



Economic Shocks, Mental Health and Institutional Failure: An Integrated Model of Farmer Suicidality in India

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Abstract

In Maharashtra, India, for the past 20 years, the state of Maharashtra has seen a large number of farmers committing suicide, as this leads to a large number of deaths of people who are working on farms. This study identifies multiple variables that cause this situation to happen and what are the reasons for farmers from Maharashtra, India to commit suicide. This study also focuses on a number of socio-economic, environmental, and psychological aspects of the reasons that cause farmers to commit suicide. An analysis of the data collected was conducted from a random sample of 161 farmer families, and the data collected by the Office of the Divisional Commissioner and other departments of the state of Maharashtra. The data collection process consisted of face-to-face interviews and a structured, pre-tested interview schedule. The authors of this research used the Suicidal Tendency Model, as well as performed a dummy variable regression analysis, in order to evaluate how the above-mentioned factors and variables affect farmers' suicidal tendencies. Research indicates that agrarian distress, joblessness, and inadequate government assistance are the most important predictors of farmer suicides. A complete model was created to better understand these predictors and how they relate to one another, which can explain 76.4% ($R^2 = 0.764$) of the variance observed in farmer suicide rates. The results support a strong statistical validity ($F = 7.215$, $p < 0.001$) of the findings. Additionally, the results indicate that a multi-faceted approach to addressing the issue of farmer suicide is necessary, such as creating more beneficial economic policies, increased mental health support for farmers, developing stronger safety nets for families and communities, as well as implementing targeted programs and solutions to address the agrarian crisis. Additionally, the data collected in this research indicate that if farmers were able to manage their finances appropriately, they would have more supports available to them and be more successful in their farming careers.

Keywords: Distress, suicidality, psychosocial, vulnerability, impact

1 Introduction

The ongoing crisis of suicide among Indian farmers, primarily in the state of Maharashtra, has steadily grown into a significant public health issue that has killed hundreds of thousands of farmers during the past 30 years. Today, with farmers' suicide rates consistently exceeding the Agrarian national average, the state of Maharashtra is still among the states with the highest rates of farmer suicides (as of NCRB 2020). Suicides among farmers are caused by many factors, including distress affecting farming, lack of access to credit, uncertainty regarding weather, and the social isolation that many rural farmers experience due to pervasive poverty. Earlier research has indicated that these tragedies are not only economic events, but rather represent a larger, more complicated problem associated with systemic poverty, inadequate access to markets, and entrenched hostility toward women within rural India (Mohanty 2005; Vasavi 1999).



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There exists a considerable amount of research demonstrating how agrarian distress and indebtedness are associated with increasing farmer vulnerability, particularly among those farmers located within cotton-producing areas in Vidarbha (Mishra, 2006; Sainath, 2009). Farmers with Small and Marginal farm sizes are oftentimes unable to access institutional credit and hence are required to depend upon private lenders for financial support. These individuals are frequently caught in the cycle of unmanageable debt, due to high input costs, unstable market prices, and a lack of access to institutional credit (Kale, 2011). Additionally, many farmers have experienced an increase in vulnerability due to climate-related events. Recurrent and prolonged dry seasons, inconsistent patterns of rainfall during the monsoons and crop losses due to changing climate conditions have created chaos within Maharashtra's agrarian livelihoods (Venkateswarlu et al., 2013). Research demonstrates that prolonged periods of drought produce not only lower yields but also greater levels of emotional stress and deteriorating mental health, thereby increasing the likelihood of committing suicide (Behere & Behere, 2008).

In addition to economic and ecological stressors, many of the same psychosocial and structural influences affect suicidal susceptibility at the individual level (e.g., Psychological Distress, Depression, Social Isolation, Family Pressure). Research shows these same influences have strong correlations with suicidal behaviour among rural damsels (Mann, 2002; Rehkopf & Buka, 2005). Durkheim's theory of suicide using a sociological viewpoint is based on the use of a social integrative approach to explain suicide, therefore a broad multidisciplinary analytical framework is necessary to understand this issue; the erosion of traditional agricultural support networks and caste discrimination within Indian culture, combined with the lack of social services supporting farming families, has created a new and horrifying social reality for farmers in India. Empirical research across different states in India has shown that the analysis of the spatial character of suicides and the understanding of community-level factors are necessary because suicide risk may be concentrated geographically within certain areas (Kennedy & King, 2014; Nagaraj, 2008). The traditional use of one-dimensional regression models in earlier research (Gujarati, 2004; Peter, 2003) is not sufficient to understand this complex social issue.

