शोध साहित्य SHODH SAHITYA
INTERNATIONAL PEER REVIEWED E-RESEARCH JOURNAL
(समसामयिक विषयों पर केंद्रित बहुविषयक मासिक ई-शोध पत्रिका)
E-ISSN 2584-2447

Year – 1
Vol – 4
February
2024

Rural Out Migration At The Household Level in District Shivpuri

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ABSTRACT
Migration is the least studied area of population change. The concept of migration includes many factors, including origin and destination, intermediary barriers and personal characteristics. In this paper, we examine household-level migration using several statistical models. This was confirmed with the help of primary data collected by the authors from Shivpuri district MP during the period (2021-2022).

KEY WORDS
Migration, Stochastic models, geometric distribution, logarithmic distribution, inflation.

INTRODUCTION

Migration, an important part of demography, is the least studied area compared to birth and death rates. Due to declining birth and death rates, migration (domestic or international) has become a more important issue for demographers and other social scientists. Most past studies (Bhagat 2005; Friedlander and Rosher 1966; Greenwood 1971; Isbell 1944; Lee 1966; Singh 1986; Stouffer 1940, 1960, and Ziff 1946) based their conceptualization of the migration process and the scale of study on national, regional, and state. and a macro approach that operates on highly aggregated data across countries. Such studies cannot fully account for the enormous regional and regional heterogeneity. They also ignore the decision-making process for individual migration (Singh and Yadava, 1981). Therefore, it is more important to study the environment in which migration occurs and the migration decision-making process at a micro level. Micro-level migration studies, i.e. at Migration, an important part of demography, is the least studied area compared to birth and death rates. Due to declining birth and death rates, migration (domestic or international) has become a more important issue for demographers and other social scientists. Most past studies (Bhagat 2005; Friedlander and Rosher 1966; Greenwood 1971; Isbell 1944; Lee 1966; Singh 1986; Stouffer 1940, 1960, and Ziff 1946) based their conceptualization of the migration process and the scale of study on national, regional, and state. and a macro approach that operates on highly aggregated data across countries. Such studies cannot fully account for the enormous regional and regional heterogeneity. They also ignore the decision-making process for individual migration (Singh and Yadava, 1981). Therefore, it is more important to study the environment in which migration occurs and the migration decision-making process at a micro level. Micro-level migration studies, i.e. at the individual level; The family or household is important not only in housing policy but also in the development of other sociological models related to the family and community (Pryor, 1975; Rossi, 1955). Migrant households (where one or more people participate in the migration process to do something outside the village) may have different socioeconomic and cultural characteristics, ideas, perceptions, and environments compared to non-migrant households. Rural-urban migration in India follows a chain pattern, at least early in the migration process, before migrants settle in urban areas or return to villages. A useful way to address the diversity of migration systems is to consider key contemporary examples within a general comparative framework (Simmons & Piche, 2002). Greater emphasis should be placed on using models to analyze and explain important population issues and predict the demographic future (Birch, 2002). One of the important properties of micro-level models is that researchers introduce heterogeneity in measured (taking into account various indicators for individuals with different characteristics such as age, gender, social class, group, etc.) and unmeasured (selected for) individuals. That you can do it. Each individual correction factor depends on the conversion speed. Several studies have been conducted on the application and/or formulation of stochastic models in both natural and social sciences (Afsar, 1995; Aryal, 2003, 2009; Wintle, 1992). Since stochastic models are better at representing large data sets concisely and clearly (Aryal, 2010), more attention has been focused on proposing and deriving stochastic models for population movements at the micro level (Yadava, 1977). Singh and Yadava (1981) introduced the negative binomial distribution to study rural migration patterns at the household level. Sharma (1984) applied this model to another data set and found that it did not fit the total number of migrants (including women and children) per household. Because immigrant women are more likely to influence the sociocultural characteristics of the household than other women in the household, it is important to examine the structure of the total number of immigrants per household. Sharma (1984) proposed a stochastic model under the assumption that (i) the number of male migrants aged 15 years or older follows a negative binomial distribution and (ii) the distribution of surviving children per couple is known. However, the distribution of pairs of living children has not yet been theoretically established, and prior knowledge of these two distributions is difficult. Singh (1985) proposed a stochastic model suggesting that there are two types of households: those in which only men over 15 years of age migrate and those in which men with their wives and children migrate. Several authors have proposed similar models to explain the distribution of households based on the total number of immigrants, including wives and children (Kushwaha, 1992; Sharma, 1987; Singh, 1990, 1992; Yadava, 1993; Yadava and Yadava, 1988). ; Yadava et al., 1989, 1994).

