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Impact of Intellectual Capital and Working Capital Management on Corporate Sustainable Growth: An Empirical Study on Pakistan Fertilizer Companies

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ABSTRACT

Intellectual capital and working capital management are gaining significant importance in achieving sustainable corporate growth, particularly in knowledge-based industries. This study empirically examines the effect of intellectual capital and working capital management on the sustainable growth of Pakistan's fertilizer industry. The study uses secondary data from 2019 to 2024 for the fertilizer firms of Pakistan. The dependent variable represents the sustainable growth rate, which is used to measure corporate financial sustainability, while the independent variables are intellectual capital efficiency and working capital management efficiency. Control variables include firm size, leverage, and age. Using panel least squares regression analysis, the study finds that intellectual capital has a strong, positive impact on business sustainable growth, which aligns with the Resource-Based View (RBV) theory. Working Capital Management Efficiency reveals a significant but negative association with sustainable growth. This proposes that inefficient working capital management may create liquidity obstacles and slow down long-term performance in the fertilizer industry. The findings highlight that efficient intellectual resource management is a key driver for long-term growth, while working capital practices require further improvement. Particularly in high energy-consuming industries like fertilizer production, this research offers managers and policymakers valuable insights on enhancing internal resource management to achieve sustained corporate growth.

1. Introduction

Agriculture plays a major role in Pakistan's economy and development. In the fiscal year 2023-24, this can be estimated at 23.1% of GDP and 37.6% of employment (Pakistan, 2024). This sector demonstrated resilience, with agricultural GDP rising by 6.25%, driven by improvements in major and minor crops, livestock, and other subsectors. Agriculture also supports the food supply chain and sustains agro-based industries, such as fertilizer production. The fertilizer industry holds strategic importance within this broader agricultural context due to its direct contribution to crop productivity and the sustainability of the food supply. Fertilizer companies increasingly adopt modern technologies and efficient resource utilization to enhance operational efficiency and long-term growth. Sustainable performance in this sector depends on physical inputs, effective management practices, and intangible resources.

According to (Sørensen et al., 2021) Sustainable development is highly dependent on people's contributions to the system, especially in terms of knowledge, experience, skills, and ability. Over the last decades, Intellectual capital (IC) and Working capital management (WCM) have been recognized as important elements for building successful businesses in every industry, including the agriculture and manufacturing sectors. According to (Makki & Lodhi, 2009)As older companies depart from their conventional industry-based models and transition into knowledge-based enterprises, they take IC as a strategic resource that enables long-term profitability and efficient WCM for operational stability.

Intellectual capital (IC) is considered an intangible asset crucial for the bottom line. It includes three basic parts, i.e., Human capital, structural capital, and relational capital. Later on, Innovative capital and capital employed became part of it. Human capital refers to the knowledge, skills, expertise, and experiences of employees. It acts as a driver for increasing growth, competitive advantage, and profitability (Balaji & Mamilla, 2024; Khorasanian, 2016; Mondal & Ghosh, 2012)**.** Structural Capital, also known as non-human knowledge, refers to an organization's framework, structure, and procedures, along with intangible assets like databases, organizational charts, management plans, and policies. Its most important function is to gather and share information, which promotes communication and innovation inside the company (Balaji & Mamilla, 2024; Khorasanian, 2016; Mondal & Ghosh, 2012)**.** Relational or Customer capital refers to all intangible assets utilized to control and govern a company's external connections and internal relationships. Good communication with stakeholders is a major element for achieving a long-term competitive advantage (Balaji & Mamilla, 2024). IC plays a pivotal role in enhancing operational efficiency, risk mitigation, and liquidity management (Shahdadi et al., 2020)**.** All of the elements of IC are essential while dealing with environmental and economic volatility (Balaji & Mamilla, 2024). Corporations with remarkable IC investment disclose ROAs that are up to 20% greater than those with less investment in IC (OECD, 2022)**.**

Working capital management (WCM) is considered a primary driver of business profitability. It impacts short-term liquidity as well as long-term growth. It comprises administering accounts payable, receivables, and inventory control (Deloof, 2000; Tran et al., 2017)**.** According to (Julius

Enqvist, 2013)A firm can raise its profitability by 1% to 3% when it achieves a 10-day reduction in the cash conversion cycle, a measure of WCM efficiency. WCM can be implemented through different strategic approaches, generally categorized as conservative and aggressive strategies, each with distinct implications for firm performance and risk. A conservative WCM strategy fosters profitability by increasing investments in inventory and accounts receivable. It can reduce risk and balance supply cost, which leads to increased sales and overall growth in market share and profitability (Awais, 2017). In contrast, an aggressive WCM strategy enhances liquidity but raises risk by reducing investment in customer credit terms and inventories (Aktas et al., 2015; Awais, 2017).

