

Intellectual Capital and Corporate Sustainable Growth: An Empirical Study on Indian Agribusinesses specific to Pesticides and Fertilizer Companies

Vaishnavi Balaji¹, Rajesh Mamilla*²

¹ VIT Business School, Vellore Institute of Technology, Vellore, Tamilnadu-632014;

² VIT Business School, Vellore Institute of Technology, Vellore, Vellore, Tamilnadu-632014;

*Corresponding author: (e-mail: rajesh.mamilla@vit.ac.in).

ABSTRACT This study aims to evaluate the impact of Intellectual Capital on the Sustainable Growth Rate of Indian Agribusiness companies. Intellectual Capital plays a vital role in the global agriculture business. Data is collected from 17 Agribusiness companies engaged explicitly in pesticides and fertilizers between 2011 and 2022, using Prowessiq (CMIE) and financial reports. The Extended Value-Added Intellectual Capital (E-VAIC) model is employed to measure Intellectual Capital. The System Generalized Method of Moments (S-GMM) regression method is employed for data analysis. The results revealed that Innovation Capital Efficiency and Human Capital Efficiency are the most significant variables that affect the Sustainable Growth of Indian Agribusiness companies. The other Intellectual Capital variables, such as Relational Capital Efficiency and Structural Capital Efficiency, positively impact the Sustainable Growth Rate. The study concludes that Indian Agribusiness companies must recognize the importance of Intellectual Capital resources and invest in them to achieve long-term corporate growth.

Keywords: Human Capital Efficiency, Indian Agri-Business Companies, Innovation Capital Efficiency, Intellectual Capital, Relational Capital Efficiency, Sustainable Growth Rate.

I. INTRODUCTION

Intellectual Capital is crucial in today's knowledge-based economy, especially for Indian Agribusinesses. According to Kader et al. (2002), Modern Agriculture requires innovative technologies, high standards, and traditional and agronomic inputs. To achieve sustainable growth, human involvement is essential, particularly their knowledge, experience, skills, and competencies (Kozera et al., 2011). Like other economic sectors, Agriculture aims to create and offer high-quality products and services (Shamsuzzoha et al., 2021). As a result, it seems even more important to begin studying intellectual capital in agriculture, taking into account that it is the end result of knowledge and the capacity to utilize it and to develop a tool for its in-depth evaluation in agricultural companies (Kozera et al., 2011).

Knowledge can be transformed into wealth-creating assets through Intellectual Capital (IC) (Marr, B. et al., 2004). According to the firm's resource-based perspective (Barney, 1991), only valuable, unique resources and strategic investments would improve financial performance and maintain competitive advantage (Anik et al., 2021; Yousaf M, 2022). These assets are vital and challenging for replication (Hall, 1992). As the economy transitions from an industry-based to a knowledge-based one, businesses are focusing increasingly on Intellectual Capital to gain an advantage over rivals and generate long-term value (Gupta et al., 2020). In order to understand the underlying value of the organization, its capacity to create value, and its ability to forecast future performance, enterprises have changed their attention from financial research to Intellectual Capital (IC).

Expanding the sustainable agriculture industry is crucial to meeting modern commercial and societal goals (Qiao et al., 2016). Sustainability becomes even more important during times of economic instability (Xu, X.L. et al., 2019). According to Xu et al. (2019), a company's financial performance and competitiveness can be enhanced by intellectual capital. In the knowledge-based economy, intellectual capital plays a vital role (Marr, 2004). Investing in intellectual capital (IC) can provide a business with several benefits, including enhancing its competitive edge and fostering long-term financial success (Xu et al., 2019). Thus, there is a need for more extensive research on this critical aspect of sustainability, particularly concerning how IC influences the sustainable growth of businesses (Phonthanukitithaworn et al., 2023).

India has a primarily agricultural economy, with most of the population working in the vast rural areas. Agriculture is the main source of income and contributes significantly to the country's GDP, according to reports by IMARC and India.gov.in. India is already the world's top agricultural producer in terms of value, making the

industry highly potential. However, the agricultural industry has undergone several changes over the last few decades, making it more important to study intellectual capital in the agribusiness sector. Intellectual Capital is especially crucial for research and development-related activities, as noted by (Scafarto et al. in 2016). Academicians and practitioners adopt Pulic's (1998) VAIC model (Xu, X.L et al., 2019). The VAIC model addresses IC only through Structural Capital, Human Capital and Capital Employed Efficiency (Xu et al., 2020; Al-Khoury, 2022).

Hence, the current study extends the "Value-Added Intellectual Capital model" by including two essential components: "Relational Capital and Innovation Capital". This study represents one of the pioneering investigations conducted within the Indian setting, focusing on examining the effects of Intellectual Capital on the Sustainable Growth of Agribusiness companies. The study also calculates the efficiencies of the components of Intellectual Capital.

II. Theoretical Background

1. Intellectual Capital

IC refers to the dynamic collection of resources (such as information, operational processes, organizational relationships, and skills) that provide company value (Demartini et al., 2016). According to Xu and Wang (2018), Intellectual Capital refers to a dynamic integration of resources possessed by a company, which confers a competitive advantage and helps it operate better. (Sveiby, 2010) classified 34 intangible asset appraisal methodologies based on research (Luthy, 1998). Author Pulic's (Pulic, 2000) VAIC model is one of the most extensively used ROA methodologies for valuing Intellectual Capital. The VAIC quantifies the proportion of a company's value attributable to intellectual capital (Stähle et al., 2011). Intellectual Capital is a compilation of intangible assets, including resources, talents, and capabilities, which contribute to an organization's enhanced functioning and value creation (Edvinsson, 1997). The initial research focused on the significance of human and structural capital in generating value for organizations (Syah & Kurniasih, 2015; Alhassan & Asare, 2016). However, in the past two decades, experts have concluded that the core components of Intellectual Capital (IC) encompass human capital efficiency (HCE), relational capital efficiency (RCE), Innovation Capital efficiency and structural capital efficiency (SCE) (Rehman et al., 2012; Singh & Narwal, 2015; Jamei, 2017; Suganda et al., 2018).

2. Intellectual Capital and Resource-based View Theory

RBV's fundamental thesis is that an organization's value-creating capability is not derived from its industry's dynamism but from organizational processes that result in the distinctive endowments of intellectual resources (Barney, 1991). According to Mouritsen (1998), IC possesses all the requisite attributes of a strategic asset, hence playing a crucial role in augmenting financial success. The phenomenon of IC is inherently inexplicable. IC is considered to be of significant value as it contributes to enhancing the overall efficiency and effectiveness of an organization.

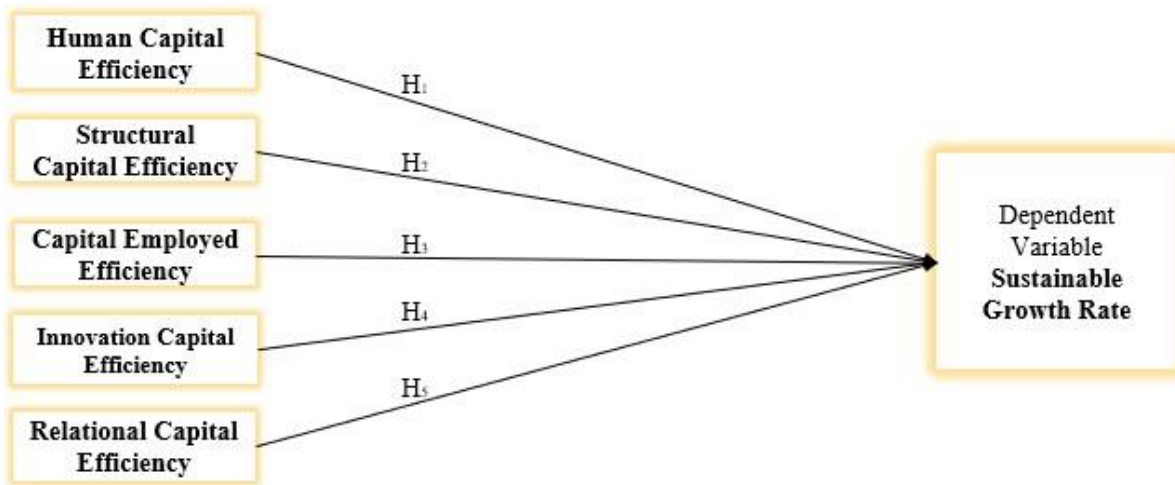
3. Intellectual Capital and Sustainable Growth Rate (SGR)

