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PREDICTION OF FINANCIAL DISTRESS USING FINANCIAL PARAMETERS AND ALTMAN Z SCORE WITH SPECIAL REFERENCE TO THE CASE OF SUZLON ENERGY LTD.

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ABSTRACT

Financial Distress is a situation where, if any company is unable to pay off its short-term and long-term Liabilities. The main aim of the research undertaken is to find out whether company is in Financial Distress using 5 years' data for the company Suzlon Energy Ltd. Data collected on various financial parameters from the year 2014 till 2018. The method used is a case study method with specific company only. The current study used financial performance indicators viz Net Sales, Total Assets, Retained Earnings, Working Capital etc. The Altman Z score is used for analyzing the data and interpret the financial distress of the company. Financial statement analysis and various financial ratios are used for analysis. The research is based on secondary data and data is mainly collected from Bombay Stock Exchange website and annual reports published. The purpose for considering Suzlon Energy Ltd. for this research is due to its lot many news related to its high debt and NPAs. The findings suggest that the financial distress can be predicted from financial performance as well leads to pledging of shares by promoter.

KEYWORDS

Altman Z Score, BSE, Suzlon Energy Ltd., financial distress, promoters pledging.

JEL CODE

G32

INTRODUCTION

Financial distress is a term in financial management which indicates a condition where company is unable to pay its creditors and lenders. The condition of financial distress is more likely when business is highly leveraged. Financial distress is more common just before a business declares bankruptcy. If the level of distress if high, the firm may be forced into immediate liquidation.

Financial distress usually refers to situation where the cash inflows of the firm are not sufficient to meet daily operational expenses. Often the financial distress comes with its own costs such as fees paid to lawyers and costs of extra interest paid for late payments. Financial distress is often a long term process and has an impact on capital structure, investment policies and performance of many firms even after the emergence of debt restructuring. Firms diversify their priority structure relative to its pre distress composition.

Financial distress is an individual, business or company's inability to generate enough revenue when there is too much debt. Predicting financial distress remains a significant area of focus for researchers due to its vital importance for the firms and stakeholders including investors, lenders and others. Financial Distress is a situation where, if any company is unable to pay off its short-term and long-term Liabilities.

ABOUT SUZLON ENERGY LTD.

Suzlon is world's leading renewable energy solutions provider offering a 360 – degree total solutions package to its customers that covers the entire spectrum of wind energy projects. Its revolutionizing and redefining the way sustainable energy sources are harnessed across the world. Present in 18 countries across Asia, Australia, Europe, Africa and America.

Suzlon is powering a greener tomorrow with its strong competencies in renewable energy systems. Suzlon Energy Ltd. is a wind turbine supplier based in Pune, India. It was formerly ranked by MAKE as the world's fifth largest wind turbine supplier. In 2014 the company dropped out of the Global top ten rankings due to extensive losses and inability to repay debts.

REVIEW OF LITERATURE

In the opinion of Baldwin and Mason (1983) "When a firms business deteriorates to the point where it cannot meet its financial obligations, the firm is said to have entered the state of financial distress" [1]

As per H.Platt and M.Platt (2006) "Financial distress and bankruptcy are different. Financial distress is something that happens to companies as a consequence of operating decisions or external forces while bankruptcy is something that companies choose to do to protect their assets from creditors" [2]

In the opinion of Zaki, Bah and Rao "Financial distress differs from bankruptcy as it refers to a period when a borrower is unable to meet a payment obligation to lenders whereas, bankruptcy is an official declaration of a firm's financial state in which it may cease business activities or reorganize. When financial distress remains unresolved, it may lead to bankruptcy, but the at outcome is not a certainty"[3]

According to Platt H. and Platt M "Financial distress is defined as the late stage of organizational decline that precedes bankruptcy"[4]

As per research by Almwajeh "Bankruptcy prediction models or financial distress prediction models even though are widely popular their use in hospitals is limited"[5]

NEED/IMPORTANCE OF THE STUDY

The term financial distress or failure of companies is becoming a growing problem all over world. Financial distress is a situation when companies are unable to pay the debt and not able to pay their liabilities. So the question arises is predication of the companies likely to go bankrupt or in distress possible? Financial Distress is a situation where, if any company is unable to pay off its short-term and long-term Liabilities. Financial distress is a term in corporate finance used to indicate a condition when promises to creditors of a company are broken or honored with difficulty. If financial distress cannot be relieved, it can lead to bankruptcy. Financial distress is associated with costs to the company.

The financial distress of company has multifold impact. Many stakeholders stake at stake. Employees, Investors, Vendors all get affected by such situation. Financial distress prediction is very important from the point of risk management perspectives. If this prediction is possible it will be really good help even for the banks. Many banks are loaded with huge NPAs due to bankruptcy of the companies. Can this likelihood of the company getting bankrupt be predicted? The researcher has undertaken the research to know this possibility of prediction.

STATEMENT OF THE PROBLEM

Financial distress prediction has become significant due to its importance to the firms and all the stakeholders including investors, lenders etc. The continuance of financial distress for long term may lead to closure of firm. Early prediction of distress can prove to be warning for long term effects. Prediction of early financial can help avoid bankruptcy.

OBJECTIVES

The researcher has undertaken the research with following objectives:

1. To understand the conceptual background of financial distress.
2. To predict the Financial Distress using Altman's Z Score
3. To suggest strategies for risk minimization.

RESEARCH METHODOLOGY

The research carried out is based on secondary data collected from various sources as research papers, news articles. The yearly annual reports and website of the company are the main sources of data. The method used is a **case study method** with specific company viz **Suzlon Energy Ltd.** For the undertaken research the Altman's Z score model was used for knowing if the company is in distress or not.

Altman Z Score model for predicting bankruptcy

$Z = 0.012X_1 + 0.014X_2 + 0.033X_3 + 0.006X_4 + 0.999X_5$

X_1, X_2, X_3, X_4 are in percentage points.