Sustainability relates to a company's strategy and actions to minimize the worst environmental and social impacts that emerge from business operations. An organization's sustainability practices are typically analysed against environmental, social, and governance (ESG) metrics. Moreover, sustainability has become a primary concern for corporations aiming for sustained success. In the modern economy, intellectual Capital (IC) and strategic resource management are vital factors for competitive advantage and sustainable growth. It is noticed by rapid technological innovation and globalization (Alvino et al., 2020).

Pakistan's fertilizer industry plays a key role in boosting the economy. The current study reports that the effects of IC and WCM efficiency contribute to long-term business growth in this sector. Earlier research revealed a strong correlation between IC and sustainable growth, particularly in the industrial sector (Balaji & Mamilla, 2024; Pradana & Chalid, 2023). Although WCM has received less attention, it plays a significant role in enhancing performance and reducing financial challenges (Boisjoly et al., 2020; Habib & Mourad, 2022). Researchers are continuously exploring the association between Intellectual Capital (IC) and Working Capital Management (WCM) in improving organizational performance. Some studies alert to the overinvesting in working capital, while others recommend that high growth and competitive advantage can only be achieved by effective IC and WCM practices (Habib & Dalwai, 2023).

Effective WCM is critical in developing countries like Pakistan due to its major effect on a company's cash flow, risk vulnerability, and ability to control economic decline (Mumtaz et al., 2024). WCM acts as an armor against economic vulnerability to determine the financial health and growth of a business (Julius Enqvist, 2013). Although some researchers report that growth and working capital are positively correlated, while others claim that uncontrollable working capital might lead to lower profitability and inefficiencies (Habib & Dalwai, 2023; Nastiti et al., 2019).

1.1. Problem Statement:
Although IC and WCM are increasingly recognized as important drivers of firm performance, prior research has generally examined these factors separately and has focused mainly on short-term financial results. Specifically, in Pakistan's fertilizer industry, limited attention has been given to understanding how IC efficiency and WCM jointly influence sustainability. The fertilizer sector faces unique challenges, like regulatory pressures, high capital requirements, and

economic uncertainty, which may affect the way firms manage both intangible resources and working capital. The absence of comprehensive, sector-specific empirical evidence highlights a clear gap in the existing literature and underscores the need for further investigation.

1.2. Objectives of the study:

The primary objective of this study is to examine the influence of IC efficiency and WCM practices on corporate sustainable growth in Pakistan's fertilizer industry, providing empirical evidence that supports managerial decision-making and policy formulation in a capital-intensive and strategically important sector.

1.3. Limitations of the Study:

This study will only take into account the Pakistani fertilizer firms that may restrict the applicability to other sectors to achieve the research objective. It only contains a small number of enterprises, which may not fully capture long-term trends. The sample may not fully reflect broader economic trends, i.e., macroeconomic and governance-related aspects, in analyzing the sustainable growth of companies.

1.4. Significance of the study:

This study offers a unique contribution to the academic and professional understanding of how internal resource efficiencies drive sustainable growth, especially within Pakistan's under-researched fertilizer industry. The relationship between working capital management and intellectual capital in Pakistan's fertilizer industry remains largely unexplored. Most of the earlier studies have emphasized banking, manufacturing, or general industry contexts, with little attention to fertilizer-specific dynamics. This sector has a unique economic and operational landscape due to its strategic importance to national food security, high reliance on government subsidies, and its relatively small number of publicly listed firms. By applying and integrating established theories such as the Resource-Based View (RBV), Trade-Off Theory, and Pecking Order Theory, the study adds a multidimensional perspective to the literature. Additionally, the results provide actionable insights for financial managers and policymakers to enhance intellectual and working capital practices for sustained economic and environmental performance. The findings may serve as a benchmark for other emerging market industries facing similar structural and resource-based challenges.

