Population mobility and the survival of small farming in the Rio Grande Valley, Jamaica

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The relationship between population mobility and farming is complex and has been the focus of numerous studies. Despite differing perspectives on the subject, there is an increasing realization that migration sustains farming in many rural communities, but with contradictory effects. Notwithstanding this conclusion, there is a paucity of village level studies that explain the precise ways in which migration in its various forms affects the survival of small farms. This paper reports on the results of a village level study of migration and small farming in the Rio Grande Valley of Jamaica. Apart from highlighting the various ways in which migration affects small farming at the local level, the study confirms the contradictory impact of migration on small farming in this remote agricultural community. It is noted, however, that the net effect is positive and the capital and labour resources, which are made available as a result of migration, play pivotal roles in the survival of small-scale farming as an economic activity in the area.

KEY WORDS: Caribbean, Jamaica, population mobility, sustainable development, small farming

Introduction

The impact of population mobility on agriculture has been the focus of much debate over the past two decades. A review of the literature reveals that there are essentially two major perspectives on the subject. One perspective focuses on the negative aspects of migration, particularly on the increased dependency of rural people on remittances, and the consequent loss of food self-sufficiency at the village level (Shankman 1976; Connell 1980; Brana-Shute and Brana-Shute 1982; Mandle 1996; Duany 2001). Writers from this perspective have argued that migration results in reduction in the size of community labour forces. This, in turn, affects the productive capacity of those remaining behind, resulting in poorly maintained land and gradual deterioration of the agricultural infrastructure. Money obtained from remittances is used to purchase food rather than cultivating it. Altogether, it is argued that communities are worse off as a result of migration.

The work of Conway and Glesne (1986), Gmelch (1987), Thomas-Hope (1993), deSouza (1998) and Poirine (1998) offers an alternative perspective on the effects of migration. For example, Thomas-Hope (1993) has argued that capital transfers, which form part of the migration circuit, are essential for the economic viability of a significant number of Caribbean households. She noted that such capital makes a major positive contribution to development because incomes are used to support local production as well as consumption. Nevertheless, she noted that negative impacts are experienced in situations where there is persistent dependency on external funds, or where absenteeism occurs for an extended period of time. In both situations, agricultural lands become idle and this undermines
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Small farming in the Rio Grande Valley will be a key issue for the survival of small farming in the area. This paper examines the ways in which the process of migration operates at the micro-level in the Rio Grande Valley. Particular attention is paid to how small-scale farming is sustained as a result of household migration decisions. Additionally, the study seeks to analyze statistically the relative importance of the various factors that contribute to the survival of small-scale farming in the Rio Grande Valley.

The Rio Grande Valley

The Rio Grande Valley has long been regarded as an environmentally sensitive region in Jamaica. Situated in the Parish of Portland in the northeastern section of the island, the area covers approximately 286 km² (Figure 1). More than one-third of the land is 1500 m above sea level, and more than one-half of the land has slope gradients of over 20%. The terrain is mountainous and the steep slopes make farming difficult.

In the Rio Grande Valley, there have been questions as to how small-scale farming (referred to as small farming) has managed to survive and expand despite out-migration, which has resulted in population decline in many communities. There have also been questions about how exactly small farming has managed to survive and expand despite the various environmental hazards that are frequently experienced. Several studies on farming sustainability in the Rio Grande Valley exist, which have greatly contributed to the understanding of the area’s farming system, and which have directly or indirectly provided answers to some of these questions (Meikle 1994; Davis-Morrison 1998; Davis-Morrison and Barker 1997; Thomas-Hope et al. 1999; Reid 1999).

Davis-Morrison (1998) and Davis-Morrison and Barker (1997) have alluded to various soil conservation strategies devised by farmers, government-sponsored flood control programmes, the ability of small-scale farmers to adapt to environmental hazards, and changing external market demands as important reasons for the persistence of small farming in this area. However, a frequently overlooked factor is the impact of population mobility in sustaining small-scale farming in the area. This paper examines the ways in which the process of migration operates at the micro-level in the Rio Grande Valley. Particular attention is paid to how small-scale farming is sustained as a result of household migration decisions. Additionally, the study seeks to analyze statistically the relative importance of the various factors that contribute to the survival of small-scale farming in the Rio Grande Valley.
Brown 1976). According to both Brown and Carey, the collapse of the sugar industry in the Valley was due to the very rainy conditions and poor roads that made transport expensive. Additionally, the heavy rains made sugar a difficult crop to grow, and with the end of slavery in 1838, the lack of cheap labour made it uneconomic to grow the crop (Carey 1970; Brown 1976).

