

Staff Paper

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Household Income and Nutritional Outcomes in
1990 and 2000**

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Exploring the Paradox of Rwandan Agricultural Household Income and Nutritional Outcomes in 1990 and 2000

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Abstract

Nationally representative surveys regarding sources of income among agricultural households in Rwanda, fielded in 1990 and 2000, provide insights into how families responded to changes in their environment in a turbulent decade. Despite political upheavals and increasing land pressure, the survey evidence suggests that by 2000 average incomes returned to the 1990 level, while the nutritional status among rural children was better in 2000 than in the early 1990s. The nutrition improvement is tempered by evidence of increasing rural inequality. While the least poor households expanded their access to income through skilled labor, the majority of households retreated into a more autarkic mode of production focused on key subsistence crops. The change in crop mix seems to be associated with the improved the nutritional status of children. This has important implications for the current agricultural commercialization strategy in Rwanda and other countries where similar conditions prevail.

18 pages

Introduction.

When most people think of Rwanda, they remember the 1994 genocide. While not seeking to minimize the trauma of the events of 1994, this article has another focus. We explore how agricultural households – for the most part, subsistence farmers – in Rwanda made their living prior to the war years, and compare the pre-war conditions with the livelihood strategies smallholders seem to be employing in more recent times. Prior to the 1994 genocide, Rwanda was one of the world's poorest countries. Unsurprisingly, it maintains that standing today, with per capita income only \$230 per year (World Bank, 2003), placing Rwanda 166th out of 179 countries for which data is available. Civil war and genocide resulted in major destruction of productive capital, notably livestock (Mpyisi et al., nd.); a sharp reduction in the prime age male population (Ministry of Finance and Economy, 2003) through death, imprisonment and flight; as well as destruction of social capital and mass population movements. There have also been substantial aid flows since 1994, initially humanitarian, which soon translated into large levels of development aid (Ministry of Finance and Economic Planning, 2004).

It is important to document how upheavals and other changes of the 1990s affected the patterns of those who remain tied to the land. Land is increasingly in short supply in Rwanda. From the 1960s to the 1990s, the land-to-person ratio¹ in Rwanda declined from .215 to .161, leading the trend in many other countries in sub-Saharan Africa (Jayne et al., 2003), and land tenure is increasingly politically charged (Human Rights Watch, 2001; CCOAIB, 2000). Surprisingly, given its political and land availability challenges, Rwanda's prevalence of under-five children who were underweight declined from thirty-two percent in 1991-2² (Ministry of Agriculture, 1992) to twenty-four percent in 2000 (Wise, 2004). Stunting and wasting rates also declined, though not as dramatically, and stunting is still evident in over forty percent of the under five population (*op. cit.*). Understanding how households adjusted their cropping and income generating strategies to produce an outcome of reduced malnutrition rates can help influence formulation of appropriate food policies not only in Rwanda, but also in other countries recovering from similar domestic crises or facing critical land shortages.

The rest of this article is laid out as follows. First, a brief introduction to Rwanda, its recent history and agricultural policies provides context for the reader. This then leads into a brief discussion of rural livelihood strategies. Next we provide basic documentation of income and expenditure surveys conducted prior to the war (1990) and after the war (2000). We then compare patterns in household strategies in a time before the disruptions to a time of relative calm after the major disruptions. In our conclusions, we draw implications for policy.

The Rwanda Context—Geography, War and Genocide.

Rwanda is a small hilly country situated on the western edge of East Africa, and shares borders with Democratic Republic of Congo, Uganda, Tanzania, and Burundi (figure 1³). In the 1980s and early 1990s, despite some strong critics (Barahinyura, 1988), and despite a one-party strong man form of government, many analysts in the international donor community viewed Rwanda as an African success story—a government that was



Figure 1. Rwanda.

coping with its landlocked resource-poor status, and the highest population density on the continent (Kleiner, 1992).

In the mid 1980s, the Government of Rwanda's policy initiatives included construction of paved roads between Kigali and the provincial capitals to facilitate the movement of food and other goods across the country. The Government worked to stabilize food prices through market and storage operations by a parastatal.⁴

The Government's agricultural policy focused on supporting varietal research in major food crops such as bananas and beans, and on campaigning to improve smallholder systems to reduce soil loss to erosion. Nonetheless data show that calorie availability deteriorated between 1984 and 1990 (Mpyisi *et al.*, nd.), and GDP data confirm that this period (and into the early 1990s) was one of macroeconomic decline.