2. Literature Review

2.1 Theoretical Background

Corporate sustainable growth (CSG) is essential for long-term viability, particularly in high-energy-consuming industries such as the fertilizer sector. In today's information-based economy, efficient resource management and intellectual capital (IC) are vital factors in a firm's ability to achieve sustainable growth and sustain a competitive advantage (Balaji & Mamilla, 2024; Habib & Dalwai, 2023). Although these topics have been the focus of numerous studies conducted globally, little empirical research has examined the correlation between IC and WCM and their impact on

sustainable growth in Pakistan's fertilizer industry. To identify gaps and lay the groundwork for the current investigation, the literature analysis reviews earlier studies.

2.1.1 Working Capital Management (WCM)

Working capital management (WCM) is a key component of financial management that focuses on managing a business's short-term assets and liabilities. WCM addresses concerns such as maintaining financial liquidity, reducing unnecessary spending, and ensuring smooth operational flows to maintain the optimal balance between liquidity and profitability (Zimon, 2019). The working capital financing (WCF) policy and the working capital investment (WCI) policy are the two main policies covered in the working capital literature (Habib & Dalwai, 2023).

2.1.1a. Working Capital Investment (WCI) Policy:

The WCI policy refers to the current assets-to-total assets ratio, which exhibits the proportion of current assets to total assets (Nazir & Afza, 2009)**.** Companies may make conservative or aggressive investments (Habib & Mourad, 2022)**.** To increase liquidity, they apply an aggressive WCI policy, which includes minimal current asset investments and limits sales and operational continuity. In contrast, a conservative WCI policy requires large current asset investments. Maximize investment in current assets boost customer satisfaction and operational stability, but also raise liquidity costs (Habib & Mourad, 2022). Large expenditures in receivables and inventory enhance sales, but they also raise high-interest costs, which leads to a reduction in shareholder value (Aktas et al., 2015; Baños-Caballero et al., 2014)**.**

2.1.1b. Working Capital Financing (WCF) Policy:

The WCF strategy is well defined on financing current assets with either short-term or long-term obligations (Habib & Dalwai, 2023)**.** An aggressive WCF policy relies on short-term debt, which offers lower costs but carries greater risk due to its immediate repayment obligations (Habib & Mourad, 2022). Conversely, a conservative WCF approach uses long-term debt, which lowers the risk of repayment but increases interest expenses (Alrahamneh et al., 2020). Effective WCM strategies, whether they be aggressive, conservative, or moderate, have a significant impact on business performance, profitability, and liquidity.

2.1.1c. Trade-Off Theory:

The trade-off theory states that businesses continuously struggle to maintain an optimal cash balance by adjusting the associated advantages and disadvantages. The theory was given in 1973 by Kraus and Litzenberger, and later on, Myers in 1977 made changes to it. According to (Venkat & Baird, 2016)**,** Firms manage their liquidity to ensure they can handle operational needs, unexpected expenses, and potential investment opportunities while minimizing costs. (Zhuravlyova et al., 2019) emphasize that firms must determine an ideal debt ratio. Firms face financial distress when exceeding this threshold (Zhuravlyova et al., 2019). They reduce their dependency on external financing against the opportunity costs and risks linked to excessive cash retention.

2.1.1d. Pecking Order Theory:

Gordon Donaldson proposed the pecking order theory in 1961. Stewart, Myers, and Nicolas modified it in 1984. This theory explains how firms prioritize financing sources, favouring internal funds first, then debt, and finally equity as a last resort. According to (Myers & Majluf, 1984) firms adopt a hierarchical financing approach that relies on internal sources of funds initially. When external financing becomes necessary, firms prefer debt over equity. Profitable firms avoid external borrowing and rely more on reinvestment of retained earnings. This theory explains the reasons why financially healthy firms accumulate cash reserves. So, they can easily fund future projects without replacing expensive external capital.

2.12   Intellectual Capital (IC)

Intellectual Capital (IC) has become a key factor in determining competitive advantage and long-term value creation as economies transfer from industrial to knowledge-based systems (Pavic Kramaric et al., 2021). Businesses are turning away from traditional financial research to IC to focus their capability to create value, evaluate performance in the future, and promote sustainability (Balaji & Mamilla, 2024)**.** According to (Demartini & Beretta, 2019)IC is a robust collection of intangible assets. The main constituents are Human capital (HC), structural capital (SC), and relational capital (RC) (Demartini & Beretta, 2019; Petty, 2000; Pulić, 1998). Human Capital (HC) reflects the employees' abilities, knowledge, and inventiveness, which promotes innovation and organizational growth (Kianto et al., 2019). Structural Capital (SC) stands for the intellectual property, organizational structures, and procedures that support creativity (Edvinsson & Sullivan, 1996; Nazari & Herremans, 2007). Relational Capital (RC) focuses on external relationships that improve competitive positioning and sustainability, including strategic alliances and customer loyalty.