Sustainability has been seen as one of the critical success elements for organizations to survive over the long term (Kuosmanen et al., 2009). Intellectual Capital is essential to generate long-term value (Zhou et al., 2003), create sustainability (Xu et al., 2018; Jardon et al., 2019), & improve economic growth and human welfare by adopting the United Nations' SDGs 2030 agenda. Several studies have shown that IC significantly affects a company's ability to grow sustainably (Subramaniam et al., 2005; Wei et al., 2023). According to several research studies, among the elements of IC, Human Capital shows the most amazing substantial favourable impact on long-term corporate development. It has established itself as the primary driving engine in a company's Sustainable progress (Rossi et al., 2016). Sustainability is consuming now and in the future without jeopardizing the Capital. Furthermore, researchers believe that Capital Employed and Intellectual Capital contribute to long-term organizational success based on studies conducted in various industries (Delgado-Verde et al., 2016).

III. MATERIAL AND METHOD

1. Research Model

Figure 1: “Extended Value-Added Intellectual Capital (E-VAIC) Model”



Modern classifications emphasize the significance of Relational Capital Efficiency (RCE) and Innovation Capital Efficiency (RDE) (Chen et al., 2005; Jin et al., 2022). Thus, these two variables are added to the “E-VAIC model” depicted in Figure 1 above. The research framework in Figure 1 demonstrates how IC factors influence Indian agribusinesses’ ability to achieve Sustainable Growth Rate.

2. Hypotheses Development

The following hypotheses are devised in light of the literature reviews that have been done. The assumptions are framed based on the proposed Extended Value-Added Intellectual Capital model.

E-VAIC Model

Hypothesis 1. (H1): Human Capital Efficiency significantly positively influences the Sustainable Growth Rate of Indian Agribusinesses.

Hypothesis 2. (H2): Structural Capital Efficiency significantly positively influences the Indian Agribusinesses Sustainable Growth.

Hypothesis 3. (H3): Capital Employed Efficiency significantly positively influences the Indian Agribusinesses Sustainable Growth.

Hypothesis 4. (H4): Innovation Capital Efficiency significantly positively influences the Indian Agribusinesses Sustainable Growth.

Hypothesis 5. (H5): Relational Capital Efficiency significantly positively influences the Indian Agribusinesses Sustainable Growth.

3. Sample Selection

The Agribusiness companies listed in the NIFTY 500 Index are chosen to test the hypotheses. The initial sample included 19 agribusiness companies taken from the NIFTY500 index. Due to incomplete or abnormal data, two companies were eliminated. As a result, the final sample includes Seventeen Agribusiness companies, which spans fifteen years from 2011 to 2022 and results in 204 firm-year observations in a balanced panel data set. The Prowess IQ database of the “Centre for Monitoring Indian Economy” and the Company’s Annual Reports serve as secondary sources from which data were gathered, categorized, and computed. Excel, EViews, and Stata are the data processing programs used. The process of selecting samples is further elucidated in **Table 1**, provided below.

Table 1: Sample selection process

The standards for selecting samples	Numbers
Agribusiness companies listed in the NIFTY 500 index between 2008 and 2022	19
Excluded companies: Companies with incomplete data	2

Notes: *17 companies x 12 years = 204 firm-years.

Source: (Author's Calculation)

4. Statistical Techniques

This study employs panel data to understand better how Indian Agribusiness Companies Intellectual Capital and Sustainable growth interact. The study uses the "Extended Value- Added Intellectual Capital (E-VAIC)" approach (Ulm et al., 2017) to compute the Intellectual Capital Coefficient. The Extended VAIC model, an authenticated IC measure, was built on the VAIC model, which author Pulic first published in 1998 (Pulic, 1998). The study employs various methods to investigate the relationship between Sustainable growth rate and Intellectual Capital Efficiency of agribusiness companies. First, the unit root test determines whether the series is stationary. The samples are then put through descriptive and correlation analysis to assess their essential characteristics. Finally, the steps listed below are followed to choose the appropriate Regression Technique.

1. Regression using Pooled ordinal least squares (POLS) is carried out. The estimate for δ is observed. Mostly, the Pooled ordinal least squares are supposed to give upper-bound estimates.
2. The Fixed Effects model is then executed. The estimate for δ is found. This is supposed to give a lower coefficient (lower-bound estimate) than Pooled OLS.
3. Then, the Difference Generalized Method of moments(D-GMM) is conducted. Suppose the δ coefficient is higher than the Fixed effects model's estimate; in that case, it suggests that Difference GMM is appropriate, and this regression technique must be employed in the study.
4. The Breusch-Pagan/Cook-Weisberg test is employed to investigate GroupWise heteroskedasticity using panel data.
5. Then, the Multicollinearity test is conducted by running the Variance Inflation Factor to check whether multicollinearity exists in the panel data.

5. Variable's Definition

Dependent Variable:

Sustainable Growth Rate (SGR)

For estimating SGR, several researchers (Huang et al., 2009; Ocak et al., 2019) have recently adopted formulae that are obtained from the (Van Horne, 1987) & (Higgins, 1981) models. Higgins proposed the SGR concept from a financial management perspective (Chen et al., 2017). The (Higgins, 1981) model is used in the current study to determine the Sustainable Growth rate.

$$\text{SGR} = \text{Profit Margin} \times \text{Retention rate} \times \text{Asset turnover ratio} \times \text{Financial Leverage} \quad 1$$

$$\text{Profit Margin} = \text{NI/S} \quad \text{Asset Turnover} = \text{S/TA} \quad \text{Retention Rate} = \text{RE/NI}$$

$$\text{Financial Leverage} = \text{TD/TA}$$

Note:

NI: Net Income, S: Sales, TA: Total Assets, RE: Retained earnings, TD: Total Debt

Independent Variables:

The primary focus of research has predominantly revolved around examining Structural and Human Capital to ascertain the efficacy of Intellectual Capital. In contrast, contemporary classifications place greater value on the elements of Intellectual Capital, specifically innovation and Relational Capital. Thus, the Extended VAIC model is employed in this research.

Human Capital Efficiency (HCE), Capital Employed Efficiency (CEE) and Structural Capital Efficiency (SCE) are the elements of the Value-Added Intellectual Capital (VAIC) model. The author's VAIC model estimates the indicators HCE, CEE, and SCE (Pulic, 1998).

Human Capital Efficiency (HCE), Innovation Capital Efficiency (RDE), Structural Capital Efficiency (SCE), Relational Capital Efficiency (RCE), and Capital Employed Efficiency (CEE) are the independent variables of the Extended VAIC Models described in the current study.

According to previous research (Xu et al., 2020), RDE and RCE are determined as follows in the present study.

The value added is determined by subtracting the input from the output.

The INPUT stands for all costs, excluding employee payroll expenses, and the OUTPUT represents the entire sales of goods and services.

1. Value-Added divided by Human Capital yields Human Capital Efficiency (HCE). Total labour costs are referred to as "Human Capital" (HC).

2. Structural Capital divided by Value-Added yields Structural Capital Efficiency (SCE). When Human Capital is deducted from Value-added, "Structural Capital" (SC) is the result.

