Socio-Economic Impact of ICT in Women's Empowerment to Foster theProcess of SDGs 2030

By

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SCHOOL OF ECONOMICS

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Dedicated to

My Beloved Mother

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ABSTRACT

This study explores whether the affordability and penetration of Information and Communication Technology (ICT) for women lead to women‟s empowerment in low- middle income countries, specifically Pakistan. The study also examines the way ICT impacts women‟s empowerment and can increase the process of attaining Sustainable Development Goals (SDGs). This study explores the opportunities ICT offers to enhance women‟s empowerment further and lists the barriers faced in this regard. The bibliometric and scientometric analysis based on the Web of Science and Scopus databases indicates that there is limited research on the current topic for Pakistan.

The thesis aims to examine the impact of ICT on women‟s autonomy in the case of developing countries from 2000-17. The study applied the Generalized Method of Moment (GMM) technique and found that ICT positively affects the female labor force participation rate. The study also found that the other control variables, GDP growth and Government expenditure on education, have a positive association with women‟s empowerment. Furthermore, the results show that ICT has a vital role in empowering women, and it is also crucial for fostering the process of the SDGs Agenda 2030.

The study also explores the relationship between ICT and women‟s decision-making power in Pakistan by using data from Pakistan Demographic and Health Survey (PDHS) 2017-18 to examine the determinants that affect women‟s decision-making power at the household level. The study‟s results showed a positive and significant association between ICT and women‟s empowerment. In addition, other socio-economic and demographic variables that are used as control variables like employment status, current age of woman, residence, level of education, wealth index,

and the number of alive sons has also showed significant associations with women‟s decision-making power.

In the end, thesis empirically examined the impact of ICT on women‟s say in household decision-making at the provincial and regional levels in Pakistan. The dataset from the Household Integrated Economic Survey (HIES) 2018-19 has been used for this study. The Logit model and the Classification and Regression Tree (CART) results highlight the significant and positive impact of ICT on women‟s say in household decision-making power, which is the most important predictor. Furthermore, byapplying the CART technique, it has been found that Punjab is ahead among all provinces, and Balochistan is, unfortunately, the furthest behind in achieving the SDG 2030 agenda.

In a nutshell, these three studies have established through panel data analysis of 51 developing countries and Pakistan using the latest data from WDI, PDHS, and HIES and found, that ICT plays a vital role in enhancing and augmenting women‟s empowerment. The achievement of Agenda 2030 hinges upon women‟s empowerment (as almost 17 goals and their indicators are directly or indirectly linked to it), and the role of ICT in enhancing women‟s empowerment has been established through this study. The study at the end emphasizes the penetration of ICT to empower women and foster the process of achievingthe SDGs Agenda 2030.

KEY WORDS: Women Empowerment Information Sustainable Development Goals

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CHAPTER 1

1.1. Introduction

The introduction of the thesis gives the overall background and motivation of the doctoral study and rationale behind the research topic. Moreover, a brief discussion on the background of the study establishes the need for women‟s empowerment and relation to Information and Communication Technology (ICT) and how it influences the process of fostering relevant Sustainable Development Goals (SDGs). The study‟s objectives, significance, and justification for the importance of ICT in women‟s empowerment are also presented in this chapter. Finally, the significant contribution of the study and chapter-wise outline is provided to guide the readers on howthe study has been presented.

There are three main reasons which motivated the author to carry out the current study: the socioeconomic need for women‟s empowerment, the need for ICT penetration in developing countries, specifically in Pakistan, and the gap in the literature on the relevance of the impact of ICT in women‟s empowerment for achieving SDGs 2030 Agenda.

As a matter of fact, there is no particular definition of empowerment due to various factors that influenced these factors could be socioeconomic, geographic, environmental, cultural, and regional. Therefore, women‟s empowerment may have different meanings in different social, cultural, and economic contexts. Empowerment is the ability to get knowledge and make decisions about one‟s own life (Dyson & Moore, 1983). Earlier studies described it as a "*degree of access to and controlled over the material and social resources within the family*" (Dixon & Mueller, 1978). Moreover, empowerment can be considered as a procedure of attainment and

monitoring of physical and knowledgeable possessions of an individual, which will develop self-competence and allow them to accomplish their self-governing rights and thereby stimulate freedom, independence, and discussion the gender- based discrimination freely (Batliwala, 1995; Malhotra *et al.,* 2002). Moreover, it has been realized that an individual is empowered if he/she can talk about his/her rights without anyinfluence, gain knowledge, and compete with others.

Empowerment may also be defined as "*the expansion in people's ability to make strategic life choices in a context where this ability was previously denied to them*" (Kabeer, 1994). Therefore, empowerment is a procedure of consciousness and capability that strengthens participation and gives decision-making power and control (Karl, 1995). Hence, empowerment implies facilitating individuals in the direction of self-determination.

The initial concept of women"s autonomy was proposed in 1848 by Elizabeth and Lucretia in the United States; they desired to be recognized as unique individuals rather than as men's servants and desired additional options for jobs and education. Hence it was the first- ever convention that discussed women"s civil and political rights (Seneca, 1848). In the late 18 century, suffragist Susan Anthony formed the National Women Suffrage Association, and more than 90 women joined this moment. European and British suffragettes also made platforms and established organizations for the individual rights ofwomen (Mill, 1865; Becker, 1867). While practically under British Crown, New Zealand was the first self-governing country that gave all women the right to vote in 1883.

Later, different international organizations were established in developing countries to empower women since the 1970s (Mosedale, 2005). The empowerment theory can be examined through three interconnected components: agency, resources,

and achievements (Kabeer, 2005). The agency represents the procedure by which preferences are made and gives some outcomes, and it is fundamental to the theory of empowerment. Resources are the means through which agency is implemented; therefore, achievements come from the consequences of agency (Kabeer, 2005). Furthermore, the World Bank has defined empowerment as "*the process of increasing the capacity of individuals or groups to make choices and to transform these choices into desired actions and outcomes*" (WB, 2007). Therefore, empowerment is the capacity building of an individual so he/she can make his/her own decisions.

Furthermore, on the same ground, women‟s empowerment gives stress to more power they have and greater control over their decision so that they can spend their lives according to their will. Hence empowerment is an extension of preferences for women and has a more remarkable ability to practice their skills (Mehra, 1997). Therefore, empowered women can strengthen themselves, make decisions about their lives, and make choices, ultimately eliminating women‟s subservience at the aggregate level.

Women‟s empowerment is a critical approach used to enhance women‟s status in the developing world. Women are commonly supposed to empower if they contribute to their household-level decisions concerning their health, visits to family and relatives, husband‟s income, household purchases, expenditures, and decisions about prevention from birth (Riaz & Pervaiz, 2018). Moreover, women‟s empowerment is considered as the establishment of a better world where women can make deliberate life preferences and choices under any circumstances (Thandar *et al.,* 2019).

Therefore, it has been argued that women‟s empowerment played a vital role in the development of social and economic betterment of society and enhance their

self- importance. Moreover, women are almost (50%) of the world‟s population and the rest of (50%)depend on women. Still they do not have the main position or autonomy in the socioeconomic development process in many parts of the world. Moreover, their position in social and economic circle is not equal to men in most parts of the world and they are not as much important as their counterpart (Rahman & Naoroze, 2007). World Economic Forum reported that women work for more hours than men, and they are paid (45%) less than men (WEF, 2017). Unfortunately, women are victimized, and hence most of the timeplaced below their male colleagues in the job sector and even at their house, especially in the case of developing countries. This disadvantaged position can be seen in almost all professions, including many human rights, cultural, economic, and social sectors.

It has been strongly argued that women with autonomy have the position to give more to their families and can take part nation‟s development. Therefore, women need to be encouraged for decision-making at the household level. Furthermore, along with other factors of economic progress (poverty alleviation, employment level, educational attainment, industrial growth), women‟s empowerment is also recognized as one of the substantial factors for development. Hence, empowered women can play a vital role in socioeconomic development in various ways. Moreover, it has been observed that empowered women have a low fertility rate and a child mortality rate also become low which makes them able to focus on the improvement in health, education, and financial well-being of women and their families (Dyson & Moore, 1983; Acharya *et al.,* 2010).

ICT can transform existing gender-based gaps into opportunities and resources for attaining gender parity and economic, political, and social empowerment for women. Therefore, ICT would play a vital role in inclusive progress, reducing

poverty and the autonomy of historically deprived groups, especially women (Hafkin & Taggart, 2001; Heeks, 2006; Islam, 2015; ITU, 2017) since ICT plays a central part in women‟s empowerment by giving them several future jobs mainly dependent on digital technology, providing virtual/online education and health facilities. This will facilitate women in the job market for sectors women could not enter due to sociocultural barriers.

ICT can be an essential tool for creating, distributing and exchanging information. It comprises various devices like telephone, analog, digital or GSM, television, radio, fax, mobile phones, computers broadband, and all other evolving technologies which make it feasible to connect quickly and efficiently all over the globe. Furthermore, ICT belongs to technologies used for information by telecommunications. Moreover, ICT is about Information Technology (IT), but its main emphasis is communication technologies. Hence, ICT is a commonly used technology; therefore, it has a persistent influence on theworld economy.

Closing the gender disparity is essential for reducing the patriarchal system in society; it is also beneficial for healthy economic activities. In developing countries, marginal groups in general and women, in particular, face many economic and social hurdles that limit their access to ICT. Therefore, the majority of these women lack skills, have lower education levels, limited employment opportunities, and have low productivity. Furthermore, ICT plays a crucial role in enhancing human development and creates parity among countries, regions, gender, and different categories of women. To have gender parity, there is a need to build productive activities for womenthat would allow them to be involved in the decision-making processes, such as entrepreneurial development and social leadership. In addition, ICT opens the door for women to exchange their opinions better.

Many organizations and authors have defined ICT in several ways "*ICT is a form of technology that is used to transmit, store, create, share, and exchange information*" defined by (UNESCO, 2009). On the same line, the United Nations Development Programhas defined ICT as a complete package of electronic tools that deal with information and knowledge (UNDP, 2016). While the United Nations considered it as "*The old ICT of radio, television, and telephone, and the new ICT of computers, satellite, and wireless technology and the internet are now able to work together and combine to form our networked world*" (UN, 2013). Hence, the internet has become an essential factor in the socioeconomic revolution in the world.

ICT is not just the computer, the internet, and the telephone but also for information and communication (Dlodlo, 2009). In other words, ICT is considered a common phrase describing technologies that collect, store, edit, and pass information in different forms. Moreover, ICT is constantly acclaimed as one of the most efficient devices for socio- economic progress. Finally, ICT is a potentially effective development enabler that is cost- efficient with the considerable transformation of control, which let emerging nations overcome many phases of the growth process and provides people with devices from which they attain self-autonomy. Therefore, the penetration of ICT can put developing economieson the path of developed economies.

It has been noticed that ICT has an impact in altering the social, economic, and political life of socially deprived individuals, especially women worldwide; if penetration of ICT is related to social and economic progress, hence it has been observed that the women of the emerging world would considerably empower (Hafkin & Taggart, 2001). Therefore, the penetration of ICT will contribute to the empowerment and capacity- building of women (Maier & Nair, 2007). Furthermore, it

has been observed that ICT can help women to get employed through telework or online jobs and have health services and education through online courses. This will help them to increase their income and autonomy without incurring traveling expenditures and related expenses. Therefore, it has been argued that ICT played a vital and critical role in establishing women‟s leadership and involvement in socio-economic progress (Anitha & Sundharavadivel, 2012).

Several researchers found that ICT is precondition for empowering women, as in participation increases empowerment by motivating individuals to actively initiate in the process of development, share knowledge, and take the initiatives to establish their autonomy (Laizu *et al.*, 2010; Obayelu & Ogunlade, 2006). Moreover, the importance of ICT in attaining women‟s empowerment have added a new component to conceptual and methodological discussions (Huyer & Sikoska, 2003). Furthermore, women in emerging economies do not have sufficient financial assets to buy hardware, software, and to connect themselves with broadband. They also do not have enough computer knowledge and training facilities to build up the required abilities to grab the chances given by ICT.

The World Summit on the Information Society (WSIS) conference in Geneva in 2003 stated that "*We affirm that development of ICT provides enormous opportunities for women. We are committed to ensure that the information society enables women's empowerment and their full participation based on equality in all spheres of society and in all decision-making processes. To this end, we should mainstream a gender equality perspective and use ICT as a tool to that end*."

Information Technology Union (ITU) analyzes that, cost of internet in many developing countries is the significant part of household monthly expenditures which is an impediment of women‟s access to internet and other ICTs. As the income of

women is (30% to 50%) less than that of men globally on average, which cause the lack of affordability of ICT tools and significantly affects women‟s access to ICT (ITU, 2017).

The SDGs launched in 2015, called for a global effort of „leaving no one behind‟ and in the advancement of empowerment of women and girls, recognizing this as the main concern to be achieved in the next 15 years by countries around the world (UNDP, 2016). Women‟s empowerment is important for this principle as it is a fundamental right and also essential for a peaceful, flourishing, and sustainable world. Hence, SDGs acknowledged women‟s empowerment as a prerequisite for achieving economic and social objectives (UN, 2015). Furthermore, ICT is assumed to be a basic prerequisite for the process of empowering women; and due to that vital role of ICT in women‟s empowerment, Goal 5 especially emphasizes to empower all women and girls through an access to and use of ICT.

Therefore, SDGs placed a greater stress on the role of technology, with ICT specific targets mentioned in 6 of the 17 goals. As well as among these targets, there are also 38 other indicators within the SDGs whose achievement hinges upon access to ICT. Hence, ICT becomes an efficient source for contributing the sustainable development and empowering women in a globe. According to the UN report, 14% fewer women have a cellphone, and (25%) less likely to have access to the internet compare to men (UN, 2019). While in all over world, illiterate women are almost (65%), and poor women (70%) (ILO, 2020). Most of them are living in developing countries, which shows the patriarchal system and dependency of women on their counterparts.

There were 4.95 billion internet users worldwide while 5.31 billion are using mobile phones, globally women and girls use the internet almost 13% less than men,

and 15% women in LDCs used the internet as compared to 86% in developed countries (ITU, 2022). These figures highlight the need for higher penetration rates of ICT access for females. Globally, 53% of the world‟s population (equivalent to some 3.7 billion people) is not connected or use ICT, majority of these are living in developing countries and are women (ITU, 2021).

The Pakistani society is a patriarchal society, where discrimination against women and gender gap exists in almost all parts of the country (Akram, 2018). Therefore, Pakistan requires special consideration in case of women‟s empowerment (Bushra & Wajiha, 2015). Pakistani society is tiered in inadequate communications between men and women, unfortunately, as women are considered below men.

It is necessary and crucial to examine women‟s empowerment in Pakistan, as Pakistani society has patriarchal system where gender gaps are very high and which harm women‟s autonomy at national and household level and stop women to imitate actively in the process of economic progress (Chaudhry & Nosheen, 2009; Awan & Naqvi, 2016). Empowerment is multifaceted and complicated discussion particularly within the culturallydiverse society of Pakistan.

World Economic Forum (WEF) also stated that the situation of women in Pakistan is not satisfying and women‟s position in the country is very deprived and gender inequality is very high in terms of education, health services, economic and political participation. Pakistan‟s Gender Parity Index (GPI) rank is 153 out of 156 countries in the world (WEF 2021). Furthermore, Pakistan has the lowest rank in South Asia with an overall gender gap of (55%). In the current situation, women‟s disempowerment is a real issue in Pakistan and the country is also placed at the bottom of Human Development Index, with a score of 0.464 (UN, 2019). In Pakistan,

the female labour force participation rate is very low, which is about 25% (WB, 2019). Moreover, secondary school education of adult women is also meager 26.7% (UN, 2019). Pakistan has 46 million internet users while the digital gender gap among them is about 64% in Pakistan (PTA, 2022).

