The Experience of Resettled Farmers in Zimbabwe

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Abstract: This study assesses the relative productivity of smallholder farmers in zimbabwe's land reform and resettlement programme. We use a panel of survey data collected in 1992, 1993, 1996, and 1997 from up to 400 resettled households, who in 1981-84 had been moved onto previously large-scale commercial farms in three distinct agro-ecological regions. A sub-sample of 166 households were surveyed in all four years, and for 1997 we have data from a comparable survey of 147 farmers in communal areas (CAS). Using these data, we ask whether and how the resettled farmers' productive efficiency might have converged to their area's efficiency frontier over time, and whether particular farmer characteristics or institutional interventions might have helped them to improve faster. Applying Data Envelopment Analysis (DEA) methods to measure productive efficiency, we find that although individual farmers often moved towards higher efficiency levels, there was no trend towards the frontier, and farmers' improvements were not consistently correlated with receiving formal credit or extension services, having more experience or education, or using more farm equipment. In sum, despite the relatively large and uniform land area available to each farmer, they had widely varying productivity levels, not overcome by conventional farm services.

Introduction

With the advent of majority rule in 1980, the government of Zimbabwe (GoZ) adopted the goal of 'growth with equity'. New policies included bringing underutilized land into full production and reducing the inequality in land holdings.[1] The first phase of the Land Reform and Resettlement Program (LRRP1) began in 1980, which by 1997 had redistributed 3.5 million hectares to 71,000 families from communal areas—well below the initial target of 8.3 million hectares and 162,000 families.[2] A second phase of resettlement (LRRP2) was begun in 1998, followed by an accelerated fast-track resettlement phase in June 2000, and then the announcement of an end to land redistribution in August 2002.[3] Although it has been more than two decades since the start of Zimbabwe's resettlement experience, this massive socioeconomic change remains relatively unstudied.

The official government critique of resettlement a decade after its implementation views the program as a failure. The program "failed to have a positive impact on agricultural productivity and rural incomes".[4] Von Blanckenburg concludes that in the first decade of land reform, the GoZ failed "sufficiently" to take care of productivity in the new resettlement sub-sector. Another opinion and perhaps a more widely shared view is that Zimbabwe's initial resettlement program was slow but remarkably successful by 'historical standards'.[5]

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http://www.africa.ufl.edu/asq/v7/v7i2-3a5.pdf

ISSN: 2152-2448

Nonetheless, there remain considerable disparities between resettlement areas and communal areas, and within the resettlements. The Ministry of Lands admitted that "although a number of settlers are already achieving the recommended income targets, a group of farmers is emerging for whom the benefits of being resettled are very marginal".[6]

Most studies of resettled farmers use the panel of surveys known as the Zimbabwe Rural Household Dynamics project (or Kinsey data), which sampled some of the very first farmers to be resettled in the early 1980s. Analyses using these data have addressed productivity, asset accumulation, diversification, consumption smoothing, welfare indicators (mainly health and child nutrition), the effectiveness of relief and development assistance, evidence of structural adjustment impacts, gender dimensions, the role of government services, and access to and use of resources.[7] In this study, we use the Kinsey dataset in a new way, to ask whether and why some resettled farmers are performing less well than others.

The paper first discusses agricultural land distribution in Zimbabwe and describes its resettlement programme. This sets the stage for our own analysis of resettled farmers' experience. By using non-parametric efficiency measurement we compare each farmer to every other farmer in the survey, and quantify each farmer's 'distance' from the 'frontier' of the most productive farmers in their area. With this approach, we test whether resettled farmers' productivity is influenced by more farm equipment, credit availability, extension, education, or other support services such as membership in farmer organizations. The result is a quantitative test of whether and how resettled farmers can discover or be taught how best to farm in their new environment.

AGRICULTURE AND LAND DISTRIBUTION IN ZIMBABWE

Agricultural Systems

The dual agricultural system inherited from the colonial era divided Zimbabwe into two sectors: a large-scale commercial (LSC) sector controlled by white settlers from Europe, and a small-scale (SS) sector controlled by indigenous people. Small-scale farming was further subdivided into small-scale commercial (SSC) areas and communal areas (CAs), plus the later resettlement areas (RAs).

As in other countries, farmers with less land tend to use it more intensively, and Zimbabwe's LSC farmers actually plough only a small fraction of potentially arable land. They typically run cattle on land that smallholders would have ploughed – resulting in well over half of the national beef herd being reared on relatively high-potential arable land.[8] One source estimated the percentage of underutilized arable land in the LSC areas at about 40-50% in high potential agro-climatic regions l, II, and 85% in lower-potential region III.[9] As shown in Table 1, the national-average cropping intensity of LSC farms was 4%, as compared to a cropping intensity of 11% in CAs and 8% in RAs. Current figures on cropping intensity could not be obtained to update these 1994 data. However, the total area in RAs has increased from 3.3 million ha as of 1994 to an estimated 7.3 million ha of mostly model A1 resettlement farms in 2002.[10]

TABLE 1. Land Use by Farming Area

	CA[b]	LSCF[c]	RA[d]	SSC[e]	Total
AVERAGES					
Area per farm (ha/hh)[a]	18	2,500	38	125	-
Of which: area planted (ha)	2	103	3	7	-
Cropping intensity (%)	11	4	8	6	-
TOTALS					
Total Area (million ha)	(16.4)[f] 16.4	(15.5)10.3	(0)7.3	(1.4)1.4	35.4
Total Area (%)	46.3	29.1	20.6	4.0	100.0
Number of Farms ('000s)					

Source: Adapted from Masters, 1994; Commercial Farmers' Union (CFU) of Zimbabwe, 2002;UNDP report, 2002.
[a] hectares per household
[b] Communal Areas
[c] Large scale commercial farming areas comprising CFU and non-CFU farms, indigenous farmers' unions farm and large estates owned by multinationals.
[d] Resettlement areas[e] Small scale commercial farming areas
[f] 1980 figures are in brackets