Investments in IC provide businesses with a competitive edge and promote long-term financial success by improving innovative capacities and operational efficiency (Balaji & Mamilla, 2024)**.** For example, since motivated and well-trained employees are the cornerstone of an efficient organizational culture and procedures, HC plays a critical role in creating SC (Mondal & Ghosh, 2012)**.** Similarly, through enhanced customer satisfaction and strategic alliances, RC assists businesses in utilizing HC and SC to optimize wealth development (Nawaz & Haniffa, 2017)**.** (Galabova & Ahonen, 2011) categorize theories of competitive advantage into two main frameworks: the market-based view and the resource-based view.

2.1.2a. The Resource-Based View Theory (RBV):

The resource-based theory emerged in the 1980s but became notable in the 1990s (Barney, 1991; Wernerfelt, 1984). According to the theory, firms can use resources to gain a sustained competitive advantage. These resources are "valuable," "rare," "inimitable," and "no substitutable", and are referred to as VRIN (Nason & Wiklund, 2018)**.** VRIN resources help neutralize external environmental deficiencies and strengthen internal advantages (Habib & Dalwai, 2023; Nason & Wiklund, 2018). A standalone resource may have little value, but when it combines physical, human, and organizational capital, its strength becomes greater for long-term competitive advantage. According to resource-based theory, one of the most important intangible resources is IC (Wright et al., 1994). The theory states that

IC is a strategic resource that accounts for two-thirds of a business's assets and, with effective management, yields in value generation. (Grant, 1991).

According to the Resource-Based View (RBV), VRIN resources contribute to a sustainable competitive advantage. IC plays a major role in long-term growth by fostering creativity, encouraging competitive advantage, and supporting value towards structural, human, and relational dimensions (Demartini & Beretta, 2019). In knowledge-based industries like fertilizers, IC must be efficiently managed and utilized to maintain resilience and sustainable growth.

2.12.1 Corporate Sustainable Growth (CSG):

Corporate sustainable growth (CSG) focuses on fulfilling economic profitability with reducing environmental impact and fostering social responsibility (Zhou et al., 2022). It is a critical element in the fertilizer sector because of its role in global food security and environmental preservation. In the fertilizer industry, adopting modern technologies increases operational efficiency and supports sustainable practices Furthermore, merging ESG (Environmental, Social, and Governance) metrics into business strategies improves adaptability and competitiveness, particularly in responding to regulatory demands and stakeholder concerns (Zhou et al., 2022).

IC plays a key role in enhancing economic development and human well-being. It creates long-term value generation (Zhou et al., 2022), thus promoting sustainability (Galabova & Ahonen, 2011) through alignment with the United Nations' SDGs 2030 agenda. Effective use of intellectual and working capital is vital for fostering innovation and achieving corporate sustainable growth in this sector (Habib & Dalwai, 2023).

2.13 Hypothesis Development
2.2.1. The Impact of IC on Corporate Sustainable Growth

Intellectual Capital (IC) is increasingly recognised as a key factor in boosting corporate sustainable growth. It is considered the leading driver of innovation, which enhances competitive advantage and fosters sustainability. Generating value depends on the effective management of IC rather than the use of physical and financial capital (Dalwai & Mohammadi, 2020). This highlights the importance of IC measurement for enhancing efficiency and leveraging resources.

IC plays a major role in creating long-term value, generating sustainability, raising economic growth, and improving human welfare by adopting the United Nations' SDGs 2030 agenda (Alvino et al., 2020). Several studies have found that IC has a substantial impact on a company's sustainability. Resource-based theory states that an organization's value-creating capability is derived from organizational processes of intellectual resources, but not from its industry's dynamism (Barney, 1991). IC occurs in the form of relationships, processes, policies, structures, and workforce of an organization. Research indicates that out of all elements of IC, human capital has a significant positive impact on long-term corporate development. It is considered a driving engine in a company's long-term progress (Balaji & Mamilla, 2024). Likewise, structural capital offers a basis for long-term performance and ongoing enhancement, for sustainable growth (Balaji & Mamilla, 2024). Furthermore, strong relational networks

build strategic alliances that propel long-term success, increase customer happiness, and cultivate brand loyalty (Bhattacharjee & Akter, 2022; Petty, 2000). Finally, researchers assure that capital employed and intellectual capital both provide long-term success after conducting research in different sectors. Firms, particularly in the fertilizer sector, must effectively manage these intellectual resources to achieve sustainable development and long-term performance (Mujeri et al., 2012). So, we hypothesized that the effective management of Intellectual Capital (IC) has a significant impact on corporate sustainable growth by enhancing innovation and competitive advantage in knowledge-based economies.