Main objective of these studies is to empirically analyze the role of ICT in women‟s empowerment in case of developing countries and Pakistan along with the cross-provincial comparison of women‟s empowerment in Pakistan with reference to selected and relevant SDGs. So, this study intends to develop new insights into the ICT for empowering women.Main summary of the objectives is given below:

- To examine the impact of ICT in female labour force participation rate in developing countries for achieving SDGs 5b. .
- To analyse the role of ICT in women‟s empowerment in fostering the process ofachievement of SDGs at national provincial and regional levels for Pakistan.
- The study will highlight the value of ICT and its impact in women‟s empowerment for achieving SDGs by applying bibliometric and scientometric reviews.

The present study attempts to explore the impact of ICT with various socioeconomic and demographic indicators of women‟s autonomy which could be taken as a guideline for the policy concerned and future researchers in this field. The study is aimto address the issue of women‟s empowerment and the way ICT helps in fostering the process of achieving the SDGs Agenda 2030.

Therefore, the primary research question is to determine the role of ICT in women‟sempowerment and how it helps achieve SDG 5.

The study conducts an in-depth quantitative analysis to evaluate the effectiveness of ICT in improving the skills of women to share knowledge, strategies, and experiences in policy-making and regulation processes. This study focus on ICT impact at house hold level on women‟s empowerment in case of Pakistan. ICT has an ability to strengthen the position of women for sustainable empowerment, productivity, and economic development in any society. The enormous facilities ICT can provide for empowering women, since ICT can redefine the traditional role of women in the society.

1.2. Structure of the Thesis

This thesis is divided into six chapters, including this first introductory chapter. Chapter 1 provides the background and motivation of the study; objectives of the study and research questions have been elaborated and finally the significance of the study has been given.

Chapter 2 is about literature review and theoretical framework. In the first part, Bibliometric and Scientometric of literature on ICT and women‟s empowerment has been given. The main terms used to extract all data are **“**Information and Communication Technology, women‟s empowerment, SDGs and female labour force participation.” This data is extracted from the Web of Science and Scopus database. These articles and papers are extracted to analyze the state of research on the role of ICT in women‟s empowerment both at the global and national levels. The second part of this Chapter is about literature review and theoretical framework of the study.

Chapter 3 will discuss the “Role of ICT in women‟s empowerment and achieving SDGs: a case study of women labour force participation in developing countries.” The study collected secondary data from 51 developing countries taken from WDI 2019. The study constructs the ICT index by using four different ICT

indicators and the female labour force participation rate as the proxy for women‟s empowerment. The study has also used several control variables and found that ICT has a positive and significant impact on the female labour force participation rate in the case of developing countries.

Chapter 4 is about the role of ICT in women‟s empowerment and achieving SDGs 2030: a case study of Pakistan by using the Pakistan Demographic Health Survey. The study has measured women‟s empowerment by constructing the women‟s empowerment index using different indicators of women‟s decision-making at household level from Pakistan Demographic Health Survey (PDHS) 2017-18. At the same time, the study measures the ICT by using the indicators of internet use by female and mobile phone owned by female, which are also indicators of SDG 5b and SDG 17. The study also uses other socioeconomic and demographic determinant for measuring women‟s empowerment in Pakistan. The reason for using PDHS data is that it has complete and detailed informationregarding indicators.

Chapter 5 is about the role of ICT in women‟s decision-making power and reducing gender inequality and achieving SDGs in Pakistan at provincial level and who are left further behind. The study measures the women‟s decision-making power at provincial level from two important indicators taken from Household Integrated Expenditure Survey(HIES). These two indicators are women‟s decision-making power regarding having more children and women‟s decision-making power regarding expenditure on food, clothing, medical and travel and recreation. Finally, Chapter 6 concludes the study.

CHAPTER 2

2.1 Bibliometric and Scientometric Analysis

This chapter is about a bibliometric and scientometric analysis of some of the most important studies conducted about the importance of ICT on women‟s empowerment and related aspects like sustainable development and socio-economic autonomy of women by reviewing existing literature within the field. The study‟s objective is to find out the state ofresearch on the role of ICT in women‟s empowerment at both global and national levels in peer-reviewed journals. Moreover, it includes internationally published research by academia, policymakers, and think tanks from all over the world, especially Pakistan that is linked with the socioeconomic role of ICT on women‟s empowerment and fosters the process of achieving the SDGs Agenda 2030.

The number of research papers has increased manifold over time, giving a baseline understanding of women‟s empowerment. There has been a dramatic improvement in the role of ICT in empowering women. Hence it is crucial to analyze this academic area more comprehensively. The ICT revolution has transformed human lives, work styles, and behaviour. This analysis will provide valuable insights into the document types and fill the gap in the literature by applying the bibliometric and scientometric techniques between theyears 2004 to 2022. The research interests or fields are co-authorship networks and co-citation analysis. Over time, vital thematic phrases and keywords are used for research articles and papers produced worldwide. It is helpful to understand the in-depth information regarding ICT and women‟s empowerment in the social sciences field and the research work on the process of achieving SDGs 2030 Agenda.

According to this scientometric analysis, there hasn't been much substantial research in Pakistan on the use of ICT for women's empowerment in relation to the SDGs. Academia and think tanks play an influential role in providing evidence-based guidelines to the government for intelligently penetrating the ICT in public and private sectors, which will change the social position of women. Research publications become reference points for scholars, practitioners, and governments to get deep insights into the underlying problems.

Moreover, it is believed that this is cutting-edge research and will serve as a guideto solving problems in a new way that was previously unknown. Researchers get a high level of credibility for the research they publish, and it is hoped that their views on certainsocietal issues will lead to better public policymaking than those who do not ascertain or find evidence.

In physical and natural sciences, research in any part of the world has similar implications for the rest of the globe. However, in social sciences, this is not generally the case, there are issues of internal and external validity. Each society has its own social and cultural norms, laws, and geographic conditions. This makes it even more important to have social sciences and economics research at the country/society level for better decision- making.

Pakistan, like any other lower-income and middle-income country, is facing a large number of challenges. Some of the major economic challenges for macroeconomic indicators imbalances are lack of ICT structure, penetration of ICT in Power and Energy Sector, Cities, low women‟s participation in decision-making. We have explored, research published and indexed in Scopus and Web of Science (WoS) databases related to the issues mentioned above for developing countries. This study

will serve as a useful guide to evaluate the direction of past research policies and design for the future course of action.

This study contributes manifold the further research for policymakers especially; firstly, it represents a scientometric overview of guidelines on how to conduct it. Secondly, the study provides a detailed review of the previous literature and how keeping all this in view, we have carried out the bibliometric and scientometric analyses of these key research terms. For a systematic review, the Web of Science and Scopus databases are used in this study to provide a scholarly examination of the topic, publications, and research. Following this portion of introduction, we gathered all research papers published between 2004 and the present from the Scopus and WoS databases. Afterward, describe our findings in more detail and conduct some co-citation and visualisation analysis. Then we sum up our findings.

2.1.1 Data Collection and Processing

Bibliometric searches are used to find relevant publications having an academic framework, and one of the most comprehensive database sources is Scopus (Bankar & Lihitkar, 2019; Baarimah *et al*., 2021; Ghaleb *et al.,* 2022) as Scopus database gives extensive coverage over competing databases. However, scientometric analysis is a process for evaluating the outcomes of prior research and investigating the relationships between citations in order to map a specific field of knowledge utilising trends obtained from academic databases (Yalcinkaya & Singh, 2015; Ghaleb *et al.,* 2022). In March 2022, a search from the Web of Science (WoS) Core Collection database turned up the following article number. On the studies, filtering was carried out. We selected a number of reviews and articles. The raw data were downloaded in "plain.txt" format. For this study, every article and review that was

published between January 1 of 2004 and the search date was taken into account. All research articles are retrieved from the WoS and Scopus databases to get pertinent studies that have been undertaken on the issue. The Bibliometric & Scientometric analysis of the following search key words are given below:

TS = ("Information and Communications Technologies" OR "Information and Communication" OR "ICT" OR "ICTs")
AND CU = ("Women"s Empowerment" or "SDGs" or "Sustainable Development Goals" or Gender Equality" or "Gender Inequality" or Female Labour Force")

According to Table 2.1, the study searched/retrieved nearly 18492 articles, books, papers, and other documents from the years 2004 to 2022. However, upon closer inspection, it was discovered that the majority of these papers were from the life sciences, specifically those dealing with medical research, and that the majority of these papers contained one or two of the key terms. After screening, the study found 229 articles and 108 proceeding papers which thoroughly discuss the SDGs, ICT, and women"s empowerment.

Table 1 : 2.1 Main Information About Data

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2004:2022
Sources (Journals, Books, etc)	278
Documents	382
Average years from publication	3.57
Average citations per documents	8.385
Average citations per year per doc	2.208
References	18492
DOCUMENT TYPES	
Article	229
article; book chapter	1
article; early access	13
article; proceedings paper	2
Correction	1
editorial material	3
Letter	1
proceedings paper	108
Review	23
review; early access	1
DOCUMENT CONTENTS	
Keywords Plus (ID)	666
Author's Keywords (DE)	1324
AUTHORS	
Authors	1102
Author Appearances	1168
Authors of single-authored documents	63
Authors of multi-authored documents	1039
AUTHORS COLLABORATION	
Single-authored documents	65
Documents per Author	0.347
Authors per Document	2.88
Co-Authors per Documents	3.06
Collaboration Index	3.28

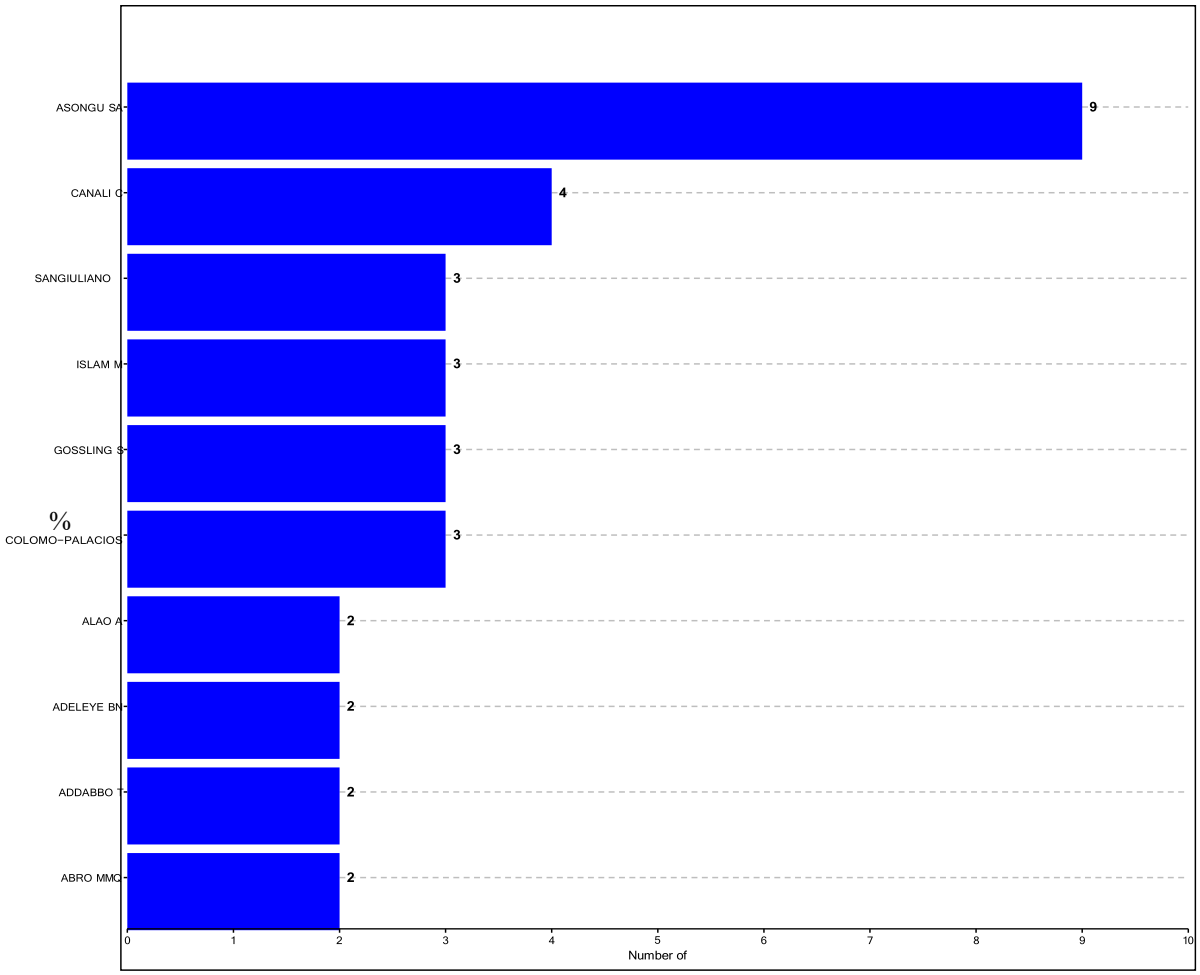
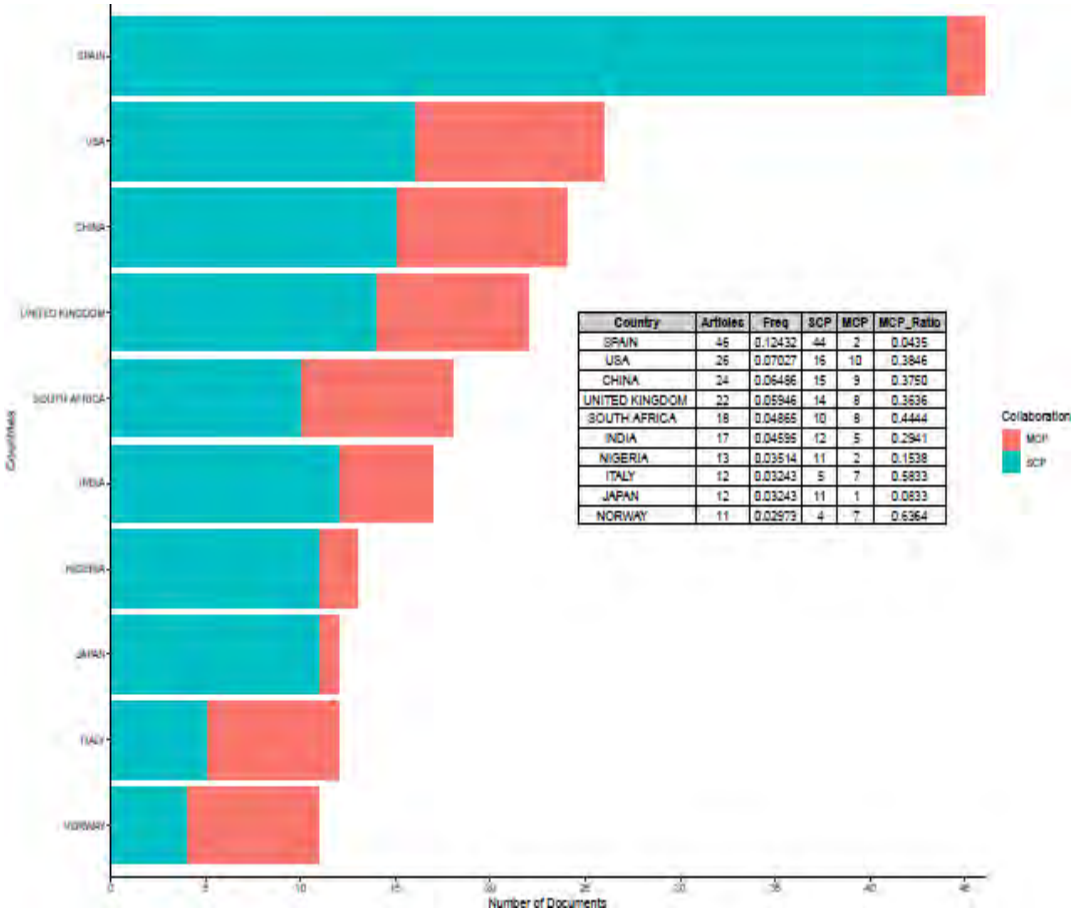


Figure 1 : 2.1: Most Productive Author



Country	Articles	Freq	SCP	MCP	MCP_Ratio
SPAIN	46	0.12432	44	2	0.0435
USA	26	0.07027	16	10	0.3846
CHINA	24	0.06486	15	9	0.3750
UNITED KINGDOM	22	0.05946	14	8	0.3636
SOUTH AFRICA	18	0.04865	10	8	0.4444
INDIA	17	0.04595	12	5	0.2941
NIGERIA	13	0.03514	11	2	0.1538
ITALY	12	0.03243	5	7	0.5833
JAPAN	12	0.03243	11	1	0.0833
NORWAY	11	0.02973	4	7	0.6364

Figure 2 : 2.2 Most Productive Countries

Collaboration between authors of different countries or the same is evidenced by publications showing that scientists collaborated with other nations to publish their work. International collaboration is measured by the number of papers published by authors from the same country (SCP), which stands for intra-country cooperation, and the number of articles published by authors from other countries (MCP), which stands for inter-country cooperation. One may see that, in comparison to other nations, Spain has the largest number of articles in the journals. VOS Viewer was used to displaying the nation's network for collaborative mapping. This networkaims to demonstrate how many nations collaborate on publication.

