regarding the distributional impact of that particular income.

In this study, the total household incomes were divided into six sources; crop income, livestock income, non-farm income, transfers and remittances as well as self employment. Types of income accruing from non-agricultural activities include incomes from labouring, rental, transfers, remittances and other non-farm activities.

RESULTS

Gini coefficient

The result of income inequality (seeTable 2) shows that the study area pooled bottom quintile earned -2.7% of income with top 20% earning 57.5% of the total income. Ngondoma results showed a staggering 0.35% as income for the bottom 20% of the population while HamaMavhaire showed a negative income of -4.8% for the bottom 20% of the population. Inequality was higher in HamaMavhaire where the top 20% of the population earned over 61.07 % of total income, while that of Ngondoma irrigation scheme stood at 57%. Growing income inequalities as in this case can undermine the foundation of market economies, leading to inequalities of opportunities, smothering social mobility as well as weakening the incentive to invest in knowledge (OECD, 2016).

Table 2: Computed income distribution

Income Bracket	Pooled Income		Ngondoma		HamaMavhaire	
	Annual Income US$	% Income US$	Annual Income US$	% Income US$	Annual Income US$	% Income US$
Bottom 20 %	-311.60	-2.70	231.71	0.35	-2379.78	-4.80
20 –40 %	6312.64	5.50	4184.06	6.40	814.05	1.66
40 –60 %	14827.13	12.95	8114.16	12.42	7938.00	16.16
60 –80 %	30644.84	26.78	15554.21	23.84	12750.60	25.95
Top 20 %	65758.90	57.5	70853.5	57.00	29993.25	61.07

Lorenz Curve: Ngondoma Irrigation Schemes

The results show the Gini coefficient (Figure 2.1B) of 0.516 for Ngondoma while results of Ward 6 (Poverty Atlas Map 2015) of the same district in which Ngondoma irrigation scheme is situated had a Gini coefficient of 0.32. There was more inequality within the irrigation scheme than within the ward, a much bigger area, similar to findings by Gbenga et al. (2014) which found a GC of 0 .28 in the study area of Kampe irrigation scheme in the Kogi State of Nigeria while a GC of 0.23 was recorded outside the irrigation area. The bottom 40% (B40) for Ngondoma earned an income share of 6.4%, while the top 20% earned 57% of the total income. The Lorenz is closer to the absolute curve thus indicating less inequality compared to HamaMavhaire (see Figure 2.1B)

