Indian Journal of Animal Sciences **87** (7): 906–911, July 2017/Article

Push and Pull factors of migration amongst livestock rearers distressed by national calamity in India: A Polytomous Universal Model analysis

SUDHANAND PRASAD LAL[1], K S KADIAN[2] and WORKNEH ABEBE WODAJO[3]

ICAR-National Dairy Research Institute, Karnal, Haryana 132 001 India

Received: 2 December 2016; Accepted: 24 January 2017

ABSTRACT

An endeavor was made to figure out push and pull factors of migration amongst livestock rearers distressed by national calamity in India. Reckoning ordinal response of 160 respondents; 86, 38 and 36 respondents were classified as not-adopter, partially adopter and fully adopter of migration, respectively; subsequently coding it into 0, 1 and 2 for the final Polytomous Universal Model (PLUM). Triangulation of different tests was done to justify aptness of PLUM. Predictor variables viz. age, income, livestock-holding [odds ratio (OR), 0.638; 99% CI of Estimate (E) = -.799 to -.101] and skilled work was statistically significant at 1% level but age and livestock-holding was found to be negatively significant. However, remaining 2 explanatory variables viz. expectation level and land holdings increased the probability for migration among farmers. Major push factor of migration was non-availability of work during agricultural lean season and pull factor was expectation of higher income. This plausibly signifies that, if curbing migration from rural to urban region is a policy agenda of government, variables identified through PLUM, viz. age, income, livestock-holding and skilled work should be given due consideration. The researchers conclude that the identified predictive variables could become cornerstone for migratory research work among livestock rearers, as such an investigation is scarce in India and worldwide.

Key words: Calamity, Logit, Migration, Ordinal logistic, PLUM

Vulnerability of major natural calamities, viz. floods, droughts, storms, unseasonal torrential rains and hailstorm is quite evident in the subcontinent of India. All these calamities severely distress the farmers because their produce and livestock are exposed to these types of extreme events. Kosi flood that occurred on 18th August 2008 was declared as 'national calamity' and so far, it is the only calamity in the narration of India to be officially declared as such (Lal *et al*. 2014, 2015). Over 90% of the population affected by calamity was contingent upon agricultural livelihoods distressing 500,000 farmers (Government of Bihar report to World Bank 2010). Livestock is also vulnerable sector during the natural calamities because the life of the livestock is at direct threat during that period and it causes permanent loss of the farmers (Lal *et al*. 2015). Migration of rural folks in such distressed situation is a common global phenomenon since pre-historic time and the most familiar example is Irish famine (popularly known as the Great Famine or the Great Hunger or Irish Potato Famine). A million people perished during the great Irish famine of mid 1840s and the early 1850s, while emigrants numbered more than half a million, who left Ireland. Grada and O'Rourke (1997) compared migration as disaster relief tool while explicating the lessons learnt from the great Irish famine. The migration due to 2008 flood was clear cut case of 'environmental refugees' in which folks could no longer gain a secure livelihood in their native land because of soil erosion, drought, deforestation and various other environmental disasters (Panigrahi 2014). In this backdrop, the present investigation was pursued to find out the push and pull factors for migration of the livestock farmers distressed by natural calamities in India and to identify the predictive variables and its log likelihood to determine future course of migration.

Present address: [1]Ph.D. Scholar (sudhanandlal100@gmail.com),[2]Principal Scientist and Head (kskadian@rediffmail.com), Dairy Extension Division. [3]Assistant Professor (wawj2017@gmail.com), Department of Rural Development and Agricultural Extension, Ambo University, Ambo, Ethiopia.

MATERIALS AND METHODS

Sampling and data collection: Due to 2008 Kosi flood fury, five districts of Bihar were affected, viz. Supaul, Madhepura, Saharsa, Araria and Purnia. Out of which, two districts, viz. Supaul and Madhepura were severely affected and so selected purposively (Government of Bihar report to World Bank 2010). Two distressed blocks from each district and from each block, two villages were randomly chosen. Among these chosen villages, 20 respondents were selected by multistage random sampling making a final sample size of 160 respondents from total eight villages (Table 1).