2.1.2 Author Co-Citation Analysis

Co-citation is a quantitative technique that aids in determining the conceptual framework of academic study domains (Backhans et al., 2011). Therefore, co-citation is the relationship between citing publications, whereas citation is the link among publications. Moreover, Co-authorship is when authors engage with one another. Therefore, Co-citation is the social interaction or relationship between authors, that is, two publications connected when they co-occur for the citation of the third author‟s publication.

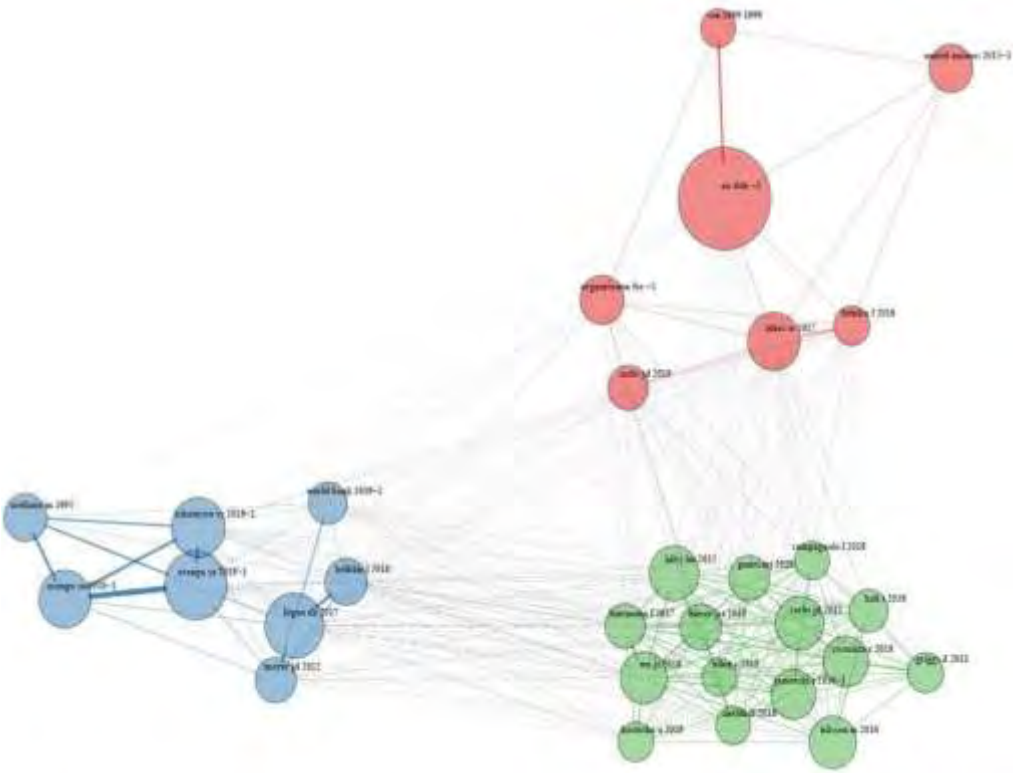


Figure 3 : 2. 3 Co-Citation Network

Though it‟s not very relevant to our main focus of the study, one important thing to mention is that Pakistani authors are not much collaborating with the rest of the world‟s scholars as the authors in other developing countries, like countries in Africa. Furthermore, most co-authors are from within Pakistan, unlike in the rest of world, where they have more international collaboration.

Word Cloud Network Plot

Word cloud network plots and work cloud plots analysis are derived from authors key words. This gives the understanding of the thematic cluster and helps authors to build the content. Hence co-words analysis also showed future research directions.

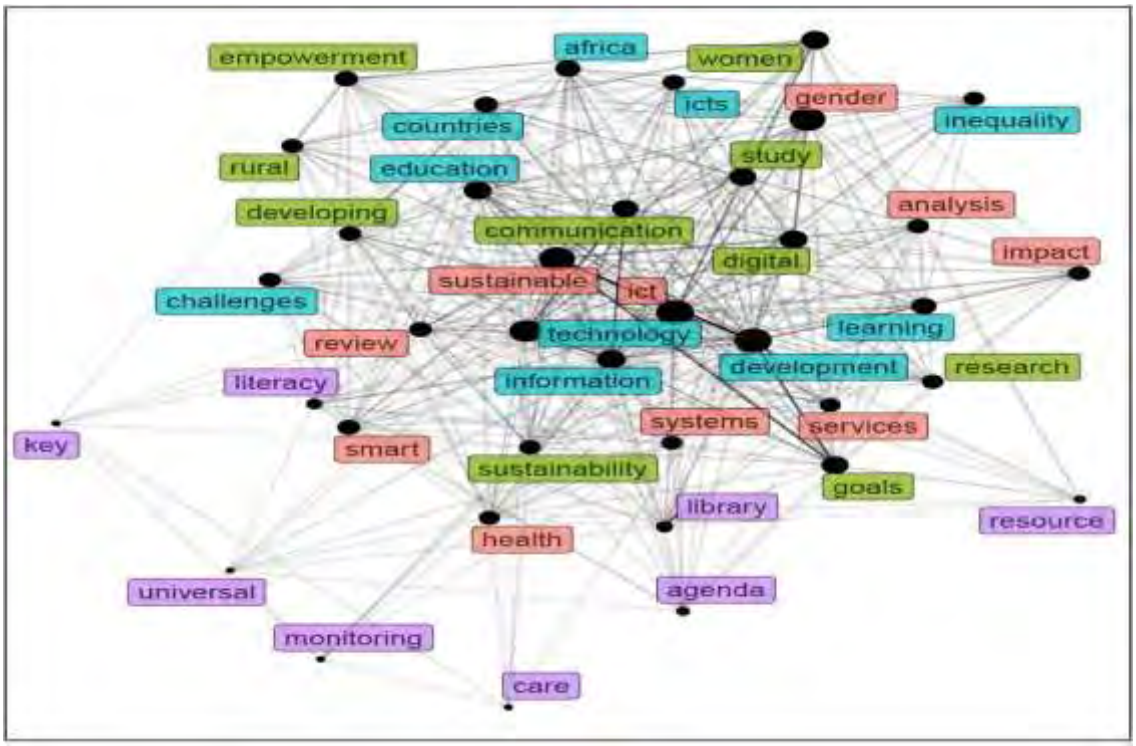


Figure 4 : 2.4 Word cloud network plot

Figure 5 : 2. 5 Words Cloud Plot

2.1.3 Research Findings

Our data provide an unfavourable image of how research on important subjects has been done up to this point in terms of publications and themes. There are not many scientific studies on the use of ICT in empirical analysis has done in case of Pakistan. It is essential to mention that we do not restrict ourselves to research where studies with word from "Pakistan" is included. Otherwise, few publications from Pakistan would have been listed containing these keywords.

From the Figure "Most Productive Authors," the study found that Asongu from Africa published eight papers regarding the role of ICT, Women"s Empowerment, Sustainable Development, etc., while in the rest of the list, a maximum of four publications were in developing countries. From the Table and Figure 2.2, it has been observed that from all over the world, Spain is the most productive country in publishing articles (46) on mentioned topics. While India published seventeen articles

and Pakistan published seven. From the word cloud, it has been seen that the most frequent words used to search these topics are Sustainable, Development, ICT, Information, Women‟s empowerment, and Gender. Overall, the paper specializes in developing countries that are not very large in number.

2.1.4 Summary and Recommendations

This bibliometric and scientometric review of the role of ICT on women‟s empowerment for fostering the process of achieving SDGs has offered a comprehensive summary and some important implications for the practitioners of this field. Therefore, this study contributes to the research methodology and how to conduct the bibliometric review. In addition, this study has helped understand the role ICT plays in achieving gender-related SDGs. For this, the study cited the articles, papers, and books from high-impact journals to low-impact journals to ground more data and fewer prior reviews.

This study presents some implications according to the finding of the bibliometric and scientometric review extract from 2004 to 2022. First, to promote researchers from the same fields, different institutions and countries should have some links and coordination to strengthen their research. Second, some valuable findings could be obtained by collaborating with authors from different regions. Third, the articles in the journal should be in all fields of social sciences, not just Business Management, ICT, and women empowerment journals should be focused on and expanded.

Summary

This bibliometric and scientrometric review of the role of ICT on women‟s empowerment for fostering the process of achieving SDGs has offered a comprehensive summary and some important implications for the practitioners of this

field. Therefore, this study contributes to the research methodology and how to conduct the bibliometric review.This study has helped understand the role ICT played in achieving gender-related SDGs. For this, the study cited the articles, paper, and books from high-impact journals to low- impact journals for grounded more data and fewer prior reviews.

This study presents some implication according to the finding of the bibliometric and scientrometric review extract from 2004 to 2022. To promote the researchers from thesame fields, different institutions and countries should have some links and coordination to strengthen their research. Some useful findings could be obtained through the collaboration of authors from different regions. The articles in journal should be in all fields of social sciences not just from Business Management, ICT and women empowerment journal shouldbe focus and expand. There are limited number of papers available research published in Scopus or Web of Science database during the last two decades which addresses critical issues related to ICT and women‟s empowerment in Pakistan. There are just seven papers published in Pakistan, and it is important to focus on research design and conducting surveys for collecting data.

2.2. Literature Review

According to the Organization for Economic Co-operation and Development, women make up nearly half of the world's population and are regarded as the source of the economy's human capital, yet they are notably underrepresented in the fields of science and technology (OECD 2002). Previous studies considered ICT as an essential indicator to empower women and girls for gender equality and enhance socio-economic development (Chen, 2004; Geldof, 2011; ITU, 2017; Asongu &

Odhiambo, 2018; Efobi *et al,* 2018). Moreover, ICT supports women in several ways which are online job training, virtual education, online healthcare, and understanding of basic human rights (Hafkin & Taggart, 2001; Huyer & Carr, 2002; Islam, 2015; ITU, 2017). Therefore, gender discrimination and unequal access to ICT may have serious consequencesfor slow economic growth.

2.2.1. Women's Empowerment through ICT

There is extensive literature on studying the relationship between ICT penetration and women‟s empowerment. In these studies, the role of ICT in women‟s empowerment and to foster the process for achieving sustainable development is considered to be interrelated. It has been also analyzed that ICT provides women the courage to transform their knowledge into advanced and new goods and services (Ambujam & Venkalakshmi, 2009; Levis, 2011; Beyond Access, 2012; Efobi *et al*, 2018; Asongu *et al,* 2020). From the early studies, it has been found that ICT has the potential to help women to build the qualities of leadership and contribute to society‟s well-being and socioeconomic progress.

The fourth conference of the UN on women held in 1995 in Beijing emphasized the importance of ICT penetration among women for gender equality. However, the use and access of ICT for Women are hindered and limited due to technological access and the patriarchal social system (UN, 1995). The ability of women to efficiently utilize the information taken from ICT is evidently determined by several social indicators: literacy rate, education level, employment status, geographic location, mobility, and socio-cultural norms (UNESCO, 2009). Hence ICT can change the thinking of our societies and the way we communicate and work. Therefore, it is essential to give opportunities for women, such as communication networks or computers (Jain, 2006). Hence, ICT is considered one of the essential

sources of empowerment.

Unfortunately, most women have not gained from ICT penetration to the level that men do (Hafkin & Huyer, 2007). It is due to the patriarchal system in most developing countries. For women, easy access and use of ICT can be possible if it relates directly to social and economic development. Then, by getting that, women could participate significantly and effectively in their country‟s development (Badran, 2010) as ICT can educate women through distance learning and also give job opportunities through online working, so they participate in the labor market from their homes (Chen, 2004). Women can also find various ICT-related jobs in the assembly, manufacturing, banking, service, andmedia sectors.

Therefore, ICT empowers workers not only those hired in the ICT sector but also from all fields of life (Raja *et al*., 2013). Therefore, raising women‟s social, political, and economic status of women should be a high-priority issue in the world. Moreover, women‟s empowerment not only helps reduce poverty but also causes higher educational attainment levels and work opportunities in developing countries (Verick, 2014).

The easy access to and use of ICT for males and females can create a competing environment in every field (ITU, 2014). Furthermore, ICT can enhance women‟s political participation, help improve their well-being and safety, and create new economic opportunities. Therefore, ITU is working on gender mainstreaming, which is "*a globally accepted strategy for promoting gender equality*." As the international organization must use gender mainstreaming and use ICTs to promote gender equality and women‟s empowerment (ITU, 2014).

In the post-2015 sustainable development agenda, policies are planned to boost theICT penetration for socioeconomic development (Asongu & Roux, 2017) and

evaluates thesample of 49 countries in Sub-Saharan Africa from 2000 to 2012, which is based on instrumental variables Tobit regression, in order to explain for simultaneity and limited range in development variables. The human development index was used as a proxy for inclusive human development, and it is based on health, long live, knowledge, and basic living standards. The study mentioned that from MDGs to SDGs, poverty reduces in all regions except SSA, where 50% of countries failed to reduce the extreme poverty target ofMDGs.

ICT has the potential to alleviate some of the barriers faced by women (Doumar, 2018) aims to explore ICT and women‟s empowerment in the context of SDGs and then give some policy recommendations. The study explores how ICT can lighten some of the barriers women face like illiteracy, poverty, hindrances, time scarcity, and cultural taboos. The study argued that the ICT's role in women‟s empowerment enhances the quality of life of millions of marginalized populations worldwide and can achieve the SDGs agenda.

2.2.2. ICT and the Labor Market

In previous research, the most popular approach to measure women‟s empowerment across countries is the female labor force participation rate, established based on a U-shaped hypothesis (Cagatay & Ozler, 1995). Women‟s empowerment can be determined through poverty, educational attainment, and opportunities created in developing countries. However, push factors force women to work, compared to developed countries, where pullfactors draw women into the labor market (Klasen & Pieters, 2012). It has been found that the impact of ICT on the female labour market is complicated, as the impact of it may be regarded as both positive and negative (Raja *et al.*, 2013).

The literature found that the research to determine women"s participation in the labour force is multifaced, mainly due to regional, social, cultural, and economic factors (Suhaida *et al.*, 2013; Nikulin, 2017). When these determinants combine with ICT, they boost economic activities and increase the female labour force participation rate as it provides flexible working hours, increasing efficiency and saving time and financial cost. The literature also found that the female labor force participation rate is higher in poor anddeveloped countries and lower in middle-income countries (Verick, 2014).

Several research works have been done based on natural experiments and household surveys to examine the role of ICT on female participation in the labor market. To analyze how technological advancement improves the female labour force participation rate, a study investigated 48 African countries from 1990-2014 (Efobi *et al.*, 2018). The study found that ICT indicators of mobile penetration, internet penetration, and fixed broadband subscription positively and significantly impact female labour force participation.