Many ex-slaves moved to the interior hills and became peasant farmers after the collapse of slavery – an early example of population mobility in response to changing conditions on large farms. However, many of them also became new land owners, as sugar estates in Portland were subdivided and sold or rented to the freed people (Carey 1970; Brown 1976). These new small farmers began to grow crops such as yam, coco (eddoes) and dasheen, and supplied them to Falmouth and Montego Bay where food was short. Shortly afterwards, Portland became known as the ‘coco parish’ (Brown 1976).

At first, small farmers grew bananas only for home consumption, but in the late nineteenth century, merchants started buying bananas from small farmers for export. Eventually, small farmers became a vital component of the banana export industry. Simultaneous with the entrance of small farmers into the export banana industry was the growth of large farm involvement in export banana cultivation (Brown 1976). Large tracts of land in Golden Vale, Fellowship, Windsor and Seaman’s Valley were bought by large farmers for banana cultivation. Thus, large-scale banana cultivation also became firmly entrenched in the lowlands of the Rio Grande Valley.

Today, the large banana farms still occupy the lowlands in the Valley. On the other hand, the smaller farms producing food crops for the domestic market and bananas for export predominate in the interior hills of the island. Beckford (1972) has documented the political economy of this dichotomy in the locational pattern of agriculture in Jamaica, where large export-oriented farms account for the largest portion and best quality of farmlands, mostly in lowland areas, and the small farms occupy marginal lands, mostly in hilly areas on steep slopes. Watts (1987) has shown that a similar pattern also exists in other Caribbean islands.
the other hand, Critchlow (1988) has pointed out that there is a definite geographic clustering of small farms on the fringes of plantations. Much of this occurred because plantation owners made marginal lands available to members of their workforce in order to have a cheap source of readily available labour. This is another early example of population movement of small farmers in response to conditions on large farms. Another trend noted by Critchlow (1988) is that small farmers’ share of total agricultural land by acreage has remained small, while large plantations have maintained a disproportionately large share of land. Thus, the resource base of small farmers, in terms of land, has diminished substantially while their numbers have steadily increased.

The classic description and analysis of how precisely small farming is organized in Jamaica can be found in the work of Edwards (1961). In terms of the Rio Grande Valley, the work of Meikle (1994), Davis-Morrison and Barker (1997), and Davis-Morrison (1998) has provided more recent insights into these small-farming systems. Since the 1960s, when Edwards’ work was published, there have been changes in farming practices. For example, agrochemicals, which were hardly used in the early 1960s, now play a significant role in cultivation practices in response to the deepening integration of export farmers into the global production system (Semple et al. forthcoming). Cropping emphasis on the small farms keeps changing constantly (Davis-Morrison 1998), and the levels of biodiversity have been on the decline, threatening the agro-ecology of farming communities and ease of access to diverse plants for varied cultural practices (Thomas-Hope et al. 2000).

Clearly, changing economic conditions have a significant impact on how agriculture is organized, and this in turn affects the interaction between small- and large-scale farms on the island. Migration by small farmers and the relocation of farms in response to changing economic conditions have always been important components of these changes.

### Methods

The base data for selecting the sample of households was the 1991 population census, which provided information on the total number of households in the study area (Table 1). A sample size of 431, or 20%, of the households was selected for interviews from across the study area, representing 249, 135 and 47 household heads from the Lower Valley, Middle Valley and Upper Valley, respectively (Figure 1). Due to the high probability of error associated with small sample sizes, this large sample was chosen to increase the reliability of the findings. A coded questionnaire was used to collect the data on topics such as household characteristics, farming practices, population mobility and labour utilization.

Houses that could be visited for interviews were identified by consulting the most recent topographic maps of the area along with existing aerial photographs. Information from the aerial photos and topographic maps was updated through field surveys. This exercise took place in July 1999. Households were selected for interviews by systematically sampling every fifth house following the main roads and footpaths. Each house in the population of houses in a given community was assigned a number and the first house on each roadway or footpath was selected randomly from the list of numbers. The other houses along the roadway were selected using the skip sequence from the initial randomly selected house. In some cases, the skip sequence had to be adjusted to take into consideration the number of houses along a particular roadway. Systematic sampling proved to be an applicable technique because of the linearity of the settlement pattern in the area. To guard against bias, and in order to maintain consistency, only household heads were interviewed. In the few cases where a house contained multiple households, the most elderly household head was interviewed.

