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The Determinants of Farmers' Suicide in Karnataka – An Econometric Analysis

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ABSTRACT: Karnataka is an agrarian state and one of the eighth largest state in India, in the area and seventh state in population. In Karnataka state, about 76% of the population lives in rural areas and about 56% of the workforce is engaged in agriculture and allied activities which generate about 49% of the State's income. Despite the tremendous agricultural profile, the state is not excluded from the burning issues like the agrarian crisis as well as farmers' suicide. Out of the last nine years, the state has experienced drought for seven years, this is one of the major reasons for farmers taking the severe step of suicide. Hence, the main intention of this paper is to examine the status and determinants of the farmers' suicide on the other hand it tries to Study the long-run and short-run relationships between Farmers' Suicide and other selected variables by using ADF and Johansen's cointegration tests. The results reveal that there is a long-run and short-run relationship between farmers' suicide and other explanatory variables.

KEY WORDS: Karnataka, Agriculture, Farmers' Suicide, Variables.

1. INTRODUCTION

Karnataka is an agrarian state and one of the eighth largest state in India, in the area and seventh state in population. It has two important river systems they are Krishna and its tributaries in the north and Cauvery and its tributaries in the south both the rivers flow toward the east and fall into the Bay of Bengal.

In Karnataka state, about 76% of the population lives in rural areas and about 56% of the workforce is engaged in agriculture and allied activities which generate about 49% of the State's income. The state has a total land area of around 1,90,49,836 hectares; out of which the net sown area is about 1,21,08,667 hectares area is accounted as "Agricultural Holdings" and nearly 62,21,000 farm families operate the same. The net irrigated area out of the total sown area is 21.7%. More or less, the state contributes about 5.59 percent in national food grains production. The income generated from horticulture constitutes over 40% of the income generated from agriculture and it is about 17% of 26 the state's GDP. In floriculture, Karnataka occupies the second position in India in terms of production.

In recent years, it is found that Karnataka is one of the states having severe agrarian distress. But it had no history of farmers' suicide when crops or market failed, although there were agitations of farmers in the past (Assadi, M. 1998). The suicidal death of Bidar farmer considered to be the first incidence of farmers' suicide attracted considerable attention of media and public in 1997, this has been also reported in the Veeresh Committee (2002). Out of the last nine years, the state has experienced drought for seven years, this is one of the major reasons for farmers taking the severe step of suicide. A large number of farmers committed suicide during the year 2000-01 to 2014-15. Union Government sources pointed out that there are 9642 suicidal deaths of farmers Between 2000-2001 to 2009-2010 have been reported in Karnataka State. But, according to NCRB reports, there were about 2630 farmers' ends their lives but it was dramatically decreased from 2630 to 1478 in the year 2015-16.

Hence, the present paper tries to identify the various factors responsible for farmers' suicide in Karnataka. For that, some of the major variables like agricultural credit, agricultural GDP, amount of fertilizers used, net irrigated area, and price identified to address the issue. Subsequently, the study first identifies the long run and short-run relationships of farmers' suicide with selected variables by using Johansen's Cointegration test.

2. OBJECTIVES OF THE STUDY

- To examine the status of farmers' suicide in Karnataka State.
- To Study the determinants of farmers' suicide in Karnataka.

3. METHODOLOGY

The study used two types of methods; one is the Augmented Dickey-Fuller test and another one is Johansen cointegration Methodology. Firstly, the study used the ADF test because, the data selected for this study is time-series in nature, hence, the study tested the spurious relationship among the selected variables by using the Unit root test. If the time series are non-stationary, then the results derived from regression become spurious. Later on, it is used the Johansen cointegration test to know the long run and short-run relationships between the selected variables.

$$y_t = d_t + \phi_1 y_{t-1} + \sum_{i-1}^{p-1} \gamma_I \ \Delta y_{t-1} - \varepsilon_t$$

Where $d_t = \sum_{i=0}^{p} \beta i^i$, for p = 0, 1, contains deterministic parts of the models.

The limiting distribution of the test statistic is identical to the distribution of DF test statistics and T → ∞ is tabulated in Dickey (1976) and McKinnon (1991).