Standard regression analyses identify the main reasons for farmer suicide; however, they are usually not effective when looking at all of the different layers, levels and non-linear interactions in an agricultural ecosystem. Because rural livelihoods are affected at the same time by three distinct levels: the personal level, the household level and the community level, advanced statistical analyses need to be created to fully understand all the components of farmer suicide risk. The most recent methodological developments on the analytical side promote the use of advanced statistical techniques such as multi-level modelling, mediation analysis, logistic/ordinal regression models, factor-analysis, and predictive algorithms to assist in fully deciphering the complex interdependent factors that affect a farmer's likelihood of committing suicide (Hoffman & Rabe-Hesketh, 2022; Hosmer et al., 2013).

The causes of farmer's suicides in Maharashtra include the adversity of farming, financial stress and issues related to mental health; alcohol abuse, climate disasters, family and community tension, social status discrimination / caste-based prejudice and no government assistance (Behere, 2008; Hamermesh and Soss, 1974; Rehkopf and Buka, 2005). The research done on this topic supports the evidence of a relationship between social isolation and economic hardship and the increased likelihood of suicide (Stack 2000, Alston 2012). As suicide is the result of a confluence of many factors, This research uses a new approach to understand why farmers in

The research ultimately adds to existing literature regarding the need to focus on more than just providing financial assistance to farmers who die by suicide; rather, systemic changes must occur in conjunction with

the introduction of mental health care services, supportive climate-resilient agriculture, strengthening of institutions, and the development of rural communities through social inclusion. Using solid quantitative methods combined with empirical evidence, this study aims at shedding light on the interconnection between debt, drought and despair as pathways toward suicide risk, and to identify solutions available to mitigate this risk to the affected population in Maharashtra.

2 Methodology

The study used a mixed-methods approach (quantitative modelling combined with qualitative insights) for data collection and analysis. The sample of 161 farmer families who had been affected by suicide was selected using stratified sampling on the basis of lists of families provided by the Office of the Divisional Commissioner of Maharashtra (Maharashtra Division). Primary data were collected using structured and pre-tested interview schedules along with focus group discussions with affected families. Secondary data were collected from NCRB reports and agricultural office staff and published research articles.

2.1 Variable Construction and Latent Indices

To reduce multicollinearity and capture underlying constructs, Principal Component Analysis (PCA) was applied to conceptually similar variables. PCA extracted latent indices for:

Economic Distress Index (EDI)

Psychosocial Stress Index (PSI)

Institutional Support Deficit Index (ISDI)

If are standardized variables, PCA constructs latent factors as:

where are factor loadings.

These indices replace correlated variables in advanced models while retaining the original variables in baseline regressions.

2.2 Baseline Suicidal Tendency Model

Following Gujarati (2004) and Peter (2003), the baseline OLS model is:

This model estimates the direct effect of agrarian, social, economic, and psychological factors on suicidal tendency scores.

2.3 Multilevel (Hierarchical) Linear Model

Because farmers are nested within villages, observations are not independent. A two-level random-intercept model accounts for clustering:

Level-1 (Household-level) model

Level-2 (Village-level) model

Combined mixed model

Where:

= village-specific deviation

= individual residual

Intraclass correlation coefficient (ICC):

measures how much variation is between villages.

2.4 Logistic Regression Model (Binary High-Risk Classification)

To understand factors predicting high suicidal risk (e.g., 1 = High-risk, 0 = not high-risk), a logistic model is estimated:

Coefficients are interpreted as odds ratios, showing the magnitude of risk attributable to each factor.

2.5 Ordinal Regression Model

If suicidal tendency is measured as ordered categories (none–low–moderate–high), the **proportional odds model** is used:

where indexes thresholds.

2.6 Mediation Analysis

To test whether institutional support (IGS) weakens the psychological impact of economic distress (AD) on suicidal tendency, a mediation framework is applied:

(a) Effect of AD on mediator M (e.g., MHI)

(b) Effect of M on ST controlling for AD

Indirect (mediated) effect

Bootstrapped confidence intervals determine significance.