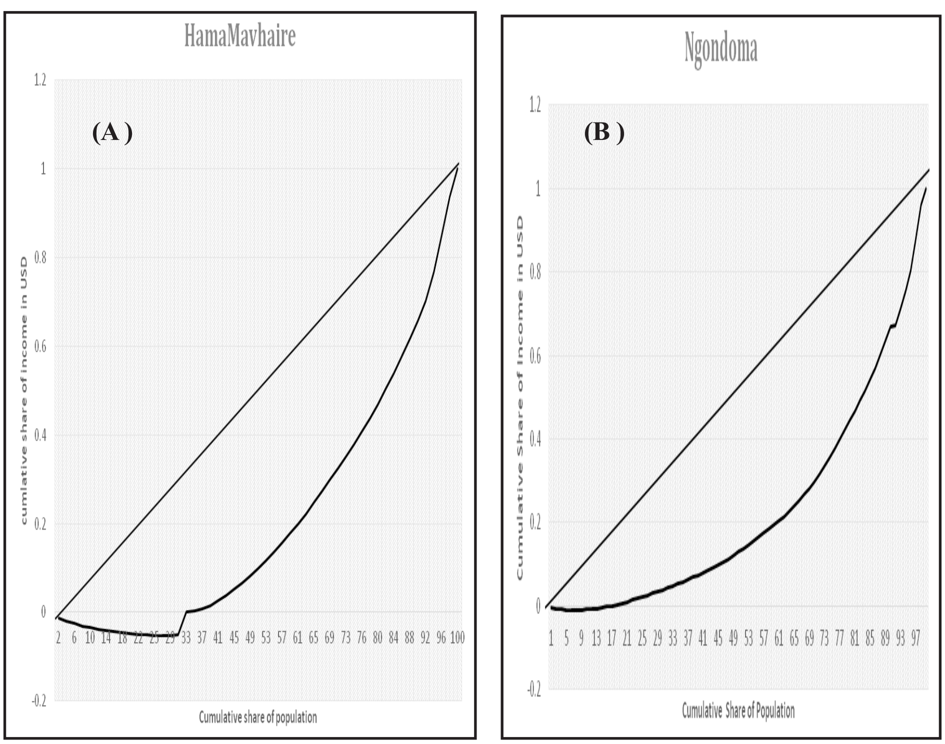

Fig 2.1A Lorenz curve for HamaMavhaire Lorenz curve and Fig 2.1B for Ngondoma

Source: Survey results 2015

Lorenz Curve: HamaMavhaire Irrigation Scheme

HamaMavhaire irrigation scheme results showed a Gini coefficient of 0.64 (Fig. 2.1A) compared to 0.335 for ward 7, (Poverty Atlas Map 2015) in the same geographical area in which the irrigation scheme is situated, which is a much bigger area with similar findings by Gbenga *et al.,* (2014) in the study of Kampe irrigation scheme in the Kogi State of Nigeria The Lorenz curve shows a negative income for the 33% of the population.The low indices at ward level show relatively low inequalities which are generally found in developed countries where the population experiences a high standard of living (Smith, 2008), which however is not the case in the study area. The figures support a situation where the population is engaged in enterprises with low incomes showing very little income disparities within and between farming households. This is in line with findings in which poor agrarian economies in developing countries have been found to have fairly homogenous distribution of income as most inhabitants perform economic activities that have similar returns (Charles - Coll, 2011). Smallholder irrigation farmers practicing the same crop rotation and applying low and similar inputs are likely to have low income disparity hence a low Gini index.

The bottom 40% in HamaMavhaire irrigation scheme earned 1.66% of the total income while the top 20% earned 61.07%. On a global scale there has been a decline in the B40 incomes during the period between 2007- 2012 (Global Monitoring Report 2015) meaning more inequality. For the assessment of social instability and crime, B40 is a very important indicator, implying that HamaMavhaire might be more socially unstable than Ngondoma (Naguib 2015). The pooled income distribution showed a Gini coefficient of 0.452, which is lower than that of the individual schemes.

Coefficient of variation and Gini coefficient decomposition

Coefficient of variation where relative concentration coefficient of the ith source of income in overall inequality **(c_1)** is greater than unity implying income sources that have an inequality - increasing effect. Such sources should not be encouraged as they contribute to the widening of the income disparity on an irrigation set-up. This occurs when undertaking such activities take place at the expense of increased crop production efficiency. Labour spared to self employment outside the farm becomes inequality-increasing if the net incomes are less than what would have been achieved by concentrating on on-farm activities. Self employment in this situation included activities like sale of firewood, handicraft, and local beer brewing, cross border trade and running a village shop or local flea market.

Coefficient of variation and Gini coefficient: Ngondoma Irrigation Scheme

Coefficient of variation

Incomes sources where (c_1) is less than unities (inequality-decreasing) include crops, livestock and non-farm income. These sources help in reducing inequalities. World Bank Group (2015) estimated that non-farm enterprises account for between 35% and 50% of rural household income thus forming a very important contribution to total household income. Increased crop income is a very important in terms of improving household income in addition to being the core business at the irrigation schemes. Self employment and transfers are inequality increasing income sources which should be discouraged especially the former as it may result in competing for resources with the desirable income inequality-decreasing sources. . Transfers are not easy to control as the sources can be outside the control of the farmer, and could be benefits resulting from previous farmer engagements outside the farm.