Previous research has found that ICT enables an individual to get jobs, employers to find skilled workers, and overcomes the social, cultural, and physical barriers between workers and employers (Raja, *et al.* 2013; Nikulin, 2017). Hence ICT makes it possible to make the labour market more transparent, productive, and efficient. Therefore, because of the intervention of ICT, women get better and more qualified jobs now and actively participate in the development process of developing countries

2.2.3. ICT and Education of Women

ICT is a knowledge-based work; the human capital variables, education, and trainingare critical factors in determining access to the labour market (Becker, 1975).

Getting an education, gaining experience and on-the-job training, staying healthy, and migrating are all ways to benefit from human capital (Shultz, 1961; Becker, 1975). It has been observed that including and adding computers into the teaching system would upgrade and improve the learning process (Alavi, 1994).

The United Nations conference in Beijing emphasized that areas for women's empowerment relate to better access to education, more health facilities, poverty reduction, and equitable welfare division between males and females (UN, 1995). It was also presented at the conference that ICT may improve the standard of living in society, creates equity in education, and improves the quality of teaching and learning.

Moreover, in the sustainable development agenda, education is an essential source from which one can benefit from ICT. However, unfortunately, the high illiteracy rate among women and girls has made it hard to reduce the digital gender gap (UNDP, 2016). Giving easy access to and use of ICT among women and girls would bridge the digital gender gap (ITU, 2017).

2.2.4. Employment in ICT Sector

The ICT sector is a significant source for empowering women, mainly living in developing countries, who suffer from time and money constraints, socially restricted environments, lack of access to knowledge, and scarcity of productive resources (Prasad & Sreedevi, 2007). ICT sectors consist of all businesses engaged in producing and marketinghardware, software, services, and networking, and ICT offers the flexibility of time and space (Suhaida *et al.,* 2013).

In the last two decades, female labour force participation increased in Germany and the US, as ICT has been used in many workplaces in these countries (Black &

Spitz-Oener, 2010). ICT penetration transformed the work environment in favor of females and gave them opportunities to work from home and enter the skilled work sector. At the same time,the impact of female labour force participation in rural South Africa is measured using primary household survey data (Klonner & Nolen, 2010). Their study found that ownership and access to mobile phones had shifted work from agriculture to waged employment and increased the employment rate. The rise in employment rate is due to an increase in female participation in the labour force, expansion in the service sector, and creation of job opportunities by penetration of ICT.

To analyze the role of broadband services in labour force participation, a panel study from 1999-07 for US states was done (Atasoy, 2013). The study showed that increased internet connection positively and significantly impacted the labour force participation rateand enhanced skilled labor. Therefore, increasing internet availability would increase the relative demand for skilled labor.

2.2.5. Empirical Evidence

Several empirical studies (Ambujam & Venkatalakshmi, 2009; Beyond Access, 2012; Levis, 2011; Efobi *et al.*, 2018; Nikulin, 2017) have been conducted about ICT affects women‟s decision-making power and empowerment. These studies are primarily based on household survey data, and the results are consistent across countries where ICT creates opportunities and contributes positively to women‟s empowerment.

Compared to other inventions, ICT has dramatically transformed the global economic, demographic, and social structure (Rahman *et al.,* 2013). The study examined the role of ICT in the educational sector, healthcare, and governance in Bangladesh. The emergence of ICT in Bangladesh reshaped and enhanced healthcare

facilities, improved management, and reshapes disaster and emergency response.

To analyze how the employment rate in Peru is affected by using the internet and mobile phone infrastructure (Guerrero & Ritter, 2014) two periods of household survey dataregressed a difference-in-difference approach. They found that the use of ICT in organizations has increased employment in general, and the rise in the prices of their products is due to the easy access and use of mobile phones and the internet.

To examine the impact of ICT on female economic participation (Efobi *et al*., 2018)used panel data from 48 African countries from the year 1999-14. They found that ICT penetration raised female economic participation in Africa. Furthermore, their results showed that ICT significantly impacts social desires and values. They also found that with the intervention of ICT, a new industry has been formed, the service sector expanded, and less physical exertion is needed, which alternately benefits female jobs. Hence the increasein the penetration of ICT is a crucial driver of job creation and inclusive growth.

This study emphasized empowerment as a process that enables women to realize their independent worth and how she takes task independently and lead women to be for decision-making about their lives at the community level and household level. Furthermore, it has been observed that ICT improves people‟s standard of living by enhancing business, education, and employment opportunities and increase their interactions. Therefore, accessto and use of ICT is directly associated with social and economic development.

2.3. Theoretical Framework

Longwe (1991) gave the framework for women‟s empowerment through achieving five levels of equality, welfare, access, conscientisation, participation, and

control. Friedman (1992) gave the idea of women's social, political, and psychological empowerment in the form of an empowerment model, a valuable inside for examining from "*power*" to "*empower*." Friedman‟s empowerment model was about self-reliance, democracy, and social learning to demonstrate empowerment and gave the socio-economic framework for women‟s empowerment. Friedman mentioned that women are economically empowered if they have control over family income, participate in family support, and control over family resources. Therefore, in the current study, empowerment is assumed if women would be socially empowered when no discrimination against the opposite gender and freedom of movement are present. Moreover, empowerment refers to the capacity of individuals to control their fortunes relative to other individuals in the community (Masons, 2006).

Romer (1990) analyzed that technological development would occur exogenously and endogenously and had features to transform into a public good. Therefore, comprehensive development can be occurred due to technological effects. Hence, the improvement of ICT infrastructure also improves an individual‟s expertise, knowledge, andability, giving positive externalities to economic progress (Coleman & Karraker, 1998). Furthermore, it could also raise the capacity of women‟s power through ICT penetration and increase her economic participation, which is the focus of the current analysis. Furthermore, ICT has the ability to reduce the distance between employees and employer and raise female economic participation (Efobi *et al.,* 2018).

Lennie (2002) mentioned the fourth form of empowerment, technological empowerment. For technological empowerment, women need to have access to information, skills, knowledge, and resources. Hence ICT can empower women socially, politically, psychologically, and technologically. Therefore, ICT is a

powerful tool for economic development, plays a vital role in women‟s development, and gives them opportunities to empower themselves. Therefore, ICT can potentially exchange informationand empower marginalized groups (Huyer & Sikoska, 2003).

The study generates the ICT index, for this arithmetic mean method is chosen for each indicator. Furthermore, women‟s empowerment can be measured through constructing an ICT index. Examples of such indicators from which study construct the ICT index are the number of persons using telephone lines, the number of persons using the internet, the number of persons using broadband, and the number of persons with mobilephones.

The sustainable development agenda also mentions that attaining gender equalityand empowering all women and girls is one of seventeen challenging goals for countries,particularly developing ones (UN, 2015). This has been given in goal 5, which includesseveral targets, while target 5b showed that enhancing the usage of existing technology, particularly ICT, encourages women‟s empowerment. Furthermore, it has been observedthat there are four vital and essential determinants of women‟s empowerment like economic participation, healthcare, political empowerment, and educational attainment (WEF, 2017).

Therefore, it has been realized that ICT penetration has the potential to remove gender inequality and close the digital gender gap (Maier & Nair, 2007). Furthermore, the easy access and use of information and knowledge with the help of ICT would be influenced community perception and belief, which changed individuals‟ approach toward women (Lennie, 2002). Moreover, ICT has been considered as an essential tool for raising women‟s educational level, which will decrease the unemployment level and thus improve gender equality (Chen, 2004;

Mitter, 2006).

Additionally, ICT has increased the opportunities for women to work and gain money, especially those who face market access restrictions. With the penetration of ICT, women could now sell products online, which saves costs of distributing products and helpsmaximize their profits (Mitter, 2006; Maier & Nair, 2007).

Figure 2.6 shows the three vast and crucial determinants of women‟s empowerment:the female labour force participation rate, from the previous literature, working women had more empowered than non-working women (Chen, 2004; Islam, 2015; Nikulin, 2017). Secondly, the women empowerment index is constructed from women decisions-making regarding their health, husband‟s earnings, household purchases, and visiting family & friends. Thirdly, women‟s decision-making power having more children and household consumption expenditures. These are used in the current study to measure the impact of ICT on women‟s empowerment.

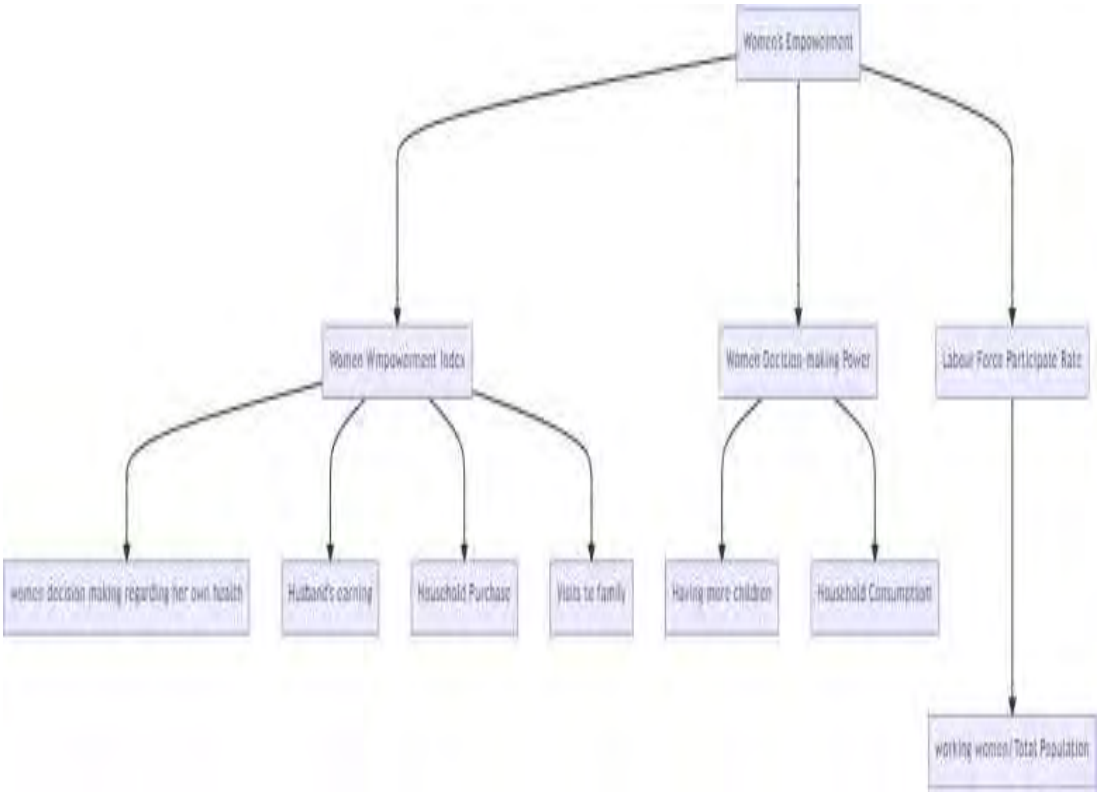


Figure 6 : 2. 6 Women's Empowerment

CHAPTER 3

ROLE OF THE ICT IN WOMEN EMPOWERMENT AND ACHIEVING SDGS: A CASESTUDY OF WOMEN LABOUR FORCE IN DEVELOPING COUNTRIES[1]

3.1. Introduction

Information and communication technology (ICT) in the last two decades have been recognized as an important indicator of women‟s empowerment. There is no exact and universal definition of ICT, most of the time it includes all devices, network components, applications and systems that allow individuals and institutions to act together easily in thedigital world like cell phone and internet.

ICT access through mobile phones and broadband has increased more rapidly thanother technologies. Broadband subscribers increased from 527 million in 2010 to 1.27 billion in 2021 (GDR, 2022). The number of internet users worldwide has increased manifold in the last few years, from 1 billion users in 2005 to 4.6 billion in 2020 (ITU, 2021). According to the latest Global Digital Report (GDR), internet users are 4.39 billion while cell phone users 5.11 billion (GDR, 2019). There are 250 million fewer women[2] online or using the internet than males worldwide (ITU, 2017).

The United Nation member states in 2015 agreed on the agenda named SDGs 2030(UN 2015), which includes 17 goals, and each goal comprises several targets and indicators. International organizations (United Nation and World Bank) are promoting ICT as a tool for empowering women and ICT is also a main attribute of the SDGs 2030 Agenda.

[1] This chapter is mainly based on research paper published in (ETIKONOMI 2021, 20(2), 339-348)
[2]In most countries, at the age of 18, girls and boys are considered women and men.

The easy and quick access of ICT for women can facilitate and accelerate the achievement of the SDGs. Women‟s use of ICT is greatly lagging behind than that of men in the developingworld (Perryman & Arcos 2016). Therefore, gender inequality is an vital policy concern in the SDGs agenda (Asongu & Odhiambo 2018). It is important to understand that for the development of a nation, the steps should be taken for empowering women.

ICT is one of the fastest ways for empowering historically disadvantaged groups, such as women and minorities (Hafkin & Huyer, 2006). ICT gives empowerment by givingaccess to complete information, excellence and reliability of such information, which helps in making decisions (Ogato, 2013). Thus, ICT empowers women by increasing their purchasing power, making choices and control over issues that improve their lives.

Globally, the number of women accessing ICT and ICT devices is 12% lower than the number of men (ITU 2017). According to the ITU, Internet access costs about 11% to 30% of the average monthly income in developing countries, with more than half of the monthly income in developed countries (ITU 2017). The World Wide Web Foundation (WWWF) has revealed that these high costs have limited women's access to ICT, information, and knowledge, and their exposure to the global digital economy. In most developing countries, the male member of the family uses the internet first and restricts theircounterparts from using it even in mostly. Even in some regions, women are discriminatedin extend that they do not allow women to use it at all. This high cost has made access to ICT a challenge for women, especially for women who face more gender discrimination and live in a patriarchal society. Developing countries suffer from many economic and social crises that they cannot provide ICT services to disadvantaged people or rural communities. Even within a

country, inequalities exist among urban and rural populations for accessing ICT penetration.

The study seeks to identify and further understand the possible ICT indicators and process of indices formation. The study analyzed the effectiveness of ICT on female labourforce participation and its effects on women‟s empowerment.

- The research question of the study is: to what extent does ICT play a role in the equation of women‟s empowerment and economic development in developing countries?

The study contributes to existing literature by examining the role of ICT on women‟s empowerment by focusing on Goal 5 (Gender Equality and Empower all Women and Girls) and target 5b specifically focus to enhance the use of technology for empowering women. This study, therefore, aims to identify the role of ICT in women‟s empowerment for fostering SDGs and will also provide policy relevance to foster the process of achieving theSDGs agenda 2030.

3.2. Literature Review

The way ICT has transformed our lives over the period of the last two decades has been effectively captured by global literature. ICT related research has given birth to a whole stream of theoretical and interdisciplinary research. A significant part of this literature has tried to assess the economic impact of ICT on women‟s empowerment.

In the literature, there are several dimensions to the definition and scope of ICT. It is like Information Technology (IT), but its main concern is communication technologies. ICT is not only confined to computers, internet, cell phones, and telephone lines but is also about information and communication (Dlodlo, 2009). Hence, ICT is combination of hardware, software, networks, and media for

assemblage, storage, processing program, and demonstration of information in the form of voice, data, text, and description.

The ICT has complete variety of electronic technologies and methods used to deal with information and knowledge, as defined by the United Nations Development Program (UNDP) *"ICT are information-handling tools – a varied set of goods, applications and services that are used to produce, store, process, distribute and exchange information."* ICT is usually referred to assets such as computers and related hardware, software, communication, and video equipment (OECD, 2017). As a result, the widespread use of ICT would enable several tasks to be completed simultaneously and at low cost in a variety of businesses and areas. ICT provides people with access to and sharing information whichcan increase their capabilities and lead them to empower (Obayelu & Ogunlade, 2006). However, ICT not only increases abilities of an individual but also empowers them (Mansell& Wehn 1998) but also an effective use of ICT can develop and enable societies through greater inclusion, well-being, cooperation, and participation. ICT affects the quality of life through knowledge, education, and skills and helps raise the standard of living of society.