A local interpreter (a small farmer from Fellowship with excellent community knowledge and public relations skills) was utilized to assist the researchers for the entire period of the fieldwork (July–December 1999). Additionally, one of the researchers resided in the Fellowship community, living with a small farmer and his family for the entire period of field investigation. This experience provided detailed information about the geography of the Rio Grande Valley and the issues related to the sustainability of farming livelihoods.

### Table 1 Population and sample sizes for different sections of study area in the Rio Grande Valley

<table>
<thead>
<tr>
<th>Area</th>
<th>Population</th>
<th>No. of households</th>
<th>Sample size (20% of total households)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Valley</td>
<td>5605</td>
<td>1245</td>
<td>249</td>
</tr>
<tr>
<td>Middle Valley</td>
<td>2877</td>
<td>676</td>
<td>135</td>
</tr>
<tr>
<td>Upper Valley</td>
<td>862</td>
<td>237</td>
<td>47</td>
</tr>
<tr>
<td>Total</td>
<td>9344</td>
<td>2158</td>
<td>431</td>
</tr>
</tbody>
</table>

*Source: Calculated from the 1991 Population Census, Parish of Portland, Statistical Institute of Jamaica (STATIN)
A second phase of informal field interviews (qualitative data collection) was carried out to obtain detailed life histories of farmers with respect to livelihood activities and geographic mobility patterns. The life histories of 17 farmers were collected. Farmers were selected from the older age group of 60 years and over, a middle aged group, 40–50 years, and the age group below 40 years. Six large-scale farmers were also interviewed because of their significant influence on small farming in the area.

Other informal interviews were conducted with officers from the Rural Agricultural Development Agency (RADA), the main government agricultural extension agency. RADA officers provided background information on the farming practices in the Rio Grande Valley and the constraints experienced by the farmers. Interviews were also conducted with officers from the Banana Export Company (BECO) to gain knowledge about practices and issues associated with the export marketing of bananas, the main export cash crop in the area. In addition to primary data collection, secondary data were collected from population censuses, agricultural censuses, aerial photographs and other historical accounts.

The use of both qualitative and quantitative methods facilitated an in-depth interpretation of the relationship between population mobility and the sustainability of farming households. As noted by Punch (1998), employing both quantitative and qualitative research methods provides a means of bridging the macro–micro gulf.

The coded questionnaires were entered into the Statistical Package for Social Scientists (SPSS). Since most data collected were categorical, chi square tests were used to study associations between variables. Logistic regression analysis was used to study the differential impact of various population mobility parameters on the survival of small farming. With respect to qualitative data, the life histories of the farmers were summarised and presented to the respective farmers to ensure that accurate recordings had been made. These summaries provided the basis for the analysis.

Data analysis

Population mobility in the Rio Grande valley

The survey data revealed that 67% of household heads and their spouses had previously migrated into the study area. Most of these people originated from communities elsewhere in the Rio Grande Valley, but others came from elsewhere in Jamaica. In addition to internal migration into the study area, some household heads had also engaged in other significant forms of migration patterns. These included migration to other communities in the Rio Grande Valley or elsewhere in Jamaica, temporary overseas migration, and long-term overseas migration. Temporary overseas migration involved migrating to work on farms in the USA and Canada, cruise ship work, unspecified casual work, and visiting relatives. Approximately 12% of household heads indicated that they had participated in temporary overseas migration. Also, approximately 38% of the households had at least one member who had migrated permanently and was thus still living outside the Rio Grande Valley – mostly in the United States, Canada and the UK. Several returned overseas migrants were also encountered during the survey.

Most of the internal migration within the Rio Grande Valley was induced by prolonged economic hardships caused by the deterioration of local roads in some communities. Survey respondents complained that the lack of maintenance of farm to market roads led to the forced abandonment of farms and increasing inaccessibility of communities. Other important reasons for migrating include the accompanying of migrating parents and spouses, and the attraction of employment on larger, export-based farms.

Impact of population mobility on small farming in the Rio Grande Valley

Population mobility affects small farming in complex ways in the Rio Grande Valley. One way of analyzing the relationship between the two factors is to use a life cycle approach and examine farming patterns before and after migration. In this way, many hitherto unaccounted factors are brought to light. In this section, the impact of different types of population mobility on a number of factors associated with small farming will be analyzed.