In October of 1990, the Government's focus changed dramatically with the brief incursion of militarized refugees from Uganda. Most refugees had left Rwanda between 1959 and before Juvenal Habyarimana rose to power in 1973. While a few repatriations were allowed during the early years of the Habyarimana regime, many refugees languished in camps in bordering countries for decades. Rebel incursions and skirmishes were routine from 1991 through early 1994. Ethnic and other tensions—never very far beneath the surface after independence—increased dramatically, culminating in the 1994 genocide. Estimates of deaths from the genocide range from 300,000 to one million.⁵ Much has been published about the Rwanda genocide so we do not provide details here. For discussions and debates from various perspectives, see for example Kamukama (1997), Harelimana (1997), Bray *et al.* (1997), and Pottier (2002), or implement a simple Internet search.

In the aftermath of the genocide, a new government was formed. In its early years, the new government had its hands full with a war in Congo, rebuilding its administrative and educational infrastructure, war crime trials, overflowing prisons, and resettlement of hundreds of thousands of returning refugees or internal migrants (Human Rights Watch, 2001; Ministry of Finance and Economic Planning, 2002).

Today, despite loss of many thousands of people to war, genocide, and flight, Rwanda's population stands at 8.1 million according to the recent population census (Ministry of Finance and Economy, 2003), or about one million higher than it did in 1994 (U.S. Dept. of State, 1996). The increase in population is due to the high birth rate among Rwanda's

adults of child-bearing age and repatriation of refugees and others who lived outside the country prior to 1994. The high birth rate, combined with division of land among heirs or as part of government settlement programs has resulted in ever-declining access to land in the typical rural agricultural household, and population resettlement has contributed to redistribution and land disputes.

Rwanda's basic agricultural technologies have essentially remained unchanged since colonial times. Fields are typically worked with hand hoe rather than by animal or machine. Mechanical or gravity irrigation is practically non-existent, and only a few commercial farms are present in the entire country. Agro-chemicals are applied in some circumstances (especially coffee and tea), but this is the exception rather than the rule (Kelly and Murekezi, 2000). High population density has reduced or eliminated fallow periods, and loss of topsoil is exacerbated by Rwanda's steep slopes and relatively high rainfall, resulting in Rwanda having one of the highest rates of soil fertility loss in Africa (Henao and Baanante, 1999). Rwanda has strong livestock traditions, especially cattle. The war and other factors engendered a precipitous decline in the livestock sector, which now seems to be recovering—the number of cattle was estimated at 837,000 in 1984 (Ministry of Agriculture, Livestock and Forests, 1985) and 671,000 in 2000 (Mpyisi et al., nd.). Loss of livestock reduces protein availability and export income, but also makes it more difficult to maintain soil fertility.

Many farm families grow most of their crops primarily for own consumption, and changes in the international market for coffee have led to substantial price declines for one of Rwanda's principal agricultural exports (Loveridge *et al.*, 2003), further isolating some families from the exchange economy.

In summary, many political factors conspired to make it nearly impossible for either of Rwanda's governments to establish and maintain consistent and effective food policies in the 1990s. The unsurprising result is that agricultural technology is stagnant. At the same time, due to population increase, the amount of land available per household declined. So the surprise is that the overall food and nutrition situation is better, not worse, than it was in the early 1990s. How rural households adjusted their income generating and food supply systems to adapt, survive and, by some measures, even improve nutritional outcomes in these difficult circumstances is the major focus of this article.

Methods.

The analysis that follows is based primarily on two surveys, the Revenue and Expenditure Survey (RES) conducted in 1990 and the integrated Household Living Conditions Survey (HLCS) conducted in 2000. The focus is predominantly on the income data collected by these data sources as constituting the best available measure for households of the importance of the different livelihood strategies in which households engage. While income data collected by household surveys in developing countries is frequently considered to be unreliable, experience varies across countries (McKay, 2000), and where the income data are reliable enough, income data provide the best indication of

the relative importance of different economic activities in commanding food and other essential consumption items.