2.7 Interaction (Moderation) Model

To test if certain conditions intensify risk (e.g., distress $\times$ landholding size):

A significant indicates heterogeneous effects.

2.8 Spatial Autocorrelation and Spatial Regression

Geographical clustering is tested using Moran's I:

If spatial dependence is significant, a **Spatial Lag Model (SLM)** is estimated:

Where:

= spatial weights matrix

= spatial autoregressive parameter

This uncovers spillover effects across neighboring villages.

2.9 Machine Learning Predictive Model (Random Forest)

To identify **top predictors** of high-risk farmers, a Random Forest classifier is applied:

Where each is a decision tree trained on bootstrap samples.

Performance metrics include:

Area Under Curve (AUC)

Sensitivity and specificity

Variable importance (Gini decrease)

2.10 Model Diagnostics and Robustness Checks

Variance Inflation Factor (VIF) for multicollinearity

Breusch–Pagan test for heteroskedasticity

Cook's Distance for outliers

RESET test for model specification

Comparison of OLS vs. robust SEs

Sensitivity analysis by removing one predictor at a time

3 Results

3.1 Principal Component Analysis (PCA)

PCA was done to reduce dimensionality of the several correlated agrarian distress-related variables as well as household economic vulnerability, psychological stress, and institutional support. There were three components having eigenvalues greater than 1, which were retained as comprising 67.4% of total variance. The first component (Economic distress) demonstrated strong loads for debt, crop loss, and credit constraint; The second component (Psychosocial stress) had significant loads on depressive symptoms and family tensions; And the third component (Deficit in institutional support) indicated limited access to credit, insurance, and relief programs (See Table 1).

Table 1. PCA Results (Rotated Component Loadings)

Variable	Economic Distress	Psychosocial Stress	Institutional Deficit
Debt Burden	.81	.22	.14
Crop Loss	.78	.15	.18
Input Costs	.72	.09	.21
Depression Score (MHI)	.12	.84	.05
Family Stress	.18	.79	.11
Social Pressure (NC)	.21	.63	.22
Access to Credit	.09	.11	.81
Access to Insurance	.17	.08	.76

These patterns align with empirical work showing that agrarian distress operates as a multi-dimensional construct shaped by structural and psychosocial pressures (Behere & Behere, 2008; Vasavi, 1999).

3.2 Multilevel Regression Results

To explain the clustering of households within villages, a two level random intercept model was estimated. The intraclass correlation coefficient (ICC = 0.19) was used to show that 19 percent of the variation in the scores of suicidal tendency could be explained by differences based on the village level. This verifies the previous research that suicides are geographically clustered because of common environmental and institutional backgrounds (Kennedy and King, 2014) (Table 2).

Table 2. Multilevel Regression Predicting Suicidal Tendency

Predictor	Coefficient (β)	SE	p-value
Agrarian Distress (AD)	0.42	0.07	< .001
Mental Health Issues (MHI)	0.31	0.06	< .001
Unemployment/Financial Stress (UFS)	0.18	0.07	.013
Family/Social Pressure (FSP)	0.14	0.05	.008
Inadequate Govt. Support (IGS)	0.27	0.09	.003
Access to Employment (EI)	−0.21	0.08	.011
Random Intercept (Village) Variance	0.38	—	—
Residual Variance	1.63	—	—
ICC	0.19	—	—

Agrarian Distress was the most effective predictor of suicidal tendency, then Mental Health Issues and Institutional Support Deficit. These findings are in line with the previous studies that have concluded that economic pressure and psychosocial unrest interact to contribute to suicide in rural India (Mishra, 2006; Rehkopf and Buka, 2005).

3.3 Logistic Regression (High-Risk Classification)

Farmers were put into high-risk and low/moderate-risk groups through the use of logistic regression. Odds ratios show the likelihood to belong to the high-risk group (Table 3).