The survey data revealed that with respect to persons classified as internal migrants into the study area, 71% of them regarded small farming as their primary occupation prior to migration. However, after migration, only 53% continued to regard small farming as their primary occupation. The decline in the proportion of persons stating farming as their primary activity is attributed mainly to migrant farmers having to seek alternative jobs as a means of adaptation to their new environment following migration. In most cases, alternative occupation involved working as labourers on the larger farms in the area. While the switch by household heads from small farming as a primary occupation to wage labour as their occupation appeared to be detrimental to the survival of small farming, it actually did not represent an overall
rejection of small farming as an economic activity. Rather, small farmers worked as wage labourers on larger farms in the hope of raising enough money to finance a full return to small farming as a primary occupation. The pace at which people were able to re-establish themselves principally as small farmers varies and depends on each household’s ability to acquire the appropriate resource base, particularly a permanent land base.

Migration and land acquisition patterns

Relocating to a new community means that small farmers rarely have access to land to practice agriculture. Farmers who were once secure in land ownership suddenly find themselves without land of their own to practice agriculture and having to develop strategies to acquire such land. Acquiring land to establish a farm after moving into a new community is a particularly difficult task for internal migrants because most of the prime land for cash crop farming, particularly the cultivation of bananas, is either already occupied by large farms, or is too far from the migrants’ place of residence. In order to establish their land base, migrant farmers become involved in an extended process lasting several years. The first stage of this process involves acquiring small plots of land. As a whole, migrant farm households possess an average of two plots while non-migrant farm households possessed an average of one plot. The small size of the plots acquired by migrant farmers was revealed by the fact that their farm size prior to migration in the previous location was between 5 and 10 acres. After migration, the farm size fell to between 1 and 5 acres.

Among migrant small farmers, it is possible to distinguish between those moving from places within the Rio Grande Valley and those migrating from places outside the Valley. Whereas migrants from within the Valley had little finance when they migrated and moved with the intention of re-establishing themselves with finance gained from labouring on larger farms or other activities, the majority of those migrating from outside of the Valley, particularly from overseas, relocated with an already strong resource base. For most in the latter group, farming in the Valley was a continuation of capital accumulation rather than the initiation of a new capital venture. Their strong capital base allowed them to acquire larger portions of land and to be farther along in the farm establishment process.

Migration and supply of farm labour

Once new land was acquired, migrant farmers had to make adjustments in methods of obtaining their labour supply. Prior to migration, farmers tended to depend on household members to supply farm labour, or on exchange of labour between households. Exchange of labour between households is a traditional arrangement that typically involves one farm household rendering unpaid service to another farm household if a major task was required to be completed. In return, the household providing the service expected to be provided with similar services, when a similar task was required on their farm. The survey revealed that 76% of farmers depended on these forms of labour supply before migration. Following migration, there was a major switch in this pattern with 71% of farmers depending on hired labour. This change in labour utilization reflected the fact that internal migration brought migrant farmers under the direct influence of a wage-based economy in which access to cash was a constant preoccupation. Within this system, traditional labour arrangements did not survive despite the fact that these arrangements were very cost effective and their abandonment put migrant small farmers under additional financial pressures as they sought to re-establish their farms.

Migration and land tenure

Land tenure arrangements also varied following migration. In the study area, 71% of household heads who had never migrated occupied family land. However, among migrant household heads, land tenure was much more diversified, with 51% occupying family land. The remaining proportion occupied land with a variety of insecure land tenure arrangements, including squatting. The process of acquiring permanent land varied and took several years, as most land holdings were still controlled by the original residents who were reluctant to sell. The term family land needs to be clarified in the context of this study. In this study, family land refers to land that is communally owned by the family of a deceased person, which is subordinated to the long-term symbolic role of serving generations of family members (Besson 1988 1997). As pointed out earlier, migration farmers go through a lengthy process of trying to re-establish a secure land base. This process can take several years and during this time, farmers occupy land with varying tenurial arrangements including squatting or being permitted to work underutilized family lands. The prevalence of insecure land tenure following migration directly influences the type of cropping system practiced. Land holdings with some form of permanent tenure were utilized for cash cropping, mainly bananas, which is the main crop produced for export in this part of
Jamaica. These lands were also cultivated with coconuts or other permanent crops destined for the local market. On the other hand, non-permanent land holdings were cultivated with ground provision crops, such as dasheen, coco, and yam. In general, the cropping regime that a small farmer decided upon was based on his or her knowledge of market demand and the quality and size of land available. However, such decisions were also dependent on the tenurial status of the occupied land.

Migration and agrochemical usage

There was also a noticeable change in the level of agrochemical usage before and after migration. Prior to moving, 10% of farmers used agrochemicals in their operations. Following migration, 88% of farmers used agrochemicals. This increased usage of agrochemicals reflected the view of migrant farmers that these chemicals were necessary in order to increase output, as their land base was very small. By increasing the level of agrochemicals, it was hoped that maximum returns could be obtained from very small plot sizes.