The Revenue and Expenditure Survey (RES) was fielded in the 1989-90 crop year by the Ministry of Agriculture, Forestry and Livestock. The RES was part of a larger household survey effort aimed at developing a better understanding of agricultural production trends and improved food availability forecasts. Enumerators made regular visits to rural agricultural households in a stratified, clustered random sample. The sampling procedure and subsequent weighting scheme was designed by a statistician from the U.S. Bureau of the Census. The basic method of data collection is the farm-level household survey; commercial farms are excluded from the sample. The information therefore reflects the situation among small farms, otherwise known as smallholders. Enumerators visited each household four times per month for an entire crop year⁶ to collect information about quantities harvested. The harvest information is complemented with measurements of the size of each of the household's fields, as well as information on the gender, age, and principal occupation of household members. Readers requiring a more complete description of the basic survey method are referred to DeJaeger et al., 1988. The basic survey was initiated in 1984, and then annually in the 1986 through 1994 crop years. Beginning October 1, 1989, the RES component was added. Due to the disruptions of the October 1990 invasion, the 1991 crop year data were not complete, leaving the 1990 crop year data as the last comprehensive rural income survey prior to the outbreak of war. The RES component visited the same households as the basic agricultural production survey, but used monthly visits to collect information on purchases, sales, and gifts of crops, livestock as well documenting sources and amounts of off-farm income. The data were cross-checked upon entry. In cases of inconsistencies among data (for example, sales without production), questionnaires were reviewed. If there was not a data entry error, a field supervisor was asked to revisit the household to determine the cause of the inconsistency. Cases where gross inconsistencies could not be resolved were dropped. A total of 1208 households produced usable results out of 1248 households sampled. A report by Loveridge (1992) provides basic RES results; the same data were further analysed in great detail by Kangasniemi (1998).⁷

The Household Living Conditions Survey (HLCS) was conducted by the Ministry of Finance and Economic Planning starting in July of 2000 and ending in July of 2001 for the rural component of the survey (the urban component having been conducted earlier). The households were selected with stratified, clustered random sampling technique designed by Christopher Scott. The combined rural and urban sample included 6450 households, of whom 6420 generated useable data, and 5271 in rural areas. The HLCS method differed from the RES in that the enumerator visited each rural household eight times over the course of a 16 day period instead of regularly over the course of a year. The recall period varied, depending on the crop or activity. The household visits were distributed across space to minimize the seasonal effects in aggregated data.

Despite the methodological differences between the two surveys, aggregates results of the HLCS compared well with results from multiple-visit agricultural production surveys conducted at about the same time in terms of average land size, values of production etc.

(Ministry of Finance and Economic Planning, 2002)⁸. By eliminating selected variables and non-agricultural rural households from the HLCS (leaving 5218 households), we obtain comparable data for the pre- and post-war periods.

We use the availability of similar data from rural agricultural household for 1990 and 2000⁹ to explore how characteristics of households at various levels of income have changed, and what this says about their strategies for surviving under conditions of political instability and decreased access to land. Both surveys were comprehensive in their coverage of income sources, and there is good reason to believe that the income data can be legitimately compared between the two surveys. Nonetheless, it is important to bear in mind some of the potential differences that could arise from the methodological differences in what follows. The most important difference is the change described above in the recall period and number of visits between the two surveys. Of particular importance, the HLCS estimated the value of own consumption as a component of income using eight two-day recall periods over the sixteen days of visits. So the results for a particular household are dependent on the season during which it was visited. While this may not make much difference in aggregate results, seasonality of agricultural production or other income sources may result in miscategorization of a household's income level in terms of the contribution of own consumption to overall household income. Households that maintain steady levels of consumption during peak price times may thus overestimate income from own consumption due to price effects. Households that reduce consumption during peak price periods may underestimate own consumption due to the temporary change in quantity. In times of low prices immediately following the harvest, the bias is analogous, but in the opposite direction. Some consideration was given to attempting to correct for these price effects, but we judged it was not possible to do this in a reliable manner given that all HLCS own consumption data were collected in terms of values, not kilograms or other standard quantity units. Loveridge (1989, 1991) documents that in Rwanda, variation of prices is not consistent over time (rural-urban commodity flow reversals) or space (seasonality differs among Rwanda's many micro-climates), so in the absence detailed seasonal and spatial price-quantity information, seasonal correction is problematic.

Given the difficulties in estimating income levels from the EICV survey, including the recall problem described above, it is important to assess the reliability of the resulting estimates. This was judged initially by comparison with an estimate of consumption expenditure for the same household. On average the income estimate is 18.4% below the corresponding expenditure estimate. Underestimation of income or overestimation of expenditure is very common in multipurpose household surveys (McKay, 2000), and the magnitude here is not excessive compared to other cases. Further analysis shows that the differential is particularly apparent among the poorer households. It is important also to identify and exclude the most extreme outlying values of income or expenditure. Many of these outliers were a consequence of the short recall period for consumption of own production in particular in the EICV survey, which can result in income (or expenditure) values that were unfeasibly large or small in the EICV survey. However the most common problem seemed to be an implausibly large number of negative income values due to the use of a much longer recall periods for input expenses compared to

consumption of own production. Excluding these, plus others with unfeasibly large production levels given their expenditure, land size or other characteristics, we worked with a data set of 5059 households for whom the income data appeared plausible.