Empirical framework: The analysis was made by the

Table 1. Randomly selected respondents from each village

Village	Marginal	Small	Medium	Large	Total
Sitapur (V1)	8	6	5	1	20
Gidarmari (V2)	6	10	3	1	20
Matiyari (V3)	7	6	5	2	20
Tangri (V4)	10	7	3	0	20
Gadhiya (V5)	6	9	4	1	20
Raghunia (V6)	9	7	3	1	20
Kolhaypatti (V7)	8	6	4	2	20
Pratapnagar (V8)	14	4	2	0	20
Total	68	55	29	8	160

application of SPSS Polytomous Universal Model (PLUM) or SPSS ordinal logistic regression procedure (IBM Corp 2011), which is the natural multivariate extension of the common linear model for the ordinal data (Liu 2009). The advantage of PLUM over normal regression models is that PLUM is unequal variance signal detection model (Decarlo 2003). PLUM was used as statistical maneuver in this research over other multivariate statistical techniques (Lal *et al.* 2016a) because the dependent/outcome variable i.e. migration consisted of ordinal response. In this PLUM model, ordinal dependent variable migration was measured on a 3-point response, viz. continued migration (score of 2), migration adopted but discontinued (score of 1) and non-adoption of migration (score of 0) to draw meaningful results for the dependent variable and to identify the factors (independent variables). As the actual distance between categories i.e. not migrated, partially migrated and migrated is unknown; so, the foundation of the research was based on the assumption that the dependent variable was measured at an ordinal level. Following Sabahiah and Sukor (2014), the equation for PLUM is as follows:

$$\text{logit}\,(Y \le i) = \ln\left(\frac{P\,(Y \le i)}{1-P\,(Y \le i)}\right) = \alpha_i + \beta_1 x_1 + \beta_2 x_2 + \ldots \beta_{im} x_m \quad i=1,\ldots k$$

where, P (Y) in this research is the probability that a national calamity affected respondent could migrate, that is also the function of a vector of predictive/independent variable X. The constant in the aforementioned equation is α_i, and β_i is the coefficient of the m^{th} predictive variable. In nutshell, when intricate analysis of variance in data set is required researchers opt for PLUM provided the outcome variable is ordinal in nature.

RESULTS AND DISCUSSION

Livestock rearing profiles of the respondents: Livestock rearing was the main occupation for 36 (22.50%) respondents while it was subsidiary occupation for 124 (77.50%) respondents in the study locale. Percentage distribution of agricultural households by all India survey accomplished by NSSO (2014) during the same period divulged that only 3.7% of agricultural households had livestock rearing as principal source of income. The conceivable reason behind higher percentage of respondents being livestock raisers was that more than one-third of the respondents in the study locale belonged to Yadav community (also keeping alternative last name of Gurmaita) and one of the prominent surnames of them is Gwalvanshi (Gwala in hindi means cattle and Buffaloes rearer), and they were cattle and buffalo rearer from pre-historic time. One of the famous couplets in the study area was 'Rome is of Pope and Madhepura is of Gope (Yadavs), which further support the evidence.

Migration pattern for attaining livelihood security and their education level: It was categorized into seasonal/ permanent type and state-wise by at least one member of the respondent's family. Data presented in the Table 2 shows that after the calamity (flood) of 18th August 2008, many of the male farmers had no other option but to migrate in order to earn their livelihood. Just after the flood in 2008, many of the respondents were sheltered in the 'relief camps' with their family and many lost their loved ones in that disastrous calamity. When the flood receded, they returned to their home. In 2008, they survived by their personal effort, Government and NGOs help. But in 2009, they decided to migrate for better opportunities and earnings. The year 2009 and 2010 witnessed 'full year migration' of 74 and 67 respondents, respectively. After they earned appropriate amount of money in 2 years from 2009–2010, they switched for 'seasonal migration' in order to live with their families and do their usual occupation i.e. agriculture and livestock rearing. The number of migrants gradually decreased from 2009 to 2013–14 as evident from Table 2. All the migrants were male and usually belonged to non-upper castes. When they had migrated, the female counterpart of their family including their children had looked after family farm and livestock. Likewise, Baby (2005) in Kerala revealed in her analysis among the cultivators that 38% of marginal farmers and 45% of the small farmers followed migration abroad as one of their livelihood option; while about 20% of the landless labour group also found to be migrated abroad. It is apparent from Table 2 that majority of the migrants in the year 2013–14 were illiterates i.e. 41.67% followed by primary (33.33%) and middle (25%) level of education.