Migration and environmental adaptation

Migration affected people’s ability to cope with their physical farming environment. In this aspect, age played a significant role in the migration process. In general, young people predominated in the movements that occurred within the Valley. The implication of this is that the traditional course that young people followed while taking up farming as an occupation was disrupted. As more young and inexperienced farmers participated in migration, there was a delay in the process of them becoming well established farmers because their land resource base was too small or they were too slow in acquiring land in their new environment. In addition, they took too long to acquire requisite farming knowledge because they spent most of their time as farm labourers on large farms rather than as full-time farmers. The problems of adaptation were more severe for older migrant farmers because they had already reached maturity in their profession, and were sometimes unable to adapt to conditions in their new environment.

Prior to migration, farm holdings were characterized by larger plots, which allowed for farming practices that included fallowing and a wider mix of crops. Since the plots were larger, it was easier to cope with adverse environmental problems, such as flooding or landslides, because adequate land would still be available for cultivation while the affected portions recuperated from environmental stress. Following migration, older farmers who had not accumulated enough capital to buy land underwent a phase of desperate adaptation. For these older migrants, disruptions of an already established and mature farming system created prolonged emotional strain as they tried to cope with the unfavourable farming conditions of the new locality. Younger migrants fared better because their physical strength allowed them greater opportunities. The steep terrain and distance of farm plots from their houses did not altogether prohibit the younger farmers from journeying back and forth to their original farmlands. The impracticability of farming on the original lands before migration added to the sustained marginalization of the older, migrant farmers.

Remittance utilization and small farming

Approximately 79% of households in the sample received remittances from persons who had emigrated outside of the Rio Grande Valley, particularly to the USA, Canada and the UK. Remittances were received mainly from family members, but some were also received from friends, and from absentee owners in return for the management of their farms.

Remittances were usually in the form of money, foodstuff and clothing. The majority of recipients received cash (47%); 31% received foodstuff and 22% received clothing. Approximately 74% of remittance recipients received cash monthly. This high percentage meant that cash remittances were a reliable source of income for household expenditure in the Valley. However, the amount of money received was not generally high. Sixty-seven percent of recipients received less than Ja$5000 per month and 90% less than Ja$10,000 (US$1 = Ja$60). Approximately 57% of the remittances were used for household expenditures while the remainder was spent on farming activities.

In many respects, remittances supported farming in the Rio Grande Valley, although, as the logistic regression analysis showed, they did not play a significant role in predicting the likelihood of a farm surviving in the Rio Grande Valley. Remittances were used to purchase farm inputs such as seeds, implements and agrochemicals, and to hire farm labour. In some cases, they were also used to finance the purchase of land for farm expansion. This was particularly true for temporary overseas migrants who remitted a large proportion of income earned overseas for farm expansion. Also, during periods of setbacks caused by environmental hazards, such as landslides and flooding, up to 80% of households depended on remittances for basic expenditures as well as rehabilitation of their farms.
Temporary overseas migration and small farming

Approximately 12% of the sample comprised household members who had periodically engaged in temporary overseas migration. The survey data revealed that male temporary overseas migrants spent slightly more than half of their earnings on farm operations, whereas female temporary migrants spent most of their income on household needs. Most temporary overseas migrants were men who worked on cruise ships or in farm work programmes. The average earnings from their farms ranged from Ja$5000 to 8000 per month, which was higher than the Ja$3000–5000 per month earned by most other small farmers in the sample. The relatively higher income of temporary overseas migrants enabled them to have larger farm operations, as they were able to hire more farm labour or purchase larger amounts of farm inputs or land for farming. Temporary overseas migrants possessed farms with an average of 5.4 acres while the overall average was just 2 acres.

The ability to afford greater amounts of hired labour and agrochemicals meant that temporary overseas migrants could engage in export-oriented agriculture, which required a greater amount of capital outlay. Approximately 78% of persons who participated in temporary overseas migration were engaged in export crop cultivation. By virtue of their exposure to modern farming technology while abroad, temporary overseas migrants also appeared to be more apt to introduce new technology on their farms.