Gini coefficient

Crops and livestock are income sources where relative concentration of the ith source in overall inequality (g_1) is greater than unity. They are described as inequality-increasing in the sense that a resource like livestock may compete for resources with the farm core business activities. Crops as inequality increasing income source (see Table 3) are due to growing of crops like wheat that have negative incomes hence may not be desirable particularly the wheat crop that the Department of Agricultural Technical and Extension Services (Agritex) prescribes as a food security measure. Income sources like nonfarm, transfers and self employment (non-crop sources) where $\mathbf{g_1}$ is less than unity are desirable inequality-decreasing sources. This is referred as diversification in inequality literature and farmers who are diversified have higher incomes than the non-diversified.

Table 3: Coefficient of variation and Gini coefficient: Ngondoma Irrigation scheme

Variable estimated	Crops	Livestock	Non farm	Transfer	Self employ	Total
μ_1	859.4183	303.4179	6.473684	145.1974	220.7632	1535.27048
$w_i = (\mu_i/\mu)$	0.573198	0.202368	0.004318	0.096841	0.14724	
$Corr\ (\rho_i)$ =	0.561926	0.545002	-0.10709	0.420763	0.602471	
$Sdev\ (\sigma_i)$	1022.594	463.1517	37.28788	492.4263	945.625	1566.786
c_i	**0.639835**	**0.796105**	**-0.59026**	**1.365559**	**2.469557**	
w_ic_i	0.366752	0.161106	-0.00255	0.132242	0.363618	
$2/n\mu$	22.61627	7.984682	0.17036	3.820983	5.809557	
$Cov\ (y\ r)$	-8010.04					
$Cov\ (y_i\ r_i)$	-1983.95	-2544.19	219.5789	-1046.02	-2551.53	
$Cov\ (y_i\ r)$	888463.2	398495	-6173.89	320358.4	880871.8	
R_i	-0.00223	-0.00638	-0.03557	-0.00327	-0.0029	
G_i	-44869.5	-20314.5	37.40749	-3996.82	-14823.2	
G	57.43114	26.24668	-0.00574	1.263798	6.322037	91.25791
g_i	**1.097924**	**1.421224**	**-0.01458**	**0.143004**	**0.4705**	
w_ig_i	0.629328	0.28761	-6.3E-05	0.013849	0.069277	

Coefficient of variation and Gini coefficient. HamaMavhaire Irrigation Scheme

Coefficient of variation

Incomes sources where (c_1) is less than unity (inequality-decreasing) include crops, livestock, transfers and non-farm income. These sources help in reducing inequalities while self employment has income-inequality increasing effect. Livestock where resources permit should be encouraged as a way of utilising crop waste to produce manure which is a desirable crop production input. Crop income should be increased as it is core business under irrigated agriculture, while self employment should be discouraged as it competes with resources like time and labour needed for other income sources. Transfers in the form of remittances while desirable as income equalising sources may be outside the control of the farmer. Findings are in line with Esquivel and Huerta-Pineda (2007) where immigrant transfers and remittances had income equalizing effects in the recipient countries.

Gini coefficient

Incomes sources where g_1 is less than unity (inequality-decreasing) include crops, non-farm and self employment, while livestock and transfers have income-inequality increasing effects. The effects of the income are not the same when making a comparison between the methods for example livestock is income decreasing under the CV method and income inequality increasing under the GC method. The GC presents abnormal behaviour where negative incomes exist such as in this situation (Manero 2017).The CV is more sensitive for individual incomes in the right tail of distribution than the GC hence the CV may be recommended over the GC if a measure of relative precision is selected to assess inequality (Charles- Coll 2011).

Table 4: Gini coefficient and Coefficient of variation-HamaMavhaire Irrigation scheme

Variable estimated	Crops	Livestock	Non farm	Transfer	Self employ	Total
μ_1 =	828.638	245.2353	31.56863	122.8824	260.28	1488.604
$w_i = (\mu_i/\mu)$ =	0.635081	0.187952	0.024195	0.094179	0.199483	
$Corr\ (\rho_i)$ =	0.762824	0.14455	-0.09089	0.01064	0.634423	
$Sdev\ (\sigma_i)$ =	1276.173	385.2822	142.4833	354.2057	1008.568	1640.446
c_i =	**0.934421**	**0.180629**	**-0.32628**	**0.024395**	**1.955317**	
w_ic_i	0.593433	0.03395	-0.00789	0.002297	0.390052	
$2/n\mu$ =	32.49561	9.61707	1.237985	4.818916	10.20706	