Table 2. Year-wise migration pattern of the respondents and the educational level of the migrants in the surveyed year of 2013–14

2009	2010	2011	2012	2013-14
74	67	58	47	36
(46.25)	(41.88)	(36.25)	(29.38)	(22.50)
(FYM)	(FYM)	(SM)	(SM)	(SM)
Education§	Illiterate	Primary	Middle	Total
Respondents	15	12	9	36
	(41.67)	(33.33)	(25)	(100)

FYM, full year migration; SM, seasonal migration; figures in parenthesis indicate the respective percentage(s). Not-adopted 86; partially adopted 38 and 36 was fully adopted vis-à-vis migration; §denotes educational level of the 36 respondents who continued migration in the surveyed year of 2013-14 out of total 160 respondents.

From the Table 2, it was also divulged that not-adopter for migration was 86 respondents (value obtained by subtracting total number of respondents to the number of respondents exhibited migration in the immediate year after calamity); partially adopted 38 and 36 was fully adopted vis-à-vis migration that lead to basis of coding respondents into 0, 1 and 2 for the final PLUM.

Demography of migration and type of occupation: It was observed from the Table 3 that inter-state migration was more prominent and the top destination of migration was Delhi (41.67%) followed by Bathinda, Jalandhar and Patiala (19.45%), Chota Nagpur in Jharkhand (13.89%), Amritsar (11.11%), Ludhiana (8.33%) and Bangalore (5.55%). The type of work ranged from labourer, mason, tiles/marbles masons, gunny bag lifter; polish cum painter of building, wooden furniture worker to line installers. The specific skill possessed by respondents had been learnt from experts in contact during their period of migration.

Factors affecting the migration of respondents: Schedule to enumerate push and pull factors affecting the migration had been espoused from the work of Baby (2005). Table 4 reveals the top push factor of migration was non-availability of work during agricultural lean season (58.33%) and top pull factor of migration was expectation of higher income (41.67%). It would be meaningful to mention that average income from migratory work was ` 9,650/month, while mean monthly family income of the respondents was ` 6,792.91 and from this it could be deduced that those who had been migrating had clear cut financial edge over others. The finding is in concordance with the result from West Africa where local populace urban migration and returns from there was the main capital source for numerous rural families, trailed by livestock penned fattening for those having resources to enter that start-up (Tiffen 2004). Deb *et al.* (2002) in Andhra Pradesh divulged that the around one-third of the backward caste households (30.8%) had four sources of income while around one-forth (23%) of households had five sources of income; thus, the proportion of income that was originated from agricultural activity decreased and there was a growing dependence on migration and non-farm livelihoods.

Battery of test used prior to application of PLUM: In order to assure that whether two or more predictive variables are exceedingly correlated among each other, its multicollinearity was tested. So, before using the PLUM, multicollinearity test was performed to exclude highly correlated predictive variables as knowing one variable is precisely the same as knowing others variables. In the present study, there was no grave multicollinearity problem (Table 6). Multicollinearity status was checked through Variance Inflation Factor (VIF). A broad accurate principle regarding VIF says that if its value exceeds 10 (it would occur if R_i^2>0.95), that predictive variable is said to be

Table 3. Demography of migration and type of occupation of the respondents in 2013–14

Location	Occupation	f (%)
Delhi	Laborer, Mason, Tiles/ Marbles Masons	15(41.67)
Bathinda, Jalandhar and Patiala	Gunny Bag Lifter; Polish Cum Painter of Building, Wooden Furniture worker	7(19.45)
Jharkhand	Brick-kiln	5(13.89)
Amritsar	Plywood mills, Furniture worker	4(11.11)
Ludhiana	Bolts, Nuts and Washers manufacturers factory for Bikes	3(8.33)
Bangalore	Line installers	2 (5.55)
Total number of respondents in the surveyed year 2013-14		36(100.00)

Note: Figures in parenthesis indicate the respective percentage(s)

Table 4. Push and pull factors affecting the migration of respondents in 2013–14

	f (%)
Push factors of migration	
Non-availability of work during agricultural lean season	21 (58.33)
Skilled work not available	15 (41.67)
Poor work environment	00 (00.00)
Pull factors of migration	
Expectation of higher income	15 (41.67)
Expectation of better opportunities	12 (33.33)
Both expectation of higher income and opportunities	09 (25.00)

f denotes frequency and % symbolizes percent.