The impact of returning residents and absentee farm owners on farming

Returning residents and absentee owners exerted a significant influence on farming in the Rio Grande Valley as they owned most of the large farms, particularly farms used for export agriculture. This group of farmers comprised 17% of the sample, with returning residents accounting for 13% of the total and absentee farmers 4% of the total. Returning residents were regarded as those persons who had lived for substantial periods of time either elsewhere in Jamaica or in foreign countries. Absentee owners of land in the Valley also included persons who were living abroad or elsewhere in Jamaica. Most farmers who had previously lived overseas relied on pensions as their primary income and farming as their main secondary income. Approximately 92% of returning residents engaged in export farming. The average size of their farms was 10 acres and they employed an average of five persons per farm.

The strong influence of returning residents and absentee farmers on small farming derives from the fact that the larger farms they operated provided jobs for people in the Valley. Larger farms accounted for 38% of the labour force in the sample. The large farms also relied on labour reservoirs outside the Rio Grande Valley, particularly in the nearby town of Port Antonio. The demand for such labour provided the basis for labour circulation within the Valley and the seasonal migration of labour from outside the Valley. In general, the ability of the large farms to induce labour to move between communities in the Valley contributed to the retention of agricultural labour in the Valley.

The impact of Port Antonio as a tourist market on migration and small farming in the Rio Grande Valley needs some elaboration. The influence of urban capital on small farming has been studied by Morton (1993), who noted that the high population density in urban areas in Africa tended to stimulate intensive cultivation on small-scale farms. Similarly, Morton (1999) used the example of Embu, Kenya to demonstrate how the economic sustainability of small farming in rural areas was maintained as a result of the presence of the nearby urban area.

In the Rio Grande Valley, there is the potential that the presence of Port Antonio as a tourist destination might further stimulate the rate of internal migration especially towards nearby farming areas in the lower part of the Valley. Port Antonio could increasingly become a catalyst for income diversification. The work of Ishemo (2005) showed that income diversification in the Rio Grande Valley improved the capacity of small farmers to gradually accumulate income. This resulted in the expansion of farm acreage and increased flexibility of choices of cropping patterns. In addition, the rise in income level among small farmers might stimulate greater demand and competition for hired labour and increase capital input in the farming process. Clearly, the growth of Port Antonio as a tourist base in the Rio Grande Valley could have a major impact on the sustainability of small farming in the Valley.

Logistic regression analysis

In addition to examining social and economic channels through which population mobility aided the survival of small farms, this study also attempted to measure statistically:

1. the degree to which population mobility promoted the survival of small farms; and
2. the differential impact of various population mobility parameters on the survival of small farming in the Rio Grande Valley.

Since most of the data collected were nominal, a logistic regression, specifically, a bivariate logistic
regression or logit model, was used to analyze the data. The bivariate logistic regression model was also chosen because of its ability to handle situations where the dependent variable was dichotomous, and where some, or all of the independent variables involved two or more responses. The general form of the bivariate logistic regression model can be specified as follows:

$$\ln\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_n X_n + \epsilon_i$$

where $P$ = the probability that a farm will survive, $1 - P$ = the probability that a farm will not survive, $\frac{P}{1-P}$ = the odds ratio in favour of a farmer having a farm that is surviving, $X_i$ = the determinants of the probability of farmers having surviving farms, $\epsilon_i$ = the error term in the equation. The error term is assumed to be normally distributed with a mean of zero and constant variance.

In the logistic regression model, the logarithm of the odds ratio (or logit) is linearly related to $X$ so that in the equation above, $\beta_0$ is the odds ratio when $X$ is zero and $\beta_i$ is the change in odds ratio per unit change in $X_i$. Thus, for a given set of independent variables, it is possible to determine the odds of a household having a farm that will survive in the Rio Grande Valley. Also, by comparing the values of the various coefficients, it is possible to assess the relative importance of the individual variables in explaining the probability of households having small farms that will survive in the Rio Grande Valley.

The logistic regression model was specified to include population mobility variables, as well as variables that captured aspects of farmers’ biographical and farm characteristics. By examining migration variables within the context of other factors affecting the survival of small farms, it was hoped that a clearer picture of the relative importance of migration variables would emerge. A large number of independent variables were considered relevant to the logistic regression model; however, only nine were used in the model. The selection of model variables was based on the fact that these variables were frequently cited in the literature as being strongly related to the survival of small farming. In addition, during fieldwork interviews, many farmers cited these variables as being strongly connected to the long-term survival of their farms. The empirical logistic model was specified as follows:

$$\text{LIKELIHOOD\_OF\_SMALL\_FARM\_SURVIVING} = \beta_0 + \beta_1 \text{RETMIG} + \beta_2 \text{TEMPMIG} + \beta_3 \text{INT\_MIGRATION} + \beta_4 \text{EDUCATION} + \beta_5 \text{EMPLOYED\_ON\_LARGEFARMS} + \beta_6 \text{HIRED\_LABOUR} + \beta_7 \text{HSEHOLD\_WITH\_MIGRANTS} + \beta_8 \text{AGE} + \beta_9 \text{REMITTANCE} + \epsilon_i$$

The key for interpreting the explanatory variables is shown in Table 2.