H1: The efficiency of Intellectual Capital has a significant impact on corporate sustainable growth.

2.2.2. The Impact of WCM on Corporate Sustainable Growth

Working capital management (WCM) has a direct impact on the long-term growth of corporations. It guarantees liquidity and improves operational efficiency, which is essential for navigating economic uncertainty (Baños-Caballero et al., 2014; Deloof, 2000). The correct decision between aggressive and conservative WCM strategies leads to the sustainable growth path of a company. According to Awais (2017) Conservative strategies support long-term growth and reduce risk as they involve greater investments in inventory and accounts receivable. It improves customer satisfaction and minimizes supply chain interruptions. Similarly, too much working capital can lead to extra expenses like increased borrowing rates, which could reduce the value of the company (Habib & Kayani, 2022).

Poorly managed working capital faces serious risks to sustainable growth since it can lead to liquidity issues and reduced profitability (Aktas et al., 2015; Baños-Caballero et al., 2020; Habib & Mourad, 2022). On the other hand, businesses with effective WCM practices, i.e., having shorter Cash Conversion Cycle (CCC), show higher profitability because they are less dependent on outside funding and have greater operational flexibility (Gill et al., 2010). Thus, we hypothesized that effective Working capital management has a significant impact on Corporate Sustainable Growth.

H2: Efficient WCM has a significant impact on Corporate Sustainable Growth.

3 Data and Methodology

3.1 Research Design

The current study aims to analyse the impact of intellectual capital and working capital management on the sustainable growth of firms in Pakistan's fertilizer sector. So, from the aspect of purpose, this study is causal, and a quantitative method will be applied to execute the research. The positivist type of research philosophy will be considered to carry out studies primarily by applying the quantitative method approach.

3.2 Sources of Data

The secondary data was used to analyse the impact of intellectual capital and working capital management on the sustainable growth of the firms. The dataset used in the study was obtained from the annual financial reports and statements of the accounts of the elected fertilizer firms, which are available through company websites, PSX database, and SCS Trade sites. The sample period will be of 6 years, i.e., from 2019 – 2024. Based on a detailed literature review, a multiple regression model will be used for analysis purposes in order to achieve the research objective.

3.3 Population

There are six fertilizer companies listed on the Pakistan Stock Exchange, and four of these are taken into account over six years (2019–2024), yielding a balanced panel dataset. While the sample size is limited due to data availability constraints, it adequately represents the core firms dominating Pakistan's fertilizer sector. However, the findings should be interpreted with caution, as the limited number of firms may restrict generalizability to other industries or economies.

3.4 Variables

This study employs a structured set of dependent, independent, and control variables to empirically examine the relationship between intellectual capital efficiency, working capital management, and corporate sustainable growth in Pakistan's fertilizer industry. Variable selection and measurement are guided by established theoretical frameworks and prior empirical studies to ensure validity and comparability of results. The dependent, independent, and control variables are defined as follows:

3.4.1. Dependent Variable

Sustainable Growth Rate (SGR) is the dependent variable of the current study. It measures a company's capacity to expand over time without needing external funding. This approach is commonly used in financial sustainability literature as a comprehensive indicator of internally generated growth capacity, particularly in capital-intensive industries.

Following (Ikhtiar & Islam, 2008), SGR is calculated as:
SGR = Return on Equity (ROE) × Retention Ratio

Where:
ROE reflects the efficiency with which a company uses equity to generate profits. It is calculated as net income divided by shareholders' equity.

The retention ratio is the percentage of net income retained by the company after paying dividends. It is sometimes referred to as the plowback ratio (i.e., 1 – dividend payout ratio). This measure allows the study to link operational efficiency and financial policies with sustainable firm expansion.

3.4.2. Independent Variables

In the current study, the independent variables are intellectual capital efficiency (ICE) and working capital management efficiency (WCME). Intellectual capital efficiency is measured using the Extended Value-Added Intellectual Coefficient (E-VAIC) model, originally developed by Pulić (1998) and later extended by Nazari and Herremans (2007). The extended model is preferred as it captures broader dimensions of intellectual capital beyond human and structural components, making it more suitable for knowledge-driven and capital-intensive industries.