X_1 = working capital / total assets

X_2 = retained earnings / total assets

X_3 = earnings before interest and taxes / total assets

X_4 = market value of equity / total liabilities

X_5 = sales / total assets

Interpretation of Z Value

Z > 2.99 …… Safe Zone

1.81 < Z < 2.99 …….Grey Zone

Z < 1.81 ……"Distress" Zone

TABLE 1

Independent Variable	Measurement	Dependent Variable	Measurement
Financial Distress	Altman Z Score	Financial Performance	Financial Ratios

RESULTS & DISCUSSION

TABLE 2

Name of Company	Financial Year	A=EBIT/Total Assets	B=Net Sales /Total Assets	C=Market Value of Equity / Total Liabilities	D=Working Capital / Total Assets	E = Retained Earnings / Total Assets	Z Value	Interpretation 1	Interpretation 2
Suzlon Energy Ltd	**2017-18**	0.01	0.48	0.32	0.25	0.06	0.84	Likelihood of bankruptcy is very high	Company is in DISTRESS
	2016-17	0.04	0.65	0.78	0.21	0.00	1.52	Likelihood of bankruptcy is very high	Company is in DISTRESS
	2015-16	0.18	0.53	1.71	0.17	0.03	2.32	Likely to go bankrupt within 2 years	CAUTION ZONE
	2014-15	0.08	0.14	0.56	0.31	0.15	0.89	Likelihood of bankruptcy is very high	Company is in DISTRESS
	2013-14	0.01	0.16	0.27	0.03	0.12	0.48	Likelihood of bankruptcy is very high	Company is in DISTRESS

The above table shows that the using financial ratios and Altman Z score value it is possible to predict if the company is in Financial Distress. If the Z score is monitored for regular frequency the likelihood of bankruptcy can well in advance predicted and can be avoided.

FINDINGS

Based on the values of Altman z Score it's possible to predict whether the company has likelihood to go bankrupt and in turn have financial distress. Before investing or lending money to any company if this type of analysis can be done it will surely help the stakeholders to minimize their risk.

The major factors which are the reasons for the financial distress of the companies are the insufficient accounting practices, unrealistic budgeting and pricing, cash flow, poor debt management, low sales and high expenses.

RECOMMENDATIONS/SUGGESTIONS

If high debt or liabilities are the cause of financial distress, the company can undergo restructuring its debt. If any operational issues are the reason for the distress, the company can negotiate a payment holiday to its creditors and improve the operations to be able to clear the debt.

CONCLUSIONS

If financial distress cannot be relieved, it can lead to bankruptcy. Analyzing financial distress and taking adequate measures to avoid bankruptcy are crucial for the success of the organization. Financial distress can be predicted using Altman Z score and this prediction will help all the stakeholders to minimize the risks involved.

SCOPE FOR FURTHER RESEARCH

The undertaken research is a **case study** method based on data collected for specific company viz. **Suzlon Energy Ltd.** The data considered for undertaken research is for 5 years only. Further research can be done with some other company or it can have done with comparative analysis of many companies. Sector wise companies can be considered for study in future.

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WOMEN EMPOWERMENT AND MICROFINANCE: A STUDY WITH REFERENCE TO SINGUR BLOCK

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ABSTRACT

Microfinance plays a key role in both poverty alleviation and the women empowerment. Women are the most vital fundamentals of the social structure and are playing a pivotal role in the socioeconomic scenario in India. Microfinance programs like the SHGs in India have been promoted for their positive economic impact and the belief that they empower women. This paper makes an attempt to evaluate the effectiveness of microfinance on empowerment of women. The survey was conducted through a structured questionnaire on around 415 women respondents who are associated with various SHGs in Singur block of Hooghly district. The analysis was done to study the empowerment of women through microfinance. The findings of this study reveal that microfinance is a powerful tool in enhancing women empowerment for its all indicators like economic empowerment, social empowerment, political empowerment, legal awareness and family decision making.

KEYWORDS

microfinance, women empowerment, self help groups, economic security.

JEL CODES

I38, G21.

1. INTRODUCTION

The unique feature of microfinance programme is that it focuses on women in development. There are more than ninety per cent women clients under this programme. The basic idea is to empower women by providing them financial assistance and allowing them to earn an independent income, contribute financially to their households and generate self-employment. This economic independence is expected to generate increased self-respect, self-esteem, self-confidence and other forms of empowerment for women participants of the programme. The process of empowerment of the beneficiaries of the programme is not automatic, but depends upon many factors. These factors may be abilities, environment, initiative and the status of women as a group.

There is no dearth of studies which show that with the help of microfinance the status of a woman improves in the family; she earns greater respect in the family than before; she participates in the decision-making and community meetings; and she gets freedom to move for the betterment of the micro-business. It may be due to the fact that women become able to contribute financially to the family. In fact, a microfinance program increases economic, social, and political empowerment. Microfinance programme may be an important programme, but not a panacea to end all the problems that the poor face. Hence, the programme beneficiaries must efficiently use the financial support to start small businesses that will help in uplifting the standard of life and empowerment of women. The present chapter studies the impact of microfinance programme on women empowerment.

This article has been divided into eight sections. Section 2 deals with the conceptual frameworks. Section 3 shows literature review. The objective of the study is exhibited in sector 4. Database and research methodology have been discussed in section 5. Results and discussion are highlighted in section 6. Finally, the study has been concluded in section 7.

2. CONCEPTUAL FRAMEWORKS

2.1 MICROFINANCE

Microfinance is the provision of financial services to low income clients who traditionally lack access to banking and related services. It helps in reaching out to the vulnerable segments of the society like women, SC, ST which are outside the purview of formal institutions. It is a form of financial development that has primarily focused on alleviating poverty through providing financial services which help poor to take up income generating activities and secondly it focuses on women empowerment.

2.2 SELF HELP GROUPS (SHGs)

SHGs is a very good idea and this encourages poor people to save small amounts and use money cautiously in emergencies like unexpected health problems, natural calamities etc. They deposit money into bank and they get interest for that money. Whenever they take loan they are charged at a very low rate than interest given on deposit amount.

2.3 EMPOWERMENT

Empowerment literally means making someone powerful; facilitating the weak to attain strength, enabling someone to confront injustice and oppression. Empowerment is a process which makes the powerless to acquire and control over power through awareness, capacity building, participation in decision making, acquiring information, attaining confidence and self employment.

2.4 MICROFINANCE AND WOMEN EMPOWERMENT

In this study, an empowered woman is considered to be one who has made her life better by having access to and utilization of resources provided by microfinance programme. She also exerts and participates in the household decision-making. She shows self-confidence and also participates in the democratic institutions in the rural area. She has a general awareness of the existing social, economic and political environment.

3. LITERATURE REVIEW

Many scholarly works and studies have been conducted by the academicians and researchers on the different aspects of microfinance over the years. Some of those studies are shown below:

Jain and Jain (2012) demonstrated that on an average, there was a significant increase in women empowerment of the Self Help Groups members by participation in microfinance programme.

Gangadhar and Malyadri (2015) revealed that microfinance is a powerful tool in enhancing women empowerment for its all indicators like household economic decision making, legal awareness, mobility, economic security and family decision making.