3. Value-Added divided by Capital Employed yields Capital Employed Efficiency (CEE). Capital Employed (CE) represents Net Asset Book Value.

4. Relational Capital divided by Value-Added results in RCE.

Relational Capital covers the expenses of sales, marketing, and promotional activities.

5. Innovation Capital divided by Value-Added results in Innovation Capital Efficiency (RDE).

Innovation capital (RD) refers to the costs associated with R&D.

6. Regression Model

Multiple linear Regression assesses how Intellectual Capital components impact the Agribusiness company's Sustainable growth.

$$SGR_{it} = \alpha_0 + \beta_1 SGR_{it-1} + \beta_2 HCE_{it} + \beta_3 SCE_{it} + \beta_4 CEE_{it} + \beta_5 RCE_{it} + \beta_6 RDE_{it} + \epsilon_{it} \quad 2$$

Where SGR_{it} is the dependent variable in the study named Sustainable Growth Rate of Agribusiness companies i at time t , SGR_{it-1} is the lagged value of the dependent variable (Sustainable Growth Rate) for Company i at time t . HCE_{it} , SCE_{it} , CEE_{it} , RDE_{it} and RCE_{it} are the explanatory variables in the research model.

7. Model Specification Test

Researchers have raised endogeneity concerns about the association between IC and company growth (Tran et al., 2018; Soetanto et al., 2019). Since the fixed-effects model does not address the issue of Endogeneity, they produce conflicting estimates (Tran et al., 2018). According to recent IC literature studies (Tran et al., 2018), endogeneity issues will likely arise due to unobserved heterogeneity. It would also be inappropriate to evaluate the model using the fixed-effects method. Employing OLS and fixed-effects models for the study becomes inconsistent and ineffective since historical performance influences the future value of IC; thereby, Endogeneity exists in the relationship. As a result, the dynamic panel model is applied in this study to evaluate the dynamic interaction amongst IC and the Sustainable Growth of Indian agribusinesses. As a result, we sought to employ a more accurate dynamic panel estimation model (GMM method) established by (Blundell et al., 1998), which can solve the endogeneity problem. The current study thus uses the Generalized Method of Moments method to assess the effect of intellectual capital on the stable growth of Indian Agribusinesses. GMM Method controls for the Endogeneity of the lagged dependent Variable. It also controls for omitted variable bias (Pesämaa et al., 2021), unobserved panel heterogeneity, and measurement errors. This method is developed for situations where independent variables are not strictly exogenous. GMM also controls for heteroscedasticity and autocorrelation problems. This system deals with Instrumental variable Regression to deal with Endogeneity (Pesämaa et al., 2021). Exogenous variables are used as instruments in this method.

IV. EMPIRICAL RESULTS AND DISCUSSION

1. Descriptive Statistics

Table 2: Descriptive Statistics of the E-VAIC Model

Variable	Mean	Std.Dev.	Min.	Max.	Skewness	Kurtosis
HCE	1.85	1.07	0.02	6.70	1.20	2.07
SCE	0.68	1.37	0.02	12.34	0.87	3.78
CEE	0.20	0.27	0.04	3.09	0.45	2.54
RDE	0.95	0.38	0.07	4.05	2.05	4.56
RCE	0.82	1.14	0.03	6.91	1.93	2.59
SGR	0.24	0.57	0.07	5.05	2.09	2.05

Source: (Author's Calculation)

Note: Human Capital Efficiency is referred to as HCE, Structural Capital Efficiency is referred to as SCE, Capital employed Efficiency is referred to as CEE, Innovation Capital Efficiency is referred to as RDE, Relational Capital Efficiency is referred to as RCE.

Table 2 provides the summary statistics for each of the study's variables. According to the findings of E-VAIC-Model depicted in Table 2, the variable HCE exhibits the greatest mean value of 1.85, while the variable RDE demonstrates the highest mean value of 0.95. Based on the findings derived from the E-VAIC Model, it can be observed that Indian agribusinesses place a greater emphasis on the utilization of Human Capital and Innovation Capital as crucial drivers for attaining Sustainable Growth.

2. Stationarity Test (ADF)

Table 3: Stationarity Test (ADF)

(At First Difference)

Variables	t-Statistic	P-Value
HCE	-4.56	0.0000***
SCE	-7.35	0.0000***
CEE	-6.30	0.0000***
RDE	-3.65	0.0000***
RCE	-4.90	0.0000***
SGR	-9.35	0.0000***

Source: (Author's Calculation)

Note: (***) Significant at 1%, (**) Significant at 5%, (*) Significant at 10%, (Mackinnon, 1996)

The Null hypothesis in the Unit root test supposes that the series has a unit root, while the Alternate theory asserts that the series is stationary or does not have a unit root. The null hypothesis is considered valid, and the alternate hypothesis is disregarded if the P-value exceeds 0.05. As a result, there is a unit root in the series.

The probability values of the regressor variables (HCE, RCE, CEE, RDE, SCE) in relation to the response variable (SGR) are under 0.05, based on the ADF unit root results described above in **Table 3**. The independent and dependent variables are stationary at first difference and highly significant (1% significance level). The control variables are stationary at the first difference and significant (5% significance level). Therefore, the unit root is

non-existent. This indicates that the Null hypothesis is denied, and the alternative hypothesis, stating that the series is stationary, is proven.

3. Correlation Analysis

Table 4: Correlation Analysis of the E-VAIC Model with SGR

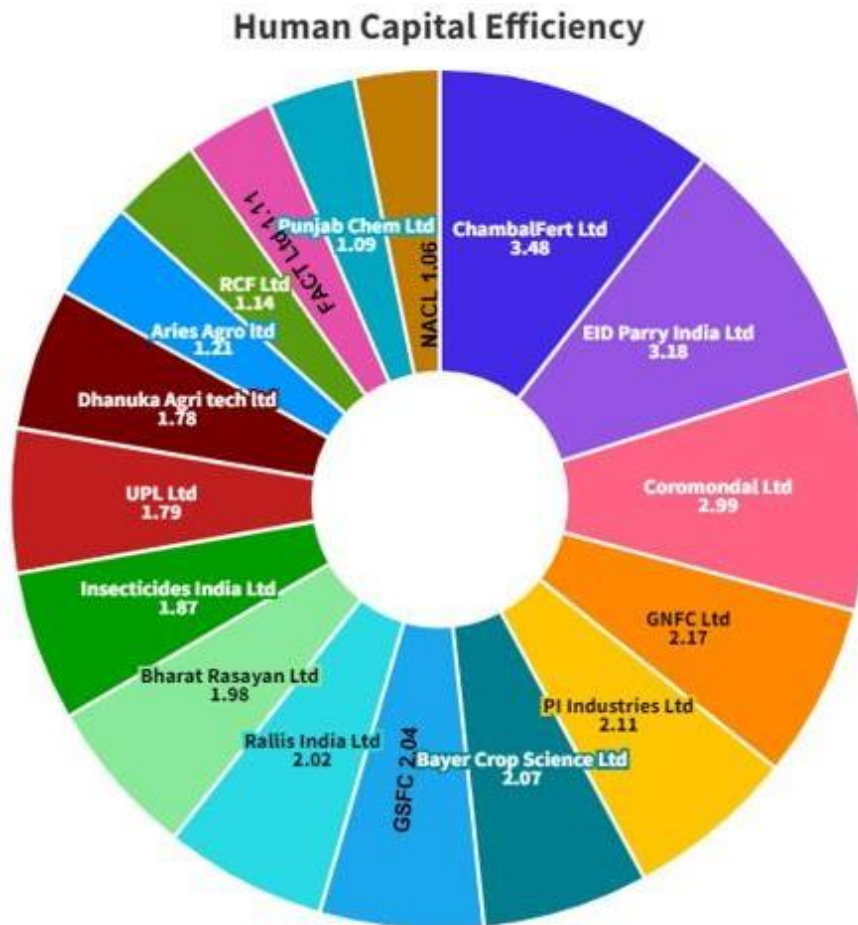
	SGR	HCE	SCE	CEE	RDE	RCE
SGR	1					
HCE	0.72*	1				
SCE	0.58*	0.59*	1			
CEE	0.63*	0.62*	0.38	1		
RDE	0.51*	0.55	0.69*	0.36	1	
RCE	0.49*	0.52*	0.45*	0.39*	0.49	1

Note: * $p < 0.05$

Source: (Author's Calculation)

Table 4 displays the (E-VAIC) model's Pearson correlation findings. HCE and SGR have a strong positive association that is of statistical significance. SCE and SGR have a statistically significant and moderately positive association. A statistically substantial and moderately positive correlation exists between CEE and SGR. There is a statistically significant and slightly positive correlation between RDE and SGR. RCE and SGR have a statistically significant but Low positive interaction. A statistically significant and moderate association exists between HCE and SCE, HCE and RCE. HCE and CEE have a statistically significant and high positive correlation. A statistically significant and highly positive association exists between SCE and RDE.