While seasonality may cause a few households to be misclassified in terms of overall income level, the HLCS found households at all levels of income used in this paper during each month of the survey. The extent of this seasonality problem is not enormous. The proportion of households in the wealthiest category was highest in the May and June months of the HLCS survey, and the proportion of households in the poorest category was correspondingly lower. October was the peak month for surveyed households to fall in the poorest income category in HLCS. A more detailed table of the seasonality issue is available from the corresponding author on request.

Results.

Surprisingly perhaps, inflation-adjusted average rural household income per adult equivalent in 2000 is estimated as being around 15% above its 1990 level, taking care to measure these incomes on a comparable basis. While there may be questions about the reliability of income comparisons and inflation adjustments, this is in fact consistent with other evidence. As already noted, agricultural production surveys show that calorie availability in 2002 was 20% above its 1990 levels (Mpyisi *et al.*, n.d.). It is also consistent with anthropometric evidence described above and discussed again below.

While all rural households in Rwanda would qualify as poor in many countries, averages can mask important differences the poorest and least poor households. Loveridge (1992) used the RES to compute household revenue per adult equivalent¹⁰ and established four income categories based on natural breaks in the data. We maintain these same categories, adjusted for inflation¹¹ for the latter data set, in what follows, and find that this division continued to work well. Table 1 presents the proportion of rural households in each category for the two years. Both the poorest and least poor households increased in proportion at the expense of households in the middle two categories. Table 2 shows further that those households in the poorest category in 2000 were even poorer on average than were their 1990 counterparts, while those in the richest category are somewhat better off. While these results may each be exaggerated by the change in the recall period, they are suggestive of an increase in inequality in the Rwandan countryside during the decade.

Table 1
Percentage of Households in Each Income Group
1990 and 2000

Income Group	1990	2000	Change
Poorest	25	29	4
2nd	20	14	-6
3rd	29	26	-3
Least Poor	25	31	6
All	100	100	

Table 2
Average Revenue per Adult Equivalent by Income Group
1990 and 2000
(1990 Frw)

Income Group	1990	2000
Poorest	3,377	2,566
2nd	5,948	5,599
3rd	9,029	8,728
Least Poor	21,480	25,462
All	10,157	11,756

War and genocide affected all ages and genders, but one outcome was substantially more female headed households (especially widows). Female headed households remain over represented in the poorest group and underrepresented in the richest group, continuing a pattern evident in 1990. One particularly surprising change though is in patterns of under five malnutrition rates by income group, in that differentials between income groups are somewhat less in 2000 than in 1990 (Table 3). Malnutrition rates have fallen for all groups, but by more among the poorer groups. This result appears counterintuitive given the above evidence on changes in income levels.

Table 3
Rates of Under Five Malnutrition, by Income Group
1990 and 2000

Malnutrition of under five children	Poorest	2nd	3rd	Least Poor	TOTAL
1991-92					
% stunted	70	58	54	46	56
% underweight	38	33	32	24	32
% wasted	5	5	5	6	5
2000					
% stunted	51	51	51	45	49
% underweight	29	24	23	22	25
% wasted	3	3	3	4	3

As mentioned previously, land area available per household declined over the decade due to population increase. The decline in land area by income category is documented in Table 4; all income categories experienced substantial losses in available land area by similar absolute extents. In these circumstances many households' agricultural income is expected to fall (as observed in Table 5). This decreased land availability increases the need for off farm income sources and over the period off-farm labor also increased on average as a source of revenue, a rational response to decreased land availability (Table 5). Another important change shown in this table is that in 2000 households are consuming a higher proportion of their agricultural output on farm, and selling a lower proportion. While this is probably partly a response to reduced land areas and smaller surpluses, it can also be seen as a rational response to political instability due to the fact that markets can be disrupted during periods of insecurity.

Table 4
Average Land Area (ares) and Change
By Household Income Category
1990 and 2000

Income Group	1990	2000	Change, percentage points
Poorest	79	58	-21
2nd	86	61	-25
3rd	95	72	-23
Least Poor	127	99	-28
All	97	75	-22

Table 5
Average Household Income from Different Sources, 1990 prices
1990 and 2000

Income Category	1990	2000	% Change
Consumption of own production (main products)	20780	23989	+15.4%
Sales of crops and crop products	13793	7991	-42.1%
Net gifts	1273	1157	-9.1%
Labor	11353	16568	+45.9%
TOTAL	47199	49705	+5.3%

But the aggregate figures hide important differences by income group (Table 6). In both 1990 and 2000 there is a substantial difference between the least poor group and the three poorest. This difference is particularly striking in regard to non-agricultural labor income, which is a major income source for the least poor group but much less important for the others. Further, it has become more important for the least poor group, and less important for the others. This is probably one reason why those in the least poor group have been able to increase their average income levels significantly between 1990 and 2000, while the average incomes for the other three groups have fallen. Respondents to the Rwanda Participatory Poverty Assessment conducted in 2001 stressed that having wage work out of agriculture was the key route out of poverty. The three poorest groups still obtain around 85% of their income from working on their own farms. With declining land areas the decline in their average incomes is unsurprising.