UNICEF, (2006) states that "*women's empowerment should be addressed at the level of basic welfare services, access to resources, mobilization, and participation, and control over power*." Women"s empowerment is not only driven by their living standard but also by women"s increasing educational attainment and opportunities created in modern countries (Klasen & Pieters, 2012). As a result, it is clear from the work of several researchers that ICT plays a crucial and necessary role in empowering women by providing them with a variety of options in the form of education, employment, and health services.

Several empirical research focused on assessing the effect of ICTs on female labourmarket involvement revealed that an increase in ICT use would in turn boost the participation of females in the labour force. (Chen, 2004; Beyond Access, 2012; Nikulin, 2017; Shehata, 2017; Efobi *et al.,* 2018). Moreover, it has been observed that easy access to and the use of ICT has a positive impact on closing the gender employment gaps as ICT hasa tendency to provide employment opportunities at large level for women also (Shehata, 2017). Furthermore, women would be empowered if easy access to virtual education and ITrelate job provided to them.

ICT is knowledge-based, and its entry into labour market is influenced by many aspects, and education is one of the most vital factors in determining access to the labour market. Involvement of the ICT with the support of educational needs help to empower women in society (Chen, 2004). Previous studies (Hafkin, 2000; Chen, 2004; Islam, 2015)have emphasized the women‟s empowerment through ICT, which could be in the form of education, knowledge formation and employment. The ICT has the ability to improve women social and economic conditions in developing countries (Asongu & Odhiambo, 2018). With simple access to and usage of ICT, particularly in developing nations, womenin particular may raise their quality of living together with their families and take part in theprocess of their nation's development.

The term empowerment is used in the current study to describe the process that enables women to recognize their own accomplishments and equips them with the skills necessary to make decisions about their life on an economic, social, and cultural level.

3.3. Conceptual Framework

ICT can potentially influence the gender discrimination observed in different

development fields, such as education, health care, and entrance to political and economic fields (UN, 2019). Many international organizations now support programs in developing countries and ensure easy access to and use of ICT for social and economic development.

Additionally, advances in ICT have created new openings for information distribution and information collection for women and men. Suppose access to and use of ICT is directly linked to social and economic development. In that case, it is essential to ensure that women in developing countries understand the importance and use of this technology. Therefore, ICT could be used as a means for women's empowerment, leading to equality and economic stability. Without the inclusion of ICT in the information age, countries are less likely to develop.

It is widely argued that ICT has the potential to enable the entrance of low-skilled and traditionally marginalized groups, such as women and individuals with disabilities, into the labor market. At the same time, ICT empowers women, and this empowerment focuses on the importance of developing their capacity and controlling the decisions and issues thatshape their lives.

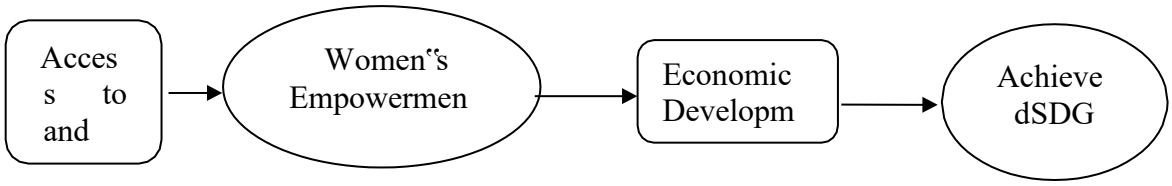


Figure 7 : 3. 1 ICT, Women's Empowerment and SDGs

ICT can potentially be vital in empowering women through education and knowledge building, poverty alleviation, and job creation (Hafkin, 2000; Marcelle, 2002). The most important determinant of a country‟s competitiveness is its human strength and talent, skills, education, and productivity of its employees. Therefore, the

SDGs 2030 agenda focuses on empowering women through ICT penetration and achieving human rights, equality, and economic productivity.

3.4. Data and Definitions of Variables

In this section, the author discusses the source of data and defines the variables. The study analyzes the panel data of 51 developing countries[3] for the time 2000-17. The data has been taken from World Development Indicators (WDI) of the World Bank for ICT indicators, female labour force participation rate, and for control variables.

The study constructs the *ICT index* from the following ICT indicators: mobile phone users per 100 people, internet users per 100 people, fixed broadband subscribers per 100 people, and telephone users per 100 people for selected developing countries (a list of 51 developing countries are given in Appendix). To develop the ICT index, the study has taken the sum of the broadband users, the telephone users, the mobile phone users, and the internetusers in the population per 100 persons. As the unit of expression is the same for all four indicators, that is, per 100 persons and the values range from 0 to 100, their sum is then divided by four and multiplied by 100 to get the average Composite Index. The purpose ofconstructing the ICT index is to compare and measure the progress of ICT among selected developing countries.

The present study also uses some control variables to avoid the problem of omitted variable bias and to check the consistency of the impact of ICT on female labour force participation. In addition, the study took the annual growth rate of GDP as a proxy of economic growth and the annual growth rate of government expenditures on education and [2]Countries name with Global IDI and GGGI ranking are given in the annexure A. consumption goods. The formula for the growth rate is

given below: Growth Rate $= \frac{Yt^{-}Yt^{-1}}{Y_{t-1}}$ Y_t is the current growth GDP of the particular variable while Y_{t-1} is the GDP of the previous year. On the same ground the growth rate of government expenditure on consumption and government expenditure on education has been calculated. The detailed definition of all dependent and independent variables is presented inTable 3.1.

Table 2 : 3.1 Data and Variables

Variables	Symbols	Description
DependentVariables		
Female labor force participation	FLFP	Labor force participation rate of females from the total working population of age 15-64. It is a proxyused for measuring women‟s empowerment.
The Main variable		
Information and Communication Technology index	ICT	It is a main independent variable and also an important indicator of SDG goal 5(5b). the Internet users per 100 persons who have access the worldwide networking, mobile phone users per 100 persons, telephone mainline users per 100 persons by connecting a customer‟s equipment to the public network the fixed broadband subscribers per 100 persons.
Control variables		
GDP growth	GDP	It is also an indicator of SDG goal 8 (Decent work and economic growth) GDP growth rate is taken as the proxy for economic growth.
Gross fixed capital formation	GFCF	Gross fixed capital formation is taken as the annual growth rate of investment.
Fertility rate	FR	Fertility rate total birth per woman.
Urban ratio	UR	Urban Population divided by total Population.
Government consumption expenditure	GCE	General government final consumption expenditure (annual growth rate).

Government Expenditure on education	GEE	GEE is the financial variable from SDG goal 4 focuses on indicators 4.5.4 and 4.5.5. Government expenditure on education (annual growth rate).
Trade openness	TO	Import plus export is divided by GDP.

Methodology

To investigate the impact of ICT on women‟s empowerment, the previous studies have used different econometric techniques like OLS, GLS, IV, ARDL, LSDV and GMM techniques (Chen, 2004; Islam, 2015; Nikulin, 2015; Efobi *et al.,* 2018; Asongu & Odhiambo, 2018). This study uses the GMM approach for the analysis (Asongu & Odhiambo, 2018; Efobi *et al.,* 2018). Before applying the GMM technique, the study appliesthe Ordinary Least Square (pooled OLS) and Fixed Effect Model (FEM/LSDV) to explain the reason for adopting the GMM technique. The GMM technique produces more efficient estimates, avoids the proliferation of instruments, and tackles the issues of endogeneity, heterogeneity, and over-identification. However, the study also regressed the pooled OLS and LSDV/FE models from where the study encountered the above mentioned issues; hence, the results are biased and inefficient. The functional form of the model is given in Equation 3.1:

$$FLFP = ((LFLFP, GDP, ICT, FR, UR, TO, GFCF, GCE, GEE) \quad 3.1$$

In the above model, FLFP stands for Female Labour Force Participation, which is used as a proxy for women‟s empowerment and is the dependent variable. So LFLFP is the lag of the outcome variable, making the model dynamic. While ICT measures the ICT index, GDP measures the economic development of the given economies. FR measures the fertility rate; UR is for the urban ratio. To measure trade openness, we use the TO abbreviation, and for the annual growth rate of the gross

fixed capital formation, the study uses the abbreviation GFCF. GCE is the annual growth rate of Government final Consumption Expenditures. GEE stands for the annual growth rate of Government Expenditure on Education, which is also an essential indicator for achieving the SDGs 2030 Agenda.

The purpose of using differenced GMM technique is to address the following issue. Firstly, the number of cross sections is greater than the number of time series, i.e., N>T; in the study number of countries is 51, while the corresponding number of periods to each country is 18- year 51>18. Secondly, to handle the endogeneity problem for time-invariant omitted variables and simultaneity is handled by taking instruments that also control heterogeneity. Thirdly, panel data for the GMM method should show that cross-country differences are considered (Asongu & Nwachukwu, 2017; Efobi *et al.,* 2018). Fourthly, the lag value of female labour force participation is characterized by stochasticity as it is consistent over time, the correlation between the level and first lag of the indicators is higher than 0.8 (Asongu & Odhiambo, 2018), and it is also the rule of thumb for establishing stochasticity in a variable.

In the current study, the correlation between the level and the first lag of the dependent variable is 0.931. Hence, this study adopts the GMM estimation technique as it produces more efficient results (Arellano & Bover, 1995; Roodman, 2009). After checking the presence of heteroscedasticity by applying the test, the study chose two-step procedure modeling instead of a one-step approach for controlling heteroscedasticity.

The study includes the lag dependent variable as an independent variable to producethe dynamic panel data model. The one lag is included in the model because it is assumed that past year female labour force participation rate influenced the current participation level (Hossain *et al*., 2022). Therefore, the standard GMM Equation in

level and first difference is given in Equation 3.2:

$$FLFP_{it} = \beta_1 + \beta_2 FLFP_{it\text{-}1} + \beta_3 GDP_{it} + \beta_4 ICT_{it} + \beta_5 FR_{it} + \beta_6 UR_{it} + \beta_7 TO_{it} + \beta_8 GFCF_{it} + \beta_9 GCE_{it} + \beta_{10} GEE_{it} + \varepsilon_i + \eta_t + \mu_{it} \quad 3.2$$

Therefore, Equation 3.2 is for the dynamic panel data model, as we are applying difference GMM technique, for that we take the first difference of above model. The studyhas taken the first difference of the level equation to tackle the issue of endogeneity and form the instruments (Hansen, 1982; Wooldridge, 2001; Roodman, 2009). As after taking the first difference time invariant variables would no more endogenous.

$$FLFP_{it} - FLFP_{it-1} = \beta_2(FLFP_{it\text{-}1} - FLFP_{it-2}) + \beta_3(GDP_{it} - GDP_{it-1}) + \beta_4(ICT_{it} - ICT_{it-1}) + \beta_5(FR_{it} - FR_{it-1}) + \beta_6(UR_{it} - UR_{it-1}) + \beta_7 TO - TO_{it-1}) + \beta_8(GFCF_{it} - GFCF_{it-1}) + \beta_9(gce_{it} - gce_{it-1}) + \beta_{10}(gee_{it} - gee_{it-1}) + (\eta_t - \eta_{t-1}) + (- \mu_{it-1}) \quad 3.3$$

Where, ε_i is the country-specific effect, η_t time-specific constant and μ_{it} is the residual of the model.

While in Equation 3.3 instruments are not explicitly disclosed, the ICT index, considered strictly exogenous, is not disclosed (Asongu, 2017; Techamyou *et al*., 2019). Moreover, based on the work done by Arellano and Bover (1995), the first difference is taken to remove any fixed effects that could be associated with error terms, and which maypotentially lead to biases in the empirical model, which involves forward mean-differencingof the variables used in the model.

The forward-orthogonal transformation approach requires the meaning of future observations to be subtracted from the variables rather than the previous observations being subtracted from the current observations (Roodman, 2009a). This approach aims to ensure that there are orthogonal conditions between forward-

differenced variables and their lagged values (Roodman, 2009a). This transformation also helps prevent data loss for all observations of all cross-sections, except for the last value ofeach cross-section as lagged values do not enter the formulae but remain valid as instruments (Roodman, 2009b; Asongu & Nwachukwu, 2016).

3.4.1 GMM

Hansen (1982) offered the extension of the Generalized Method of Moment with over identified restriction by taking the first difference and solving the simultaneity issue by taking the lagged explanatory variable as an instrument, given that the fixed effect is correlated with the error term. Therefore, the ICT index, which is a strictly exogenous variable, would affect the dependent variable through the number of suspected endogenous variables. Furthermore, the validation of exclusion restriction is examined with the Difference in the Hansen Test for the significance of instruments.

Let"s suppose we have the papulation linear regression model.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k + \cdots + \mu$$

Where Y is the dependent variable, X is the independent variable and μ is the errorterm. Given the random sample of y and x variables, the aim is to estimate the k+1 parameterβ_j, as the linear regression has assumed that population error has zero mean, each X_i is uncorrelated with the error term, and μ has a zero-mean conditional on the covariates. That

$$(\mu) = 0 \qquad 3.4a$$

$$(\mathrm{Xj}\ \mu) = 0 \qquad 3.4b$$

$$(\mu \mid X_1, X_2, \ldots, X_k) = 0 \quad here\ j = 1,2,\ldots \qquad 3.4c,$$

Let β_0 denotes the k×1 parameter vector of interest, and $g_t(\beta)$ denote the m×1 vectorof moments that depends on data through β, with m ≥ k. the vector of moments is

stationaryand satisfies the orthogonality condition,

$Eg_t(\beta_0) = 0$ *3.4d*

When the conditional variance and covariance are not equal to zero, in this case, Ordinary Least Square will not work, and GMM works by obtaining the variance- covariance weighting matrix of the moment conditions. GMM has the ability to allow moremoment conditions than there are parameters to be estimate and allows the parameters to beover identified.

Arellano & Bond, (1991) gave the dynamic panel data model specification of the GMM technique in their paper:

$y_{it} = \alpha y_{i,t-1} + \gamma x_{i,t-1} + \eta_i + \mu_{it}$ *3.4e* , $t = 1\ldots.. T$

and $i = 1\ldots\ldots\ldots n, \mu_{it} = \eta_i + \nu_{it}$ *3.4f*

Where x_{it} is the scalar and η_i and μ_{it} are the error components. Furthermore, x_{it} is correlated with individual effects η_i and x_{it} and ν_{it} would determine the instrument α and β. The instruments have been determined exogenously as x_{it} is exogenous.

By taking the first difference to remove the fixed effects would result in$\Delta y_{it} =$

$\alpha\Delta y_{it-1} + \gamma\Delta x_{it-1} + \Delta\mu_{it}$ *3.4g*

If $\{\mu_{it}\}$ assume to be iid then moment condition according to (Arellano & Bond1991) would be:

$[(\Delta y_{it} - \beta\Delta y_{it-1})_{-s}] = 0$ *3.4h*

The above is the first difference dynamic panel data model in which study applies the difference GMM technique.

The panel data has the problem of identification exclusion restriction due to the number of instruments. Furthermore, as in the panel, data time is exogenous, while othervariables are endogenous and predetermined. Therefore, the dependent variable is affected by the identified exogenous variables through the endogenous variables (Roodman, 2009), and exogenous variables become endogenous after the first difference.

The Difference in Hansen Test (DHT) is the criteria used to assess the validity of restriction for the exogeneity of instruments. For this, the null hypothesis is to test whether the instruments are valid and whether these instruments affect the dependent variable through endogenous variables. Therefore, the null hypothesis should not be rejected in DHTto hold the identification and exclusion restriction. This shows that the instruments are validand do not affect the dependent variable (women empowerment index). While the Sargan test is not robust but not weakened by instruments. Hence, in order for the instrument to bevalid, the Sargan test should be rejected. Moreover, a reaction of the alternative hypothesisproves that the dependent variable is exclusively affected by the identified instruments through endogenous mechanisms (Asongu & Nwachukwu, 2016; Asongu & Odhiambo, 2019).

In the difference GMM, the second order test for autocorrelation (AR (2)) should not be rejected null hypothesis then the results are valid. The null hypothesis indicates the absence of autocorrelation in the residuals in orders one and two. Moreover, the rejection of the null hypothesis indicates that there is no autocorrelation (AR (1)) and (AR (2)).