Modi. et al. (2014) examined that four of the five factors (i.e. socio-economic status upgradation, autonomy for life choices, women position in the family/society and positive approach towards child development) have significant impact on rural women empowerment.

Datta and Sahu (2017) attempted to comprehend the role of MFIs and its associated factors towards empowerment in Paschim Medinipur district of West Bengal.

Mahesha (2016) revealed that SHGs help the deprived class of society to come out from the poverty level and by that way help in social and economic empowerment.

Vishnuvarthini and Ayyothi (2016) concluded that the women working in the SHGs were facilitated with better access health care and services and thus progressed in overall socioeconomic development and they became more confident and independent to make self-decision.

Samuel. et al. (2011) found that the basic problem was conflict and misunderstandings among the group members. There were also problem of improper savings and lack of involvement in group activities as well as less involvement in training activities.

Shylendra. et al. (2010) said that the linkage program has given a fillip to the formation of SHGs in the study district. It also reveals a few potential strengths as well as some inherent constraints of SHGs.

Lungbila (2016) exhibited that SHGs have been identified as a way to alleviate poverty and women empowerment. And women empowerment aims at realizing their identities, power and potentiality in all spheres of lives. But empowerment is possible only when a woman has increased access to economic resources, with more confidence and self-motivation, more strength, more recognition, more involvement in the family matters through participation.

The microfinance empowered rural women in many aspects of their life. No such study was conducted in Singur block of Hooghly district about the impact of micro finance on the empowerment of rural women. Hence, the study was undertaken in Singur block of Hooghly district, West Bengal to assess the impact of micro-finance on women empowerment.

4. OBJECTIVE OF THE STUDY

To evaluate the empowerment of rural women in Singur block of Hooghly district through participation in microfinance programmes.

5. DATABASES AND RESEARCH METHODOLOGY

5.1 Sources of Data: The study is both exploratory and empirical in nature. The explorative part of the study is based on the existing literature on the subject, including books, journal articles and research based publications on Microfinance in various journals.

The empirical analysis has been done on the basis of primary data. The primary data have been collected from the field survey with the help of a structured questionnaire. The secondary data have been collected from various sources, including research article, Journals and web based resources.

5.2 SAMPLE DESIGN

5.2.1 Area of the Research Study: Rural areas of Singur block

5.2.2 Target Respondent: Women leader of rural SHGs

5.2.3 Sampling Technique: Non-probability sampling technique

5.2.4 Sampling Method: Convenience sampling method

5.2.5 Sampling Size: 415 (total 2322 SHGs in Singur block[1])

5.2.6 Data Collection Method: Survey method through structured questionnaire.

5.2.7 Survey Period: October'18 to December'18.

5.2.8 Statistical Tools and Techniques Applied: Principal Component Analysis and Paired t-test have been used to present and interpret the data to draw logical conclusion.

Internal consistency of the questionnaire has been tested by using Cronbach's alpha, which has given a result of 0.691. Usually, a reliability coefficient above 0.60 is considered sufficient. Therefore, it can be said that the measures used in this study are valid and reliable. The processing and analysis of data have been done by using statistical package (SPSS-20.0 version).

5.3 Hypothesis Formulation

Hypothesis-1: H_0= There is no difference in mean income of respondents before and after joining SHG.

Hypothesis-2: H_0= There is no difference in mean of expression of views in the family as well as in groups before and after joining SHG.

Hypothesis-3: H_0= There is no difference in mean of participation in Gram Sabha meetings before and after joining SHG.

Hypothesis-4: H_0= There is no difference in mean of role in decision making related to Savings, Expenses and Children's Education before and after joining SHG.

Hypothesis-5: H_0= There is no difference in mean of interaction with bankers/Govt. officers and NGOs before and after joining SHG.

6. RESULTS AND DISCUSSION

The responses obtained were analyzed using SPSS package. Principal Component Analysis and Paired samples t test are used for the analysis.

6.1 RESULTS OF PRINCIPAL COMPONENT ANALYSIS

Principal Component Analysis (PCA) is a data reduction technique. It analyses all the variance in the observed variables. The main purpose of using Principal Component Analysis in this context is that, from many observable variables, it will enable one to create one synthetic indicator for each dimension considered. This involves choosing the appropriate number of latent components.

The present study has tried to analyze the various aspects of women empowerment in post microfinance programme intervention. This involves many variables. In order to keep correlated variables and to exclude the uncorrelated variables PCA technique has been used in this respect.

TABLE 1: KMO AND BARTLETT'S TEST

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.731
Bartlett's Test of Sphericity	Approx. Chi-Square	3572.242
	df	105
	Sig.	.000

(Source: Field survey by the researcher)

Interpretation: Kaiser-Meyer-Olkin test value is.731. It is expected to be satisfactory. The calculated Bartlett's Test value is.000. So, correlation matrix is not identity matrix. These tests provide a minimum standard which should be passed before a principal component analysis should be conducted. So, here both, the results are positive therefore, PCA could be run successfully.

[1] Ministry of Rural Development, Government of India.

TABLE 2: TOTAL VARIANCE EXPLAINED

Component	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.295	28.636	28.636	4.295	28.636	28.636	4.115	27.432	27.432
2	2.398	15.985	44.621	2.398	15.985	44.621	2.364	15.757	43.189
3	2.024	13.492	58.113	2.024	13.492	58.113	2.110	14.064	57.254
4	1.211	8.073	66.186	1.211	8.073	66.186	1.201	8.006	65.260
5	1.030	6.867	73.054	1.030	6.867	73.054	1.169	7.794	**73.054**
6	.944	6.293	79.347						
7	.774	5.162	84.510						
8	.659	4.391	88.901						
9	.504	3.361	92.262						
10	.371	2.474	94.736						
11	.237	1.581	96.317						
12	.205	1.365	97.682						
13	.159	1.060	98.742						
14	.107	.712	99.454						
15	.082	.546	100.000						

Extraction Method: Principal Component Analysis. (Source: Field survey by the researcher)

Interpretation: Eigen value is the measure of the amount of total variance in the data explained by a component. The cumulative % column contains the cumulative percentage of variance accounted for by the current and all preceding components. In this case, the result is 73.054. This means that the first five components together account for 73.054% of the total variance.