The aim of this study is to investigate rural migration trends at the household level using some stochastic models and modify existing estimation procedures. data The study is based on primary data obtained from a survey titled "Migration and related characteristics - Shivpuri district case study" conducted from October 2021 to June 2022. Data were collected using a multistage random sampling procedure. Shivpuri (MP) district was selected for the study. The sample consisted of (339) households from (8) villages.

3. Probability models for rural migration
3.1 Model A1
A stochastic model explaining changes in the number of rural migrant households was derived based on the following assumptions:

• At the time of the survey, households are either exposed or not at risk of migration. Let α and (1-α) be the corresponding probabilities.
The probability of one male per household migrating is greater than the probability of 2 male migrating, and the probability of 2 male migrating is greater than the probability of 3 men per household migrating. Therefore, the pattern of migration from a household is a decreasing function and follows a logarithmic distribution with parameter λ."

Let x represents the number of rural migrants per household. Under assumptions (i) and (ii), the probability function x is given by
P(x=k)=1-â, k=o =â[Î^k/klog(1-Î")] for k=1,2,3,…,0,

3 Probability Models for Rural Out Migrants
3.1 Model A_1
A probability model for describing the variation in the number of rural out-migrant households has been derived on the basis of following assumptions:
At the survey point, the household is either exposed, is not exposed to the migration risk. Let α and (1-α) be the respective probabilities.

The probability of one male's migration, from a household is greater than that of two males, and probability of two male's migration is greater than that of three males from a household. Thus, the pattern of migration from a household is a decreasing function and follows a logarithmic series distribution with parameter λ.

Let x represent the number of rural out-migrants from a household. Under the assumptions (i) and (ii), the probability function of x is given by

$$P(x = k) = 1-\propto , \qquad k = o$$

$$=\propto \left[\frac{\lambda^k}{klog(1-\lambda)}\right] \text{ for } \quad k = 1,2,3, \ldots, 0, < \lambda < 1; 0 < \alpha < 1$$

…(1)

The log-series distribution has a long positive tail and the shape of the tail is similar to that of geometric distribution for large values of k. However, the log-series distribution has the advantage that it has only one parameter instead of two parameters of Negative Binomial Distribution (Chatfield et. al., 1966).

3.1.1 Estimation

Consider a sample consisting of n observations of the random variable x with probability function given by equation (1).

Suppose that n_k $(k = 0,1,2,\cdots, m)$ represents the number of observations of k'th cell and $\sum_{k=1}^{n} n_K$ The likelihood function for the given sample $(x_1, x_2, x_3, \ldots, x_n)$ can be expressed as:

$$L[a, \lambda | (x_1, x_2, x_3, \ldots, x_n)] = (1-\alpha)^{n_0} \prod_{k=1}^{m} \left[\alpha \left(\frac{\lambda^k}{klog(1-\lambda)}\right)\right]^{n_k}$$

…(2)

$$= \frac{(1-\alpha)^{n_0}(-\alpha)^{n-n_0} \lambda \sum_{k=1}^{n} n_K x_K}{\prod_{k=1}^{m} x_k^{n_k} [\log(1-\lambda)]^{n-n_0}}$$

…(3)

where $x_k$represents the value of k. Taking logarithms of equation (3), differentiating with respect to α and λ respectively and equating to zero give the following equations:

$$\frac{\delta logL}{\delta \alpha} = \frac{n_0}{1-\alpha} + \frac{n-n_0}{\alpha} = 0$$

…(4)

$$\frac{\delta logL}{\delta \lambda} = \frac{\sum_{k=1}^{m} n_k x_k}{\lambda} + \frac{n-n_0}{(1-\lambda)(log(1-\lambda))} = 0$$

…(5)

Equation (4) yields the estimator of α as

$$\hat{\alpha} = \frac{n-n_0}{n}$$

the estimating equation for λ is obtained by solving equation (5) as:

$$(1-\lambda)\log(1-\lambda)\sum_{k=1}^{m} n_k\, x_k + (n-n_0)\lambda = 0$$
…(6)

This equation can be solved numerically and the numerical solution of (6) is the desired maximum likelihood estimate for λ.