Johansen suggests two different likelihood ratio tests of the significance of these canonical correlations and thereby the reduced rank of the II matrix; the trace test and maximum eigenvalue test, shown in the below equation.

$$J_{trace} = -T\sum_{i=r+1}^{n} \ln (1-\hat{\lambda}_i)$$

$$J_{max} = -T \ln (1-\hat{\lambda}_{r+1})$$

Here the T is the sample size $\hat{\lambda}_i$ is the i^{th} largest canonical correlation. The trace test tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of n cointegrating vectors. The maximum eigenvalue test, on the other hand, tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of r+1 cointegrating vectors. The critical values used for the maximum eigenvalue and trace statistics are based on a pure unit-root assumption, they will no longer be correct when the variables in the system are near unit-root processes.

4. RESULTS AND DISCUSSION

This section interprets and discusses the results of the Unit root, long run, and short-run relationship obtained from the Johansen co-integration methodology. The results of the Augmented Dickey-Fuller Unit root test are shown in table 1. The results reveal that all the selected variables are non-stationary at a level that can be seen from the t statistic and p values in columns no 2 and 3 of the table. The probability values of all the variables are greater than the assumed level of significance namely 5 percent; hence, the null hypothesis of unit root cannot be rejected. Hence, all the variables are containing a unit root. But, all the variables become stationary at the I^{st} difference which has been observed from the last two columns of the table. The probability values are lesser than the 5 percent level of significance and also they are statistically significant. From this result, it is revealed that the study cannot use classical regression methodology or OLS method, therefore, the co-integration test is used in this context.

Table 1: Results of ADF Unit Root Test for the Determinants of Farmers' Suicide in Karnataka

Variable	**At Level**		**Ist Difference**	
	't' stat	**'p' value**	**'t' stat**	**'p' value**
Farmers Suicide	-1.701612	0.4105	-4.905447	0.0021*
Agriculture Credit	1.2934	0.60369	-2.136768	0.0357**
Agriculture GDP	-1.036338	0.7112	-4.741156	0.0044*
Fertilizer Use	-1.339192	0.5825	-3.958598	0.0109**
Area Irrigation	-1.787257	0.3694	-4.593948	0.0156**
Sugarcane Price	-0.973257	0.7341	-3.447788	0.0286**

Note: p values are significant at *1%, **5%, ***10%

Here, before performing cointegration test, again we need to first determine the optimal number of lags.

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It is necessary at the onset of cointegration analysis that we need to solve the problem of optimal lag length because multivariate cointegration analysis which the study used is very sensitive to lag length selection. The most commonly used lag length selection criteria are the Akaike Information Criterion (AIC) and the Schwartz Bayesian Criterion (SBC).

Table 2: Lag Length Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	67.17455	NA	1.16e-11	-8.156607	-7.873387	-8.159624
1	146.7297	84.85886*	5.55e-14*	-13.96396*	- 11.98142*	-13.98508*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

The results of lag length selection criteria are produced in table 2. The results reveal that the 1 lag is optimal based on all the criteria reported in the above table. Hence, the study used 1 lag for estimation of cointegration.

Table 3: Results of Johansen Co-integration Test for Long Run Relationship

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.954484	125.4697	95.75366	0.0001
At most 1 *	0.921760	79.12439	69.81889	0.0075
At most 2	0.695646	40.90479	47.85613	0.1917
At most 3	0.599650	23.06134	29.79707	0.2431
At most 4	0.401432	9.330111	15.49471	0.3357
At most 5	0.103083	1.631874	3.841466	0.2014

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.954484	46.34534	40.07757	0.0087
At most 1 *	0.921760	38.21960	33.87687	0.0142
At most 2	0.695646	17.84345	27.58434	0.5082
At most 3	0.599650	13.73123	21.13162	0.3875
At most 4	0.401432	7.698237	14.26460	0.4102
At most 5	0.103083	1.631874	3.841466	0.2014

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 3 indicates the results for testing the number of cointegrating relations. Two types of test statistics are reported, namely, trace statistics and maximum eigenvalue statistics. For each table, the first column is the number of cointegrating relations under the null hypothesis, the second column is the ordered eigenvalue of the II matrix, the third column is the test statistic, and the last two columns are the 5% critical values and prob. Values respectively.

On the basis of the two test statistics such as trace statistics and maximum eigenvalue statistic, the study draws an inference that there is two cointegrating relationships exists among the chosen variables. Because the null hypothesis of no cointegration and at most 1 cointegrating equation are rejected. Based on this, the study infers that there is a long-run relationship or cointegration that exists among farmers' suicide and variables like agricultural credit, agricultural GDP, amount of fertilizers used, the area under irrigation, and price.