TABLE 3: ROTATED COMPONENT MATRIX[a]

	Component				
	1	2	3	4	5
Participation in election as contestants	.035		**0.935**	-.089	-.076
Expression of views in family as well as in groups	**.929**				
Assertiveness in participating protests against alcohol, abuse by male members of the family, environmental pollution, drinking water problem, dowry related problems and abuse of women by their husbands	**.900**		.101		
Participation in rallies for Women's day, Child labour abolition	**.865**		-.080	.052	.062
Participation in Gram Sabha meetings	.458		**.749**	-.053	
Role in decision making related to Savings, Expenses and Children's Education	-.077	**.912**			
Reduction of poverty in the family	.101	.075		.067	**0.875**
Increase in Income generating activities		.021			**0.824**
Voting independently			**.945**	.105	
Moving to other places independently without the support of male members	**.906**	-.063	-.018		
Ability to meet the financial crisis in the family		.108	-.238	-.154	**.639**
Interaction with bankers/Govt. officers and NGOs		-.142	.201	**.630**	
Reduction of dependency on money lenders	-.133	-.224	-.203	.222	**.565**
Increase in Savings	-.084		-.082	-.074	**.873**
Increase in Income	.442		.069	.197	**.562**
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization					

a. Rotation converged in 5 iterations. (Source: Field survey by the researcher)

Interpretation: It can be concluded that the 15 variables are grouped under five components, 1st component has 4 variables (Expression of views in family as well as in groups, Assertiveness in participating protests against alcohol, abuse by male members of the family, environmental pollution, drinking water problem, dowry related problems and abuse of women by their husbands, Participation in rallies for Women's day, Child labour abolition and Moving to other places independently without the support of male members), 2nd component has 1 variable (Role in decision making related to Savings, Expenses and Children's Education), 3rd component has 3 variables (Participation in election as contestants, Participation in Gram Sabha meetings and Voting independently), 4th component has 1 variable (Interaction with bankers/Govt. officers and NGOs), and the 5th component has 6 variables (Reduction of poverty in the family, Increase in Income generating activities, Ability to meet the financial crisis in the family, Reduction of dependency on money lenders, Increase in Savings and Increase in Income).

1st component is named as '**Social Empowerment'**, 2nd component is named as '**Family Decision Making**'. 3rd component is named as '**Political Empowerment**', 4th component is named **Legal Awareness** and 5th component is named as '**Economic Empowerment**'.

6.2 HYPOTHESIS TESTING THROUGH PAIRED SAMPLES T- TEST

Paired sample t test analysis was done to investigate the significant difference between women perception regarding empowerment in pre and post microfinance intervention. Microfinance intervention will be considered effective if women perception score regarding empowerment after participation in microfinance programme is found to be more than women perception score before participation in microfinance programme.

Hypothesis-1: H_0= There is no difference in mean income of respondents before and after joining SHG.

TABLE 4: PAIRED SAMPLES STATISTICS

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1 Increase in Income	Before Joining Group	1.7518	415	.43249	.02123
	After Joining Group	1.2072	415	.40581	.01992

(Source: Field survey by the researcher)

TABLE 5: PAIRED SAMPLES TEST

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1 Increase in Income	Before & After Joining Group	.54458	.53144	.02609	.49330	.59586	20.875	414	.000

(Source: Field survey by the researcher)

Interpretation: Since the P value of the test at the 5% level of significance is.000 which is less than 0.05. So, the null hypothesis is rejected and the alternative hypothesis is accepted. Therefore, it can be concluded that the mean income after joining SHG is significantly higher than the mean income before joining SHG. Thus the microfinance is significantly increasing the income of the respondents.

Hypothesis-2: H_0= There is no difference in mean of expression of views in the family as well as in groups before and after joining SHG.

TABLE 6: PAIRED SAMPLES STATISTICS

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1 Expression of views in family as well as in groups	Before Joining Group	1.8627	415	.34463	.01692
	After Joining Group	1.1470	415	.35452	.01740

(Source: Field survey by the researcher)

TABLE 7: PAIRED SAMPLES TEST

		Paired Differences					t	df	Sig. (2 tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1 Expression of views in family as well as in groups	Before & After Joining Group	.71566	.45164	.02217	.67208	.75924	32.28	414	.000

(Source: Field survey by the researcher)

Interpretation: Since the P value of the test at the 5% level of significance is.000 which is less than 0.05. So, the null hypothesis is rejected and the alternative hypothesis is accepted. Therefore, it can be concluded that the mean of expression of views in the family as well as in groups after joining SHG is significantly higher than the mean of expression of views in the family as well as in groups before joining SHG. Thus the microfinance is considerably escalating the expression of views by the respondents in the family as well as in groups.

Hypothesis-3: H_0= There is no difference in mean of participation in Gram Sabha meetings before and after joining SHG.

TABLE 8: PAIRED SAMPLES STATISTICS

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1 Participation in Gram Sabha meetings	Before Joining Group	1.8602	415	.34716	.01704
	After Joining Group	1.2120	415	.40925	.02009

(Source: Field survey by the researcher)

TABLE 9: PAIRED SAMPLES TEST

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1 Participation in Gram Sabha meetings	Before & After Joining Group	.64819	.47811	.02347	.60206	.69433	27.618	414	.000

(Source: Field survey by the researcher)

Interpretation: Since the P value of the test at the 5% level of significance is.000 which is less than 0.05. So, the null hypothesis is rejected and the alternative hypothesis is accepted. Therefore, it can be concluded that the mean of participation in Gram Sabha meetings after joining SHG is notably higher than the mean of participation in Gram Sabha meetings before joining SHG. Thus, it can be said that the microfinance is substantially increasing the participation of respondents in Gram Sabha meetings.

Hypothesis-4: H_0= There is no difference in mean of role in decision making related to Savings, Expenses and Children's Education before and after joining SHG.

TABLE 10: PAIRED SAMPLES STATISTICS

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1 Role in decision making related to Savings, Expenses and Children's Education	Before Joining Group	1.6386	415	.48100	.02361
	After Joining Group	1.1084	415	.31130	.01528

(Source: Field survey by the researcher)

TABLE 11: PAIRED SAMPLES TEST

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1 Role in decision making related to Savings, Expenses and Children's Education	Before & After Joining Group	.53012	.49969	.02453	.48190	.57834	21.612	414	.000

(Source: Field survey by the researcher)

Interpretation: Since the P value of the test at the 5% level of significance is.000 which is less than 0.05. So, the null hypothesis is rejected and the alternative hypothesis is accepted. Therefore, it can be concluded that the mean of role in decision making related to Savings, Expenses and Children's Education after joining SHG is notably higher than the mean of role in decision making related to Savings, Expenses and Children's Education before joining SHG. Thus, it can be said that the microfinance is significantly mounting the role of the respondents in decision making related to Savings, Expenses and Children's Education.