It is essential to discuss critical aspects of the GMM estimation technique: identification, simultaneity, and exclusion restrictions. Tchamyou & Asongu (2017)

have employed mainly years as strictly exogenous variables; the study also considers ICT to exhibit strict exogeneity, by the role of ICT on women‟s labour force participation rate. Hence, on the one hand, ICT is adopted independently as strictly exogenous variables, and on the other hand, ICT is complemented with years in the conception of strictly exogenous variables. The motivation for including the time-invariant variables in ICT is consistent with the underlying literature; notably: it is not feasible for the time-invariant variables to be endogenous after the first difference (Roodman, 2009b).

The corresponding predetermined or suspected endogenous variables represent how ICT affects women‟s empowerment. Hence, in the GMM specification, the procedure employed for ICT and the time-invariant omitted indicators (or *ivstyle*) is „iv(ICT, years, eq(diff)). In contrast, the procedure for examining the predetermined variables is the *gmmstyle.* Regarding the exclusion restrictions, the Difference in Hansen Test (DHT) was used in this study to test the validity of the exclusion restriction (Asongu & Odhiambo, 2019; Asongu & Nwachukwu, 2016). The Hansen test states that if the alternative hypothesis is not accepted, the instruments can only fully explain the dependent variable using suspected endogenous factors (Tchamyou & Asongu, 2017).

The issue of simultaneity is solved with lagged explanatory variables as instruments. Given that fixed effects correlate with the error terms, taking the first difference approach removes those fixed effects to avoid obtaining biased estimations (Arellano & Bover, 1995). Forward mean variations are used in the transformation, which differs from removing earlier data from more recent ones. In more detail, the meaning of anticipated observations is subtracted from historical observations (Roodman, 2009b). These transformations enable scenarios where lagging

observations and forward-differenced indicators are orthogonal orparallel. In order to prevent data loss, transformations are also computed for all observations in each country other than the most recent one.

It is possible in panel data that about the exclusion restrictions, the adopted strictly exogenous variables (ICT and time-invariant indicators) affect the dependent variable exclusively through the suspected endogenous variables. Moreover, the statistical validity related to the exclusion restrictions is examined with the Difference in the Hansen Test forthe relevance of instruments.

In theory, the null hypothesis should not be rejected for the variables exhibiting strict exogeneity to explain the dependent variable only through the endogenous explaining variables. It is essential to note that when the null hypothesis of the Sargan Over identifying Restrictions test is rejected in the instrumental variable method, it implies that the instruments do not exclusively explain the dependent variable via the predetermined variables (Beck *et al*., 2003). However, the Difference in Hansen Test is the information criterion needed to investigate if ICT is strictly exogenous in the GMM estimation techniquewith forward orthogonal deviations. Therefore, for such an assumption of strict exogeneityto hold, the alternative hypothesis of the Difference in Hansen associated with an instrumental variable (ICT, year, eq(diff)) is rejected.

3.5. Results

Table 3.2 presents descriptive statistics of the given variables. Summary statistics show that almost an average of 46% of the women in developing countries participate in thelabor force and across countries, variation in the labour force is 15%. As provided in Table 3.2, the average penetration of ICT in developing countries is (25.81), which is assumed as one reason for the low level of women‟s

empowerment in developing countries. While across these developing countries, the ICT index variation is 17%. The GDP growthof selected developing countries is also very low, on average is (4.3) even though the minimum level is negative in selected middle-income countries. The reason for negative GDP growth is that compared to the previous year, the rise in GDP is low, which shows negative growth. Whereas minimum growth rate of government expenditure on consumption goods is also unfavorable (-3.07%), and the maximum range is (85.4%). However, the maximum growth rate of government expenditure on education is just (14.1%), and on average, government expenditure on education rate is 2.02.

Table 3 : 3.2 Descriptive statistics

Variable	Obs	Mean	Std.Dv	Min	Max
Flfpr	918	45.82	15.044	11.893	81.841
ICT	918	25.81	17.526	0.167	70.966
GDP	918	4.344	3.368	-14.759	18.287
Fr	918	2.622	0.975	1.085	5.58
Ur	918	0.552	0.194	0.182	0.988
Gfcf	918	6.027	13.15	-41	57.964
Gce	918	4.395	6.643	-23.076	85.359
Gee	918	4.394	2.023	1.012	14.059
Trade	918	0.742	0.354	0.156	2.473

Table 3.3 provides the correlation matrix for all variables that are used in estimation process. From the Table, it has been observed that ICT index has positive as well as negative correlation with other independent variables. Also, there is no

multicollinearity observedamong variables.

Table 4 : 3.3 Correlation Matrix

Variables	1	2	3	4	5	6	7	8	9
FLFP	1								
ICT	0.047	1							
GDP	0.073	-0.448	1						
Fr	0.032	-0.545	0.036	1					
Ur	-0.044	0.423	-0.218	-0.464	1				
Gfcf	-0.014	-0.631	0.407	-0.01	-0.033	1			
Gce	0.082	-0.437	0.238	0.159	-0.179	0.036	1		
Gee	0.09	0.409	-0.148	-0.135	0.187	-0.077	-0.147	1	
Trade	0.276	0.214	0.017	-0.183	-0.027	-0.007	-0.015	0.241	1

The study individually regress the 10 countries from 51 selected developing countries to show the regression results of these countries (regression results are shown in Appendix). From the results, the study found that in the case of most of the middle-income countries trade openness, urban ratios, government expenditure on education, and gross fixed capital formation show the negative impact on female labour force participation. Therefore, in panel of 51 developing countries including middle-income and upper middle-income group, some unexpected results have produced. Like trade openness shows the negative and significant association in case of Belarus, Russia, and Senegal. Same as for other indicators like urban ratio and government expenditure on education.

The study also applies pooled Ordinary Least Square (OLS) and Least Square Dummy Variable (LSDV) model, but the results were not consistent and biased due to the problem of heteroscedasticity and expected endogeneity.

Test for Heterogeneity

Breusch–Pagan/Cook–Weisberg test for heteroscedasticity

This test is used to determine whether heteroscedasticity is present in the model or not. Assumption: Normal error terms

H_0 : Homoscedasticity is present

H_1 : Heteroscedasticity is present

If the p-value of the test is less than some significance level ($\alpha = 0.05$) then we reject null hypothesis and conclude that heteroscedasticity is present.

chi2(1) = 6.19

Prob > chi2 = 0.041

The p-value corresponding to the chi-square test is 0.041, which is less than a 0.05 significance level. Therefore, we reject the null hypothesis and conclude that heteroscedasticity is present in the data. Now in this case stand errors shown in Table 3.3 columns 1 and 2 are unreliable. Therefore, to tackle heteroscedasticity from the model, GMM technique has been used. In column 3, the results of two-step difference GMM has been given which tackle the problem of heterogeneity and exogeneity specifically. In Table 3.4, the results of GMM are presented where female labour force participation rate is use as the proxy for women"s empowerment. The coefficient of ICT index is statistically significant with expected sign which implies that ICT has a positive impact on FLFP and can strengthen the efforts for achieving SDG 5.

Table 5 : 3.4: Regression Results for Women's Empowerment

FLFP	Pooled OLS	LSDV	GMM
flfp_1			0.541***
	(347.06)	(32.11)	(85.97)
ICT	-0.002	0.004	0.0347***
	(-0.84)	(0.80)	(7.46)
GDP	0.014	0.022	0.0162***
	(1.00)	(1.23)	(5.24)
GCE	0.011	0.01	0.108***
	(0.93)	(0.97)	(11.14)
GEE	-0.001	-0.001	-0.001***
	(-0.74)	(-0.04)	(-4.55)
TO	0.159	-0.668	1.153***
	(1.27)	(-1.30)	(5.63)
Fertility	0.081	0.163	-0.533
	(1.48)	(0.52)	(-1.60)
GFCF	-0.002	-0.001	-0.004**
	(-1.03)	(-1.20)	(-3.06)
UR	0.797**	2.354	-12.97**
	(3.10)	(0.75)	(-3.08)
_cons	-0.299	5.503*	
	(-0.82)	(2.47)	
N	867	867	867

t-statistics in parentheses ** p<0.05, *p<0.1, *** p<0.01

The detailed results of the GMM technique are shown in Table 3.5. The results in Table 3.5 show that the lagged dependent variable has a positive and significant association with the female labour force participation rate. Furthermore, it shows that the previous year‟s female labour force participation rate would influence the current year‟s female labour force participation. From Table 3.5, it has been noticed that the ICT index is a highly significant and positive association with the female labour force participation rate, which istaken as a proxy for women‟s empowerment. Although the size of the coefficient is

small, one unit increase in ICT penetration would increase the female labour force participation by 3.5 percent, the value is very low due to the case of some developing countries where the infrastructure for ICT penetration is underdeveloped. From the results, it has been observed that easy access to and use of ICT will enhance women‟s empowerment and foster the process of achieving the SDGs 2030 agenda.

The expected signs of GDP growth, used as a proxy for economic growth and development, have a positive and significant impact on women‟s empowerment. The results indicate that economic growth is inclusive concerning women‟s empowerment in developing countries.

On the other hand, the estimated results of gross fixed capital formation and the government expenditure on education are significant but negatively associated with female labour force participation rate. Educational expenditure increase the attainment of higher education level which in turn decreases female participation in the labour force. However, a negative association with GFCF shows that investment has increased capital formation, which as a result, demands skilled workers andcauses a negative impact on female labour force participation due to two main reasons, firstly, investment as a percentage of GDP could be made for non-developmental works which causes a negative impact on employment generation (Mushtaq *et al.,* 2013), secondly in developing countries, most females are associated with the unskilled labour force, for example, handy craft and agricultural sector.

Table 6 : 3.5 Results from GMM Model

Variable	coeffficients	p-values	[95% conf. interval]
FLFP_1	0.541****	0.000	0.528-0.553
	(0.006)		
ICT Index	0.035***	0.000	0.025-0.044
	(0.005)		
GDP Growth	0.016***	0.001	0.01-0.022
	(0.003)		
GCE	0.108***	0.004	0.088-0.127
	(0.01)		
GEE	-0.0003***	0.001	-0.004- -0.001
	(0.001)		
Trade Openness	1.153***	0.000	0.741-1.564
	(0.205)		
Urban Ratio	-12.972***	0.007	-21.436- -4.508
	(4.215)		
GFCF	-0.004***	0.0040	-0.007- -0.001
	(0.001)		
Fertility	-0.533	0.115	-1.201-0.134
	(0.333)		
Pr z> AR(1)	0.004	Pr z> AR(2)	0.819
Pr > Chi2 Hansen test	1.00		

***p < 0.01, **p < 0.05, *p <0.1

The government consumption expenditure shows an expected positive association with the female labour force participation rate, and the results are consistent with previous studies (Chen, 2004; Islam, 2015; Nikulin, 2017). Also, trade openness has a significant and positive impact on FLFP in the case of developing countries. On the other hand, the calculated findings of urban ratios indicate a negative correlation with FLFP, suggesting that, on average, a unit increase in the

urban ratio would result in a 12-unit reduction in the FLFP rate. The decline in female labor market participation in urban areas is due to several plausible reasons: in rural areas, most females are involved in agriculture work, and this holds less often for urban areas. In urban areas, skilled workers are in high demand, and males are more involve in skilled work. Moreover, in a transition period from rural to urban areas, women did not find employment. Lastly, in urban areas girls and women are more focused on pursuing higher education than performing unskilled labour (Mitra, 2019).

The Sargan (1958) test and the Hansen (1982) J-test, two-step GMM diagnostic tests used in the study to confirm the accuracy of the results. The model's instruments were tested for validity using the Hansen test, and over identifying constraints were checked using the Sargan test. From the Table 3.5, it has been seen that there is no second-order serial correlation in the model, as indicated by the p-value (0.819) AR (2). The p-value of 0.819 is higher than the default value at 5%; hence unable to reject the null hypothesis. Additionally, based on the p-value, the Hansen test statistic result indicates that the instruments included in the model are valid. Moreover, the Sargan test also gave a significant result, that is, a 0.282 level of significance, according to Roodman (2009a) Sargan p-value should be greater than 0.25 to accept the null hypothesis that the instrument as a group are exogenousor all instruments are valid.

3.6. Summary

Women having almost an equal proportion in terms of population, it is as necessaryto highlight the issues to provide suitable solutions for women as for men so that both can contribute towards socio-economic betterment. ICT has played an important role in empowering women over the past couple of decades and has a distinctive consideration in setting SDGs.

The study finds that ICT has a statistically significant and positive impact on women‟s empowerment, which shows that easy access to and use of ICT can improve the female labor force participation rate. Other feature variables like GDP growth, government consumption expenditure, trade openness, and lagged dependent variable also significantly and positively impact women‟s empowerment.

The study‟s finding supports the positive role of ICT on the female labor force participation rate, which has implications for SDGs goal 5 in many perspectives, notably empowering women, enhancing technology, increasing participation of women in the labour force, inclusive development, and economic growth in developing countries.

It is necessary to make women feel empowered, as an essential part of society as women can participate in economic activities. In addition, there is a need to feel women motivated enough to lead them to achieve self-actualization, increasing their productivity and fostering the SDGs agenda 2030 through easy access to and use of ICT. Therefore, it is beneficial for any society to empower women, and ICT is one of the essential tools to achieve this objective.

CHAPTER 4
ROLE OF ICT ON WOMEN'S DECISION-MAKING AND ACHIEVING THESDGS AGENDA 2030: A CASE STUDY OF PAKISTAN

4.1. Introduction

The easy access and the use of ICT has significantly reduced gender inequality over time in many parts of the developing world. In developing countries disadvantaged groups especially, women are facing many economic and social obstacles in participating the decision regarding their own life. The lifestyle of people living in these countries can efficiently improve by providing them the easy access to technology. Hence, the ICT can provide more than just information to women and therefore, ICT has ability to foster the process of sustainable development (Mackey, 2012).

Women are an essential part of the domestic and global workforce. Female labour force participation rate for developed countries is around 80% and for developing countriesit is almost 40% (ILO 2018). Nevertheless, ICT is playing vital role to improve women in the developing countries. Women"s empowerment can be analyzed using measures such asparticipation in decision-making at household level (Afifi, 2009; Ndaimani *et al.,* 2018). Additionally, it has been found that the socioeconomic empowerment of women can be achieved by the use of ICT which in turn positively influences the participation of women in decision-making (Joseph, 2011).

The potential scope of the ICT for empowering women is very crucial for the patriarchal country like Pakistan, where it is hard for women to go out for their financial needs. The easy access and effective use of the ICT by women, in return promoting the socio and economic development as the ICT brought new jobs opportunities for them. Therefore, there is a need for mainstreaming the transformation of the ICT sector by integration of women into the sector (Marcelle, 2002).

The 2030 agenda for the Sustainable Development was launched in 2015 and it hasemphasized a lot on gender equality and women empowerment. Agenda 2030 is a comprehensive agenda with the slogan of "*leaving no one behind*". Therefore, a dedicated goal 5 out of the 17 goals aimed at promoting gender equality and empowerment of all women and girls. While the target 5b especially emphasizes empowering women through technology. Hence, achievement of SDGs in general and target 5b in particular will play aneffective role in women‟s empowerment.

The constitution of Pakistan gives equal rights to women and every successive government has tried to promote socioeconomic status of women. There is general agreement that women should be empowered for playing an active part in county‟s progress. However, women‟s empowerment remained major concern in Pakistan and the country remained on the lowest position in gender parity indices. Moreover, it has been observed that gender equality is essential for economic progress and boosting human well-being of a country. Therefore, Women‟s disempowerment has taken the attention of academicians and policymakers. It has been realized that there is a need to analyze the determinants of women‟s empowerment to form policies for national development.