Land Use and Production

LSC farms are highly mechanized with widespread use of irrigation and chemical spraying equipment as well as land preparation, planting and harvesting equipment. But these resources are concentrated on their best and most conveniently located land, while their other land is left to cattle.[11] Also, the LSC sector as a whole is more diversified than SS farming, including wildlife ranching as well as horticulture and many niche products, but individual LSC farmers tend to be more specialized than individual SS farmers.[12] Finally, LSC farms are much more market-oriented, contributing about 40% of market delivery of maize, cotton, groundnut, 90-100% of market delivery of wheat, soyabean, tobacco, coffee, tea and sugar cane, 80% of all commercial beef sales and virtually all milk deliveries to the Dairy Marketing Board; supplying about a third of the raw materials to local manufacturing; and, contributing about 50% of all export earnings via exports of tobacco, maize, cotton, beef, etc in the normal seasons.[13] The Ministry of Lands, Agriculture and Rural Resettlement reported in 1992 that the LSC Farms had provided 72% of the national production value of all major crops since 1983/84.[14]

Smallholder farmers in Zimbabwe generally engage in subsistence mixed farming. Livestock provides animal draught for tillage, transport, manure, milk, meat, some cash income, and a stock of wealth.[15] Crop production provides most of the food for the household, which may also sell or buy some food.[16] Land preparation is mostly by ox-drawn plough, some weeding is done by ox-drawn cultivator, and some transportation is by ox-drawn carts.[17] Some SS farmers and few CA and RA farmers own or hire tractors and other mechanical equipment. There are several donor-funded equipment-hire schemes, which may have been underutilized because of their high costs outweighing the costs of animal draught cultivation.[18] In the early 1990s, maize and cotton were reportedly the largest crops by market value, although large areas of land were also under sorghum, millets, groundnuts, and sunflowers.[19] Maize is the dominant food crop, in part because the development of increasingly high-performance hybrid seeds since the 1960s displaced other food crops.

With majority rule in 1980, maize production by SS farmers grew rapidly, and the LSC sector turned increasingly towards exports, especially horticulture: by 1995, 1,600 LSC farmers were horticultural producers.[20] The land area under flowers, fruits and horticulture almost tripled from less than 4,000 hectares to almost 11,000 hectares of formally registered areas of production in 1993.[21]

Moyo categorizes five land use regimes that reflect the emerging values underlying Zimbabwe's land markets and demand: extensive and exotic land use zone (wildlife, forest and tourism), the wildlife buffer zone, the CA subsistence mixed farming, commercial wildlife/cattle ranching and commercial intensive cropping zone. The extensive and exotic land use zone comprises very large state-owned estates interspersed with LSC farms.[22] The wildlife buffer zone borders large parks and LSC areas, which are gradually transforming existing CAs into community wildlife management zones. Besides wildlife, these areas produce maize, cotton, and various woodlands products. The CA subsistence mixed farming zone comprises CAs in natural regions III, IV, and V producing on a mixed farm basis and selling any surplus in good rainy seasons.[23] LSC farmers and some CAs dominate the commercial wildlife and cattle ranching zone. According to Moyo, 70% of the intensive cropping zone is LSC-owned with most commercial grain production, tobacco, and horticultural activities occurring in this zone. Incidentally, until 1995, there was little land redistribution in the area and most legal contests to compulsory acquisition took place despite underutilization of 50% of the arable land.[24] Because resettlement focused on lower-potential areas, Deininger et al.. reported in 2000 that the redistribution efforts of 3.2 million hectares had no negative impact on LSC farm output. Since then, however, Zimbabwe's commercial agricultural production has been almost fully disrupted, contributing to collapse of the entire national economy.[25]

Agro-Climatic Regions

Zimbabwe's agricultural areas have been classified into five broad agro-climatic or Natural Regions, in which the dominant natural factor conditioning agricultural production is rainfall (Table 2).

Table 2. Land Classification by Natural Region

Natural Region	Area extent (million ha)	% Total land area	Annual Rainfall (mm)	Agricultural Productivity
I	0.62	1.6	>1000	Suitable for dairy farming, forestry, tea, coffee, fruit, beef and maize production
II	7.31	18.8	750-1000	Suitable for intensive farming based on maize, tobacco, cotton and livestock.
III	6.85	17.6	650-800	Semi-intensive farming region. Severe mid-season dry spells are common. Suitable for livestock production, together with production of fodder crops and cash crops under good farm management.
IV	12.84	33.0	450-650	Semi-extensive region. Subject to periodic seasonal droughts and severe dry spell during the rainy season. Suitable for farming systems based on livestock and resistant fodder crops. Forestry, wildlife/tourism.
V	11.28	29.0	<450	Extensive farming region. Suitable for extensive cattle ranching or game ranching. Zambezi Valley is infested with tsetse flies. Forestry, wildlife/tourism.