Using the fact that

$$E(n_0) = n(1-\alpha)$$

$$E(n-n_0) = n\alpha$$

$$E(x_k) = \frac{\alpha\lambda}{(1-\lambda)\log(1-\lambda)}$$

and

$$E\left(\sum_{k=1}^{m} n_k\, x_k\right) = \frac{-n\alpha\lambda}{(1-\lambda)\log(1-\lambda)}$$

the expected values of second partial derivatives are obtained as

$$-E\left(\frac{\delta^2 logL}{\delta\alpha^2}\right) = \frac{E(n_0)}{(1-\alpha)^2} + \frac{E(n-n_0)}{\alpha^2} = \frac{n}{\alpha(1-\alpha)} = \psi_{11}(say)$$
…(7)

$$-E\left(\frac{\delta^2 logL}{\delta\lambda^2}\right) = \frac{\sum_{k=1}^{m} n_k\, x_k}{\lambda^2} + \frac{[1+log(1-\lambda)]E(n-n_0)}{[(1-\lambda)(log(1-\lambda)]^2} = 0$$

$$= -n\alpha\left[\frac{1}{\lambda(1-\lambda)\log(1-\lambda)} + \frac{1+log(1-\lambda)}{[(1-\lambda)(log(1-\lambda)]^2}\right] = \psi_{22}(say)$$
…(8)

The covariance between $\boldsymbol{\alpha}$ and $\boldsymbol{\lambda}$**'s** zero since

$$\boldsymbol{E\left(\frac{\delta^2 logL}{\delta\alpha\delta\lambda}\right) = 0,}$$

and hence the variance of $\boldsymbol{\alpha}$ and $\boldsymbol{\lambda}$ can be obtained as

$$\boldsymbol{V(\hat{\alpha}) = \frac{1}{\psi_{11}} \quad and \quad V(\hat{\lambda}) = \frac{1}{\psi_{22}}}$$

3.2 Model A2

Sharma (1985) has proposed a probability model for the number of rural male out-migrants aged 15 years and above from a household under the following assumptions:

At any point in time, let $\boldsymbol{\alpha}$ be the probability migration out from a household and $(\mathbf{1}-\boldsymbol{\alpha})$ be the probability of not migrating from a household.

2. If p represents the probability of a single individual migrating from a household, the pattern of migration from each household follows the geometric distribution.
If x represents the number of migrants from a household, x follows the inflated geometric distribution with probability density function as

$$\boldsymbol{P(x=0)=1-\propto+\propto p,\qquad k=o}$$

$$\boldsymbol{P(x=k)=+\propto p\ \text{for}\ \ k=1,2,3,\dots,0,<\lambda<1;0<\alpha<1} \qquad \dots(9)$$

$$\boldsymbol{where\ p+q=1}$$

3.2.1 Estimation

As mentioned above, Sharma (1985) used method of moments to estimate the parameters $\boldsymbol{\alpha\ and\ p}$ of model (9) and obtained the asymptotic expressions for variance and covariance of the estimators using multivariate central limit theorem. Iwunor (1995) proposed an alternative estimation technique based on likelihood function and obtained the variance and covariance of the estimators.

Let (X1,X2, , ...,Xn) denote a random sample of size n from the above-mentioned probability model. Furthermore, let nk(k =0,1,2, ..,m) denote the number of observations corresponding to the kth cell. The likelihood function for estimating the parameters a and p can be expressed as:

$$\boldsymbol{L[a,\lambda|(x_1,x_2,x_3,\dots,x_n)]=(1-\alpha+\alpha p)^{n_0}\prod_{k=1}^{m}(\alpha p q^k)^{n_k}} \qquad \dots(10)$$

$$\boldsymbol{=(1-\alpha+\alpha p)^{n_0}\alpha^{n-n_0}p^{n-n_0q^s}} \qquad \dots(11)$$

where $\boldsymbol{n_0+n_1+n_2+\cdots+n_m=n}$ and $\boldsymbol{s=n_1+2n_2+3n_3+\cdots+mn_m=\sum_{k=1}^{m}n_kx_k}$, where $\boldsymbol{x_k}$ represents the value of k.