The overall intellectual capital efficiency is computed as:
ICE=HCE+SCE+RCE
where:
Human Capital Efficiency (HCE) = HC / VA

Structural Capital Efficiency (SCE) = SC / VA

Relational Capital Efficiency (RCE) = RC / VA

Value Added = Output – Input

Output: the entire sales of goods and services, Input: all costs, excluding employee payroll expenses.

HC: Total labour cost, SC: Value added minus human capital, RC: the expenses of sales, marketing, and promotional activities.

The E-VAIC model is suitable for this study as it relies on audited accounting data, ensuring objectivity and consistency across firms.

Working capital management efficiency is measured through the cash conversion cycle. This is considered a broader metric to measure working capital management. It includes the number of days accounts receivable (DSO), the number of days of inventory (DIO), and the number of days accounts payable (DPO). The study specifies the formulae for the Cash Conversion Cycle (CCC) below.

$$WCME= DSO + DIO – DPO$$

Days Sales Outstanding = DSO = (Accounts Receivable / Total Credit Sales) *365

Days Inventory Outstanding = DIO = (Average Inventory / Cost of Goods Sold) *365

Days Payable Outstanding = DPO = (Accounts Payable / Cost of Goods Sold) *365

3.4.3. Control Variables

In combination with efficiency ratios, this study also proposes additional financial indicators to control for other factors that may impact sustainable growth. So, the control variables are Financial Leverage (LEV), Firm Size (SIZE), and Firm Age (AGE). The study specified the formulae for the control variables.

Financial Leverage (LEV) = Total Debt / Total Shareholders' Equity

Firm Size (SIZE) = Log of Total Assets to account for scale effects and reduce heteroscedasticity

Firm Age (AGE) = Ln of the number of years the firm has been established, capturing experience and maturity effects.

The following table provides a brief description of the variables and their corresponding measurements.

Table 1: Variables and Measurements

Variables	Type	Measurements
Sustainable Growth Rate (SGR)	Dependent Variable	ROE x Retention Ratio
Working Capital Management Efficiency (WCME)	Independent Variable	Days sales outstanding
		Days inventory Outstanding
		Days Payable Outstanding
Intellectual Capital Efficiency (ICE)	Independent Variable	Human Capital Efficiency
		Structural Capital Efficiency

		Relational Capital Efficiency
Financial Leverage (LEV)	Control Variable	Total debt divided by total shareholders' equity
Firm Size (SIZE)	Control Variable	Log of total assets
Firm Age (AGE)	Control Variable	Ln of the Firm's year

Source: Author's Compilation

3.5. Regression Model

A panel least squares regression model is performed using EViews 10 software to figure out the possible statistical effect of ICE and WCME on the sustainable growth of the firms in the fertilizer sector. This technique is appropriate as it accounts for both cross-sectional and time-series variations in the data.

The econometric model is specified as:

$SGR_{it} = \beta_0 + \beta_1(ICE)_{it} + \beta_2(WCME)_{it} + \beta_3(LEV)_{it} + \beta_4(SIZE)_{it} + \beta_5(AGE)_{it} + \varepsilon_{it}$

Where,

SGR$_{it}$ represents the dependent variable of fertilizer firm *i* at time *t*. ICE$_{it}$ and WCME$_{it}$ are independent variables of fertilizer firm i at time t. LEV, SIZE, and AGE are control variables of firm i at time t. β_0 is a constant term while β_1, β_2, β_3, β_4, and β_5 denote the coefficients, and ε_{it} points to an error term.

Panel least squares is preferred due to the relatively small sample size and balanced panel structure. Nevertheless, the study acknowledges potential concerns related to endogeneity, omitted variables, and unobserved heterogeneity, which are common limitations in firm-level panel studies. These issues are considered when interpreting the results, and future research may employ advanced estimators such as fixed effects, random effects, or dynamic panel models to enhance robustness.