4. Calculating the efficiencies of the components of Intellectual Capital



Source: (Author’s compilation)

Figure:2 Human Capital Efficiency of the selected Indian Agribusiness companies

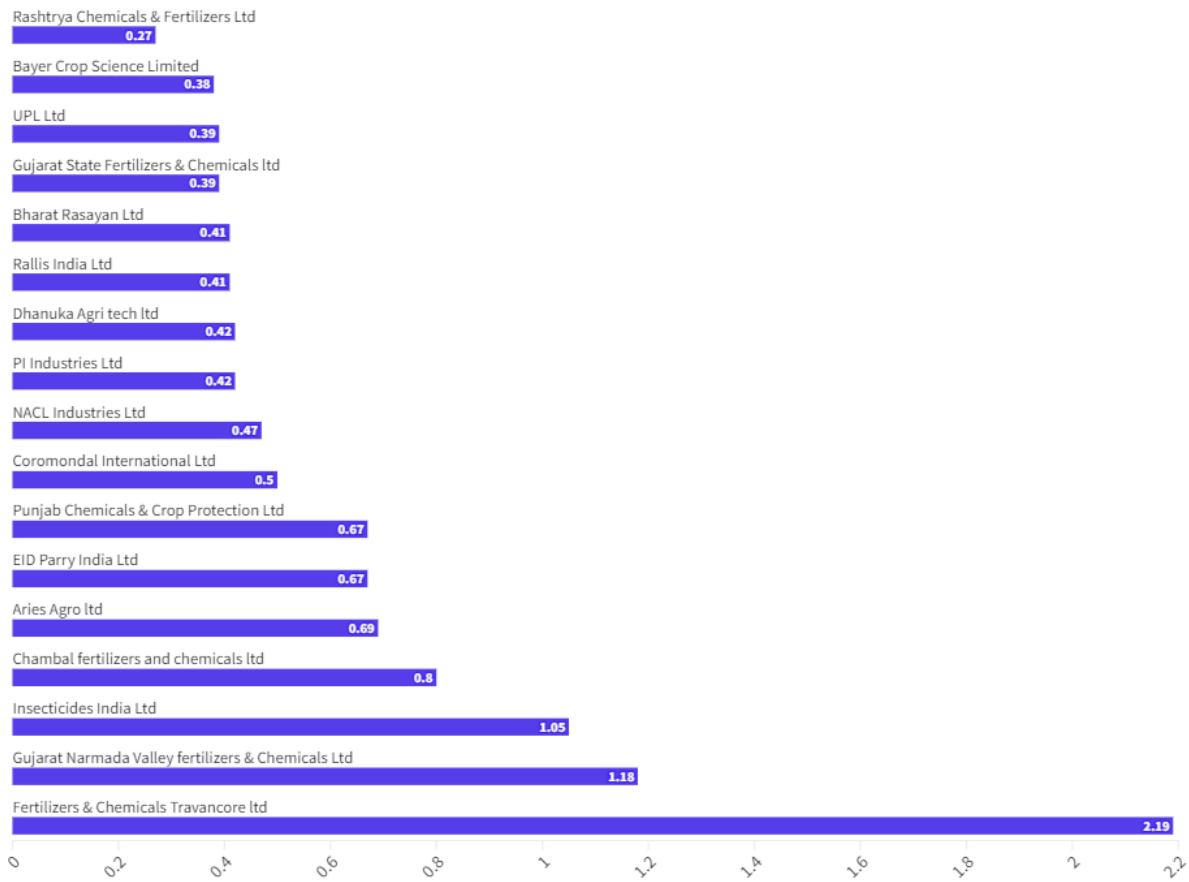
As per the Author (Pulic, 1998), “If the productivity of knowledge workers is <1 (Human Capital Efficiency (HCE)<1), then Value Added (VA) cannot cover wages and salaries. There is value destruction”.

“If HCE=1, then VA covers just the employee costs, and there is no value creation”. “If HCE>1, there is value creation, and VA overcomes employee costs”.

A Higher human capital efficiency indicates that a company is more efficient in generating value from its human resources. Chambal Fertilizers and Chemicals Ltd has the highest human capital efficiency of 3.48, and their contribution to value addition is more.

From the image 2 given above, it is understood that the HCE of all the selected Indian Agribusiness companies are greater than 1, which implies that the selected Indian Agribusiness companies have created value from their human resources through their inherent and obtained knowledge, skills, and abilities, talents and competences, personal networks and the like and value-added can overcome employee costs.

Structural Capital Efficiency



Source: (Author’s compilation)

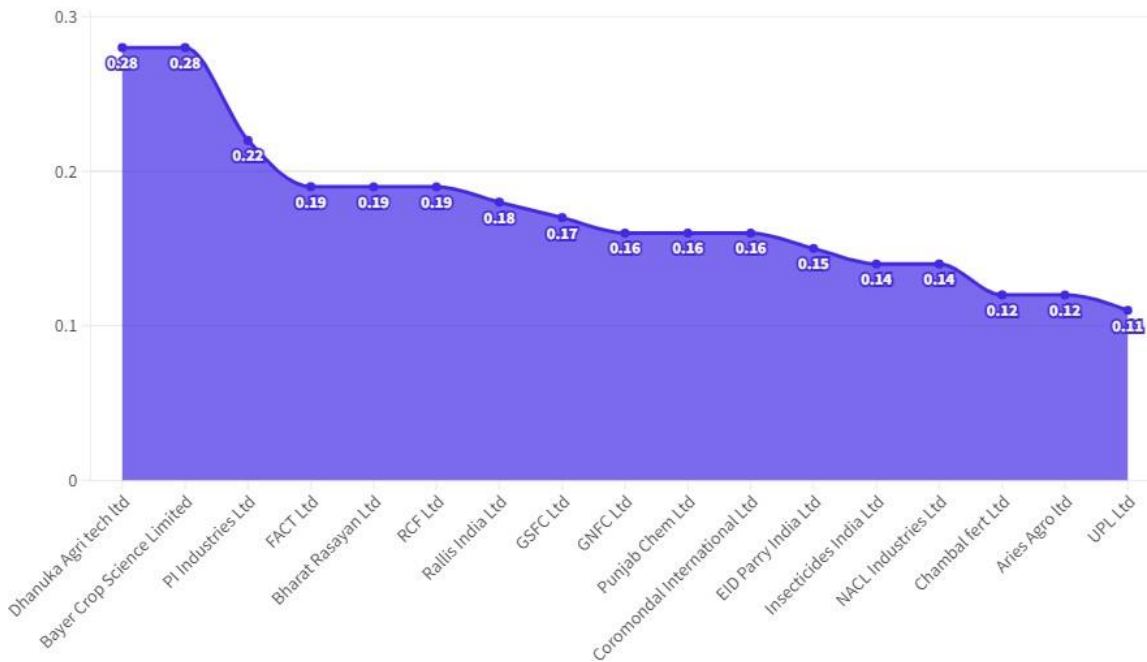
Figure:3 Structural Capital Efficiency of the selected Indian Agribusiness companies

“If Structural Capital Efficiency (SCE) =0, then VA covers just the employee costs and creates no value (Pulic, 1998)”.