Taking logarithms of equation (11), differentiating with respect to $\boldsymbol{\alpha}$ and $\boldsymbol{p}$ respectively and equating to zero give the following equations:

$$\frac{\delta \log L}{\delta \alpha} = \frac{n_0(p-1)}{(1-\alpha+\alpha p)} + \frac{n-n_0}{\alpha} = 0$$

...(12)

$$\frac{\delta \log L}{\delta p} = \frac{n-n_0}{p} - \frac{s}{1-p} + \frac{n_0 \alpha}{(1-\alpha+\alpha p)} = 0$$

...(13)

Equation (12) yields the estimator of α as

$$\hat{\alpha} = \frac{n-n_0}{\alpha}$$

Substitute the value of α and rearrange equation (13) yield the estimator of p as

$$\hat{p} = \frac{n-n_0}{\sum_{k=1}^{m} n_k x_k}$$

Using the fact that

$$E(n_0) = np(X=0) = n(1-\alpha+\alpha p)$$

$$E(n-n_0) = n\alpha(1-p)$$

the expected values of second partial derivatives are obtained as

$$-E\left(\frac{\delta^2 \log L}{\delta \alpha^2}\right) = \frac{n(1-p)}{\alpha(1-\alpha+\alpha p)} = \psi_{11}(say)$$

...(14)

$$-E\left(\frac{\delta^2 \log L}{\delta p^2}\right) = \frac{n\alpha q}{p^2}\frac{n\alpha}{pq} + \frac{n\alpha^2}{(1-\alpha+\alpha p)} = \psi_{22}(say)$$

...(15)

$$-E\left(\frac{\delta^2 \log L}{\delta \alpha \delta \lambda}\right) = -\frac{n}{(1-\alpha+\alpha p)} = \psi_{12}(say)$$

E-ISSN 2584-2447
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2024

…(16)

Therefore, through inverting the information matrix, the expression for variances and covariance of the estimators can be obtained as

$$V(\hat{\alpha}) = \frac{\psi_{22}}{\psi_{11}\psi_{22} - \psi_{12}^2}$$

$$V(\hat{p}) = \frac{\psi_{11}}{\psi_{11}\psi_{22} - \psi_{12}^2}$$

And

$$cov(\hat{\alpha}, \hat{p}) = \frac{\psi_{22}}{\psi_{11}\psi_{22} - \psi_{12}^2}$$

Table 1: Distribution of Observed and Expected Frequency of Number of Households According to the Number of Rural Out Migrants

No of Migrants	Observed	Model A_1	$\chi^2_{0.05}$
0	201	201.00	
1	101	100.98	
2	47	46.93	
3	25	24.84	
4	14	13.75	3.67
5	6	5.75	
6	4	3.84	
7	1	0.93	
8	0	0.00	
Total	399		
α	0.3861		
ρ	0.5268		
Λ	0.3754		
Var(α)	0.0026		
Var(λ)	0.0075		

Table 2: Distribution of Observed and Expected Frequency of Number of Households According to the Number of Rural Out Migrants

No of Migrants	Observed	Model A_2	$\chi^2_{0.05}$
0	201	201.00	
1	101	98.33	
2	47	49.35	
3	25	27.30	
4	14	14.45	2.97
5	6	4.85	
6	4	2.47	
7	1	1.25	
8	0	0.00	
Total	399		
A	0.4568		
P	0.74568		
Var(α)	0.0026		
Var(λ)	0.0075		

RESULTS

Estimating the parameter values for given data we had shown results in 2 different tables. Table-1and Table-2 shows the observed frequencies from data and expected frequencies for Model A_1 and Model A_2 corresponding to the estimated values of parameters and their frequencies. The fitness of data had been tested on the basis of χ^2 at 5% level of significance.

CONCLUSION

The study indicates that the proposed model (A1) is a reasonable approximation to describe the distribution of households for the rural out migrants and at least at the micro-level. It also provides the estimates of the parameters of model (A2) using maximum likelihood technique. The exact variance and covariance of the estimators for both the models (A1 & A2) have been computed.

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