Table 4: Results of Long-run Relationship of farmers' suicide with selected variables

Normalized cointegrating coefficients (standard error in parentheses)					
LOGFS	LOGAC	LOGAGDP	LOGFER	LOGIRR	LOGPRICE
1.000000	0.436675	-1.184279	-2.516880	-4.669116	-0.493699
	(0.06810)	(0.28654)	(0.15328)	(0.33681)	(0.08198)
't' stat	6.41226	-4.13303	-16.42014	-13.86275	-6.02218

So, according to the above results shown in table 4, the effect of log credit on farmers' suicide is positive and statistically significant which implies that when there is an increase in credit amount the farmers' suicide also increases. But all other variables have negatively influenced on farmers suicide; namely agricultural GDP, amount of fertilizers used, area under irrigation and price. It means that, if the agricultural GDP increases, the farmers' suicide decreases. Similarly, when the amount of fertilizers increases the risk involved in farmers' suicide decreases, likewise, area under irrigation increases, the percentage of occurrence of farmers' suicide decreases. Lastly, the price of the product increases, the risk in farmers' suicide decreases. Hence, the variable agricultural credit has a positive impact on farmers' suicide and other variables like agricultural GDP, amount of fertilizers used, area under irrigation and price of the product have negative influence on farmers' suicide as per the expectation of the study.

Table 5: Results of Short-run Relationship between Farmers Suicide with Selected Variables

Error Correction:	D(LOGFS)	D(LOGAC)	D(LOGAGDP)	D(LOGFER)	D(LOGIRR)	D(LOGPRICE)
CointEq1	-0.457086	0.293925	0.042665	0.590279	0.158959	0.104915
	(0.21654)	(0.22023)	(0.07345)	(0.13733)	(0.08434)	(0.21205)
	[-2.11086]	[1.33465]	[0.58086]	[4.29824]	[1.88480]	[0.49478]
C	-0.038420	0.147152	-0.022274	0.023259	0.022381	0.041736
	(0.04141)	(0.04211)	(0.01404)	(0.02626)	(0.01613)	(0.04055)
	[-0.92789]	[3.49446]	[-1.58592]	[0.88572]	[1.38783]	[1.02936]
R-squared	0.255258	0.120510	0.025298	0.586972	0.214618	0.018483
Adj. R-squared	0.197970	0.052856	-0.049680	0.555201	0.154204	-0.057018
Sum sq. resids	0.334308	0.345786	0.038465	0.134462	0.050712	0.320571
S.E. equation	0.160362	0.163092	0.054395	0.101702	0.062457	0.157033
F-statistic	4.455713	1.781286	0.337403	18.47490	3.552459	0.244805
Log likelihood	7.243987	6.990820	23.46134	14.07483	21.38827	7.558681
Akaike AIC	-0.699198	-0.665443	-2.861512	-1.609977	-2.585103	-0.741157
Schwarz SC	-0.604792	-0.571036	-2.767105	-1.515570	-2.490696	-0.646751
Mean dependent	-0.038420	0.147152	-0.022274	0.023259	0.022381	0.041736

S.D. dependent	0.179063	0.167581	0.053092	0.152492	0.067913	0.152739
Determinant resid covariance (dof adj.)	5.92E-14					
Determinant resid covariance	2.51E-14					
Log likelihood	107.1675					
Akaike information criterion	-11.88901					
Schwarz criterion	-11.03935					
Number of coefficients	18					

The results of the short-run relationship for farmers' suicide are given in table 5. As the study expected the sign for the error term is negative in the estimated short-run equilibrium which means that any deviations from the equilibrium are corrected and the variables move back to the long-run equilibrium trend. These results support the granger representation theorem.

In sum, the agriculture sector is the main source of income for more than 60 percent of the total population of the country and the Karnataka state also has more or less the same percentage of agriculture dependency. However, the agriculture sector has been facing different kinds of worst crisis. Agriculture is often attributed as gambling with monsoons which lead to drought, lack of better prices, and exploitation of farmers by middlemen and this lead to series of suicides committed by the farmers. Farmer's suicides are not only confined to the drought district of Karnataka but also some prosperous districts of the south. Many factors like agricultural credit, lack of irrigation, lack of inputs, lack of price, lack of market facilities, the problem of money lenders, and production shock have associated with this burning issue of the state. The results reveal that, there are long run and short run relationship between farmers' suicide and other explanatory variables.

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