Hypothesis-5: H_0= There is no difference in mean of interaction with bankers/Govt. officers and NGOs before and after joining SHG.

TABLE 12: PAIRED SAMPLES STATISTICS

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1 Interaction with bankers/Govt. officers and NGOs	Before Joining Group	1.8386	415	.36839	.01808
	After Joining Group	1.1855	415	.38921	.01911

(Source: Field survey by the researcher)

TABLE 13: PAIRED SAMPLES TEST

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1 Interaction with bankers/ Govt. officers and NGOs	Before & After Joining Group	.65301	.48163	.02364	.60654	.69949	27.621	414	.000

(Source: Field survey by the researcher)

Interpretation: Since the P value of the test at the 5% level of significance is.000 which is less than 0.05. So, the null hypothesis is rejected and the alternative hypothesis is accepted. Therefore, it can be concluded that the mean of interaction with bankers/Govt. officers and NGOs after joining SHG is notably higher than the mean of interaction with bankers/Govt. officers and NGOs before joining SHG. Thus, it can be supposed that the microfinance is increasing the interaction of the respondents with bankers/Govt. officers and NGOs.

7. CONCLUSIONS

Empowering women is the main social objective of microfinance programs. It is difficult to evaluate the effectiveness of microfinance programme on women empowerment because measurement of women empowerment is a difficult task. In most of the studies women empowerment is measured as latent variable. This study also measures women empowerment as latent variable. The findings of this study revealed that microfinance is a powerful tool in enhancing women empowerment for its all indicators like economic empowerment, social empowerment, political empowerment, family decision making and legal awareness. Only participation in microfinance programme does not lead to increase in women empowerment but when it is coupled with participation in seminars, workshops and training then it helps women in enhancing their empowerment. These training programs not only provide self employment training but also facilitate good decision-making.

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TECHNICAL EFFICIENCY ESTIMATION: A STUDY ON SMALL SCALE PINEAPPLE FARMS IN KERALA

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ABSTRACT

Agriculture in Kerala experienced a shift in area of production in the 1980's which is favourable towards pineapple cultivation. Though Kerala has a conducive environment for pineapple cultivation, it faces stagnation in productivity. In this context the present study is undertaken to analyse the efficiency in resource utilization in small scale intercropped pineapple cultivation in Kerala. The study is conducted among the farms having < 2ha of area of cultivation selected on the basis of stratified random sampling and data was through pre tested questionnaire. The efficiency is estimated by fitting a production function of Cobb-Douglass type on a Stochastic Frontier Model. The parameters of the function estimated by the Maximum Likelihood Estimation method and the method is validated using Generalized Ratio Test. The results of the study revealed that the mean technical efficiency of farms is 72 per cent and the major inputs that can contribute for the improvement of efficiency are plant density, weedicides and pesticides and chemical fertilizers. The exogenous variables that can reduce inefficiency are mode of ownership and experience of farmers. The study is concluded with some suggestions and the scope for further area of research.

KEYWORDS

maximum likelihood estimation, pineapple cultivation, productivity technical efficiency.

JEL CODES

C10, C13, Q15.

INTRODUCTION

Agriculture in Kerala has undergone a structural change by the end of 1980's. The shift in pattern of area of cultivation was favourable mainly to pineapple cultivation, one of the prominent fruit crop in Kerala. A statistics of shift in cropping pattern of area of cultivation showed a huge hike in area of pineapple cultivation and a decline in area of cultivation of traditional crops like ginger, turmeric and tapioca in the State. This shift in cultivation of pineapple gained its momentum when the farmers began to cultivate pineapple as an intercrop in new /replanted rubber plantations and coconut plantations and as a mono crop in converted paddy lands. The main reasons for the flourishing of pineapple cultivation as an intercrop are: firstly, unlike annual intercrops, pineapple is cultivated in the first 3-4 years of the new / replanted rubber and it gives income to farmers when there is no income from rubber plantations. Secondly the intercropping of pineapple in rubber plantations prevents soil erosion and helps to reduce weed growth in rubber plantations (Jose 1993 and Joy 2010). Thirdly, as a major part of pineapple cultivation is taken place in the leased lands, and considering the severe unemployment and high fragmentation of agricultural land in Kerala, the pineapple cultivation gives an opportunity to the thousands of land less farmers to engage in agriculture and earn a livelihood to their lives.

Main varieties of pineapple cultivated in Kerala are Kew and Mauritius. The variety mostly cultivated in Kerala is Mauritius, which is very much in demand as a fresh fruit throughout India and also in foreign countries because it is considered as the best in quality and has good flavor. More than 95per cent of the pineapple produced in Kerala is marketable as fresh fruit throughout India and pineapple is the only fruit in Kerala which has the marketable surplus. Joy, P.P (2010)

REVIEW OF LITERATURE

The literature regarding technical efficiency began in the 1950's with the work of Koopmans (1951), Debreu (1951) and Shephard (1953). Farrel (1957) was the first to use frontier production functions to measure technical efficiency. The method involves estimating a frontier production function in order to calculate the maximum output that can be obtained by each production unit with a given combination of inputs. Units that are technically efficient will be located at the frontier, while those that are not will appear below the frontier since they obtain less output than technically possible. The estimation of production frontiers has proceeded along two general paths i.e. deterministic frontier and stochastic frontier.

DETERMINISTIC FRONTIERS

Deterministic Frontiers force all observations to be or below production frontiers so that all observations from the frontier are attributed to inefficiency. In deterministic specification, all deviations from the efficient frontier are under the control of the agent. However, there are some circumstances out of the agents control that can also determine the suboptimal performance of units. Regulatory –competitive environments, weather, luck, socio economic and demographic factors uncertainty etc. should not properly be considered as technical efficiency. Aiger and Chu (1968), Timmer (1971), Afriat (1972) and Richmond (1974) were the major contributors of deterministic thought. The estimation of efficiency in this model is either by means of linear programming techniques or by modification to least squares technique requiring all residuals to be non-positive. The Cobb-Douglas form model can be expressed as:

$Yi = f(Xi; \beta).\exp\{-Ui\}$

Where Ui is the farm specific technical efficiency parameter. If the firm is technically efficient, Ui takes the value zero and the production frontier function is the same as Y*, Ui takes the value less than zero for the firms which are not technically efficient and the firms accordingly obtain their output Yi < Y*. The negative value of Ui will vary among firms depending up on their technical efficiency accordingly to how close they are to the frontier. (Kalirajan & Shand 1986).