All four groups sell a lower proportion of their output in 2000 compared to 1990, but this decline is particularly notable for the three poorest groups. Agricultural labor is the main second source of income in the first two groups, but the contribution to household income remains small (as in 1990). The poorest derive less income from non-agricultural wage work in 2000 than in 1990, and this may be one driver of increasing inequality in rural areas.

Table 6
Percentage Composition of Household Income, by Income Group
1990 and 2000

Composition of Household Income	Poorest	2nd	3rd	Least Poor	Total
1990					
consumption of own production: main crops	52.6%	52.2%	48.8%	36.1%	46.3%
sales of crops and crop products	25.6%	28.9%	34.3%	28.6%	32.5%
net gifts	4.4%	2.9%	2.8%	2.3%	2.7%
agric labor	9.3%	6.9%	3.9%	1.5%	3.6%
non agric labor: unskilled	8.1%	9.0%	10.2%	31.6%	2.6%
non agric labor: skilled					17.9%
TOTAL	100.0%	99.9%	100.0%	100.1%	100.0%
2000					
consumption of own production: main crops	76.5%	74.9%	71.5%	35.2%	48.3%
sales of crops and crop products	7.4%	11.4%	12.5%	18.6%	16.1%
net gifts	3.5%	1.7%	1.8%	2.4%	2.3%
agric labor	7.9%	7.3%	6.0%	2.9%	4.2%
non agric labor: unskilled	1.6%	1.0%	2.4%	3.3%	2.8%
non agric labor: skilled	3.1%	3.8%	5.8%	37.6%	26.3%
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%

Focusing specifically on agriculture, the EICV survey provides information on production values, though unfortunately not on quantities.¹² Comparing values between 1990 and 2000 shows an increased share over this period of beans, sweet potatoes and Irish potatoes (now the most important consumption staples in Rwanda according to the HLCS) and a sharp reduction in the share of bananas. But as this conflates price and quantity effects, it is of greater interest to consider changes in production volumes. Fortunately this is possible, because a randomly selected subset of the EICV households were also selected for agricultural production surveys similar to those conducted by the Ministry of Agriculture in the pre-war period. Thus it is possible to match 1369 households who in answered both the agricultural production and the EICV surveys, and to use this as the basis for examining changing patterns of agricultural production by income group. This subset of households does have very similar characteristics to the full sample, for instance in terms of each of tables 1 to 6 above.

Table 7
Changes in average household production levels by main crop,
1990 and 2000

Production of Key Crops	Poorest	2nd	3rd	Least Poor	Total
1990 average household production levels (kg)					
Beans	67	119	151	302	162
Sorghum	41	75	95	229	112
Sweet potato	443	624	714	778	644
Cassava	76	142	221	376	208
Irish Potato	54	137	223	463	224
Cooking banana	197	281	452	925	474
Beer banana	611	998	1627	2658	1507
Coffee	7	18	36	64	32
Increases in production, 1990 to 2000 (%)					
Beans	30	-2	-14	-51	-26
Sorghum	39	36	10	-54	-19
Sweet potato	-4	1	-30	-17	-16
Cassava	270	90	78	35	80
Irish Potato	128	101	-1	-43	-5
Cooking banana	-49	-57	-72	-77	-70
Beer banana	-47	-50	-67	-73	-66
Coffee	-36	-57	-81	-81	-75

In aggregate, with the exception of cassava, average household production of most commodities fell between 1990 and 2000 (Table 7), which is not surprising given falling average land size. The declines are particularly evident for bananas and coffee, although the very large reduction in bananas partly reflects a very poor harvest in 2000. But there are important variations by income group. While the changes for the least poor group are in line with the overall pattern, the situation is very different among the poorer groups. Among the two poorest groups households are producing much more cassava and Irish potatoes (relatively unimportant crops in 1990), more beans and sorghum, and similar quantities of sweet potato. They are producing much smaller quantities of bananas and other smaller crops not reported here (including maize and soya). These poorest households have managed to increase their production of many staple food crops despite declining average land sizes; this reflects a number of factors including the change in production pattern mix itself and the introduction of new varieties, such as climbing beans. Many of these staple crops, such as cassava, are low price crops, and this may partly account for the reduced value of agricultural production apparent in Table 5. This also provides an explanation for the reduction in under five malnutrition among the poorer groups despite declining incomes, in that production of many key sources of nutrients (beans, potatoes, and now cassava) have increased while production of crops for sale (coffee, beer bananas) has fallen sharply. Indeed, for the two poorest groups,

revenue from sales of banana beer (by far the largest sales revenue source in 1990, and still in 2000) fell by three quarters between 1990 and 2000. Sales of most other agricultural crops fell sharply in these same groups, as well as for the third poorest group. As already seen the least poor group maintained a similar level of agricultural sales in 2000 compared to 1990.