Table 5. Triangulation of different tests prior to use PLUM

Model Fitting Information				
Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept only	316.507			
Final	254.400	62.106	7	.000
Goodness-of-Fit				
Pearson		268.760	299	.895
Deviance		247.469	299	.987
Test of Parallel Lines[a]				
Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null hypothesis	254.400			
General	248.050[b]	6.351[c]	7	.499

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.[a]; a. Link function: Logit; b. The log-likelihood value cannot be further increased after maximum number of step-halving; c. The Chi-Square statistic is computed based on the log-likelihood value of the last iteration of the general model.

highly collinear and this is due to fact that as R_i^2 pproaches 1, VIF value approaches infinity. Kothri and Garg (2014) proposed more stringent rule of thumb i.e. VIF>5 denotes specific variable is highly correlated with other explanatory variables. PLUM can't be validated if before running it assumptions are met and the model robustness is checked thoroughly. So, in Table 5, triangulation of different tests before using PLUM was done and first in series was 'model fitting information' which explored that χ^2 value as 62.106 at 1% level (P=.000; degrees of freedom=7). PLUM was evaluated by assessing the –2 times natural log likelihood (-2LL) and its value was commendable (254.400) at barely 7 explanatory variables therefore and it must be contemplated that larger value of the -2LL indicate weakly fitting the PLUM (Field 2013). The second in series was Pearson and Deviance $\chi 2$ tests of Goodness of Fit with all predictive variables in the PLUM showed good fit with P=.987 by the Deviance and with P=.895 for Pearson's χ^2 criterion. Test of Parallel Lines was non-significant at P=.499, which divulge that non-parallel lines of explanatory variables showed up significant interactions, which further supported the model.

Parameter estimates by application of Polytomous Universal Model: Prior to application of PLUM, the SPSS version 20 (IBM Corp 2011) was recalibrated at maximum iterations (100, iterations are frequentative of the PLUM model before it terminates); maximum step-halving (5); log likelihood convergence (0); confidence interval (CI=99%); Delta (0); singularity tolerance (10^{-8}). From Table 6, it is asserted that threshold values [Category = 0; not-adopter for migration] and [Category = 1; partially adaptor of migration] had non-significant relationship with the migrant respondents and from this it could be implied that among the respondents category there is not much difference. Predictive variables influencing the migration of the affected farmers are discussed in detail.

Age: It was operationally defined as the number of years the respondent completed chronologically at the time of interview. It was found to be statistically significant at P<0.01, with the Wald statistics value of 13.446. The odds in favour of migration decreased by 0.926 times that had higher chronological age. In other words, the odd ratio states that unit increase in age decreased the odd of migrant farmer by 7.40%, CI for estimate was -.132 to -.023 at 99% level of significance. The plausible reason behind the reciprocal relationship is that the over aged farmers preferred to stay at home rather than going to distant place. The finding was in discordance with Bergfjord *et al.* (2011) in Norway who used structural equation model (SEM) to figured out the fact that older aged farmers were quitting agriculture and migrating to urban area as in old age agriculture was not physically feasible to them and due to one of this strong reason; agricultural holdings shrunk from 99,382 in 1989 to 48,800 in 2008 in Norway.

Education: It was operationalized as number of schooling year accomplished by the individual respondent. This explanatory variable was statistically non-significant at P>0.01 (P=.217), with the Wald statistics value of 1.525. The odds in favour of educated respondent decreased by 0.955 times [OR=0.955; 99% CI of Estimate (E) =–0.143 to 0.050] that had higher educational level. The odd ratio states that unit increase in educational level decreased the odd of migrant farmer by 4.50% at 99% confidence interval (Table 6). The conceivable theory behind the reciprocal association may possibly be due to the fact that majority of the respondents had low educational level consequently leading it to non-significant relationship.