STOCHASTIC PRODUCTION FRONTIER

In Stochastic Production Frontier the disturbance term consists of two components, the first one represents technical inefficiency and the other the usual random noise. The advantage of the stochastic frontier over the deterministic frontier is that farm specific efficiency and random error effect can be separated. A key feature of the stochastic production frontier is that the disturbance term is composed of two parts, one symmetric and other one sided. The symmetric component captures the random effects outside the control of the decision maker including the statistical noise contained in every empirical relationship. The one sided component captures deviation from the frontier due to inefficiency. The Cobb-Douglas form model can be expressed as:

$Yi = f(Xi; \beta).\exp\{Vi-Ui\}$

Introduction of Vi in *equation* means that Y*& Yi is stochastic and that Vi captures other random factors such as errors in measurements and deviation from the true functional relationship. The value of Vi therefore may either be positive, negative or zero. Thus the stochastic production frontier model is a composed error model $\varepsilon i = Vi-Ui$ where Vi is the two sided noise component and Ui is the one sided non negative technical inefficiency component of the error term. The two sided noise component Vi is assumed to be independently and identically distributed (iid) and symmetrically distributed independently of Ui. But the composed error term $\varepsilon i = Vi-Ui$ is asymmetric since $Ui \geq 0$.

Stochastic Production Frontier originated with three independent papers, published nearly simultaneously by three teams. Meeusen &van den Brock (MB)1977, Aigner, Lovell &Schmidt (ALS) 1977 and Battese &Corra(BC) 1977.These Stochastic Production Frontier models shared the composed error structure. MB assigned an exponential distribution to U, BC assigned a half normal distribution to U and ALS considered both exponential and half normal distribution for U. Parameters to be estimated include $\beta, \sigma^2 v$ and a variance parameter $\sigma^2 u$ associated with U. Either distributional assumption on U implies that the composed error (V-U) is negatively skewed and statistical efficiency requires that the model is estimated by maximum likelihood method.

IMPORTANCE OF THE STUDY

One of the peculiarities of land in Kerala is the higher fragmentation of the land in the state when compared with other states. The average operational land holding size is only 0.2 ha and marginal and small farmers have predominance in operational holding of land. Statistics regarding the percentage increase of area, production and productivity of pineapple for the period 1992-2007 revealed that area of cultivation increased by 62 per cent, production increased by 68 per cent and productivity increased by mere 0.59 per cent between the period The area and production of pineapple showed an increasing trend, but the productivity was in a stagnant stage for the same period (Economics and Statistics Department. Govt of Kerala, various years). A negative or narrow percentage change in yield coupled with positive change in production implies that the total gain in production has come from area expansion alone. The statistics revealed that in Kerala the sustainable growth of pineapple cultivation lies more on productivity improvement than on area expansion. Various studies also revealed that about 60 per cent of farmers engaged in pineapple cultivation are small operational holders (Padmini 2002).

The aforesaid discussions may lead to some relevant research questions regarding the intercrop pineapple cultivation in Kerala. What is the present level of efficiency in utilizing the available resources? Whether the low productivity of crop is due to the inefficient use of inputs by the farmers? If inefficiency exists among farmers, then what are the probable factors that contribute to inefficiency? etc. So the present study is aimed to find out the probable answers to the above research questions on small scale intercropped pineapple farms

STATEMENT OF THE PROBLEM

The pineapple farming in Kerala faces low productivity which may arise due to the inefficiency of input usage by farmers or may be of the inefficiency due to random factors outside the control of farmers or by both. It should be made clear about what type of inefficiency leads to low productivity before initiating actions to improve efficiency among the small farms.

OBJECTIVES OF THE STUDY

The present study is carried out with following objectives.

1. To estimate the technical efficiency of intercrop pineapple cultivation in Kerala among the small farms
2. To identify the determinants of inefficiency in the intercrop pineapple cultivation in Kerala among the small farms.

HYPOTHESIS

The following null hypotheses are used to test the validity of the model.

1) H_0: Inefficiency effects are not present in small scale pineapple farms.

H_0:$\gamma = \delta_0 = \delta_1 \ldots\ldots \delta_k = 0$

2) H_0: Inefficiency effects are not stochastic.

H_0:$\gamma = 0$

3) H_0: Variables in the Inefficiency effects model have no effect on level of technical inefficiency.

H_0: $= \delta_0 = \delta_1 \ldots\ldots \delta_k = 0$

These null hypotheses are tested using the generalized likelihood ratio statistics λ defined by: $\lambda = -2\ln[L(H_0)-L(H_1)]$, where $L(H_0)$ and $L(H_1)$ are the values of the likelihood function under the specifications of null and alternative hypothesis respectively.

METHODOLOGY

In Kerala, Ernakulam, Idukki and Kottayam districts together constitute 80 per cent of total area and 85 per cent of total production of pineapple in the state (Agricultural Statistics, Government of Kerala, various years). The present study is using primary data collected by conducting a sample survey among the pineapple farmers using a pre tested structured questionnaire. Multi stage sampling was used in the present study. A stratification of farmers was done on the basis of operational holdings of below 2 ha in the above districts and a sample of 149 and was selected by proportionate stratified random sampling. The technical efficiency estimation was done through Maximum likelihood (ML) estimation which was done by regression analysis. The results of the analysis were tested for significance using Generalised LR (Log likelihood Ratio) test. The technical efficiency (TE) is estimated for the small farms, using the stochastic production frontier technique. Consider the following generalized stochastic production function that can be specified as

$Y_i = f(X_i; \beta)\exp\{V_i - U_i\}, \; i = 1, \ldots, N \ldots\ldots\ldots\ldots (1)$.

Where

Yi = Production of the i-th firm.

Xi = k ×1 vector of (or transformation of) the input quantities of the i^{th} firm.

β = vector of unknown parameters.

Vi = random variables which are assumed to be independently and identically distributed (iid) as $N(0, \sigma^2 v)$.

Ui = non-negative random variables that are assumed to account for technical inefficiency in production and are often assumed to be iid as $N(0, \sigma^2 u)$. It is assumed to be half normal, exponential and truncated from below at zero.

Let $X = (X_1, \ldots\ldots X_N) \geq 0$ be an input vector used to produce scalar output $Y \geq 0$ and let $Z = (Z_1, \ldots\ldots Z_Q)$ be a vector of exogenous variables that influences the structure of the production process by which inputs *X* are converted to output *Y*.