Pakistan is a developing country with a population of 220.875 million and 24.3 percent of that population lives below the poverty line. It has been observed that women‟s status in Pakistan is not socioeconomically comparable with men. The low rate of women‟s participation in economic activities and lower levels of educational accomplishment than men in Pakistan is a major reason for hurdles in women‟s empowerment (Riaz & Pervaiz, 2018). Pakistan is a patriarchal society and there is a continuous increase in discrimination against women, which causes rise in the gender gap in all sectors (UNICEF, 2006). Unfortunately, patriarchal and social norms restrict women‟s participation in the labour force.

Nowadays, this is burning issue and a dire need to study the factors that can help the policy makers in Pakistan to achieve SDGs with special focus on ICT for women‟s empowerment. Therefore, present research conducted to explore the impact of ICT and other possible factors that have influenced women‟s empowerment in light of SDGs in Pakistan. Pakistan faces great challenges in achieving gender equality. Present study assessed the association between women‟s empowerment and selected ICTs indicators with socioeconomic and demographic factors based on household surveyed data (PDHS) from the year 2017-18.

The study will also highlight the important indicators along with ICT that may play critical role in improving gender equality and enhancingng the process of achieving SDG 5 in Pakistan. This study also addresses the gap in the literature on women‟s empowerment, ICT, and SDGs in Pakistan. The study is further divided into the following sections. Section 4.2 discusses the literature, section 4.3 mentions data sources and variables description and section 4.4 state methodology. In section 4.5 the discussion of the empirical results given which will be followed by conclusion and recommendation of the study in section 4.6 has been given

4.2. Literature Review

Empowerment is a complex and a multidimensional phenomenon, as some policy or action valid for one country may not be true for other countries because of the differencebetween sociocultural and ethical norms among countries and this results in different proxyindicators for empowerment (Chaudhry & Nosheen, 2009; Cornwall & Edwards, 2010; Thandar *et al.,* 2019). Most of the definitions of empowerment indicate that it is an ability to take decisions and control own destiny.

Mansell (2014) considered empowerment as a practice which includes a shift from a state of disempowerment to the empowerment. Moreover, empowerment is the procedure which has the ability to make choices and convert those choices into an outcome. Women‟s empowerment is a conventional aspect of economic progress which has been admitted locally nationally and globally (UNDP, 2016). Furthermore, empowerment is considered as a process from which individual could enhance and raise his/her self-reliance, self-confidence, self-esteem, and self-worth.

The empowerment theory comprises three interconnected dimensions: resources, agency, and achievement (Kabeer, 1999 & 2001). The dimension of agency got primary attention and showed comparative women‟s power with their partners, revealing their independence (Chaudhry & Nosheen, 2009). Hence, much literature works on these three dimensions of women‟s empowerment. The conceptualizations of women‟s empowerment have taken as the term „independence‟ explicitly discusses women‟s decision-making power and freedom (Thandar *et al.,* 2019). It has been observed that (Kabeer, 1999 & 2001; Chaudhry & Nosheen, 2009; Thandar *et al.,* 2019) all believed that women‟s empowerment could be achieved by giving them independence in their decisions regarding their selves andtheir families.

Several studies have specified numerous indicators influencing a woman‟s autonomy and ability to engage in a patriarchal bargain with their husband. These factors include educational level, literacy, household size, age at marriage, income, marital status, employment, number of living children, and wealth status (Chaudhry & Nosheen, 2009; Akram, 2018; Riaz & Pervaiz, 2018; Thandar *et al.,* 2019). These studies examined the role of demographic and economic variables on women‟s autonomy and found that these indicators significantly impact women‟s empowerment.

Successful case studies from many countries describe the use of ICT as a tool for the economic empowerment of women (Prasad & Sreedevi, 2007), participation in public life (Lennie, 2002), and enhancing women's skills and capabilities in society (Mitchell & Gillis, 2007). When used effectively, ICT can create better opportunities for women to exchange information, access online education, and engage in e-commerce activities (Marcelle, 2002). Overall, previous studies have considered ICT as a crucial indicator for empowering women.

The study (Akram, 2018) mentioned the important determinant of women‟s decision-making power by using the data from PDHS 2012-13 and examined the variables which mostly play a role in women's empowerment in Pakistan. The study estimated Logit and Ordered Logit models to explore that age, residence, education of women, participation in paid jobs, ownership of assets, wealth index, number of sons and daughters alive, and the use of electronic media have a significant impact on women‟s empowerment (Akram, 2018). At the same time, the age of the household head, the size of the family, and being a relative of the husband hurts the women‟s empowerment.

On the same line (Riaz & Pervaiz, 2018) examine the impact of education and employment on women‟s empowerment in Pakistan using household-level data from PDHS2012-13. Women‟s participation in decision-making regarding their health care, visits to relatives, spending of husband‟s income, major household purchases, and decisions regarding contraceptive use show women‟s empowerment. Using Binary Logistic regression (Riaz & Pervaiz, 2018) showed that women‟s education and employmentpositively and significantly impacted women's empowerment in Pakistan.

The analysis of feminists mobilizing in formulating the gender equality agenda of SDGs has been studied by (Sen, 2019), who argued for the need to locate feminists mobilizing for the SDGs in the context of the history and persistence of gender inequality and violations of girls and women‟s human rights, and the struggle against these violations.Sen, (2019) emphasized the importance and sensitivity of an effective political and economic environment, better institutions, and vigorous movements for empowering women and achieving the SDGs. The study emphasizes that women‟s organizations focus on accomplishing SDG 5.

The relationship between women‟s economic, social, and demographic status and the dimension of women empowerment among married women in Myanmar is analyzed by(Thandar *et al.,* 2019). The study investigated how these indicators impact women‟s empowerment using a logistic model in the data taken from MDHS. The study (Thandar *et al.,* 2019) found that educated, employed, and wealthier women positively associated with women‟s decision-making power. It was also observed that urban residence, the number of children, and women‟s increasing age gave higher empowerment to women for participatingin household decision-making.

All the above studies have to mention the different socioeconomic and demographic indicators of women‟s empowerment, but slightly any study mentioned

the role of ICT on women‟s empowerment in the context of Goal 5 of the SDGs 2030 agenda. Therefore, the Current study examines the impact of ICT penetration on women‟s empowerment in the context of SDG 5 and explores how it helps in fostering the process of achieving the SDG 2030 agenda.

4.3. Data Source and Variables Description

The present study takes the definition of women‟s empowerment as a process that gives control of power and resources, and changes women‟s lives over time through their active participation in decision-making.

To analyze the impact of ICT on women‟s empowerment, the study has used household level data from Pakistan Demographic Health Survey PDHS 2017–18 surveyed by National Institute of Population Studies (NIPS) with the support of US Agency for International Development (USAID). The unit of analysis for each DHS data file varies from Women (IR file) to Men (MR file) to Household (HR file) to Child (KR file). In the Women Recode file, the unit of analysis is ever married women under the age of 15 to 49 has used for current analysis.

A sample size of 15,675 households was selected, in which 7894 (50.4%) households belonged to urban areas and 7783 (49.6%) to rural areas. Number of women interviewed were 15,068. Ever married women of aged 15–49 is the respondent variable that has been used for our empirical investigation.

The study constructed a variable named as Women Empowerment Index (WMI) byusing indicators of decision-making in own health care, household purchases, visits to family and control over husband‟s earning (Thandar *et al.,* 2019). The detailed definition of variables is given in Table 4.1.

The study has taken „own mobile phone‟ and „internet use‟ as ICT indicators. Theseare also mentioned in SDGs (goal 5b and goal 17.8); these are our main variables

to measure the women‟s empowerment index. While age, education, employment, region, residence, sex of household head, wealth index, number of alive sons, and exposure to media are taken as control variables. Many studies also took these socioeconomic and demographic variables (Mahmud *et al.,* 2012; Akram, 2018; Riaz & Pervaiz, 2018; Sen, 2019; Thandar *et al.,* 2019).

In the PDHS 2017–18 dataset, women‟s participation in decision-making in their health care, household purchases, visits to family, and control over their husband‟s earnings has been divided into five categories. These categories are as follows women take decisions alone, a woman takes a decision jointly with her husband, woman takes a decision jointly with other family members, a woman‟s husband takes the decision alone, and other/family elders decide without consulting the woman. The first three responses in which women participate in decision-making will take the value of 1 and suppose that women are empowered to take decisions. The other responses in which women have not participated will be coded as 0. Therefore, the study transforms these four indicators into a binary category, 0 when the decision is taken without the concern of a woman and 1 when the decision is taken by a woman or jointly with the concern of a woman.

To construct the women‟s empowerment index, the study adds participation in decision about own health, household purchases, visit to family or relative, and decision on the spending husband‟s earnings. Through this process, the study has multinomial categories from 0 to 4, woman is considered empowered if she participates in at least three areas of decision-making (Thandar *et al.,* 2019). In the current study, values 3 and 4 stand 1: if the woman is empowered and otherwise 0.

In DHS, the definition of head of household is “the head of the household is one of the household members recognized as the head of the unit by the other

members." Therefore, it is not necessary if female headed house, she would be widow; it could be divorced, her husband is living abroad or somewhere else for work, or even if the husband is there. However, from mutual understanding, the women decide for the family. In the current study, the sex of household head is taken as 1: if female is heading the household (respondent or any female above 49) and 0: if the male is the head of household.

In the DHS, the household head is one who takes the decision in the family and all other family members mutually considered him/her the head of household. The gender of household head measured through a dichotomous variable. Coded as 0, if head of householdis male and coded as 1 if female headed household.

Table 7 : 4.1 Definition of Variables

Variables	Definition
Women's Empowerment Index	WMI is composed of four indicators of decision making. These are participation in decision about own health, household purchases, visit to family or relative and decision on spending of husband‟s earning. Our dependent variable is binary with value 0-1. Where 0 means no empowerment and 1 means fully empowered.
Own mobile phone	it is a dichotomous variable and is label as, 1: if own mobile phone 0: otherwise
Use internet	The use internet is also a dichotomous variable 1: if using internet 0: otherwise
Women's education	Education of respondent women has four categories: 1: if no education; 2: if primary (min 5 yrs.), 3: if secondary (min 10 yrs.); 4: higher education (min 12 yrs.)
Women's occupation	Women‟s occupation is divided into: 1: if working 0: if not working
Wealth index	The wealth status of women‟s household is measured through the score of wealth index. The value of score is 0-4 where 0 if poorest, 1 if poorer, 2 if middle, 3 if richer and 4 if richest.
Husband's education	The education of husband also classified into four categories: 1: no education, 2: primary education, 3: secondary education and 4 higher education.
Husband's occupation	It is binary variable 1: if working 0: if not working
Media	It is also a categorical variable; we include frequency of reading newspaper. Frequency of listening to radio and frequency of watching TV. With four categories: 1: not at all, 2: occasionally, 3: at least once a week and 4; daily.
Region	Region of Residence used as categorical variable with five possible outcomes depending upon that in which region of the country 1, if Punjab; 2, if Sindh; 3, if Khyber Pakhtunkhwa; 4, if Balochistan;

	and 5, if others.
Residence	Place of residence is a dichotomous variable and has been classified into two categories i.e., urban, and rural. Coded as 1, if respondent lives in urban area and coded as 0 if respondent lives in rural area.
Number of alive Sons	The number of alive sons is combined with no. of son home and no. of son away. Alive sons= 0: if no son; 1: if 1to 2 sons; 2: if 3 to 4 sons; 3: if 5 and more sons.
Sex of household Head	Sex of household head is categorized as 0 if male is head of household and 1 if female is heading the house.
Women's age	Women"s age has been classified into seven categories of seven age cohorts i.e., 15–19, 20–24, 25–29, 30–34, 35–39, 40–44 and 45–49. Thus, it is a categorical variable with sevenpossible outcomes.
Husband's age	Husband"s age has classified into four categories, and it is a categorical variable.

4.4. Methodology

To find out the impact of ICT on women"s empowerment, the study has used the PDHS 2017-18 data. Our dependent variable is women"s empowerment, measured throughthe proxy of decision-making variables. Women"s own mobile phones, and the use internet are our main independent variables used for ICT along with other socio-economic and demographic indicators of women"s empowerment. As dependent variable of the current study is a binary variable. Therefore, we use binary logistic regression to predict theoutcome (Akram, 2018; Riaz & Pervaiz, 2018; Thandar *et al.,* 2019). The logistic regressionanalysis has given the Odds Ratio (OR) concept, which measures the strength and association between the dependent and independent variables.

The functional form of the model is given below.

$$(Y) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 \quad 4.1$$

Where Y is the women"s empowerment index, which is constructed from the women"s participation in decision-making indicators. While X_1 is the women own mobile phone, X_2 is the women use internet, X_3 shows women age, X_4 present"s women education level and X_5 is the women"s employment status. Likewise, X_6, X_7, X_8 and X_9 are the region, residence, sex of household head, and wealth index. In the present study WMI was computed by constructing the following participation in decision-making variables: women"s own control over their husband"s earnings, major household purchases, visits to family or relatives and women"s own decision on their health care. The study used binary logistic regression model for women"s empowerment index, and other four dependent variables of decision making, by using the same independent variables. Hence the study estimated five categorical binary models through logistic regression estimation technique.

As empowered women may have ICT access, and there is a strong likelihood that causality will exist in our model. However, finding causality in the study will be challenging because cross-section data are typically collected at a single point in time while considering various population characteristics. Additionally, it is discovered in the literature that the main difficulty with cross-section research is separating the cause and effect from a simplerelationship (Mann, 2003).

4.4.1 Logit Model

Mostly, research in the household data survey is aimed at describing, understanding and making use of the relationship between independent variables and outcome variable that is discrete. When the dependent variable is discrete categorical

variable, the conventional estimation techniques become obsolete, and researchers mostly preferred to use logit/probitmodels. Therefore, when the dependent variable is not continuous variable, then instead ofmodelling the value of the outcome variable the probability of outcome is modelled.

Logistic regression model belongs to the family of Generalized Linear Model (GLM), and it is used when the dependent variable is categorical. Binary Logistic Model iscommonly used form of logit model which gives results as success or failure. These categories could be given in nominal or ordinal form depending on the scale of the respond variable. Logistic regression is usually used in social, educational, and medical research One of the assumptions of the Logistic model is that it does not assume any linear relationship between dependent and independent variables and hence takes the log odds to develop the linear relationship between the independent and dependent variables. Additionally, it is assumed in the model that error term does not need to be normally distributed. In logistic model homoscedasticity in not required, while error term has binomial distribution rather than normal distribution. Moreover, dependent variables could be categorical and continuous and measures on an interval. Furthermore, for dichotomous dependent variables, OLS is inappropriate because it tends to produce predicted probabilities greater than one and less than zero. Nevertheless, the most suitable technique here is logistic regression analysis. More elaborately probability of being Happy or not can be elaborated as a function of cultural variables depicted below as, For keeping the predicted probabilities between zero and one, logistic relationship fits a shaped relation with empowered and other covariates./

$\pi i = p(empowered = 1)$ probability for women's empowerment $= \alpha +$ $\beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 + \beta 6X6 + \beta 7X7 + \beta 8X8 + \beta 9X\ 9$ *4.2*

$\pi\ logit(Y) = \ln(1-\pi) = \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9$ *4.3*

Here $\pi i / 1-\pi i$

is odds of the respondent with empowerment, which is attained by dividing the probability of empowerment π_i by the probability of being with noempowerment state as $1 - \pi_i$ leads to the formulation of log-odds We have to find the probability of women"s empowerment in the context of othercovariates as Logit model predicts the probability of success of an event by fitting data to a logit function. The dependent variables in the study are dichotomous which can take the value from 1and 0. Where 1 is for empowerment and 0 for no empowerment.

$$\pi = \frac{e^{\alpha+ \beta_1x_1+ \beta_2x_2+ \beta_3x_3+\beta_4x_4+\beta_5x_5+\beta_6x_6+\beta_7X_7+\beta_8X_8+\beta_9X_9}}{(1 + e^{\alpha+ \beta_1x_1+ \beta_2x_2+ \beta_3x_3+\beta_4x_4+\beta_5x_5+\beta_6x_6 +\beta_7X_7+\beta_8X_8+\beta_9X_9})} \quad 4.4$$

4.5. Empirical Results

Table 4.2 shows the description of empowerment status of women with respect to the own mobile, use of internet, socioeconomic and demographic indicators of women empowerment. The Table 4.2 calculates the descriptive statistics of women"s participation in decision-making regarding their own health, visits to family, household purchases and control over husband"s earning with respect to own mobile, use of internet, age, education,employment, residence, region, number of children and wealth index From the Table 4.2, we can see that about 43% women own mobile phone and 18%women have access to internet in Pakistan. Participation in decision-making has been increased with respondent who used internet and own mobile phone. Nearly 57% respondents do not have own mobile phone and their participation in

decision-making regarding all four areas are less than 40%. While 43% respondent own mobile phone and their participation in all type of decision-making at household level is more than 50% and are more empowered than those who do not own mobile phone.