Table 3. Logistic Regression Predicting High Suicide Risk

Predictor	Odds Ratio (OR)	95% CI	p-value
Agrarian Distress	2.76	1.89–4.12	< .001
Psychosocial Stress	2.34	1.61–3.48	< .001
Govt. Support Deficit	1.82	1.20–2.78	.005
Employment Access	0.63	0.41–0.96	.033

This model validates that economic disadvantage, mental ill health, and institutional rupture are risk factors of suicide that vary sharply unlike access to employment as a protective factor as per literature that focuses on the buffering of livelihood (Durkheim, 1897/2002; Singh and Jenkins, 2000).

3.4 Mediation Analysis

The interrelationship between Agrarian Distress and suicidal tendency was mediated by Psychosocial Stress (MHI) to a certain degree. The total effect was attributed to the indirect effect (0.14, $p < .01$) by 33% (table 4).

Table 4. Mediation Analysis

Effect Type	Estimate	SE	p-value
Direct Effect (AD → ST)	0.28	0.07	< .001
Indirect Effect (AD → MHI → ST)	0.14	0.04	.002

Total Effect	0.42	—	—
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This state of mediation is also consistent with the suicidology literature that the economic shocks increase psychological distress that subsequently raises suicidal ideation (Behere and Behere, 2008; Patel et al., 2012).

3.5 Interaction Effects

Agrarian Distress and Land Size were found to have a significant interaction ($\beta = -0.19$, $p = .016$), which implies that distress is influenced more severely among marginally farmers, which supports the arguments that have been made long before this study that smallholders do not have buffers against agricultural shocks (Venkateswarlu et al., 2013).

3.6 Spatial Autocorrelation

The $I = 0.21$ ($p = .032$) of Moran proved the spatial clustering of suicidal tendency scores. This is in line with facts that suicides in agrarian countries are geographically correlated with drought severity, loss of crops, and deficits in local institutions (Kennedy and King, 2014).

3.7 Random Forest Predictive Model

Random Forest classifier was also very predictive accurate ($AUC = 0.83$). The hierarchy based on the variable importance score was as follows (Table 5).

Table 5. Random Forest Variable Importance

Rank	Predictor	Importance Score
1	Agrarian Distress	0.34
2	Mental Health	0.27
3	Crop Loss/Debt	0.19
4	Institutional Support Deficit	0.12
5	Family/Social Pressure	0.08

The intersection of predictive and inferential models enhances the trust of the strength of the risk factors identified.

4 Discussion

The analysis indicates an overall pattern of coherent and multi-layered influences underlining the suicidal behaviours of farmers from Maharashtra (India). Agri-cultural stress, psychological burden and lack of adequate institutional support were shown to be major contributing factors to farmer suicides in the state. Through multilevel modelling, we have shown that the social context of the village in which the farmer resides significantly influences how vulnerable that farmer is to suicide, which is supported by prior research indicating that farmers often commit suicide in specific agricultural and social environments (Vasavi, 1999; Kennedy & King, 2014). In contrast to agrarian distress, the emotional impact of financial distress was seen to operate through the framework of social isolation, suggesting that economic stress not only affects the farmer and his family, but also creates isolation in the village (Mann, 2002; Patel et al., 2012). Logistic and Random Forest regression analysis confirm the earlier findings that economic and financial pressures, combined with the lack of social support from the employment market and families provide the most significant risk factors that contribute to suicide among farmers, while providing evidence of the protective

nature of Social Integration and Regulation as presented in classical sociology (Durkheim, 1897/2002). The clustering of suicide within local contexts reinforces the fact that suicide clusters occur when social conditions (environmental, access to credit, and high risk of contagion) exist and therefore support calls to have place-based intervention strategies (Kennedy & King, 2014).

5 Summary, Conclusion and Future Perspectives

To analyze suicidal behavior among farmers in Maharashtra, this study evaluated multiple dimensions of risk using multiple types of advanced analysis including: regression, logistic and ordinal regression, mediation analysis, PCA derived latent constructs, spatial autocorrelation, and machine-learning classification. In line with prior research regarding farmer suicide in India (Deshpande, 2002; Mishra, 2006; Sainath, 2009), agrarian suffering caused by debt, crop failure, fluctuating input costs and lack of access to institutional credit is found to be the most prominent risk predictor for increased susceptibility to commit suicide.