The log-linear Cobb-Douglas form of *equation* (1) can be written as:

$\ln Y_i = \beta_0 + \Sigma_n \beta_n \ln X_{ni} + V_i - U_i \ldots\ldots\ldots (2)$

Where *ln* denotes natural logarithms, Yi, β and Xi are as defined in *equation* (1).

Vi = random variables which are assumed to be independently and identically distributed (iid) as $N(0, \sigma^2 v)$.

Ui = non-negative random variables that are assumed to account for technical inefficiency in production assumed to follow a truncated (at zero) normal distribution as $N(\mu_i, \sigma^2 u)$.

With these assumptions the mean of technical inefficiency effects μ_i is a function of the explanatory variables and can be specified as:

$\mu_i = Z_i\delta + W_i \ldots\ldots\ldots (3)$

Where

Zi is a (p×1) vector of variables which may influence the efficiency of a firm; δ is an (1×p) vector of unknown parameters to be estimated.The technical efficiency of production for the i^{th} farm is defined as follows:

$TE_i = \exp(-U_i) \ldots\ldots\ldots (4)$.

The technical efficiency of a farmer is between zero and one and is inversely related to the inefficiency effect. The parameters to be estimated are β,δ, λ, $\sigma^2 v$ and $\sigma^2 u$. $\sigma^2 = \sigma^2 v + \sigma^2 u$ and $\gamma = \frac{\sigma^2 u}{\sigma^2}$. The γ parameter lies between zero and one. If γ =0 then all deviations from the frontier are due to noise, while γ = 1 means all deviations are due to technical inefficiency. The log likelihood estimation of the parameters of both the stochastic frontier model and the inefficiency effects model is done through the software FRONTIER 4.1 was developed by Coelli (1996).

Empirical Model

The technical efficiency of small scale intercrop pineapple cultivation in Kerala is estimated by stochastic production frontier fitted to the Cobb-Douglas production function. The following stochastic frontier production function of the Cobb-Douglas type is specified to estimate the technical efficiencies of the farmers.

$LnYi=\alpha+ \beta_1 lnX_1+\beta_2 lnX_2+ \beta_3 lnX_3+ \beta_4 lnX_4+ \beta_5 lnX_5+ \beta_6 lnX_6+Vi-Ui$

Where

Yi	=	Actual output of the i^{th} farm (kg /ha)
α	=	Constant term
X_1	=	Plant density (per ha)
X_2	=	Total labour (Man days /ha)
X_3	=	Manure (kg/ha)
X_4	=	Plant protection chemicals (kg /ha)
X_5	=	Chemical fertilizer (kg /ha)
X_6	=	Irrigation (dummy variable),1 for irrigated, 0 for otherwise.
β_i	=	Unknown parameters to be estimated.
Vi	=	Symmetric component of the error term and
Ui	=	Non negative random variables which are under the control of the firm

The inefficiency model specified (Battese &Coelli 1995) was as follows:

$Ui = \delta_0+\delta_1 Z_1+ \delta_2 Z_2+ \delta_3 Z_3+ \delta_4 Z_4+ Wi.$

Where

Ui	=	Mean technical inefficiency
δ_0	=	Constant
Z_1	=	Experience of farmer (No of years)
Z_2	=	Mode of ownership of cultivation (dummy) 1 if lease &0 if otherwise
Z_3	=	Education level (No of years of formal education)
Z_4	=	Access to farm extension service (dummy), 1 if seek advice &0 otherwise.
δ_k	=	Unknown parameters to be estimated.
W_i	=	error term

RESULTS AND DISCUSSION

The results of the present study are presented in the following tables and analysis is done accordingly.

TABLE 1: MAXIMUM LIKELIHOOD ESTIMATES OF SMALL SCALE FARMERS

Production function	Coefficient	Standard-error	t-ratio
β_0	0.361	1.119	
β_1	1.779	0.419	4.24*
β_2	0.744	0.214	0.347
β_3	-0.001	0.015	-0.078
β_4	0.208	0.103	2.019*
β_5	-0.135	0.063	-2.142*
β_6	-0.033	-0.041	- 0.803
Inefficiency effects	**Coefficient**	**Standard- error**	**t-ratio**
δ_0	0.045	0.198	
δ_1	0.192	0.095	2.021*
δ_2	0.021	0.063	0.333
δ_3	0.133	0.159	0.834
δ_4	-0.042	0.052	-0.816
Sigma-squared	0.062	0.005	10.94*
Gamma	0.99	0.143	6.92*

Source: Computed from primary data *Significant at 5% level.

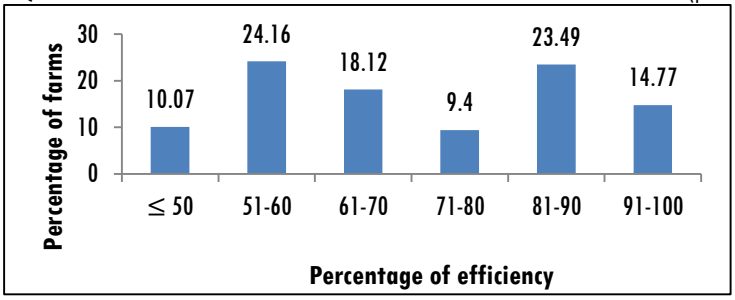
Mean efficiency : 72%
Minimum efficiency : 43%
Maximum efficiency : 99%

TABLE 2: DECILES RANGE FREQUENCY DISTRIBUTION OF TECHNICAL EFFICIENCY OF SMALL SCALE FARMS

Efficiency level (percentage)	Frequency	Percentage
≤ 50	15	10.07
51-60	36	24.16
61-70	27	18.12
71-80	14	9.4
81-90	35	23.49
91-100	22	14.77
Total	149	100

Source: Computed from primary data

FIGURE 1: FREQUENCY DISTRIBUTION OF TECHNICAL EFFICIENCY OF SMALL SCALE FARMS (percentage wise)



Source: Computed from primary data

The maximum likelihood estimation of production function of small scale farmers has an *a priori* positive sign for the coefficients of variables except for the variables manure, chemical fertilizer and irrigation (dummy variable) which shows a negative sign. The negative coefficient indicates the over use of the particular input and positive coefficient indicates under use of the particular input. The efficiency can be increased through the reduction of negative signed coefficient and can be increased by the additional use of positive signed coefficient. Among the elasticity of coefficient of various inputs, the coefficient of the input plant density is significant and the most prominent one. The elasticity is more than one which means increasing returns to scale and increase in pineapple output more than proportionately with one per cent increase in number of suckers. Other inputs in the model that increase efficiency by additional use are plant protection chemicals and total labour. Of these plants protection chemical is significant at 5 per cent level and the coefficient total labour is only indicative in nature and not significant. The negative signed coefficients of inputs are manure, chemical fertilizers and irrigation and of these, chemical fertilizer is significant at 5 per cent level and others are indicative in nature. The probable reason for the over use of chemical fertilizer may be due to application of chemical fertilizer to a lower number of suckers per hectare. The value of coefficients manure and dummy variable irrigation is small and the standard error of the coefficients seems to be higher as compared with the value of coefficient.