Income: It referred to the total income of the respondents and other family members earned from their land, livestock and/or from any other source (s), on monthly basis. This predictor variable was statistically significant at P<0.01 (P=.000), with the Wald statistics value of 24.025, which was highest among all the 7 response variables subsequently denoting the strong association of the variable with the outcome variable. The odds in favour of income increased by more than 1 times [OR=1.135; 99% CI of Estimate (E) = 0.060 to 0.194] that came under higher income echelon. The odd ratio states (Table 6) that unit increase in income

Table 6. Parameter estimates vis-à-vis empirical and latent findings of the study through PLUM

Specifics TH Location	VIF	Estimate	Std. Error	Wald	Sig.	Exp (E)	99% CI	
							LB	UB
[Category = 0]	NP	-.147	1.345	.012	.913	0.863	-3.611	3.317
[Category = 1]	NP	1.331	1.351	.971	.324	3.785	-2.148	4.811
Age	1.608	-.077	.021	13.446	.000*	0.926	-.132	-.023
Education	1.096	-.046	.037	1.525	.217	0.955	-.143	.050
Income	2.100	.127	.026	24.025	.000*	1.135	.060	.194
Expectation	1.446	.066	.114	.337	.562	1.068	-.227	.359
Livestock	1.281	-.450	.136	11.020	.001*	0.638	-.799	-.101
Land-holding	1.166	.572	.429	1.778	.182	1.772	-.533	1.678
Skilled work	1.042	1.060	.357	8.823	.003*	2.886	.141	1.979

VIF, variance inflation factor; TH, threshold; NP, not pertinent; Exp (E), exponential of estimate denotes odd ratio; CI, confidence interval; LB, lower bound; UB, upper bound; Nagelkerke Pseudo R-Square =.371; *Significant at 1% level (P<0.01)

level increased the odd of migrant farmer by 13.50% at 99% confidence interval. The conceivable cause behind the direct relationship is due to the fact that mean income from migratory job was ` 9,650/month, while average monthly family income of the respondents was ` 6,792.91, which clearly shows the edge of migratory farmers over others.

Expectation: It was broadly defined as anticipation of higher income, better job opportunities, enhancement of proficiency in non-farm profession and higher social status for migratory work. Expectation is widely analyzed in medical science sector but is normally neglected in animal research (Lal *et al.* 2016b). It was clearly evident in the study area that when any family member returned from migratory job, they usually had good amount of cash and other paraphernalia. This predictor variable was statistically non-significant at P>0.01 (P=.562), with the Wald statistics value of 337, which was lowest among all the 7 response variables subsequently denoting the weak association of the variable with the outcome variable (Table 6). The odds in favour of income increased by more than 1 times [OR=1.068; 99% CI of Estimate (E) = –0.227 to –0.359] that came under higher expectation strata. The odd ratio states that unit increase in expectation level increased the odd of migrant farmer by 6.80%. The plausible basis for this could be expectation led to migration but as expectation is one aspect whilst pursuing the migratory job is other thing so it was found to be non-significant. The finding is inharmonious with Bergfjord *et al.* (2011) who measured farmers' expectation in terms of future prices and support payments, which acted as an important measure to curb migration in Norway.

Livestock holdings: It was operationally termed as the total number of cattle, buffaloes, poultry birds, sheep and goat owned by the respondent at the time of investigation. Table 6 states that this explanatory variable was statistically significant at P<0.01 (P=.001), with the Wald statistics value of 11.020, which was 3rd highest among all the variables. The odds in favor of more livestock holdings respondent decreased by 0.638 times [OR=0.638; 99% CI of Estimate (E) = –0.799 to –0.101]. The odd ratio states that unit increases in livestock holdings decrease the odd of migrant farmer by 37.20% at 99% confidence interval. The possible basis behind the reciprocal association may be due to the fact that those having high livestock holdings had to stay at their home to look after their livestock asset. The findings reported by Deshingkar and Start (2003) in Andhra Pradesh was also similar to this study, who after taking into account the livestock, illustrated a significant negative relationship (OR=0.973; P=.009) i.e. livestock raisers with more animals have less likelihood to migrate to urban setup (Table 6). But, the research finding is in cacophonous with Bergfjord *et al.* (2011), who revealed in their study that those practicing crop production with livestock/dairy production (P value was negative) are more likely to quit agriculture as crop production alone helps farmers (P<0.01) to pursue local part-time work thus are more likely to continue agriculture.