“If SCE>0, there is value creation, and VA overcomes employee costs (Pulic, 1998)”.

From Figure 3 presented above, the SCE of all the selected Indian Agribusiness companies are greater than zero, which denotes that there is value creation, and Value Added can cover employee costs. This indicates that the selected companies are efficiently utilizing their structural resources, such as institutional knowledge created and owned by the organization that is stored in database manuals. The SCE of Fertilizers and Chemicals Travancore Ltd. This means that the company has a high level of structural capital intensity and reliance and may have a competitive advantage in the industry.

Capital Employed Efficiency

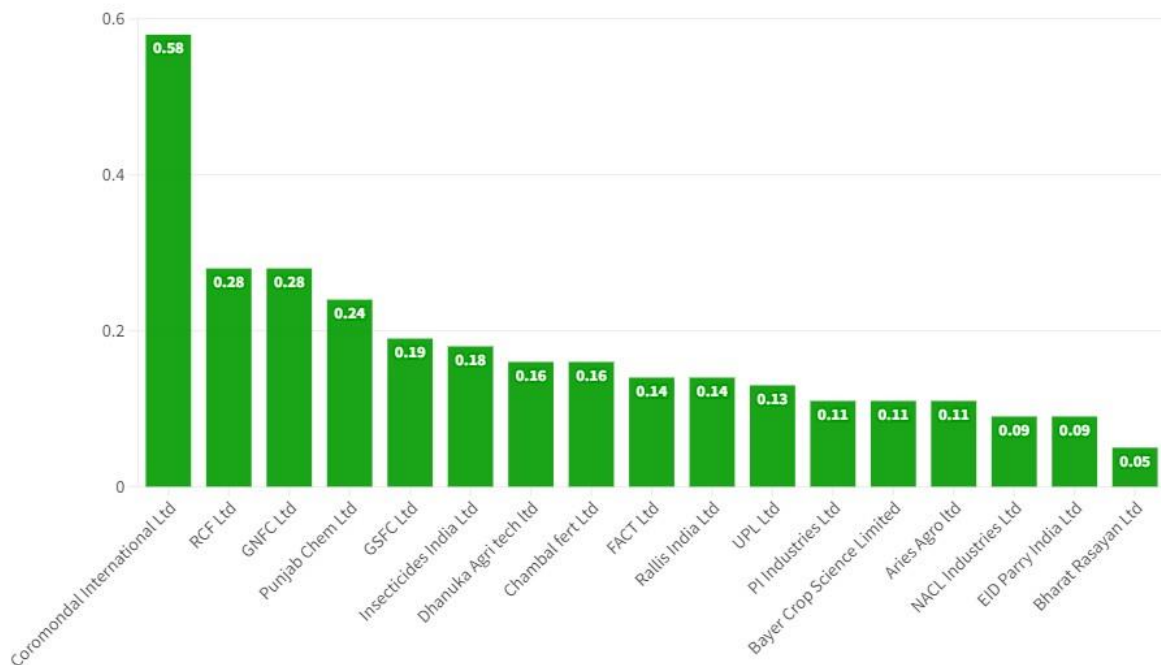


Source: (Author's compilation)

Figure:4 Capital Employed Efficiency of the selected Indian Agribusiness companies

Figure 4 represents the CEE of the selected Indian Agribusiness companies. A higher CEE value indicates that a company is more efficient in generating value from its invested capital.

Innovation Capital Efficiency

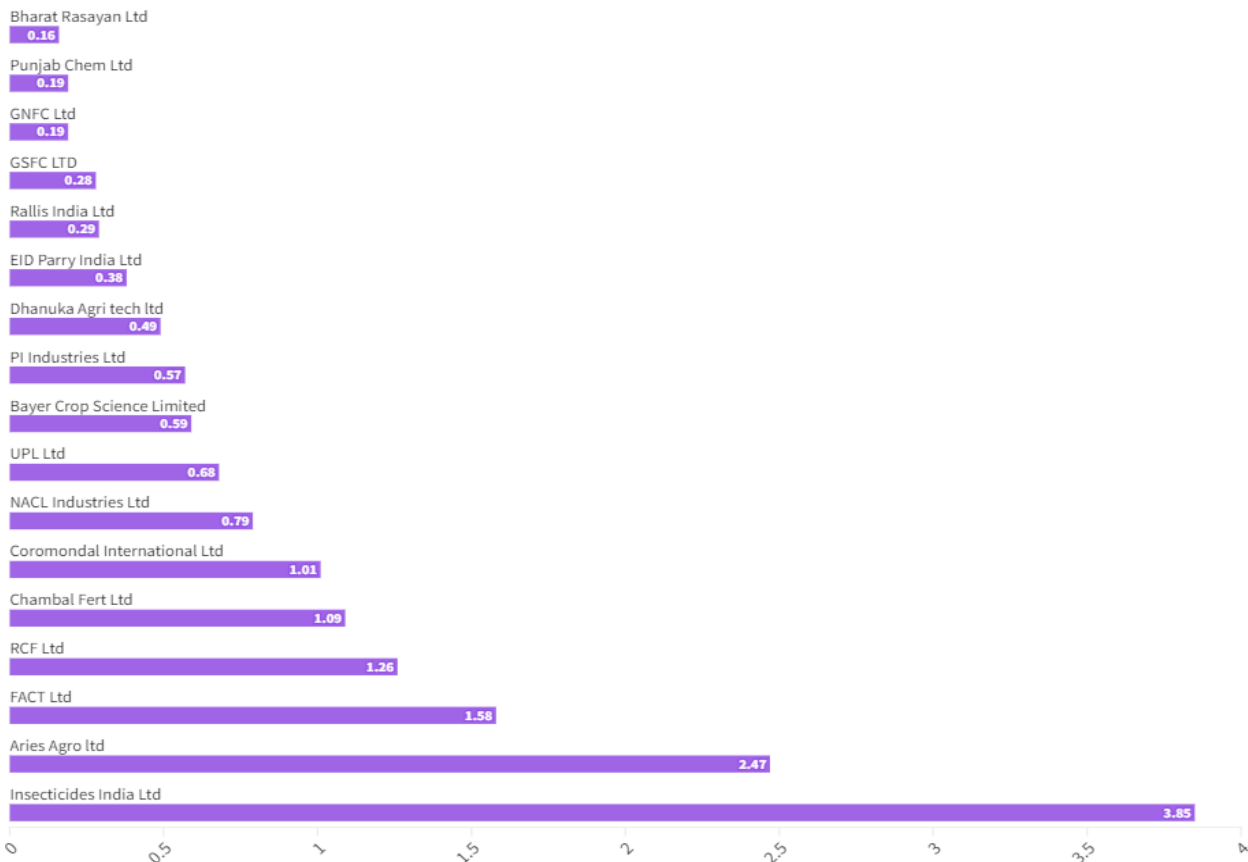


Source: (Author's compilation)

Figure:5 Innovation Capital Efficiency of the selected Indian Agribusiness companies

A higher innovation capital efficiency indicates that the companies are pursuing a strategy of innovation and differentiation, and that you have a strong capability to generate new knowledge and solutions. From Figure 5, Coromandel International Ltd has the highest Innovation Capital Efficiency.