Among the inefficiency effects, the coefficients of the variables experience of the farmer,the dummy variable ownership of farm and level of education of farmers shows a positive relation with production function.The positive sign of coefficient of the inefficiency effects have a negative impact on the efficiency i.e., increase of these variables will reduce the efficiency. Among the inefficiency effects that increase inefficiency the coefficient of the variable experience of the farmer is significant at 5 per cent level. The experienced farmers may be reluctant to follow the scientific methods of cultivation and stick on their experience and probably this may lead to inefficiency in production. Similarly, the leased and educated small farmers are less efficient probably due to low plant density per hectare, even though the result is unexpected and only indicative in nature. The sign of the inefficiency variable access to farm extension services is negative and not significant which indicates that the more the farmers follows the practices advised by experts, the less the possibility of arising inefficiency in production.

The gamma (γ) parameter is 0.99 and is significant which shows that the onside error (inefficiency of the farmer) is the main source of total inefficiency and the random effect has no impact on the total inefficiency. The mean efficiency is 72 per cent which means on an average the farmers can improve efficiency by 28 per cent by the proper utilization of available resources.

TABLE 3: GENERALIZED LIKELIHOOD RATIO TEST OF SMALL SCALE FARMERS

Null Hypothesis (H_0)	Test Statistic(λ)	Critical value($\chi^2_{0.95}$)	Decision
H_0: γ = 0	16.33	7.05	Reject(H_0)
H_0 :γ = $\delta_0 = \delta_1 \ldots\ldots \delta_4 = 0$	53.06	11.91	Reject(H_0)
H_0 : $\delta_1 \ldots\ldots \delta_4 = 0$	51.05	9.45	Reject(H_0)

The table 3 presents the result of generalized likelihood ratio test of small scale farmers. The rejection of the first null hypothesis H_0: γ = 0, implies the existence of a stochastic production frontier ie the traditional average response function is not suitable. The second null hypothesis, which implies inefficiency effects are absent from the model is also rejected. The third null hypothesis farm specific factors have no effect on the level of inefficiency which is also rejected, indicates that the joint effects of the explanatory variables on the inefficiencies of production are significant although the individual effects of one or more of the variables may not be statistically significant.

Thus, it can be concluded here that the proposed inefficiency stochastic frontier production is a significant improvement over the stochastic frontier which does not involve a model for the technical inefficiency effects.

FINDINGS

1. The mean technical efficiency of small farms is 72 per cent and The inefficiency parameter gamma has the value of 0.99 in small farms, and is significant at 5 percent level which indicates that the inefficiency that exists is not due to random factors but due to the factors which are under the control of farmers
2. The rejection of various null establish that the traditional average response function is not suitable to estimate the efficiency, inefficiency effects are present in the model, and the inefficiency variables have an effect on the level of technical efficiency of pineapple cultivation
3. The major inputs that affect the efficiency of small farms are plant density, weedicides and pesticides and chemical fertilizers (negative) and in the case of medium farm size, the major inputs are plant density, total labour (man days per hectare), manures per and weedicides and pesticides.
4. All exogenous variables have a negative impact on inefficiency and the significant ones are experience of farmers and mode of ownership of cultivation. i.e. more experienced farmers manage farms efficiently and leased land cultivation reduces inefficiency in farming among the small farms

SUGGESTIONS

The following are some of the suggestions based on the findings:

1. The improvement in productivity can be achieved only through the harmonious effort of farmers, agricultural experts and government which is much needed in Kerala for the sustainable growth of pineapple cultivation
2. The productivity can be improved by increasing the present plant density to the recommended level and extending the intercrop cultivation to coconut plantations as well as by cultivating the crop as a pure crop. Along with this, following a scientific practice of cultivation as recommended by Kerala Agricultural University may help to improve the yield per hectare in the state.
3. Increasing the efficiency in utilization of inputs helps to for bring down the unit cost of pineapple farming. Efforts should be taken to improve the input efficiency, especially in small farmers who face loss in cultivation more often.

CONCLUSION

The present study revealed that there is a room for further improvement in technical efficiency by the proper utilzation of available resources. It can be concluded from the study that through a joint effort of the government, agricultural experts and farmers, the pineapple cultivation in Kerala can enhance the income level of farmers and can contribute towards the economic growth of the nation.

LIMITATIONS

The following are the limitations that affect the present study.

1. The study does not cover the entire form of pineapple cultivation in Kerala. The pure crop and intercropping in coconut plantations are outside the scope of the present study.
2. The present study does not consider the scale inefficiency and time varying inefficiency, if any which exists in the pineapple cultivation.
3. There exist differences in the fertility, texture of land and the availability of rain on cultivation, and these matters are not covered under the present study

SCOPE FOR FURTHER RESEARCH

Some areas where future research on pineapple cultivation can be done are given below.

1. The cost efficiency of the cultivation will yield a picture about cost optimization possibilities of pineapple cultivation in Kerala.
2. The marketing efficiency and other marketing aspects of pineapple cultivation are the areas that require further research which can improve the income level of farmers.

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APPENDIX

DESCRIPTIVE STATISTICS OF SMALL SCALE FARMS

Variables	N	Minimum	Maximum	Mean	Std. deviation
Output Y(kg/ha)	149	2180	80275	51478	13441
Plant density X_1(No/ha)	149	14500	25000	19528	2313
Total labour X_2(Man days/ha)	149	494	719	608	54
Manure X_3 (kg/ha)	149	3400	9386	6284	1427
Weedicide & Pesticide X_4(kg/ha)	149	12.50	48.99	31.57	7.43
Chemical Fertilizer X_5(kg/ha)	149	3582	10959	7335	1630
Irrigation X_6 (dummy variable)	149	0	1	0.64	0.48
Experience of farmer Z_1 ((No of years)	149	4	36	18	7
Mode of ownership of cultivation Z_2 (dummy variable)	149	0	1	0.41	0.49
Education level Z_3 (No of years of formal education)	149	5	17	10	3
Access to farm extension service Z_4 (dummy variable)	149	0	1	0.25	0.43

Source: Computed from primary data

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