It is important to note that in the HLCS, in common with many household surveys in developing countries (McKay, 2000), estimated household income levels are significantly lower on average than their expenditure levels. This is likely to reflect underestimation of income, and there may be systematic patterns to this – in particular there may be more underestimation among the poorest groups. Unfortunately there is no precise way of making an allowance for this. One approach would be to exclude the households that show a very wide differential between their income and expenditure levels in the HLCS. Depending on the precise criterion applied, such an approach excludes many households, and especially so among the poorest group. Applying this therefore suggests a higher level of income growth between 1990 and 2000, but in any case the evidence of increased differentiation between the least poor group and the three lowest groups still remains. Ultimately though there is no precise way of applying such a criterion in practice. But also, and more importantly, the focus is in comparing two points in time and we cannot apply an equivalent criterion to the 1990 survey because it did not collect equivalently detailed data on expenditure. For these reasons we prefer the tables presented here which do not make an adjustment for the income underestimation in the 2000 data. Even though there will be some uncertainty in the precise numbers, the patterns of change the surveys indicate appear robust.

Summary and Conclusions.

Notwithstanding the catastrophic events Rwanda experienced in the first half of the 1990s, including genocide, civil war, massive population movements, and widespread destruction of assets and communities, the comparison between 1990 and 2000 suggests that rural incomes in 2000 had recovered to their (very low) 1990 levels. Although there are various issues in measuring income, and especially in comparing two points in time, there is sufficient supporting evidence to indicate that this finding is robust, for instance from agricultural production or child malnutrition data. This recovery in incomes has been achieved also in the face of increasing population pressure (despite the massive numbers killed in the genocide and civil war), which has resulted in still further reduced land sizes.

The average value of agricultural production has fallen slightly over this period, but more significantly households in 2000 are now consuming much higher proportions of their output themselves. Production patterns have also changed, with a sharp reduction in the value of output due to coffee and an increase in the shares of core consumption commodities such as sweet potatoes, irish potatoes and beans. The reduced agricultural production has been compensated for by an increase in non-agricultural wage income.

However, disaggregation by income level shows a highly differentiated pattern of change. Defining four income groups for 2000 at the same real income levels used in an

earlier analysis of the 1990 survey, the extreme groups have become larger in size and the gap between them has increased. In 2000 there were more households in the poorest group compared to 1990 (and they were poorer on average), and also more households in 2000 in the least poor group (then richer on average). Two major factors accounting for this are non-agricultural wage employment and the extent of agricultural sales. The non-agricultural wage employment regarded as a key route out of poverty is predominantly undertaken by the richer households, more so in 2000 compared to 1990. And though the proportion of agricultural production sold has fallen dramatically overall, among the richest group the sales levels have actually risen in real terms. These would appear to be key drivers of the increased differentiation.

The aggregate picture is therefore very misleading as an indicator of the situation of nearly 70% of the rural population for whom income levels have not recovered and especially so among the poorest 30% (even if some of these incomes are underestimated). Increased land size pressure is particularly critical for these groups, whose land sizes are smaller anyway and who have experienced larger proportionate reductions in land size. That they now market much smaller proportions of their output is therefore not surprising. These households have also had very limited opportunities for off-farm work, even poorly paid and insecure agricultural wage labor.

It is clearly important to understand the processes underlying the increasing inequality in the Rwandan countryside, given the extreme level of poverty many of these households live in and given the introduction of an agricultural commercialization strategy in the Rwanda Poverty Reduction Strategy. The three poorest groups here are unlikely to derive much, in any, direct benefit from agricultural commercialization given that they have withdrawn from the market and are mostly cultivating too small land areas to be able to produce a surplus. Measures to increase the productivity – and sustainability – of Rwanda's small scale agriculture are critical but there is a clear risk that commercialization by itself could further increase rural inequality. It is also clear though that many of the poorest rural households will never be to obtain adequate consumption levels based on agriculture alone – but at the moment the opportunities for off farm work for these households appear very limited. The proposed widespread introduction of labor intensive public works, also envisaged in the Poverty Reduction Strategy and currently under discussion in Rwanda, may offer opportunities here.