Relational Capital Efficiency



Source: (Author's compilation)

Figure:6 Relational Capital Efficiency of the selected Indian Agribusiness companies

Higher relational capital efficiency indicates that an organization can create more value with its relationships with external stakeholders such as customers, suppliers, competitors, and partners. It also means that the organization is able to leverage its relational capital to access new markets, opportunities, and resources. A higher RCE means that the firm is able to generate more value from its RC than the cost of its RC investment.

5. Heteroskedasticity test

Table 5: Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Research Models	Variable	chi2	Prob. > chi2
E-VAIC Model	SGR	1.56	0.19

Source: Author's Compilation

The breusch-pagan test has been employed to determine whether heteroscedasticity exists in a regression model. The null hypothesis posits that there is homoscedasticity and that the residuals exhibit a distribution characterized by constant variance. The alternative hypothesis posits the presence of heteroscedasticity, indicating that the residuals do not exhibit a uniform variance distribution. The null hypothesis is disproved, and it is decided that there is heteroscedasticity in the regression models if the test's p-value is less than the significance threshold (i.e., p-value < 0.05). The probability value of the research model depicted in **table 5** is 0.19, which is more than 0.05, denoting that homoscedasticity is present in the regression model.

6. Multicollinearity test

Table 6: Multicollinearity test of the E-VAIC Model

Variables	VIF	1/VIF
RCE	1.84	0.57
SCE	1.59	0.78
RDE	1.19	0.91
CEE	1.00	0.95
HCE	1.05	0.95
Mean VIF	1.97	

Source: Author's Compilation

Multicollinearity is examined by evaluating the variance inflation factor (VIF) & tolerance thresholds shown in **Table 6**. Multicollinearity exists when the tolerance values are less than 0.1 and the VIF is greater than 10 (Pallant, 2011). However, all predictor variables' VIF values are under 10, and tolerance levels are greater than 0.1., indicating no multicollinearity presence in the data (O'Brien, 1985). As a result, diagnostic analysis shows that the multicollinearity assumption is not violated.

7. Difference or System GMM

Table 7: Difference or System GMM

Coefficient of Dep Variable	Pooled OLS	Fixed Effects Model	Difference GMM
SGR	0.79	0.71	0.49

Source: Author's compilation

If the estimate of lagged dependent variables in Difference GMM is close to or below the Fixed Effects estimate, it suggests that Difference GMM is downward biased and System GMM should be used. In **Table 7**, the lagged value of dependent variable SGR is observed to be 0.49, respectively, in the Difference Generalized Method of Moments (GMM). The value is lower than those observed in the Fixed Effects model. Therefore, the System GMM regression method is deemed appropriate for the present study.

8. Dynamic panel data results: System GMM

Table 8a: Panel regression results of Intellectual Capital and Sustainable Growth Rate

Variables	Coefficient	Std.Error	Prob.
HCE	0.798	0.157	0.000***
SCE	0.254	0.035	0.001***

CEE	0.155	0.144	0.256
RDE	0.754	0.195	0.032**
RCE	0.369	0.047	0.041***
SGR	0.280	0.087	0.000**

Source: Author's compilation; **Note:** $p < 1\%$ ***, $p < 5\%$ **, $p < 10\%$ *

Table 8b: Panel regression results of Intellectual Capital and Sustainable Growth Rate

Research Model	AR(1)	AR(2)	Sargan test
E-VAIC Model	0.031	0.254	0.186

Source: Author's compilation

Empirical results of the E-VAIC Model: Intellectual Capital components impact on SGR

The study demonstrates that the variables Human Capital Efficiency (HCE), Relational Capital Efficiency (RCE), Structural Capital Efficiency (SCE), and Innovation Capital Efficiency (RDE) exert a substantial and positive impact on the Sustainable Growth Rate of Indian Agribusiness companies as illustrated in **table 8a**. This finding is supported by the dynamic panel regression analysis results conducted using the E-VAIC model, as presented in table 8a. Therefore, the assumptions mentioned above, H_1 , H_2 , H_4 , H_5 , are substantiated.

When there is a rise in Human Capital Efficiency, there is a corresponding increase of 79.8 per cent in the Sustainable Growth Rate of Indian Agri-businesses. The Sustainable Growth rate of Indian Agribusinesses increases by 75.4 per cent when there is an increase in innovation capital efficiency. The Sustainable Growth rate (SGR) of Indian agribusiness companies experiences a significant boost of 36.9 per cent in response to an upward trend in Relational Capital Efficiency. When there is a rise in Structural Capital Efficiency, there is a corresponding increase of 25.4 per cent in the Sustainable Growth rate of Indian Agri-Businesses. The present findings corroborate prior studies indicating that each of the elements of Intellectual Capital plays a crucial role in facilitating the attainment of a sustainable growth rate in companies (Xu, j., & Wang, b, 2018; Xu, X.I et al., 2020; Lu, y et al., 2021). According to the findings, the most crucial components of Intellectual Capital are Human Capital Efficiency and Innovation Capital Efficiency. These have an immense beneficial effect on the Sustainable Growth rate of Agribusiness companies in India.

The following prerequisites must be satisfied in order to validate the model fit:

- 1. The Coefficient of the lagged value of the dependent variable should be less than one and significant.***
- 2. The Sargan test should be insignificant (p -value > 0.05).***
- 3. The presence of serial correlation or autocorrelation in an AR(1) model is expected to be statistically significant, while in an AR(2) model, it is expected to be statistically insignificant. (Beck et al., 2013; Roodman, 2009).***

The regression results in **Tables 8a and 8b** indicate that the lag time values of the dependent variable, sustainable growth rate, exhibit statistical significance and are less than one (0.280). The p-value associated with the sargan test exceeds the significance level of 0.05. In E-VAIC model, the autocorrelation at AR(1) demonstrates statistical significance ($p = 0.031$), but the autocorrelation at AR(2) does not exhibit statistical significance ($p = 0.254$). The findings demonstrate that the model has attained an ideal degree of fit.

V. DISCUSSION AND IMPLICATIONS

From a practical standpoint, this study spans the gap between theory and reality by providing Agribusiness companies in India with a more profound knowledge of enhancing their Intellectual Capital growth. Intellectual Capital has proven to be crucial in achieving Sustainable Growth for Agribusinesses specific to pesticides and fertilizer companies. As a result, this study suggests that Indian agri-businesses should closely monitor the effectiveness of each of the five Intellectual Capital types—Human, Structural, Capital-employed, Relational, and Innovation Capital.

Global agribusiness heavily relies on Intellectual Capital, notably in R&D-related activities. According to the current study, Innovation Capital Efficiency (RDE) has a major favourable impact on the Sustainable Growth rate, demonstrating that Indian Agribusinesses are growing well due to effective R&D resource management. In the context of Agribusinesses, the presence of Innovation Capital becomes crucial in addressing the escalating levels of unpredictability within the operational landscape, hence facilitating economic sustainability through enhanced competitiveness. Therefore, it is essential for Indian Agribusiness companies to invest resources towards the enhancement of Innovation Capital and integrate it into their long-term business goals. It is abundantly apparent from the current study's findings that Human Capital is a crucial part of Intellectual Capital. The empirical results show that employees of Indian agribusinesses contribute towards achieving Sustainable Growth through their innate skills, knowledge, competencies, and experience. The results demonstrate that long-term business strategy should include human capital investment to maximize sustainable growth. The findings imply that employers should view personnel costs as investments and that these human resources should be utilized effectively to create wealth.

Relational Capital Efficiency positively and significantly impacts Sustainable Growth, indicating that Agribusiness companies in India have an excellent relationship with their customers, consumers, intermediaries, representatives, suppliers, partners, owners, and lenders. Hence, based on the research, Relational Capital Investments should be embedded into long-term business goals. Sustainable Growth rate is favourably influenced by Structural Capital Efficiency, which indicates that Agribusiness companies in India have strong internal business processes, a positive company culture, and suitable management control mechanisms. Hence, Indian Agribusinesses should invest in Structural Capital to sustain themselves in the competitive world and achieve a long-term steady growth rate. In addition, the findings indicate that capital-employed efficiency does not significantly impact Sustainable Growth. The results substantiate that Indian agribusinesses place more trust and significance in Intellectual Capital assets.