Land-holding: It referred to the extent of land a respondent possessed and cultivated in acres. This predictive variable was statistically non-significant at P>0.01 (P=.182), with the meager Wald statistics value of 1.778 (Table 6). The odds in favour of more land holdings respondent increased by 1.772 times [OR=1.772; 99% CI of Estimate (E) = -.533 to 1.678]. The odd ratio states that unit increase in land holdings increased the odd of migrant farmer by 77.20%. The potential base behind the direct association is due to the fact that large area of land had become unsuitable for cultivation due to sand-casting, undulation, soil-erosion and water-logging in the study area as the direct ramification of the flood. The above pronouncement was in discordance with the PLUM analysis for Madhya Pradesh, where it was confirmed that there was a significant negative relationship (OR=0.584; P=.000) between land-holding and migration i.e. the more the land-holding the less the respondents is likely to migrate in urban setup (Deshingkar and Start 2003). In the same line, Cámara-Cabrales (1999) studied Panamanian land *Campesinos* (peasant farmers) to figure out reason for migration and found that steep topography with low soil fertility was the main motive for migration eventually resulted in low agricultural and livestock production.

Skilled work: It was operationally termed as positive adaptive skills learnt during migratory period. It was diversified, viz. mason, tiles/marbles masons, polish cum painter of building, wooden furniture worker, brick-kiln and line installers etc. in nature. Table 6 depicted that this predictor variable was statistically significant at P<0.01 (P=.003), with the passable Wald statistics value of 8.823. The odds ratio for skilled work [OR=2.886; 99% CI of Estimate (E) = .141 to 1.979] indicates that the odds of adopting migration are almost three times greater among farmers who had skilled work. The odd ratio states that unit increase in skill work increased the odd of migrant farmer by 188.60% at 99% confidence interval. The likely reason behind the direct relationship was due to the fact that those having additional skill were enjoying new profession due to its risk free and comparatively assured income nature. Nagelkerke Pseudo R-Square was 0.371 representing the modest PLUM fit with just 7 predictive variables. It must be remembered that R-square value signifies how well PLUM predicts the dependent variable and its value always ranges from $0<R^2<1$. The model is far better than Elias *et al.* (2015) who analyzed farmers' satisfaction with agricultural extension service using PLUM in which Pseudo R^2 value was 0.41with 13 explanatory variables. It is a rule of thumb that better model fit is seeking balance between R^2 and number of explanatory variables fitted in the final model.

We conclude that as preponderant migrated respondents in the surveyed year of 2013–14 were found to be illiterate followed by primary and middle level of education, so they should be made at least functionally literate. Moreover, battery of test suggested, viz. model fitting information, goodness of fit and test of parallel lines should be

functionalized prior to application of PLUM to confirm its correctness and validity as it is usually not followed by most of the researchers. In this manuscript, significant model fitting information and non-significant goodness of fit and test of parallel lines proved aptness of the model. Variables age, income, livestock-holding and skilled work were found to be statistically significant at $P<0.01$; out of that age and livestock-holding was found to be negatively significant. Education, expectation and land-holding were came across to be non-significant even at 10% level. But expectation level and land holdings increase the odd of migrant farmer by 6.80% and 77.20% respectively. Since the World Bank project worth US$ 0.259 billion (Project ID: P122096) is still active in the grieved area—significant variables identified through PLUM, viz. age, income, livestock-holding and skilled work; should be worked out to curb migration to the urban area as it hampers urban threshold and create chaos. Predictor variables identified and suggestion to stop migration from rural areas could be crucial for policy formulation and its implementation by the government of Bihar in the near future also. Moreover, the identified variables can also become the cornerstone for the research in almost the similar setup.

ACKNOWLEDGEMENT

The authors want to avow fellow farmers of Kosi region, who shared their agony and trauma despite losing precious life of their near and dear one during Kosi flood, 2008.

REFERENCES

Baby S. 2005. Livelihood security of rural community: A critical analysis. Published Ph.D. thesis, IARI, New Delhi. Published online at KrishiPrabha (e-Theses) - Nehru Library, CSS HAU, Hisar, India. http://14.139.232.167:8080/equestthesis/TextResult.do

Bergfjord O J, Lien G and Hoveid O. 2011. Factors influencing farmer migration in Norway: A study based on survey results linked to financial data, *ActaAgriculturaeScandinavica, Section C — Food Economics* **8**(2): 92–104.

Cámara-Cabrales L. 1999. Small farmer migration and the agro-forestry alternative in the Panama Canal watershed. *Journal of Sustainable Forestry* **8**(3/4): 11–22.