Psychosocial stress is also found to be as significant a factor as agrarian distress and measures of psychosocial stress included mental health indicators and pressures from family and social systems. When all variables of agrarian distress are included together in a model, psychosocial stress represents approximately one-third of the total effect of agrarian distress on suicidal behavior. This result supports previous research indicating that emotional trauma, as a result of economic shocks, and subsequent depression, will increase risk of suicide (Mann, 2002; Rehkopf & Buka, 2005).

Another key discovery in this research is that the insufficient support of institutions for the public living in Maharashtra (e.g. very limited access to insurance, compensation and public credit systems) increases the number of farmer's suicides and is therefore supportive of previous research findings conducted with respect to the agrarian crisis in the area of Vidarbha (Behere & Behere, 2008; Mohanty, 2005).

Multilevel modeling has shown the significant role of community level characteristics in regards to the rates of suicidal behaviour; approximately 19% of the variance associated with the rate of suicidal behaviour is due to village-level differences. The clustering of suicides within a geographic region is indicative of the shared risk exposure and other institutional inadequacies associated with the agricultural industry (Kennedy & King, 2014). Via a Random Forest model with high levels of predictive accuracy. The results validated the conclusions reached from the findings of the Random Forest model through identification of agrarian distress, psychological trauma, and deficiencies in institutional support as being the leading variables in determining instances of high-risk cases.

6 Conclusion

This research suggests that the high prevalence of suicide among farmers in Maharashtra is situated within a larger systemic problem affected by numerous interrelated economic, psychological, social, and institutional forces. While agrarian distress serves as a major structural component of the crisis, the outcomes of agrarian distress are compounded by the negative effects of deteriorating mental health, familial stressors, inadequate responses from the government, and a larger environment of rural vulnerability. As such, farmer suicide is not simply the result of an individual's lack of coping mechanism but is a result of the interacting structural vulnerabilities, community deprivations and agency neglect.

These findings also align with Durkheim's (1897/2002) concepts of anomie, which concludes that lack of social integration and regulatory assistance lead to a heightened sense of hopelessness for those farmers who are experiencing economic distress. Additionally, the findings of this study support the expanding view

that effective suicide prevention must expand beyond purely economic strategies, encompassing psychosocial, institutional, and spatially targeted interventions (Patel et al., 2012; Singh & Jenkins, 2000).

In conclusion, this research supports the need for a comprehensive multidimensional policy framework that will promote stabilisation of farm income, improve access to mental health services, enhance availability of institutional credit and provide increased levels of support through local community-based systems. If only one dimension such as compensation or loan waiver were to be considered to decrease the incidence of farmer suicide, it would have no significant effect.

6.1 Future Perspectives

Based on the findings revealed in this study, there are many potential avenues for both future policy development and further research. Examples of these avenues include the need for researchers to utilize longitudinal or panel datasets to track the evolution of three factors: (1) Economic shocks; (2) Climate variability; (3) Psychosocial health. Researchers utilizing these types of datasets will allow researchers to make stronger causal inferences and better understand vulnerable populations' long-term vulnerability trajectories (Raudenbush & Bryk, 2002). Because agriculture in the Vidarbha region is particularly sensitive to climate, future research should develop a set of satellite-derived indices, as well as use data on rainfall anomalies and soil moisture, to better understand the relationship between environmental stress and socioeconomic vulnerability (Venkateswarlu et al., 2013). Additionally, researchers should expand their use of spatial regression and geostatistical methods to identify "hotspot" micro-regions that require targeted intervention. This is consistent with the emerging "best practice" guidance for geographically-specific delivery of mental health and welfare services worldwide (Kennedy & King, 2014). Another important area for research is the evaluation of rural counselling centres, mobile mental health units, and community wellness programmes to determine their effectiveness by conducting intervention studies. Very little research has been conducted on evidence-based models for providing mental health services to rural agrarian populations (Patel et al., 2012). Lastly, future research should evaluate how improved credit access, crop insurance reform, and direct benefit transfer schemes reduce distress among the community and assess which institutional programme(s) yield the greatest protective benefit through the use of randomized policy pilot experiments. Future studies will develop real-time early warning systems using agricultural, climatic, and social indicators to identify households at acute risk for suicide with predictive models that have better accuracy than current models (and all indicators). Such predictive tools could drastically improve the ability of welfare agencies to deliver assistance proactively.

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