Societal Implications

E. If Indian Agribusiness companies invest in Intellectual Capital resources, they can minimize the use of chemical fertilizers and pesticides, promote crop diversity, and conserve natural resources such as water and soil. Indian Agribusiness companies employ modern technologies and equipment to test the quality of their products and ensure that they are free from harmful contaminants. In this way, their commitment to quality will earn the trust of their Stakeholders, and hence, they continue to strive for excellence in all their endeavours.

VI. LIMITATIONS AND SCOPE FOR FURTHER RESEARCH

The present study has focused exclusively on Indian Agribusiness businesses listed on the NSE NIFTY 500 index. Subsequent investigations could potentially enhance the robustness of the study by expanding the sample size, extending the temporal scope, and using alternative metrics for assessing sustainable growth within the research framework. Furthermore, it is recommended that future scholars undertake analogous investigations in alternative emerging markets. Future research endeavours may seek to conduct comparative analyses between the outcomes derived from the utilization of the VAIC model and those obtained from employing the Extended VAIC models.

VII. CONCLUSION

The importance of Intellectual Capital in a company's competitive advantage and its potential to achieve Sustainable Growth is acknowledged more. This research aims to examine the impact of Intellectual Capital components on the Sustainable Growth rate in the Agribusiness companies of India, utilizing the "Extended Value-added Intellectual Capital model (E- VAIC)". The evaluation encompasses a period of twelve years, specifically from 2011 to 2022, during which seventeen Agribusiness companies specific to pesticides and fertilizer companies from the NIFTY 500 index are assessed. The results of this study provide a significant addition to the current corpus of academic research on Intellectual Capital (IC) since the research study indicates that IC plays a significant role in achieving Sustainable Growth for Agribusiness companies in India.

The overall findings indicate that Human Capital Efficiency (HCE), Innovation Capital Efficiency (RDE), Structural Capital Efficiency (SCE), and Relational Capital Efficiency (RCE) substantially positively impact the Sustainable Growth Rate (SGR) of Indian Agribusiness Companies. Innovation Capital Efficiency and Human Capital Efficiency are the most influencing variables having a substantial and major favourable effect on the Sustainable Growth Rate of Indian Agribusiness companies. By investing in Innovation Capital, Agribusiness companies can create new products and technologies that increase efficiency, reduce waste, and improve yields.

The results indicate that the competencies, knowledge, skills, and experience possessed by personnel in the Agribusiness sector in India play a significant role in achieving sustainable growth. Human Capital Efficiency (HCE) strategies can potentially enhance the knowledge, skills, and competencies of personnel working in Indian Agribusiness companies. This can be achieved by implementing strategic planning, training, and development programmes. The utilization of HCE provides the organization with a competitive advantage due to its role as the major catalyst for generating revolutionary ideas and innovation. Structural Capital Efficiency substantially favours the and Sustainable Growth of Indian agribusinesses. The findings suggest that agricultural businesses in India possess robust internal business processes, foster a favourable corporate culture, and employ sufficient management control measures. The favourable impact of Relational Capital Efficiency on Sustainable Growth in Indian agribusinesses is enormous. The findings illustrate a robust correlation between Indian Agribusinesses and various stakeholders, including clientele, customers, distributors, marketers, vendors, partners, owners, and financiers. These results indicate that Indian agribusiness companies seeking to enhance their Sustainable growth should emphasize more on Intellectual Capital resources and invest in them. The findings are in line with earlier study investigations that Intellectual Capital is vital for achieving Sustainable Growth (Coulson-Thomas, C. J., 2003; Ashton, R. H., 2005; Cuganesan, S., 2005; Mageza, P. Z., 2008; Xu, J., & Wang, B, 2018; Xu, X.L et al., 2020; Lu, Y et al., 2021; Ali et al., 2021; Xu, X. L et al., 2021; Jordão, R. V. D et al., 2022; Otuya, S et al., 2023).

Conflict of Interest: The Authors declare that there is no conflict of interest regarding the publication of this work.

Acknowledgments: The Authors are grateful to the editor and reviewers for their helpful suggestions.

REFERENCES:

- Alhassan, A. L., & Asare, N. (2016). Intellectual capital and bank productivity in emerging markets: evidence from Ghana. *Management Decision*, 54(3), 589-609.
- Ali, BJ, & Anwar, G. (2021). Intellectual capital: A modern model to measure the value creation in a business. *International journal of Engineering, Business and Management*, 5(2),31-43.
- Al-Khoury, A., Hussein, S. A., Abdulwhab, M., Aljuboori, Z. M., Haddad, H., Ali, M. A., ... & Flayyih, H. H. (2022). Intellectual Capital History and Trends: A Bibliometric Analysis Using Scopus Database. *Sustainability*, 14(18), 11615.
- Anik, S., & Sulisty, H. (2021). The role of green intellectual capital and green innovation on competitive advantage of SMEs. *International Journal of Learning and Intellectual Capital*, 18(1), 28-44.
- Ashton, R. H. (2005). Intellectual capital and value creation: a review. *Journal of accounting literature*, 24, 53.
- Azamat, K., Galiya, J., Bezhan, R., & Nurdana, Z. (2023). The impact of intangible assets on the value of FMCG companies worldwide. *Journal of Innovation and Knowledge*, 8(1), 100330.
- Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of management*, 17(1), 99-120.

- Beck, R., Jakubik, P., & PiloIU, A. (2013). Non-performing loans: What matters in addition to the economic cycle?.
- Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of econometrics*, 87(1), 115-143.
- Chen, L., Zhao, X., Tang, O., Price, L., Zhang, S., & Zhu, W. (2017). Supply chain collaboration for sustainability: A literature review and future research agenda. *International Journal of Production Economics*, 194(1), 73-87.
- Chen, M. C., Cheng, S. J., & Hwang, Y. (2005). An empirical investigation of the relationship between intellectual capital and firms' market value and financial performance. *Journal of intellectual capital*, 6(2), 159-176.
- Cuganesan, S. (2005). Intellectual capital-in-action and value creation: a case study of knowledge transformations in an innovation project. *Journal of Intellectual Capital*, 6(3), 357-373.
- Demartini, C., & Trucco, S. (2016). Does intellectual capital disclosure matter for audit risk? evidence from the UK and Italy. *Sustainability*, 8(9), 867.
- Edvinsson, L. (1997). Developing intellectual capital at Skandia. *Long range planning*, 30(3), 366-373.
- Gupta, K., Goel, S., & Bhatia, P. (2020). Intellectual capital and profitability: evidence from Indian pharmaceutical sector. *Vision*, 24(2), 204-216.
- Hall, R. (1992). The strategic analysis of intangible resources. *Strategic Management Journal*, 13(2), 135-144.
- Higgins, R.C. (1981). Sustainable growth under inflation. *Financial Management*, 10(4), 36- 40.
- Huang, R., & Liu, G. (2009). Study on the enterprise sustainable growth and the leverage mechanism. *International journal of Business and Management*, 4(3), 200-205.
- Jamei, R. (2017). Intellectual capital and corporate governance mechanisms: Evidence from tehran stock exchange. *International Journal of Economics and Financial Issues*, 7(5), 86-72.
- Jin, G., & Xu, J. (2022). Does intellectual capital affect financial leverage of Chinese agricultural companies? Exploring the role of firm profitability. *Sustainability*, 14(5), 2682.
- Jordão, R. V. D., Almeida, V. R. D., & Novas, J. (2022). Intellectual capital, sustainable economic and financial performance and value creation in emerging markets: the case of Brazil. *Bottom Line*, 35(1), 1-22.
- Kader, M. (2001). Intellectual capital management in agricultural research efforts and the role of smartcard applications in enabling knowledge exchange. *Journal of Agriculture in the Tropics and Subtropics*, 102(1), 53-58.
- Kozera, M. (2011). Intellectual Capital in agriculture—measurement and determinants. *Acta Scientiarum Polonorum, Oeco-nomia*, 10(3), 83-95.
- Lee, S. (2010). Effects of Capital intensity on firm performance: the US Restaurant industry. *The Journal of Hospitality Financial Management*, 18(1), 1-13.
- Lu, Y., Li, G., Luo, Z., Anwar, M., & Zhang, Y. (2021). Does intellectual capital spur sustainable competitive advantage and sustainable growth?: A study of Chinese and Pakistanifirms. *Sage Open*, 11(1), 2158244021996702.
- Luthy, D. H. (1998, August). Intellectual capital and its measurement. In *Proceedings of the Asian Pacific Interdisciplinary Research in Accounting Conference (APIRA), Osaka, Japan* (pp. 16-17).
- MacKinnon, J. G. (1996). Numerical distribution functions for unit root and cointegration tests. *Journal of applied econometrics*, 11(6), 601-618.