Source: Adapted from Moyo (2000)

The skewed distribution of land between the different farming sub-sectors is evident from Table 3, as the commercial farmers have the majority of their land in the higher potential areas, while CAs and RAs are concentrated in the lower agro-potential regions IV and V. In the low-potential areas, normal rainfall levels are barely adequate for intensive crop production, irrigation development is limited, and in low-rainfall years such as 1982-84, 1986-87, 1991-92, 1994-95 and 2001-02 there are widespread crop failures.[26]

Table 3. Land Distribution by Natural Region

Natural Region	Mean Annual Rainfall mm	Area ha	Total %	Communal & Resettlement[a] %	Commercial LSC & SSC[b] and Urban %	State DNPWM[c] Forest %

I	>1,000	7,050	1.8	19 (1)	64	17
II	750-1,000	58,750	15.0	21 (8)	77	1
III	650-1,000	72,900	18.6	39 (17)	52	9
IV	450-650	147,700	37.8	50 (45)	29	21
V	<450	104,500	26.7	46 (29)	36	18
Total	650	390,900	100.0	42 (100)	43	15

Source: Bratton (1994)
a The figure in brackets gives the proportion of communal area located in that Natural Region.
[b] Large-scale, Small-scale commercial and Urban.
[c] Department of National Parks and Wildlife Management

THE LAND REFORM AND RESETTLEMENT PROGRAMME (LRRP)

Since 1980, three GoZ resettlement programs and one joint government-LSC program have been implemented. Since1980, the GoZ acquired land only on a willing-buyer-willing seller basis. Later, compulsory acquisition was facilitated by the Land Acquisition Act of 1992 and subsequent amendments.

LRRP Phase One (1980-1997)

LRRP1 redistributed 3,498,440 million hectares to 71,000 families.[27] The progress of the program was much slower than anticipated. The GoZ had planned to resettle 8.3 million hectares on four resettlement models of varying sizes and land use. At the end of 1985, 2.46 million hectares had been acquired and 36,000 families were settled.[28] During the ten-year resettlement period 1981-1991, von Blanckenburg reports that resettlement averaged 4,800 farmers per year, only one third of the 1985 target. Slow progress was attributed by the Ministry of Lands to drought, financial constraints and problems of acquiring contiguous land adjacent to communal lands, as the willing buyer-willing seller approach meant that resettlements were scattered and therefore difficult to administer.[29] Land purchase and acquisition processes were cumbersome and expensive. There was also a lack of transparency in beneficiary selection.

LRRP Phase Two (1997-December 2004)

In the second phase of LRRP (LRRP2), the target was to acquire 5 million hectares between September 1998 and December 2004 using existing but improving government approaches.[30] Beneficiaries were to include the landless poor (to relieve congested communal areas), graduates of agricultural colleges, and individuals with established farming experience, and to other disadvantaged groups such as women. With several amendments to the statutory land policy instruments, additional acquisition procedures were identified after the first decade of LRRP. These included land designation or compulsory acquisition of land identified through screening of a given set of designation criteria, which included under-utilized land, land contiguous to congested CAs, multiple farm ownership, derelict land, and absentee landowners.

The government sought donor support for the new plan at a widely publicized September 1998 conference. The World Bank agreed to support a two-year Inception Phase project, in which the government proposed to resettle as many families as possible on one million hectares. A UNDP 2002 interim report states that in the end, only 4,697 families were resettled on 145,000 hectares.[31]

Fast Track Resettlement Phase (July 2000-December 2001)

In 2000, acceleration of LRRP2 began in response to the relatively little progress made for the two-year period following the September 1998 donor conference. The GoZ resolved to redistribute the 5 million hectares target by December 2001. Methods of land acquisition, beneficiary selection and resettlement support were changed to a completely command-driven approach. New targets were to redistribute 9 million hectares and to cover 160,000 model A1 beneficiaries from the poor and 51,000 small to medium-scale 'indigenous' commercial farmers. [32] As of mid-November 2001, about 160,000 families had been resettled on 3,074 previously large-scale commercial farms covering about 7.3 million hectares.[33]

Resettlement Models and Beneficiary Selection

Four different models of resettlement were initially pursued in the various resettlement schemes implemented under LRRP. These were supplemented later by other variations. [34] The most successful and large part of LRRP has occurred under model A.[35] Model A was further elaborated into two categories, model A1, for accelerated intensive resettlement, and model A2, normal intensive resettlement. One of the GoZ's objectives for LRRP, the A1 model, is the decongestion of communal areas. It provides for farms that are relatively small but adequate to sustain a family and produce a surplus.[36] They can be either villagised or self-contained. For the former, the settlers are provided with three hectares of arable land and communal grazing. The self-contained farm is one contiguous area that could be used for crops and livestock. A settlement scheme may be composed of several such units but without a village structure.[37] The A2 model is aimed at providing small-scale commercial farms to applicants with experience in agriculture, preferably those trained to be master farmers.[38] Of the more than 71,000 families resettled up to late 1996, 93% were settled on model A schemes, fewer than 6% on Model B schemes, and just less than 1% on Model C schemes.[39] Model B was a general failure because of poor infrastructure, financing and management.[40] Although about 20,000 families are benefiting from additional grazing land made available under model D, these have generally not involved resettlement.[41]

The GoZ employed several criteria in selecting beneficiaries for post-independence resettlement as has been done by other governments such as Kenya, Indonesia and Malaysia.[42] Resettlement took place after an applicant has successfully completed the steps required to determine eligibility. A2 model applicants must show evidence of access to enough capital to develop the farms into viable enterprises. Having demonstrated the ability to repay the cost of the farm, successful applicants are provided with 99-year leases with the option to purchase.[43] In the last year, A2 applicants have been notified of their selection via print and broadcast media announcements.

Resettlement Support and Resources

LRRP1 beneficiaries were provided with start-up tillage services and inputs for half a hectare for each family.[44] This suggests that beneficiaries were either expected to provide their own inputs to cover the remainder of the cultivated portion of the five hectare plot or make alternative arrangements to secure inputs through financial institutions or public and private input supplier credit schemes. For purposes other than land purchase, the pre-existing credit system was used for a short trial period, but defaults caused by droughts kept many settlers outside the formal credit system for almost a decade.[45] The GoZ relaxed strict prohibitions against off-farm employment to enable settlers who had fallen out of the institutional credit net to meet their own funding needs. In the two-year action plan for LRRP2, the Inception Phase Framework Plan, the GOZ proposed that the Agricultural Finance Corporation (AFC) would provide credit for development and working capital under its Farm Input Credit Scheme.[46] Further, the Resettlement Credit Scheme would be enhanced to provide loans in the first year of settlement and start-up grants to cover part of the initial production needs would be provided.[47] The UNPD reported that GoZ funds trickled down to settlers through the Grain Marketing Board (GMB) and through the Agricultural Development Bank (AGRIBANK). The Agricultural Development Assistance Fund (ADAF), a spin off from the commercialization of AFC in 1999, makes seasonal and investment loans with excellent recovery rate compared to AGRIBANK, whose clientele was predominantly large-scale farmers.[48] The UNDP also projected that ADAF could be an important institution for providing credit on a competitive basis to all small-scale farmers if it were to become independent.