3.6. Research Model

Figure 1: Research Model
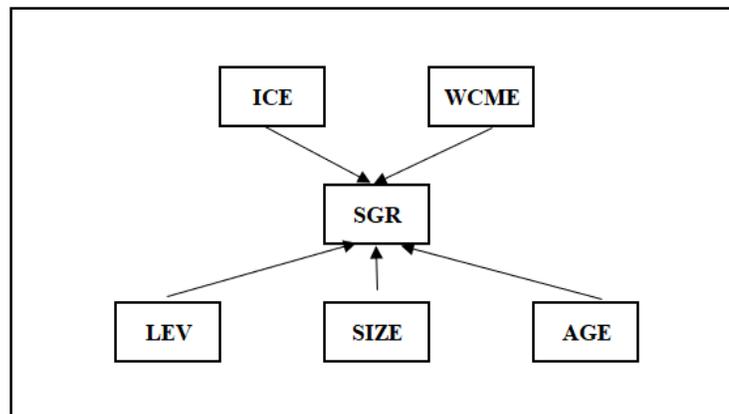
Source: Author's own creation

4. RESULTS AND DISCUSSION

4.1. Descriptive Results

Table 2 reports the descriptive statistics for all variables used in the analysis over the period 2019–2024. The mean SGR of 0.104 indicates moderate internal growth capacity among Pakistan's fertilizer firms, reflecting the capital-intensive nature of the sector. ICE exhibits relatively limited dispersion, indicating a consistent level of intellectual capital utilization across the sampled firms. In contrast, WCME, measured through the cash conversion cycle, exhibits substantial variation, indicating notable differences in short-term liquidity management practices among firms.

Firm Size (SIZE) and Firm Age (AGE) display relatively low variability, reflecting the mature and stable structure of the fertilizer industry in Pakistan. Financial leverage (LEV) shows moderate dispersion, implying heterogeneous financing strategies across firms.

The Jarque–Bera statistics indicate deviations from normality for some variables, particularly ICE and SIZE, which is common in firm-level panel data. Given the panel structure and reliance on large-sample asymptotic properties, strict normality is not a prerequisite for valid regression inference. Overall, the descriptive results provide preliminary evidence of sufficient variation across firms and time to support regression analysis.

Table 2: Descriptive Statistics of Fertilizer Firms

	SGR	IC	WCME	LEV	SIZE	AGE
Mean	0.104498	1.00964	25.71667	0.466608	8.284264	3.137509
Median	0.10512	1.014371	28.88000	0.49355	8.249453	3.151309
Maximum	0.2876	1.083414	74.00000	0.9199	8.758672	3.83.000
Minimum	0.061317	0.731603	100.000	0.0427	8.10809	2.302585
Std. Dev.	0.101138	0.062119	49.70689	0.248567	0.164561	0.488915
Skewness	0.069552	3.865086	0.330256	0.097345	1.151497	0.051797
Kurtosis	1.900836	18.33025	2.124133	1.983525	3.955651	1.759375
Jarq-Bera	1.227512	294.7722	1.203419	1.071125	6.217051	1.549882
Probability	0.541314	0.00000	0.547874	0.58534	0.044667	0.460731

4.2. Correlation Matrix and Multicollinearity Verification

Table 3 (Panel A) presents pairwise correlations among the study variables. Sustainable Growth Rate (SGR) is positively correlated with ICE, WCME, SIZE, and AGE, suggesting that firms with

stronger intellectual capital efficiency, better working capital practices, larger scale, and greater experience tend to exhibit higher sustainable growth. The correlation between ICE and WCME is positive but moderate, indicating that these dimensions capture distinct aspects of firm efficiency.

Financial leverage (LEV) shows a weak association with SGR and a negative correlation with ICE, implying that firms relying more heavily on debt may invest less in intellectual capital development. The positive correlations between WCME, SIZE, and AGE suggest that larger and more established firms manage working capital more efficiently, likely due to operational scale and experience.

Table 3: Pairwise correlations and multicollinearity verification

Variables	SGR	IC	WCME	LEV	SIZE	AGE
Panel A: Pairwise correlations						
SGR	1.0000	0.3520	0.4611	0.1336	0.4666	0.6914
IC	0.3520	1.0000	0.2626	-0.3081	0.1236	-0.0040
WCME	0.4611	0.2626	1.0000	-0.0676	0.6136	0.7255
LEV	0.1336	-0.3081	-0.0676	1.0000	-0.3694	-0.0877
AGE	0.6914	-0.0040	0.7255	-0.0877	0.6698	1.0000

Panel B: Variance inflation Factor and tolerance					
Variables	IC	WCME	LEV	SIZE	AGE
VIF	1.33	2.73	1.39	2.39	2.80
Tolerance	0.75	0.37	0.72	0.42	0.36

Panel B reports the Variance Inflation Factor (VIF) and tolerance values. All VIF values are below the conventional threshold of 5, and tolerance levels exceed 0.1, confirming the absence of serious multicollinearity. These results indicate that the regression coefficients can be interpreted reliably.