Finally, on a methodological note, this paper has demonstrated the value of using income data from household surveys – sensitively to its strengths and weaknesses – to understand patterns of change in livelihood strategies over time, even over a highly disrupted period as in this case.

List of References

- Barahinyura, S. 1988. 1973-1988 Le General-Major Habyarimana: Quinze Ans de Tyrannie et de Tartuferie au Rwanda.
- Bray, M., A. Cook, and S. Neath. 1997. Rwanda: Perspectives. University of Westminster. London.
- CCOAIB (Conseil de Concertation des Organisations d'Appui aux Initiatives de Base). 2000. Problématique du Régime foncier au Rwanda. Contexte et perspectives, relations avec l'habitat regroupé. Kigali, Rwanda.
- DeJaeger, Y., D. Clay, S. Rwamasirabo, and J. Ngirumwami. 1988. Aperçu Historique et Methologique: Enquete Nationale Agricole 1984. Service des Enquetes et de Statistiques Agricoles. Ministry of Agriculture, Livestock and Forests. Republic of Rwanda. Kigali. Web accessible at: http://www.aec.msu.edu/agecon/fs2/rwanda/pre1994/1988_Aug_Dejaeagher_Apercu_Hist orique.pdf
- Harelimana, F. 1997. Rwanda: Society and Culture of a Nation in Transition. Oregon State University. Corvallis.
- Henao, J. and Baanante, C. 1999. Nutrient Depletion in the Agricultural Soils of Africa. International Food Policy Research Institute 2020 Brief No. 62. Washington, D.C. Web accessible at: <http://www.ifpri.org/2020/briefs/number62.htm>.
- Human Rights Watch. 2001. Uprooting the Rural Poor in Rwanda. New York.
- Jayne, T., T. Yamano, M. Weber, D. Tschirley, R. Benefica, A. Chapato, and B. Zulu. 2003. Smallholder Income and Land Distribution in Africa: Implications for Poverty Reduction Strategies. *Food Policy* 28(3): 253-275.
- Kamukama, D. 1997. Rwanda Conflict: Its Roots and Implications. Fountain Publishers. Kampala, Uganda.
- Kangasniemi, J. 1998. People and Bananas on Steep Slopes: Agricultural Intensification and Food Security Under Demographic Pressure and Environmental Degradation in Rwanda. Unpublished PhD Dissertation. Department of Agricultural Economics. Michigan State University, East Lansing, MI. Web accessible at: http://www.aec.msu.edu/agecon/fs2/rwanda/1998_Dec_Kangasniemi_People_n_Bananas .pdf
- Kangasniemi, J. and T. Reardon. Demographic Pressure and the Sustainability of Land Use in Rwanda. In *Issues in Agricultural Competitiveness: Markets and Policies* edited by Roger Rose; Carolyn Tanner and Margot A. Bellamy. Contributed paper presented at the IAAE 22nd Congress, Harare, Zimbabwe, August 1994. IAAE Occasional Paper no. 7, 1997, pp. 23-33.

Kelly, V., and A. Murekezi. 2000. Fertilizer Response and Profitability in Rwanda. Republic of Rwanda, Ministry of Agriculture, Animal Resources and Forestry. Kigali, Rwanda. Web accessible at: <http://www.aec.msu.edu/agecon/fs2/rwanda/fertilizer.pdf>

Kleiner, H. 1992. Allmanhlich schwand die Bewunderung fur 'Habis' Regime. Frankfurter Rundschau. November 5. Cited in Le Regime Habyarimana: de 1973 a la fin des annees 1980. Reseau Voltaire.net. Web accessible at <http://www.reseauvoltaire.net/article8023.html>.

Loveridge, S. 1991. Marketing in Rwanda: Imports and Infrastructure. *Food Policy*, 16(2), 95-104.

Loveridge, S. 1992. Sources of Agricultural Household Revenue, Exports, and their Impact on Rural Food Availability, Rwanda, 1990. Republic of Rwanda, Ministry of Agriculture and Livestock, Agricultural Statistics Division. No. P.24. Web accessible at: <http://www.aec.msu.edu/agecon/fs2/rwanda/pre1994/revenuedep.pdf>

Loveridge, S., J. Nyarwaya, and E. Shingiro. 2003. Decafeinated? Situation, Trends and Prospects for Smallholder Coffee Production in Rwanda: Analysis of a Rural Household Survey, 2002. Food Security Research Project. Division of Agricultural Surveys. Ministry of Agriculture, Livestock and Forestry. Kigali, Rwanda. Web accessible at: http://www.aec.msu.edu/agecon/fs2/rwanda/farmer_attitudes_coffee.pdf

McKay, A. (2000), "Should the Survey Aim to Measure Total Household Income?", chapter 17 of M. Grosh and P. Glewwe (eds), *Designing Household Survey Questionnaires for Developing Countries: Lessons from 15 Years of LSMS Experience*, Oxford University Press for World Bank, 2000.