Kinsey and Binswanger reported that in the early resettlement stages extension coverage was virtually universal, and helped resettled farmers make a major shift in production technology. Coverage has since returned to pre-resettlement levels.[49] Earlier resettlement was also plagued by inexperienced and untrained extension workers who brought nothing new to resettlement projects but instead tended to propagate CA-type farming practices.[50] Through the Inception Phase Framework Plan of 1999-2000, the GoZ pledged to deliver customized extension and training to meet the specific needs to beneficiaries. Training institutions were expected to range from government, private sector, non-governmental organizations, farmer organizations, local development associations, commodity organizations and parastatals.[51] However, the UNDP found the capacity of the existing extension staff too limited to provide new settlers with the intensive advice required at the initial stages of development.

There are several motives why the GoZ chose this program instead of a more equitable and more efficient one such as the farm subdivision approach in Kenya following its independence.[52] The GoZ imposed a crude approach of taking over whole farms and proceeding with slow, expensive and unproductive extension work to establish uniform lots of three or five hectares per family. As it happened, many politicians and military people obtained very low-cost leases to operate the purchased but not yet resettled farms, creating a strong constituency for having a very slow resettlement process that focused on taking over whole farms. The target plot size was much larger than the land area typically ploughed by CA households, ensuring that those eventually resettled would have relatively high incomes – but also ensuring that the disparity between CAs and other farming areas would remain.

In addition, the implementation of LRRP has been marred by disruptive and controversial land occupations or invasions, noticeably more rampant since the gazetting of LSCF commercial farms in November 1997. The 'land grab' was sanctioned by the ruling party and backed by overnight 'cooked up' legislative instruments to overturn legal contests by white farmers.[53] Tension between stakeholders in the Zimbabwe program has been fueled by forced (and often-times) violent eviction of white farmers, displacement of thousands of farmworkers, the mushrooming of squatter camps of mainly war veterans, and settlement by elite beneficiaries who in many cases turn out to be tied to the ruling party.

THE PERFORMANCE OF RESETTLED FARMERS

The UNDP report states that despite the problems, early settlers, many of whom produced high-value crops such as tobacco, cotton and paprika as well as maize, in combination with livestock, earned higher incomes per family than in their previous occupations (often also farming) in CAs. With their initially very large land area relative to CA farmers, RA farmers were able to invest more thus further widening the income gap between them. Kinsey released evidence from the panel data set that real crop incomes in RAs more than doubled over the period 1982/83 and 1995/96.[54] Another research later by Gunning, Hoddinott, Kinsey and Owens show that there has been an impressive accumulation of capital assets.[55]

The authors calculated gross revenues from crop production by multiplying the physical quantities reported by the households by the unit prices and the returns to agricultural tools and household labor increased three-fold and by about sixty percent respectively.[56] They found that the value of gross production increased about 460% between 1982/83 and 1995/96. Although household sizes increased significantly, they found the increase in per capita income of approximately 250% to be very impressive given that national-average per capita incomes had been stagnant since 1980.

In a follow-up analysis of the Kinsey 1999 study, Kinsey showed using the same data and additional information obtained from another survey round in 1999, that land reform beneficiaries cultivated 50% more land than non-beneficiaries, obtained four times as much in crop revenues, owned more livestock and had higher expenditures by 50 percent.[57] Using indicators of per-capita performance such as sales value of crops, hectares planted, remittances, livestock equivalents and expenditure, Kinsey showed that the resettled households earned twice as much from agriculture as did CA households, hence they were successful.

Most empirical work using this data has emphasized comparison indicators between beneficiaries and non-beneficiaries to make conclusions about the performance of resettled farmers. While it is important to discern if beneficiaries are actually better off than in their previous occupations, our work focuses on performance within resettlement schemes to detect the relative growth and development of beneficiaries within their sector.

Literature on this type of analysis seems limited to comparing performance between initial conditions at the start of the program (1982/83 in the case of the farmers in the panel dataset) to a later period. A common theory shared by all researchers is that households 'learn by doing'. We use 1992 as the base year for comparison when it is presumed farmers, who are at least 10 year veterans of resettlement, are on a well-defined path of growth with the majority of them operating at relatively high levels of efficiencies each year.

Factors influencing the Performance of Resettled Farmers

Kinsey and Binswanger present a review of the performance resettlement programs in Kenya, Indonesia, Malaysia and Zimbabwe. They identify critical success factors from the experiences of farmers in these countries as age, education, family labor force, marital status, farming experience and skills, and capital assets. Using age as a selection criterion, those aged under 45 are generally more successful. In terms of education, the authors say there is strong evidence that better-educated settlers in these countries are more successful. Agricultural and economic performance has a strong positive correlation with the number of family members able to work.[58] It was generally found that married settlers outperform unmarried settlers. Farming experience and skills are strong predictors of good performance.[59] Interestingly, there is no consistent evidence in favor of selecting settlers who already have capital or assets, as settlers who have gone into schemes well equipped have not fared better than those with little. However, the tendency has been for capable settlers to accumulate capital and acquire assets remarkably quickly.[60]

The Gunning et al. study examined possible effects on farm output of agricultural tools, household adult labor, land area used in crop production, the number of ox-teams owned by households, years of education of the household head and rainfall.[61] The quantity of household labor was not a statistically significant factor on gross crop output. However, the impact of education was only significant and modest in 1995/96 and not significant in 1982/83. There was a significant relationship between gross crop output and rainfall. Changes in agricultural tools and land accounted for much of the change in gross crop income.