The model was estimated using SPSS, version 10. In evaluating how well the model fitted the data, the log likelihood statistic and the Wald chi square values for individual coefficients need to be examined. The log likelihood statistic is an indicator of how well the overall logistic regression fits the data. Ideally, the log likelihood statistic should be as close as possible to zero, which indicates a perfect fit between the specified model and the data. A large log likelihood statistic indicates a poorly fitting model. However, if the model is re-specified with better variables, the log likelihood

Table 2 The key for interpreting the explanatory variables

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIKELIHOOD_OF_SMALL_FARM SURVIVING</td>
<td>Surviving farm: 1 if farm increased output or if output remained constant; 0 if otherwise</td>
</tr>
<tr>
<td>RETMIG</td>
<td>Returned migration: 1 if household head is a returned migrant; 0 if otherwise</td>
</tr>
<tr>
<td>TEMPMIG</td>
<td>Temporary migration: 1 if household head is a temporary overseas migrant; 0 if otherwise</td>
</tr>
<tr>
<td>REMITTAN</td>
<td>Remittance: 1 if household receives remittance; 0 if otherwise</td>
</tr>
<tr>
<td>EDUCATION</td>
<td>Education of respondent: 1 if more than secondary school; 0 if less than secondary school</td>
</tr>
<tr>
<td>INTMIGR</td>
<td>Internal migration: 1 if household head is an internal migrant; 0 if otherwise</td>
</tr>
<tr>
<td>LARGEFA</td>
<td>Is household head employed on a large farm: 1 if yes, 0 if no</td>
</tr>
<tr>
<td>HRDLABOUR</td>
<td>Hired labour: 1 if household hires labour; 0 if otherwise</td>
</tr>
<tr>
<td>HSEHOLD_WITH_MIGRANTS</td>
<td>Household with member who is a migrant: 1 if yes; 0 if otherwise</td>
</tr>
<tr>
<td>AGE</td>
<td>Age of farmers: 1 if farmer is under 40 years old; 0 if farmer is over 40 years old</td>
</tr>
</tbody>
</table>

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will decrease. Usually, instead of reporting the actual log likelihood, SPSS reports the value of $-2 \log$ likelihood ($-2LL$), because $-2LL$ has an approximate chi square distribution, which makes it possible to determine whether the value of the log likelihood is statistically significant, either initially, or if new variables are added to a re-specified model. The Wald chi square statistic tests the null hypothesis that the constant and the model coefficients were equal to zero.

**Model results**

The log likelihood statistic ($-2LL$) for the logistic regression model was 431, but the chi square results showed that this value was significant at the 0.05 level. Therefore, although not fitting the data perfectly, the model does have some predictive power in identifying the odds of households having farms that will survive based on their migration, biographical and farm characteristics.

The coefficients generated for the individual model parameters, as well as their Wald chi square statistic and significance levels, are shown in Table 3. Of the variables included in the model, four had coefficients that were significantly different from zero at the 5% level. Two of the four variables were migration related, these being internal migration (INTMIGR) and temporary migration (TEMPMIG). The other two were households that hire labour (HRDLABOUR) and age of farmer (AGE).

According to the results of the logistic regression, the best overall predictor of whether a farm would survive was not a migration variable, but the farm characteristic variable of households that hired labour (HSHLABOUR). Other things being equal, a household that hired farm labour improved their odds of having a farm that would survive by 19.72:1 over a household that did not hire farm labour. This result was consistent with observations made during this study, in that whenever a household started hiring farm labour, it reflected a commitment to small farming that was usually above the level of subsistence farming. In most cases, such a household was committed to cash crop farming and allocated a significant amount of resources towards making its farm both profitable and capable of surviving in the long run.

The two migration variables that were significant had the expected signs for the coefficients. Thus, other things being equal, a household head that was involved in internal migration improved his/her odds of having a farm that would survive by 2.2:1 over a household head that had never moved. Also, other things being equal, a household head that had engaged in temporary migration improved his/her odds of having a farm that would survive by approximately 2.6:1 over a household head that was never involved in temporary migration.

The odds ratio for the age variable was 0.59:1. Since the odds ratio was below one, it indicated that, other things being equal, a household head that was under 45 years old decreased his/her odds of having a farm that would survive by 0.59 as compared to a household head that was over 45 years old.