Cov (y r) =	-166.757					
Cov (y_i r_i) =	643.0433	2215.471	64.5098	-671.941	1451.42	
Cov (y_i r) =	1816318	89569.12	-20827.4	6061.484	1042164	
R_i =	0.000354	0.024735	-0.0031	-0.11085	0.001393	
G_i =	20896.08	21306.34	79.86219	-3238.03	14814.73	
G =	4.698318	99.05214	-0.00598	33.80546	4.115815	141.6657
g_i =	**0.052221**	**3.720074**	**-0.00175**	**2.533775**	**0.145642**	
$w_i g_i$	0.033165	0.699196	-4.2E-05	0.238628	0.029053	

DISCUSSION

The results in this specific objective show the B40 of the irrigation schemes earning 6.4% and 1.6% of total income at Ngondoma and HamaMavhaire respectively, all of which are in extreme poverty. World Bank (2016) second goal after that of ending extreme poverty by 2030 is to increase the income of the B40. The above figures show very low levels especially HamaMavhaire were the B40 earned 1.6% of total income The HamaMavhaire Lorenz curve shows about 33% of the population having negative incomes and thereafter a gradual move showing positive incomes thus indicating greater inequality than Ngondoma irrigation scheme. Based on the Dorward (2009) classification of rural households, farmers that continue earning negative incomes will move out to the non-agricultural sector given opportunities of employment outside agricultural sector.

Allanson, (2005) noted that it is possible to record negative incomes when output goes below a certain level due to unpredictable scenarios like drought, frost or any factors that contribute to an increase in farm operating costs without a matching increase in produce prices. The existence of negative incomes should therefore not be viewed as unusual or abnormal situations in the agricultural sector. Inequality in HamaMavhaire had a Gini coefficient of 0.64 compared to Ngondoma which had a Gini coefficient of 0.516, with similar findings of 0.60 and 0.43 for Mkoba and Silalabuhwa irrigation schemes. Zimbabwe is ranked amongst the ten most unequal SSA countries with GC of 0.50 in 2006 (CIA, 2014, Vinaya et al. 2017) meaning that the GC found in this study were not an unusual phenomenon in the country and SSA region.

The income CV decomposition results showed crops, livestock, nonfarm and transfers as inequality-decreasing sources while the Gini decomposition showed inconsistent results. Both irrigation schemes indicate transfers and self employment (non agricultural sources) as inequality increasing sources while livestock and crops contribute differently in the two schemes. According to Bendel, et al. (1989) coefficient of variation is relatively more precise than Gini coefficient hence its results should be more preferred than those of the Gini coefficient.

In both schemes agricultural sources (crops and livestock) contributed more revenue to total incomes with HamaMavhaire and Ngondoma contributing 72% and 75.74% very much comparable to findings in Tanzania where agriculture contributed 72% to total income (Manero, 2017). Contrary to research findings on non-agricultural sources, Manero (2017) found that remittances contributed 50% to 75% of revenue to total incomes on selected irrigation schemes in Zimbabwe, contrary to study findings where the same source contributed 8.25% and 9.45% respectively at HamaMavhaire and Ngondoma respectively. Such large disparities may be few and far between as such a contribution may possibly be expected under rain fed agriculture in the semi-arid areas of the country.

CONCLUSION

Income inequality contribution to poverty alleviation has been the main point of discussion. Results showed higher income inequality on both sites. Income decomposition using the GC and CV showed mixed results with the non-crop income sources showing unequalising effects, while the crop income source and livestock, tend to have equalising effects hence increasing agricultural productivity and contributing to poverty reduction (Manero, 2017)**.**

The null hypothesis that smallholder irrigated agriculture has no effect on income distribution among smallholder irrigation farmers is rejected and the alternative hypothesis accepted.

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