Owens, Hoddinott and Kinsey examined the impact of agricultural extension on farm production in resettlement areas of Zimbabwe. The same data provided statistical evidence that farm-level extension visits increased productivity even after controlling for innate productivity characteristics and farmer ability. However, their results from single-year cross-sectional study need to be treated with caution as they found variability in the parameter estimates across individual crop years, especially between drought and non-drought years.[62] In a forthcoming publication, Owens, Hoddinott and Kinsey regress net crop income (net of input costs) on the real value of agricultural tools, pairs of trained oxen, available labor (measured by the number of adults 15-64), land used for crop production, visits by extension agents, average education of adults in the household, plot characteristics (soil type, slope, distance from home), distance to local markets, log rainfall and extension worker assessment of farmer ability.[63] Agricultural tools and trained oxen raise net crop incomes, though the latter is negligible in the drought year 1994/95. Owens et al. also found that having more land under crop increased output. With extension however, it was found that having one or two extension visits increased net crop incomes in the three non-drought years 1992/93, 1993/94 and 1995/96. For the drought year 1994/95, one or two visits had no or a negative effect on production. Farmers may have received technical advice early and fertilized their crops anticipating early rains only to suffer losses due to the drought. Those who received three or more visits however, got additional advice in a later visit that advised them not to top-dress their crops and to plant additional plots of unfertilized crop following sporadic rains. These had higher levels of crop production. Households who reported no crop income had significantly lower levels of capital ownership, labor and cultivated land.

Previous research suggests that the performance of resettled farmers hinges on access and delivery of adequate resources such as initial seed and fertilizer, labor, equipment, extension services and training to support production. We investigate the impact of credit delivery, extension visits, seed, spray and manure on the efficiency levels of crop production using the same data set. In addition we look at farmer characteristics: farming experience-measured by the number of years that the household head has been farming, and also by the number of years the family has been resettled; educational background measured by the total number of years of school for household head; participation in farmer organizations; and, access to off-farm income. Finally, we investigate the location effect of the resettlement schemes by including dummy variables for the three different natural regions which were represented by three different resettlement schemes.

PROCEDURE

Data

The data for this study come from the Zimbabwe Rural Household Dynamics project, a panel of surveys targeting resettled households beginning in 1982-1984. A household is a family unit allocated a 5-hectare plot of arable land under the model A resettlement scheme. These schemes were in three of Zimbabwe's natural regions. One scheme was randomly selected from each zone: Natural Region II – Mpfurudzi; Natural Region III – Sengezi (Wedza district); and Natural Region IV – Mutanda. Mpfurudzi Resettlement scheme is in Mashonaland Central, Sengezi resettlement scheme in Mashonaland East and Mutanda in Manicaland. The resulting panel of 400 households in 20 villages has been surveyed annually since 1983. In 1997, a set of 150 households in Communal Areas (CAs) from where the resettled families originated, was added for counterfactual comparison in evaluating resettlement performance.

TABLE 4 Efficiency of Resettled Farmers and Communal Farmers

	1992	1993	1996	1997	1997([a])
Overall sample: Average Efficiency No. of Farmers	0.47 219 23(10.50)	0.47 337 35(10.39)	0.58 172 31(18.02)	0.19 394 18(4.57)	0.12 147 6(4.08)

Frontier Farmers (b)	0.49	0.18	0.18	0.36	-	
	166	166	166	166	-	
Matched sample (c)	17 (10.24)	6 (3.61)	6 (3.61)	16 (9.64)	-	
Average Efficiency						
No. of Farmers						
Frontier Farmers (b)						

(a) Communal farmer set introduced in 1997
(b) Figures outside brackets represent number of observations, whilst the figure in brackets is the percentage of total observations.
(c) Matched sample contains households that had data available for all four years.

The households were surveyed each year. After data cleaning, we were left with years 1992, 1993, 1996 and 1997 with which we could perform our efficiency measurement. Cleaning the data yielded a subset of 166 households who were surveyed in all four of these years. The data were analyzed in a cross-sectional manner, separately for each year, to limit the influence of year-to-year weather or other shocks on relative productivity.

The households were highly dependent on crop output for their livelihood.[64] Almost all households planted maize and at least one of the following crops: cotton, tobacco, sunflowers, groundnuts, *nyimo* (bambara nuts), *rapoko* (finger millet), *mhunga* (small grains), and sorghum. Ninety nine percent of the farmers planted maize in 1990/91 through to 1995/96.[65]

Model Framework

There are two stages to this analysis. First, a nonparametric technique was used to measure efficiency (or distance from the efficiency possibility frontier) on a farm-by-farm basis. Second, a tobit regression was used to test whether farmers' relative efficiency levels were correlated with other factors, such as credit or extension visits received.

Efficiency Measurement by Data Envelopment Analysis (DEA)

DEA is a mathematical programming approach to construct a non-parametric frontier over cross-sectional data, and then measure efficiency relative to that frontier. The concept behind DEA is illustrated in Figure 2. The curve represents the efficiency frontier where the yields can be optimised for a given level of input X. In this model, we assume constant returns to scale.[66] We see that an efficient household at input level X, has maximum possible yield of Y*. Whilst an inefficient household operating below the frontier, at the same level of input X, produces only Y. The difference between the two represents technical inefficiency and the proportional expansion in output required for efficiency catch-up to frontier is the ratio OY*/OY.