- Marr, B. (2004). Measuring and benchmarking intellectual Capital. *Benchmarking: An International Journal*, 11(6), 559-570.
- Marr, B., Schiuma, G., & Neely, A. (2004). Intellectual capital—defining key performance indicators for organizational knowledge assets. *Business Process Management Journal*, 10(5), 551-569.
- Mouritsen, J. (1998). Driving growth: economic value added versus intellectual capital. *Management accounting research*, 9(4), 461-482.
- O'Brien, R. G., & Kaiser, M. K. (1985). MANOVA method for analyzing repeated measures designs: an extensive primer. *Psychological bulletin*, 97(2), 316.
- Ocak, M., & Findik, D. (2019). The impact of intangible assets and sub-components of intangible assets on sustainable growth and firm value: evidence from Turkish listed firms. *Sustainability*, 11(19), 5359.
- Pallant, J. (2011). Survival manual. *A step by step guide to data analysis using SPSS*, 4(4).
- Peppard, J., & Rylander, A. (2001). Using an intellectual capital perspective to design and implement a growth strategy: the case of APiON. *European Management Journal*, 19(5), 510-525.
- Pesämaa, O., Zwikael, O., Hair Jr, J., & Huemann, M. (2021). Publishing quantitative papers with rigor and transparency. *International Journal of Project Management*, 39(3), 217-222.
- Phonthanakitithaworn, C., Srisathan, W. A., Ketkaew, C., & Naruetharadhol, P. (2023). Sustainable Development towards Openness SME Innovation: Taking Advantage of Intellectual Capital, Sustainable Initiatives, and Open Innovation. *Sustainability*, 15(3), 2126.
- Pulic, A. (1998, January). Measuring the performance of intellectual potential in knowledge economy. In *2nd McMaster word congress on measuring and managing intellectual capital by the Austrian team for intellectual potential* (pp. 1-20).
- Pulic, A. (2000). VAIC™—an accounting tool for IC management. *International journal of technology management*, 20(5-8), 702-714.
- Qiao, S.; Xu, X.L.; Liu, C.K.; Chen, H.H. (2016). A panel study on the relationship between biofuels production and sustainable development. *International Journal of Green Energy*, 13(1), 94–101.
- Rehman, W. U., Rehman, H. U., Usman, M., & Asghar, N. (2012). A Link of intellectual capital performance with corporate performance: comparative study from banking sector in Pakistan. *International Journal of Business and Social Science*, 3(12), 313-321.
- Rochmadhona, B. N., Suganda, T. R., & Cahyadi, S. (2018). The competitive advantage between intellectual capital and financial performance of banking sector in ASEAN. *Jurnal keuangan dan Perbankan*, 22(2), 321-334.
- Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *The stata journal*, 9(1), 86-136.
- Scafarto, V., Ricci, F. and Scafarto, F. (2016). Intellectual capital and firm performance in the global agribusiness industry: the moderating role of human capital. *Journal of Intellectual Capital*, 17(3), 530–552.
- Shamsuzzoha, & Tanaka, M. (2021). The role of human capital on the performance of manufacturing firms in Bangladesh. *Managerial and Decision Economics*, 42(1), pp.21-33.
- Singh, R. D., & Narwal, K. P. (2015). Intellectual capital and its consequences on company performance: a study of Indian sectors. *International Journal of Learning and Intellectual Capital*, 12(3), 300-322.

- Soetanto, T., & Liem, P. F. (2019). Intellectual capital in Indonesia: Dynamic panel approach. *Journal of Asia Business Studies*, 13(2), 240-262.
- Stähle, P., Stähle, S., & Aho, S. (2011). Value added intellectual coefficient (VAIC): a critical analysis. *Journal of Intellectual Capital*, 12(4), 531-551.
- Sveiby, K. E., & Lloyd, T. (2010). Methods for measuring intangible assets.
- Syah Aji, R. H., & Kurniasih, K. (2015). The intellectual capital effect on financial performances at Islamic insurance. *Al-Iqtishad Journal of Islamic Economics*, 7(2), 181-196.
- Tobin, J. (1969). A general equilibrium approach to monetary theory. *Journal of money, credit and banking*, 1(1), 15-29.
- Tran, D. B., & Vo, D. H. (2018). Should bankers be concerned with Intellectual capital? A study of the Thai banking sector. *Journal of Intellectual Capital*, 19(5), 897-914.
- Ulum, I., Kharismawati, N. and Syam, D. (2017). Modified value-added intellectual coefficient (M-VAIC) and traditional financial performance of Indonesian biggest companies. *International Journal of Learning and Intellectual Capital*, 14(3), 207-219.
- Van Horne, J.C. (1987). Sustainable growth modelling. *Journal of Corporate Finance*, 2(3), 19-26.
- Xu, J., & Wang, B. (2018). Intellectual capital, financial performance and companies' sustainable growth: Evidence from the Korean manufacturing industry. *Sustainability*, 10(12), 4651.
- Xu, X. L., Li, J., Wu, D., & Zhang, X. (2021). The intellectual capital efficiency and corporate sustainable growth nexus: Comparison from agriculture, tourism and renewable energy sector. *Environment, Development and Sustainability*, 1-19.
- Xu, X.L., Chen, H.H. and Zhang, R.R. (2020). The impact of intellectual capital efficiency on corporate sustainable growth-evidence from smart agriculture in China. *Agriculture*, 10(6), 199.
- Xu, X.L.; Liu, C.K. (2019). How to keep renewable energy enterprises to reach economic sustainable performance: From the views of intellectual Capital and life cycle. *Energy, Sustainability and Society*, 9(1), 1-10.
- Xu, X.L.; Sun, CH; Chen, H. (2019). How diversified fuel-fired power enterprises keep their competitive advantages to reach sustainable development. *Environmental Progress & Sustainable Energy*, 38(2), 137-142.
- Yousaf, M. (2022). Intellectual capital and firm performance: evidence from certified firms from the EFQM excellence model. *Total Quality Management & Business Excellence*, 33 (13-14), 1472-1488.
- Zhang, Y., Ma, E., & Qu, H. (2018). Transaction cost and resources based views on hotels' outsourcing mechanism: An empirical study in China. *Journal of Hospitality Marketing & Management*, 27(5), 583-600.

WEBSITES:

<https://www.imarcgroup.com/agriculture-industry-in-india#:~:text=The%20agriculture%20industry%20in%20India,12%25%20during%202021%2D2026>.

<https://www.india.gov.in/topics/agriculture#:~:text=This%20Portal%20is%20a%20Mission,b%20the%20respective%20Ministries%2FDepartments>.