Deb U K, Rao G D N, Rao Y M and Slater R. 2002. Diversification and Livelihood Options: A Study of Two Villages in Andhra Pradesh, India 1975–2001, Working Paper 178, Overseas Development Institute, London, United Kingdom. https://www.odi.org/resources/docs/2694.pdf.

Decarlo L T. 2003. Using the PLUM procedure of SPSS to fit unequalvariance and generalized signal detection models. *Behavior Research Methods, Instruments, & Computers* **35** (1): 49–56.

Deshingkar, P and Start D. 2003. Seasonal migration for livelihoods in India: Coping, accumulation and exclusion. Working Paper 220, Overseas Development Institute, London. http://164.100.154.90/files/migration.pdf.

Elias A, Nohmi M, Yasunobu K and Ishida A. 2015. Farmers' satisfaction with agricultural extension service and its influencing factors: a case study in North West Ethiopia. *Journal of Agricultural Science and Technology* **17**(1): 39–53.

Field A. 2013. *Discovering Statistics Using IBM SPSS Statistics: Sex and Drugs and Rock 'n' Roll*. 4th edn. pp. 952p. SAGE Publications Ltd, London, United Kingdom. https://in.sagepub.com/en-in/sas/discovering-statistics-using-ibm-spss-statistics/book238032.

Grada C O and O' Rourke K H. 1997. Migration as disaster relief: lessons from the great Irish famine. *European Review of Economic History* **1**(1): 3–25.

Government of Bihar report to World Bank. 2010. Need assessment report: Bihar Kosi flood 2008. Report submitted to World Bank on June 2010. https://www.gfdrr.org/sites/gfdrr/files/publication/GFDRR_India_PDNA_2010_EN.pdf.

IBM Corp. 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp. Released 2011. http://www-01.ibm.com/support/docview.wss?uid=swg21476197

Lal S P, Kadian K S, Jha S K,Sharma A K, Goyal J, Kumar R S, Chauhan A K, Singh S R K and Singh S P. 2015. Change in livestock holdings, adaptation strategies and livelihood security of the farmers affected by national calamity in Bihar, India. *Indian Journal of Dairy Science* **68** (1): 83–90.

Lal S P, Kadian K S, Jha S K, Singh S R K, Goyal, Kumar R S, and Singh S P. 2014. A resilience scale to measure farmers' suicidal tendencies in national calamity hit region of India. *Current World Environment* **9**(3): 1001–07.

Lal S P, Mohammad A, Ponnusamy K and Kale R B. 2016a. A methodological pathway to quantify perception of the participants in animal fairs with relevance to national dairy mela at NDRI Karnal, India. *Journal of Animal Research* **6** (3): 437–44.

Lal S P, Mohammad A, Ponnusamy K and Kale R B. 2016b. Expectation of participants in national dairy fair of India: A complete itemization by multivariate analysis. *The Indian Journal of Animal Sciences* **86**(8): 940–46.

Kothri C R and Garg G. 2014. Research methodology: methods and techniques. 3rd edn. pp.xx, 449p. New Age International Publishers, New Delhi. http://www.newagepublishers.com/servlet/nagetbiblio?bno=000896.

Liu X. 2009. Ordinal regression analysis: fitting the proportional odds model using Stata, SAS and SPSS. *Journal of Modern Applied Statistical Methods* **8**(2): 632–45.

NSSO. 2014. Key Indicators of Situation of Agricultural Households in India, NSS 70th Round, January–December 2013; Report Number: NSS KI (70/33), National Sample Survey Office, Ministry of Statistics and Programme Implementation, Government of India, December. 2014. http://mail.mospi.gov.in/index.php/catalog/157/related_materials

Panigrahi S K. 2014. Environmental refugees–the result of another form of forced rural migration. *Kurukshetra*, **62**(11): 11–13.

Sabahiah N and Sukor A. 2014. *Neglecting helmet usage in rural area: behavioral causal factors according to different age groups*. Hassan R, Yusoff, M, Ismail Z, Amin, N Mand Fadzil M A (Eds.). CIEC 2013: Proceedings of the International Civil and Infrastructure Engineering Conference 2013, Springer Science and Business Media, Singapore, pp. 413–422. http://www.springer.com/us/book/9789814585019.

Tiffen M. 2004. Population pressure, migration and urbanization: Impacts on crop–livestock systems development in West Africa. Drylands Research, Somerset, United Kingdom.http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.511.2863.