Table 5. Average Household Efficiencies by Resettlement Scheme

	1992	1993	1996	1997
Mfurudzi	0.4873	0.4258	0.5355	0.1731
Sengezi	(0.5098)[a]	(0.1044)	(0.1083)	(0.3140)
Mutanda	0.4074	0.5076	0.6245	0.1237
	(0.5139)	(0.3578)	(0.3717)	(0.3605)
	0.4817	0.5567	0.7543	0.3615
	(0.4167)	(0.2891)	(0.2389)	(0.4618)

[a] Figures in brackets are average efficiencies of households in the matched sample

The efficiency or distance measure calculated for each household is the reciprocal of the proportional expansion given. This measure falls within the range of 0 to 1 where the best or frontier households for the year take the value of 1, whilst the less efficient households take values lower than 1 or each household, a linear problem, as given, is solved to compute the optimal efficiency θ (the envelope), which denotes the reciprocal of the output-based distance ratio required for farmers to catch up to the frontier. The constraints are output and input-based as shown for a sample of I producers.

$$\text{Max} \quad \theta_{z,\theta}$$

subject to

$$y^l \theta \leq z^k y^k \qquad k = 1,2,3,\ldots\ldots\ldots\ldots l$$

$$x^l \geq z^k x^k$$

$$z \geq 0$$

where x^l and y^l are the inputs and outputs of the household being evaluated and x^k and y^k are inputs and outputs of all farmers in the dataset, and z is an l by 1 intensity vector. At optimum, $\{\theta = 1, y^l\theta = z^k y^k, x^l = z^k x^k\}$, characterizes an efficient household. 67

The distance (efficiency score) was computed for households for individual years 1992, 1993, 1996 and 1997 using yield outputs of 5 major crops reported by each household. Three inputs, land, labor and fertilizer, were used together with the household aggregate crop yield variable to compute efficiencies. The incorporation of the land variable in this computation is an advantage of using DEA to measure efficiencies. By running linear programs, the land area constraint optimises output whilst maximizing the efficiency multiplier. This means given the same amount of land and labor, we are able to measure and compare the relative performance of farmers to an optimal level of performance within each year, unlike the methods used in the previous studies we have reviewed. However, since we calculated efficiency frontier for each of the individual years, the land area does vary by year.

Since actual data of family labor was not available for certain years, household composition data for household members were transformed in total days worked per year based on age and sex. We calculated household members of both sexes between the age of 7 to above 65 using a gender-age group labor equivalence conversion scale as given by Johnson.[68]

Total days worked per year for family and hired labor were available for 1994 and 1996. These data were compared with household composition to relate with the "real" days worked for each household. Household composition in 1992 and 1997 was multiplied by this coefficient to derive hired and family labor for these years. It was not possible to estimate this labor measure for communal households introduced in 1997 because household composition data was not available. Therefore, the efficiency measurements of the communal households lacked a labor variable. Acreage allocated to crops was used to calculate the total land used by the household for crop production. Fertilizer allocated to crops was aggregated to find the total fertilizer used by household.

A limitation with our model is the small number of the input variables included in the input vector. Other input data were categorical making it difficult to incorporate them into the efficiency measure. A more robust efficiency measure could probably be obtained with the inclusion of more input variables in the computations. However, we proceeded to analyse the efficiency measure further by regressing it on other non-continuous variables, which, apart from explaining variation in efficiency, to a certain extent corrected for the weakness of our efficiency model.

REGRESSION ANALYSIS

Efficiency gaps between households were explained using tobit regressions. The tobit regression model is used since the dependent variable is truncated at the high value. With the distance measure as the dependent variable, a regression model was estimated for each year with all available households, for available right-hand variables. Similar regressions were performed using the matched household set of the same 166 households each year.

RESULTS AND IMPLICATIONS

The Performance of Resettled Farmers

The relative production efficiency of resettled farmers was observed to fluctuate over the four years of data, with no significant trend over this time period. Using the unmatched sample for the largest sample size, the mean efficiencies were stagnant at 0.47 for 1992 and 1993, and increased to a high of 0.58 in 1996. Using 1992 or 1993 as the base year for comparison, this apparent catch-up of relatively low-productivity farmers to their high-productivity neighbors could help explain the Gunning et al. finding of improvement in average productivity over time. But looking only at the matched sample of 166 RA households that were observed in all four years, there was no such catch-up (Table 4). Clearly, there is no consistent trend in the variation of productivity among RA households.

Table 6. Coefficients of the factors related to efficiencies (Unmatched set)

Dependent variable: log {distance to efficiency frontier}				
Independent Variables	1992	1993	1996	1997
intercept	-2.0195** (4.7721)	-0.1293 (0.0683)	-0.4616 (0.2234)	-2.2927***(9.3553)
No cloan With loan (base group)	0.0724 (0.0895)	0.1538*** (8.2964)	0.3433* (3.7518)	-1.8548 (2.6237)
motorized vehicles (tractor, etc) 2 trained oxen, plow & cart 2 trained oxen & plow no oxen or plow, just bicycle no equipment (base group)	0.7489** (3.9253) 1.3219*** (6.8722) 0.6879** (4.0674) 0.6770** (3.9705)	-0.1149 (0.1599) 0.0031 (0.0001) -0.2105 (0.6240) -0.3038 (1.3217)	0.6195 (2.5639) 10.0890 (0.0000) 0.4903 (2.0395) 0.3527 (1.0277)	1.4715** (4.6176) 1.0699 (1.9730) 1.4653** (4.9470) 1.2659* (3,6754)
one extension visit twice visited 3 to 5 visits 6 to 10 visits plus 10 visits (base group)	0.0262 (0.0142) 0.0832 (0.1315) -0.1448 (0.5532) -0.0670 (0.0841)	0.0729 (0.3050) 0.0862 (0.5091) 0.0449 (0.1305) -0.0242 (0.0251)	-0.0014 (0.0000) 0.3495 (1.7180) 0.1594 (0.4706) -0.5416* (2.9826)	-0.4245 (1.5466) 0.1486 (0.1832) 0.0246 (0.0053) -0.1059 (0.0688)
Years of farming experience of of household head	0.0036 (0.1531)	-0.0109* (2.7808)	-0.0220* (3.6659)	----
School years of household head	0.0198 (0.5101)	-0.0170 (0.9727)	0.0170 (0.3693)	----
Resettlment experience (years)	0.0395 (0.6663)	-0.0249 (0.7908)	0.0082 (0.0237)	----
Share of land that is	-0.0004 (0.0189)	-0.0020 (1.5488)	0.0012 (0.3671)	0.0016 (0.6566)