Surprisingly, receipt of remittances was an insignificant predictor of the survival of farms. The coefficient of this variable was not only insignificant but inverse. A likely reason for the negative sign is that although a large number of households benefited from remittances, the value of the small amounts involved in remittances and their use in a variety of household expenditures over farming meant that they had little direct impact on farmers’ decisions to increase or decrease output.

Being a returned migrant was also an insignificant variable in predicting the survival of farms. This
result was surprising as it was inconsistent with the role and contribution, described earlier, that returned migrants have on small farming. For example, returned migrants owned most of the large farms in the Rio Grande Valley and they employed approximately 40% of the agricultural labour force in the Valley. Money earned on these large farms was invested in small farming and helped new migrant farmers to eventually become established in their new communities.

Odds ratios (exp $\beta$) are the exponentiation of the coefficients. A different perspective on these values can be obtained if they are converted to probabilities. Odds ratios were converted to probabilities using the following formula: probability = odds/(1 + odds). Thus, households that hired farm labour had a 95% probability of having farms that would survive in the long run; households with heads who were temporary migrants had a 72% probability of having a farm that would survive; households with heads who were internal migrants had a 70% probability of having a farm that would survive; and households with heads under age 45 years had a 37% less probability of having farms that would survive compared to those with heads over 45 years.

Discussion

This study has discussed different types of migration that occur among farmers in the Rio Grande Valley and the intricate ways in which these migration streams contribute to the survival of small farming. Using a life cycle approach, the study discussed the migration experiences of household heads in relation to small farming before and after they migrated. The study revealed that farmers in the Rio Grande Valley migrate to other places in the Valley if their community infrastructure, particularly the deterioration of roads, renders it impossible to make a living from farming. As farmers engage in local-level internal migration, they disrupt traditional social and production relations that help them to survive as small farmers. For example, they take a long time to acquire sufficient land in their new communities and they frequently hire farm labour rather than depend on free household labour. Farmers are also forced to make wage labour their primary occupation rather than farming. While these moves can be viewed as detrimental to the survival of farming, this is actually not the case, as farmers view their involvement in wage labour occupation as a necessary activity to raise funds to help them to become re-established as farmers. The re-establishment process takes time, but the long-term result is that the farms owned by these individuals had greater odds of surviving than those owned by people who had never migrated.

Temporary overseas migration had a profound positive impact on the survival of farming in the Rio Grande Valley. By working on farms in the USA and Canada and on cruise ships, many farmers had managed to improve the capitalization of their farms, hence their short-term migration had a positive impact on farming in the Valley. Long-term migration had conflicting impacts on small farming. While it did reduce the available household labour supply, remittances from migrants served to meet day-to-day needs of households, while at the same time contributing to funds needed to operate the farms. Persons who returned to the Valley after living for varying periods in the USA, Canada and Great Britain also contributed to the survival of farming in the Valley. Many of these people invested in export agriculture, and the larger farmers provided jobs for farmers migrating internally.

The impact of migration on small farming is undoubtedly complex. However, there is a clear indication that migration supports the sustainability of farming in the Valley. The channels through which migration affects farming are not always direct, but are frequently indirect and sometimes time dependent, but the overall effect is the sustenance of agriculture rather than its destruction.

Apart from examining the complex relationship between migration and small farming, this study has also examined the relative importance of certain factors in predicting the long-term survival of small farms in the Rio Grande Valley. Using an empirical logistic regression model, the study identified four significant predictors of whether farms will survive in the Rio Grande Valley. Two of these predictors were population mobility variables, i.e. internal migration and temporary overseas migration. Of the two migration variables, temporary overseas migration was a stronger predictor of the survival of small farms than internal migration.

Some of the independent variables in the empirical model were found to be insignificant and the −2LL remained high. This suggests that the model remains under-specified and other variables, perhaps environmental and cultural variables, play significant roles in the survival of small farms. Also, the operational definition of farms that are sustainable needs to be revised as some farmers may have strategically reduced output to ensure the survival of their farms. Such farmers were not included in the definition of farms that are sustainable. It is also recognized that there is a decided lag effect in terms of how migration affects small farming. Thus the effects of internal migration, temporary overseas migration and remittances are felt some time after these processes are initiated.
The logistic regression model failed to capture these time-dependent effects but they were clearly evident during in-depth interviews with farmers. Further statistical analysis may therefore be required for a more complete understanding of the relative importance of these migration variables on small farming.

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