4.3. *Regression Result and Discussion*

Table 4 reports the results of the panel least squares regression. ICE exhibits a positive and highly significant coefficient ($\beta = 0.962$, $p < 0.01$), indicating that improvements in intellectual capital utilization substantially enhance corporate sustainable growth. So, H1a is accepted. Economically, this implies that firms that effectively leverage human, structural, and relational capital are better positioned to generate internally financed growth. This finding strongly supports resource-based and knowledge-based theories, which emphasize intangible assets as key drivers of long-term competitive advantage.

WCME shows a negative and statistically significant relationship with SGR ($\beta = -0.00097$, $p < 0.05$). Since WCME is measured using the cash conversion cycle, this negative outcome could imply that longer cash conversion periods reduce sustainable growth. Firms that take more time to convert inventory and receivables into cash face liquidity constraints, limiting their ability to finance growth internally. Therefore, H2 is also accepted. This finding is consistent with working capital theory, which emphasizes the importance of efficient liquidity management for financial sustainability.

Among control variables, Financial Leverage (LEV) has a positive and significant effect on SGR (β = 0.184, p < 0.01), indicating that moderate use of debt may support sustainable growth in the fertilizer sector by providing access to additional resources. This result is plausible in capital-intensive industries where debt financing is often used to support expansion and operational continuity. Firm Size (SIZE) shows a positive but statistically insignificant coefficient, suggesting that scale alone does not guarantee sustainable growth once efficiency and leverage are accounted for. In contrast, AGE exhibits a strong positive and highly significant relationship with SGR (β = 0.191, p < 0.01), pointing out that older firms benefit over time from accumulated experience, established market advantages, and stable operational structures that support sustainable growth.

Although ICE has a strong positive influence, WCM exhibits a negative relationship with SGR. The result proposes that the strength is not fully realized in the sample firms. The model explains approximately 79.5% of the variation in sustainable growth; the F-statistic confirms the overall model's significance. Meanwhile, H1 is supported through the strong positive significance of ICE, the theoretical framework of RBV (Barney, 1991; Nason & Wiklund, 2018). The result suggests that IC plays a moderating role during volatility, but the current inefficiency in WCM needs improvement to support long-term resilience.

Table 4: Regression Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.774624	0.864644	-3.208979	0.0049
IC	0.961747	0.200054	4.807443	0.0001
WCME	-0.00097	0.000359	-2.703881	0.0145
LEV	0.183609	0.051174	3.587955	0.0021
SIZE	0.144794	0.101315	1.429149	0.1701
AGE	0.19059	0.036911	5.163518	0.0001
R-squared	0.795451	Mean dependent var		0.104498
Adj R-squared	0.738632	S.D. dependent var		0.101138
S.E of Reg	0.051706	Akaike info criterion		2.874175
Sum squad resid	0.048123	Schwarz criterion		2.579662
Log likelihood	40.4901	Hannan-Quinn criterion		2.796041
F-statistic	13.99973	Durbin-Watson stat		1.704312
Prob(F-statistic)	0.000011			

Conclusion

The study examines the impact of intellectual capital efficiency and working capital management efficiency on the corporate sustainable growth of the firms in the fertilizer sector of Pakistan. The results reveal that Intellectual Capital has a significant positive effect on sustainable growth, providing a clear picture of how resource utilization impacts growth performance. The result supports the Resource-Based View (RBV) theory for long-term corporate success. Well-structured management of human, structural, and relational capital promotes innovation and maintains competitive advantage, which leads to sustainability. In contrast, Working Capital Management Efficiency reveals a significant but negative

association with sustainable growth. This proposes that inefficient working capital management may create liquidity obstacles and slow down long-term performance in the fertilizer industry.

Overall, the regression model confirms that IC, WCME, and control variables collectively explain a major proportion of the variation in long-term sustainability. These results spotlight the fertilizer firms not only focusing on leveraging their intellectual capital assets but also on enhancing the efficiency of their working capital management. This leads to strengthening resilience and sustaining long-term development. The findings highlight the need for managers to pursue an integrated strategy that strengthens intellectual capital development while improving working capital efficiency. Policymakers may also draw on these results to promote knowledge-based and financially disciplined practices within the fertilizer sector.

This study is limited by its small, sector-specific sample and reliance on accounting-based proxies, which may not capture qualitative firm attributes. Future research may expand the analysis across industries or countries and apply advanced econometric techniques to address endogeneity and explore additional moderating factors.

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