manured				
NR II (Mfurudzi base group)	0.3056 (0.6005)	0.1942 (1.9067)	0.1423 (0.6075)	-0.6462***(12.8667)
NR III (Sengezi base group)	0.2145 (0.8534)	0.2192 (2.3503)	0.2054 (1.1805)	-0.6984*** (8.9738)
NR IV (Mutanda base group)	-2.0195** (4.7721)	-0.1293 (0.0683)	-0.4616 (0.2234)	-2.2927*** (9.3553)
No off –farm income Off-farm income (base group)	----	-0.1487 (0.0616)	-0.8024* (2.7472)	0.0671 (0.2242)
Not in farmer organisation Member (base group)	-0.0583 (0.1737)	-0.1008 (1.5446)	-0.1211 (1.0100)	-0.2422** (2.9308)
Share of land under with certified seed	-0.0024 (0.1918)	-0.0009 (0.2521)	----	----
Share of land sprayed	0.0050 (1.9930)	-0.0041* (3.7221)	----	----
Sample size	117	221	79	290
Log likelihood	-128.4790	-196.5043	-52.6365	-478.2624

Notes:Variables are defined in the text.
Parameter estimates are computed by TOBIT regression in SAS with *Chi-Square* values in brackets. Asterisks indicate significance at 10% (*), 5% (**) and 1% (***).

The empirical results in Table 4 also show that communal farmers are more diverse in their efficiency levels than resettled farmers, with an average efficiency level among the CA farmers of 0.12 compared to an average efficiency of 0.19 among the RA farmers. However, a crucial limitation with this result is that the efficiency scores for communal farmers lack information on labor input.

Dividing the households by resettlement schemes, again the matched and unmatched samples give different results, and there is no trend over time in the dispersion of productivity among farmers (Table 5). Clearly, these results do not support the idea that resettled farmers generally learned from each other and moved towards a common productivity frontier between 1992 and 1997. We are cautious, however, not to draw strong conclusions from this, due to the shortness of the period and the nature of the data. On the other hand, we can use differences in the relative productivity of individual farmers to ask what helped some to catch up with the frontier, while others fell behind. Multicollinearity was not a problem with the independent variables, as no significant correlations were found between them. Furthermore, dummy variables incorporated in a pooled model did not reveal consistent household or year effects. Proceeding with year-by-year regressions, we find that no factors were consistently correlated with relative productivity. Regression results for the whole sample (Table 6) and the matched sample (Table 7) show occasional statistical significance for some variables, but none are robust across years or samples.

Table 7. Coefficients of the factors related to efficiencies (Matched set)

Dependent variable: log {distance to efficiency frontier}				
Independent Variables	1992	1993	1996	1997
intercept	-1.8061 (1.4343)	1.0943 (0.1961)	2.0942 (0.6073)	-2.7124*** (13.2512)
No cloan With loan (base group)	0.2026 (0.5996)	0.1218 (0.1866)	0.1281 (0.1061)	----
motorized vehicles (tractor, etc) 2 trained oxen, plow & cart 2 trained oxen & plow no oxen or plow, just bicycle no equipment (base group)	0.9440** (5.6922) 1.5278***(9.3834) 0.7335** (4.6310) 0.7229** (4.2301) -1.8061 (1.4343)	-0.5601 (0.4905) 0.4068 (0.1424) -0.4022 (0.3153) -0.1084 (0.0230) 1.0943 (0.1961)	1.3444 (2.6469) 2.1396* (3.2478) 0.5595 (0.6468) 0.7229 (1.0031) 2.0942 (0.6073)	0.5150 (0.6747) 0.6747 (0.8311) 0.5352 (0.7717) 0.1542 (0.0621) -2.7124*** (13.2512)
one extension visit twice visited 3 to 5 visits 6 to 10 visits plus 10 visits (base group)	0.0282 (0.0138) 0.1620 (0.3943) -0.1182 (0.2846) -0.1621 (0.3885)	-0.0704 (0.0273) 0.0948 (0.0573) -0.0743 (0.0395) -0.2331 (0.2354)	-0.4062 (0.4191) 0.6392 (0.9426) 0.2299 (0.1431) -0.6793 (0.9000)	-0.4821 (1.1191) 0.0837 (0.0342) 0.2574 (0.2981) -0.1974 (0.1545)
Years of farming experience of of household head	-0.0022 (0.0401)	-0.0196 (0.7880)	-0.0831***(10.2890)	----
School years of household head	-0.0179 (0.3404)	0.0117 (0.0377)	-0.0020 (0.0014)	----
Resettlement experience (years)	0.0296 (0.0734)	-0.2367 (1.9250)	-0.1751 (1.1428)	----
Share of land that is manured	-0.0055* (2.9529)	-0.0014 (0.0697)	0.0014 (0.1097)	0.0030 (1.5801)
NR II (Mfurudzi base group)	0.5552 (2.0510)	1.2517***(6.8598)	1.2329*** (8.3033)	1.0268*** (19.1675)
NR III (Sengezi base group)	0.2159 (0.5538)	0.0894 (0.0292)	-0.4276 (0.8983)	1.1255*** (9.4937)
NR IV (Mutanda base group)	-1.8061 (1.4343)	1.0943 (0.1961)	2.0942 (0.6073)	-2.7124*** (13.2512)
No off –farm income Off-farm income (base group)	----	0.1910 (0.6351)	-0.7907* (3.6096)	0.0432 (0.0651)
Not in farmer organisation Member (base group)	-0.0269 (0.0318)	-0.0269 (0.0113)	-0.8790***(12.2269)	0.1706 (1.1460)
Share of land under with certified seed	-0.0015 (0.0560)	0.0000 (0.0001)	-0.0069 (0.0881)	----
Share of land sprayed	0.0040 (1.2488)	-0.0088 (1.3372)	-0.0053 (0.2987)	----
Log likelihood	-94.1313	-183.2921	-105.0482	-136.5540