Ministère de l'Agriculture et de l'Élevage, Fonds des Nations Unies pour l'Enfance. 1992. Statut Nutritionnel et Sécurité Alimentaire au Rwanda: Resultats de l'Équête Nationale sur la Nutrition et la Sécurité Alimentaire des Enfants de 0 a 5 ans et leurs Mères Novembre 1991 – Janvier 1992.. Division des Statistiques Agricoles. Document de Travail No. DT 83. Web accessible at: http://www.aec.msu.edu/agecon/fs2/rwanda/pre1994/1992_Dec_MinAgri_Statut_Nutritionnel.pdf.

Ministère du Plan. 1988. "Enquête Nationale sur le Budget et la Consommation des Menages (Milieu Rural), Volume 4: Consommation Alimentaire en Milieu Rural. République Rwandaise.

Ministry of Finance and Economic Planning. 2002. A Profile of Poverty in Rwanda: An Analysis of Based on the Results of the Household Living Conditions Survey, 1999-2001. Government of Rwanda. Kigali.

Ministry of Finance and Economic Planning. 2003. National Census Service 3rd General Census of Population and Housing of Rwanda, August 2002: Final Results, Statistical Tables. Web accessible at: http://www.minecofin.gov.rw/docs/Final_ResultsST.pdf

Ministry of Finance and Economic Planning. 2004. Registry of External Aid to Rwanda. Kigali, Rwanda. Web accessible at: <http://www.minecofin.gov.rw/docs/DONORS1-ANGL.pdf>

Mypisi, E., J. Nyarwaya, and E. Shingiro. nd. *Statistiques Agricoles: Production Agricole, Elevage, Superficies et Utilisation des Terres. Annee Agricole 2000*. Food Security Research Project et Division des Statistiques Agricoles, Ministry of Agriculture, Livestock and Forests. Publication FSRP/DSA no. 4F. Web accessible at: <http://www.aec.msu.edu/agecon/fs2/rwanda/anneeagricole.pdf>

Pottier, J. 2002. *Re-Imagining Rwanda: Conflict, Survival and Disinformation in the Late Twentieth Century*. Cambridge University Press. London.

Wise, V. 2004. *The Nutritional Situation of Young Children in Rwanda: An Analysis of Anthropometric Data Collected by the Household Living Conditions Survey, 1999-2001*. Rwanda Food Security Research Project. Michigan State University. Web accessible at: http://www.aec.msu.edu/agecon/fs2/rwanda/wpr_anthro_rwanda_english_wise.pdf

The World Bank Group. 2002. *Rwanda at a Glance*. Washington, D.C. Web accessible at: http://www.worldbank.org/data/countrydata/aag/rwa_aag.pdf.

U.S. Department of State. 1996. *Background Notes: Rwanda, June 1996*. Bureau of African Affairs, Office of Central African Affairs. Washington, DC. Web accessible at: <http://dosfan.lib.uic.edu/ERC/bgnotes/af/rwanda9606.html>.

¹ Land cultivated in annual and permanent crops divided by population in agriculture.

² Sample of rural children who were measured between November 1991 and January 1992.

³ Our thanks to Bilal Butt for assistance in creating the map.

⁴ An exception was one season in 1986 when dry bean prices were raised by decree (Loveridge, 1991).

⁵ Exact estimates are difficult to obtain due poor communications and records systems and the mass exodus of individuals into nearby countries, especially Tanzania and Democratic Republic of Congo.

⁶ To be consistent with major planting and harvest times, the crop year runs from October through September.

⁷ A summary of results is also available in Kangasniemi and Reardon, (1997).

⁸ The 2000 agricultural production survey used essentially the same method as used by the basic agricultural production surveys during the pre-war period—see Mypisi et al., nd. for details.

⁹ While the data collection periods do not correspond exactly to the two calendar years, we use “1990” and “2000” to increase readability.

¹⁰ Adult-equivalent is conceptually similar to “per person” except that it takes into account age and gender differences. The conversion from people to adult-equivalents is based on rates reported in *Ministere du Plan* (1988).

¹¹ Rwanda Consumer Price Index was from the Ministry of Economic Planning and Finance (personal communication). 1990=106.7 2000=348.44. The index likely has an urban bias; in what follows, patterns evident in the data would probably be stronger if a rural CPI were available.

¹² More specifically, the production quantity data collected by the EICV survey are collected in many different non-standard units without there being adequate conversion factors available.