Notes:
Variables are defined in the text.
Parameter estimates are computed by TOBIT regression in SAS with *Chi-Square* values in brackets. Asterisks indicate significance at 10% (*), 5% (**) and 1% (***).

Conclusions and Recommendations

The limited duration and nature of the available data makes it difficult to draw solid conclusions about the performance of resettled farmers, other than the persistence of large productivity differences among them – and the absence of consistent correlation between those differences and standard explanations of farm productivity. In the unusual context of Zimbabwe's resettlement schemes, we do not find generally higher relative efficiencies among farmers who use more equipment, receive formal credit, have more visits from extension workers, have more education or experience, or are members of a farmer organization.

Since we find wide and persistent variation in productivity that cannot be explained by variation in government services, we conclude that the GoZ approach did not help farmers converge to locally appropriate best practices in these resettlement areas. Resettled families were given plots of identical size—but large differences in performance continued for more than a decade, throughout the period for which we have data. The Zimbabwean experience thus provides little positive guidance as to what should be done to help farmers discover best practices, but it does provide fresh evidence on the degree to which productivity differences can persist despite equalization of plot size across households.

Notes:

1. Adams and Howell, 2001
2. UNDP, 2002a
3. UNDP, 2002b
4. Government of Zimbabwe, 1993
5. Masters, 1994a
6. von Blanckenburg, 1994a
7. Kinsey, 1999
8. ibid
9. Deininger, van der Brink, Hoogeveen and Moyo, 2000
10. Masters, 1994b; UNDP, 2002c
11. Masters, 1994c
12. Moyo, 2000a
13. von Blanckenburg, 1994b
14. ibid.
15. Masters, 1994d
16. ibid.
17. ibid.
18. ibid.
19. ibid.
20. Moyo, 2000b
21. ibid.
22. ibid.
23. ibid.
24. Moyo, 2000c
25. Crisis in Zimbabwe Coalition, 2002; Reserve Bank of Zimbabwe, 2003; Tony Hawkins, 2001
26. Thirtle et al., 1993a, 1993b; Masters, 1994e
27. GoZ, 1999a
28. von Blanckenburg, 1994c
29. UNDP, 2002d

30. GoZ, 1999b; UNDP, 2002e
31. UNDP, 2000f
32. ibid
33. ibid
34. von Blanckenburg, 1994d.
35. ibid; Kinsey,1998a.
36. UNDP, 2002g
37. ibid.
38. ibid.
39. Kinsey, 1998b
40. Rukuni, 1994
41. Kinsey, 1998c.
42. Kinsey and Binswanger, 1993a
43. UNDP, 2002h
44. UNDP, 2002i
45. Kinsey and Binswanger, 1993b
46. GoZ, 1999c
47. ibid.
48. UNDP, 2002j
49. Kinsey and Binswanger, 1993d
50. Masters, 1994f; von Blanckenburg, 1994e; UNDP, 2002k [51] Parastatals are entities such as GMB that are partially owned by the government- privatization under ESAP (the economic structural adjustment programme) later replaced by ZIMPREST (Zimbabwe Program for Economic and Social Transformation) in the last 1990s rendered most of the parastatals independent of government.
51. Gunning, Hoddinott, Kinsey, & Owens, 2000; Kinsey and Binswanger, 1993c; Masters, 1994g
52. The term 'land grab' has been increasingly used particularly in international media to define the aggressive land reform adopted by the GoZ post the September 1998 donor conference.
53. Kinsey, 1999
54. Gunning, Hoddinott, Kinsey and Owens, 2000
55. For example, agricultural tools included ox-drawn ploughs, ox-carts, cultivator/harrows, ox-planters, water carts, cotton sprayers, wheelbarrows, tractors and tractor implements, hoe, axes, spades, machetes and slashers
56. Kinsey, 2001
57. Kinsey and Binswanger, 1993d
58. ibid.
59. ibid.
60. Gunning, Hoddinott and Owens, 2000.
61. Owens, Hoddinott and Kinsey, 2001
62. Owens, Hoddinott, Kinsey, forthcoming publication made available by one of the authors, Bill Kinsey.

63. Hoddinott, Kinsey and Owens, 1999
64. ibid.
65. Other papers have considered alternative sets of assumptions in which a variable returns to scale model is proposed.
66. Lovell, 1993; Battese *et al.*, 1998
67. Johnson, 1990: Conversion scale
68.

Labor class	Age (years)	Man-units	Equivalent man-days/month
Small child	Less than 7	0.0	0
Large child	7-14	0.4	10
Male adult	15-64	1.0	25
Female adult	15-64	0.8	20
Male adult	65 or more	0.5	12.5
Female adult	65 or more	0.5	12.5

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Reference Style: The following is the suggested format for referencing this article: Chiremba, Sophia and William Masters. "The Experience of Resettled Farmersin Zimbabwe." African Studies Quarterly 7, no.2&3: [online] URL: http://web.africa.ufl.edu/asq/v7/v7i2a5.htm