Table 8 : 4.2 percentage Distribution of Empowerment Status of Women

	Percent	Health Decision	Financial Decision	Purchase Decision	visits Decision
Own mobile					
No	56.72	38	34	32	37
Yes	43.28	57	51	50	55
Internet user					
No	82	38	39	38	42
Yes	18	57	54	56	62
Residence					
Urban	48.14	52	46	45	50
Rural	51.86	42	37	35	39
Region					
Punjab	22.56	54	49	48	50
Sindh	18.18	56	55	51	60
Khyber Pakhtunkhwa	15.78	29	24	25	29
Baluchistan	11.44	34	23	28	28
Others	32.02	48	42	40	46
Sex of head					
Male	89.01	45	40	39	44
Female	10.99	46	50	46	49
Wealth index					
Poorest	19.15	36	32	29	36
Poorer	21.5	41	37	35	38
Middle	19.68	46	42	42	44
Richer	19.1	50	45	44	48
Riches	20.56	58	49	49	57
Sons alive					
0	26.37	40	34	32	36
1-2	50.9	49	43	43	48
3-4	19.09	48	44	43	48
5 and more	3.64	42	38	39	41
Employment					
Not working	83	45	39	38	43
Working	17	58	54	54	57

	Percent	Health	Financial Decision	Purchase Decision	Visit Decision

		Decision			
Education					
No education	50.62	38	34	33	37
Primary	13.96	49	44	43	46
Secondary/higher	35.43	57	49	48	55
Age					
15-19	4.83	22	20	15	18
20-24	14.73	35	29	25	30
25-29	20.88	43	37	35	40
30-34	18.93	50	44	43	48
35-39	18.17	52	47	46	51
40-44	12.09	54	48	51	54
45-49	10.37	57	50	54	57
Media					
No	35.71	34	29	29	33
Yes	64.29	53	47	46	51
Husband's employment					
No	4	41	16	33	38
Yes	96	49	44	42	47
Husband's education					
No education	27.5	42	37	37	40
Primary	13.28	48	43	39	44
Secondary/higher	59.22	52	45	44	50
Husband's age					
15-24	3	29	26	19	25
25-34	27	41	35	33	37
35-44	36	52	47	46	51
45-54	27	58	52	54	59
55-64	6	58	47	54	59
65-74	1	54	39	47	51

From the above result, the study found that in Pakistan almost 82% married women do not have the access to use internet and their participation in decision making are almost less than 40% in contrast with 18% women who use internet and are more empowered in decision making, as their participation in all types of decision-making is more than 50%. It has also been noticed that nearly 52% women live in rural areas of Pakistan and their participation in household level decision-making are less than 40%. While just 18% respondent live in urban areas but their

percentage of participation in all type of decision making at household level is more than 50%.

From the given sample, we have seen that 17% respondents are working women and more empowered, they are participating in all type of decision-making more as compared to not working women. Unfortunately, in Pakistan the majority of women have no education, according to the given sample approximately 51% women are illiterate, and their participation level is low as compared to educated women. The participation level is high for women aged 35-49 and for those women who belong to higher wealth index. More while, women having more than 2 sons are more independent in decision making. Women having educated husbands have a greater extent of empowerment. Moreover, women whose husbands are employed enjoy more empowerment than their unemployed husbands.

There is very much possibility of the presence of causality in our model as empowered women may have the access to ICT, but from the theory and literature it has been noticed that cross section data are taken at single point in time and considered several characteristics of population. Several authors state that the primary drawback of cross-section data analysisis that it lacks a time dimension and does not demonstrate a causal relationship, that is, it does not measure the cause and effect at the same time (ICT and Women's Empowerment). Therefore, cross-section studies are unable to establish causation but can aid in developing causal hypotheses (Thelle *et al,* 2015; Jacob & Ganguli, 2016). It is also found from the literature that the major disadvantage of cross-section studies is identifying the cause and effect from simple association is the biggest challenge (Mann, 2003). Furthermore, it can be used to define community attributes but not to establish cause-and-effect relations between

various factors. This technique is frequently employed to draw conclusions about potential relation or to collect introductory information to encourage additional investigation and experimentation.

The results of the Logistic regression model in which the dependent variable is the empowerment index has been shown in Table 4.3. The estimation results showed that the ICT indicators (mobile phone and use of the internet) had expected positive association and statistically significant impact on women empowerment index. Further, the results indicate that the odds ratios of women‟s empowerment for owning a mobile phone are 1.6 as large as the odds compared to women with no mobile phone controlling for other factors. Likewise, women using the internet have 1.2 odds more likely to be empowered than those with no internet access, controlling for other factors. This positive association also helps in achieving the SDGs target of 2030.

The odds of currently employed women are 1.7 times more likely to empower than non-working women, controlling for other factors. It is also highly significant with positive sign and consistent results (Akram 2018; Thandar *et al.,* 2019). It is also interesting to note that women with any education level primary and secondary or higher is positive and significant association. It is worthwhile to note that oddsratios for educated women are 1.2 and 1.3 times more likely to empowered than compared to women with no education level, control other factors. It shows that educated women are more empowered and can take part is decision making process at all levels.

Table 9 : 4.3 Logistic Regression Model of WMI

Empowerment index	**OR**	**Std.Err.**	**z**	**P>z**
Own_mobile	1.601***	0.071	10.44	0.000
Internet_user	1.313***	0.084	4.23	0.000
Employment	1.775***	0.103	9.92	0.000

Education				
Primary	1.23***	.074	3.23	0.001
Secondary/higher	1.314***	.075	4.78	0.000
Age				
20-24	1.349***	.211	2.39	0.017
25-29	1.981***	.256	5.29	0.000
30-34	2.643***	.354	7.25	0.000
35-39	2.984***	.416	7.83	0.000
40-44	3.862***	.574	9.08	0.000
Wealth index				
poorer	1.197***	.077	2.78	0.005
middle	1.174**	.084	2.25	0.025
richer	1.088	.086	1.08	0.280
richest	1.077	.093	0.86	0.392
Residence				
rural	.854***	.038	-3.55	0.000
Region				
Sindh	1.604***	.095	7.94	0.000
Khyber-Pakhtunkhwa	0.398***	.026	-14.00	0.000
Balochistan	0.454***	.035	-10.38	0.000
others	0.727***	.037	-6.18	0.000
Sex of household head				
female	1.884***	.118	10.11	0.000
Media	1.341***	.064	6.10	0.000
Son alive				
1. 1-2	1.136**	.056	2.60	0.009
2. 3-4	1.074	.069	1.11	0.265
3. 4 and above	0.791**	.088	-2.11	0.035

Empowerment index	**OR**	**Std.Err**	**z**	**P>z**
Husband education				
Primary	.862**	.056	-2.29	0.022
Secondary/Higher	.921*	. 048	-1.60	0.109
Husband age				

25-34	1.093*	.111	0.88	0.381
35-443	1.347**	.151	2.66	0.008
45-54	1.491***	.186	3.21	0.001
55-64	1.579***	.241	3.04	0.002
65-74	1.667**	.476	1.79	0.073
Employment	1.449***	.127	4.24	0.000
constant	.0911***	.015	-14.74	0.000

Odds ratios in Table 4.3 indicate that women aged 20-49 are 2 to 4.8 odds more likely, to have high empowerment levels than women aged 15-19, controlling for other factors. The residence has a negative and statistically significant association, which shows that the odds for rural women are eight times less than urban women by controlling other factors. Likewise, the Sindh region has a positive and significant association. The odds are 1.6 times for women in Punjab, while for respondents who lived in Khyber Pakhtunkhwa, Baluchistan, and other regions‟ the odds are less than those who lived in Punjab, controllingfor other factors.

The number of alive sons (1-2) has a positive association and is statistically significant at the 5% level. Therefore, women with one or two sons have 1.36 time more likely to have a high empowerment level than women without sons, controlling for other factors. Men‟s primary, secondary, or higher education levels are statistically significant at the 5% and 1% levels, respectively. Women whose husbands have an education at the primary, secondary, or higher levels are 0.86 and 0.92 odds less likely, to have a high empowerment level compared with a husband with no education level, controlling for otherfactors.

In Table 4.3, the odds ratio is more significant than one as our base category is

if thehead is male, now if the female is heading the house compared to men, the odds for women heading the house is more likely 1.884 odds increase in their decision-making power thanif men would be the head of household.

The study estimated four different models of participation in decision-making at thehousehold level, visits to family and friends, household purchases, spending of husband earnings, and decision about her healthcare are taken as dependent variables. These modelshave been estimated through the binary logit technique, as all dependent variables are dichotomous. The estimated results are given in Table 4.4.

Table 10 : 4.4 Results of Binomial Logistic Model for women's Participation in Decision-making

	Decision Health	Decision Visits	Decision Purchases	Decision Financials
Own Mobile	1.55***	1.521***	1.654***	1.573***
Internet User	1.315***	1.367***	1.319***	1.116
Employment	1.699***	1.714***	1.857***	1.67***
Education				
Primary	1.234***	1.204**	1.251***	1.18**
secondary or higher	1.433***	1.455***	1.311***	1.281***
Age				
20-24	1.552***	1.602****	1.43**	1.277*
25-29	2.001***	2.21***	2.099***	1.665***
30-34	2.413***	2.811***	2.8***	2.067***
35-39	2.731***	3.305***	3.271***	2.435***
40-44	3.571***	4.24***	4.61***1	2.90***
45-49	4.212***	5.44***	5.382***	3.532***
Wealth Index				
Poorer	1.121	1.086	1.213**	1.218**
Middle	1.103	1.023	1.242**	1.161*
Richer	0.974	0.927	1.086	1.08
Richest	1.101	0.978	1.086	0.955
Residence				
Rural	0.877**	0.84***	-0.991***	0.857***
Region				
Sindh	1.35***	1.941***	0.837***	1.591***
Khyber Pakhtunkhwa	0.391***	0.459***	1.474****	0.362***
Balochistan	0.619***	0.521***	0.396***	0.399***
Others	0.766***	0.809***	0.579***	0.723***
Sex Household Head				
Female	1.946***	1.598***	0.682***	2.029***

Media	1.40***1	1.363***	1.751***	1.41***
Sons Alive				
1-2	1.122*	1.223***	1.357**	1.152**
3-4	1.03	1.13	1.161	1.21**
				0.934
5 and above	0.823	0.796*	1.103	
Husband Education				
Primary	0.888	0.971	0.878	0.997
Secondary or higher	0.949	1.011	0.946	0.968
Husband Age				
25-34	0.971	0.971	1.111	0.906
35-44	1.175	1.249*	1.306*	1.057
45-44	1.269*	1.38**	1.416**	1.135
55-64	1.376*	1.511**	1.485**	1.109
65-75	1.482	1.442	1.453	1.181
Husband Employment	1.154	1.301**	1.234*	3.958***
Constant	0.097***	0.121***	0.102***	0.057***

*Note *** if p<0.01, ** if p<0.05 & * if p<0.1*

Estimations of Table 4.4 indicate that women who own mobile phones and use the internet have positive and significant impact on women‟s participation in decision-makingin all categories. Furthermore, owning a mobile and using the internet will increase women'sdecision-making power at the household level.

Employment status, education level, and age of women have a positive and significant impact on participation in decision-making indicators. The odds of employed women are approximately 1.7 to 1.8 times more than unemployed women in all areas of decision-making. The odds of educated women, whether having primary and secondary or higher levels of education, having more decision-making

power, and being empowered than women with no education, have shown in all four models. The odds of being older are more than young women, which shows that older women have more decision-making power than younger women in all four models, and are highly significant, and results are consistent with other studies (Akram, 2018; Riaz & Pervaiz, 2018; Thandar *et al.,* 2019). Moreover, urban residence, region, and media positively associate with women‟s participation in all levels of decision-making. It has been seen that number of sons alive from 1-4 has a positive association with all levels of decision-making, but more than four are not significant.

From the estimation results of all four models, the study found that women whose husband‟s age is between 35 years to 64 have approximately 1.5 odds more than young husbands. While the odds that women whose husbands are employed would make a financial decision is four times more than those whose husbands are unemployed, employment status significantly impacts women‟s decision-making power. At the same time, the husband‟s education level was not significant for women‟s decision-making at the household level.

4.6. Summary

The study has investigated the impact of ICT on women‟s empowerment in Pakistan by using household level data from PDHS 2017-18. The indicators of women‟s participation in decision making indicators have been used to construct women empowerment index. Women‟s participation in their own healthcare, visits to family and friends, household major purchases and control over husbands earning are converted into women‟s empowerment index. The dependent variable is binary in nature therefore, the current study uses logistic regression model for the analysis. This study includes several control variables like employment, education, age, residence,

region, number of alive sons, media, and wealth index.

In this study, empirical results show that ICT has strong positive and significant impact in women‟s empowerment, after controlling socioeconomic and demographic predictors. This implied importance and enhanced role of the ICT to achieve SDGs 2030 for empowering women. The estimation has shown that women with employment status, education level, in a middle wealth quintile, and with urban residence show a higher level of participation in decision-making and hence are empowered. It has also found that womenwith one or two sons tend to behave a higher level of women‟s empowerment than women without any son and also women who lived in Punjab and Sindh region are supposed to be more empowered than women lived in other regions.

The study also examined that own mobile phone, use of internet, employment and education which are also very crucial indicators of SDGs have positive and significant association with women‟s empowerment. Most important is that ICT will help in reducing gender inequality which in turn helps in achieving SDGs agenda 2030. According to the findings, it is recommended that there should be easy and frequent access and use of ICT for women. It is also suggested that there should be an increase in the number of women in work force and give more focus on women education.

CHAPTER 5
ROLE OF ICT IN EXPLORING DISPARITIES AMONG WOMEN REGARDINGEXPENDITURE AND HAVING CHILDREN AT PROVINCIAL AND REGIONAL LEVEL FOR PAKISTAN

5.1. Introduction

Information and Communication Technology (ICT) has changed our lives unprecedentedly and impacted how we live, work, learn, and communicate with others. Thishas been possible mainly because the speed and scale of transfer of information and services have increased tremendously with high-speed broadband connectivity, 5G service, artificial intelligence (AI), and big data. These technologies have also improved women‟s decision-making power at the household level, facilitated them to participate in socio-economic development, and hence increased economic productivity.

The 2030‟s Agenda for Sustainable Development also emphasizes ICT as an essential indicator to measure the empowerment of women and the achievement of SDGs. 7 ICT indicators include 6 SDGs targets of which five indicators are the deal/ responsibilityof ITU. These appear under:

- SDG target 4 (quality education) and its indicators 4.4.1 "*proportion of youth andadults with ICT skills, by type of skills.*"
- SDG 5 (gender equality) and its indicator 5.b.1 *"proportion of individuals who owna mobile phone, by sex*."
- SDG 9 (industry, innovation, and infrastructure) and its indicator 9.c.1 *"proportionof the population covered by the mobile network, by technology" and* SDG target 17 (partnership) and its indicators 17.6.1 and 17.8.1 "*fixed internet broadband subscriptions per 100 inhabitants and proportion of*

individual using theinternet".

Hence to make sure that no one is left behind, it is essential to identify and understand the socioeconomic and demographic characteristics of regions that are left behind in their accessto and use of ICT.

Pakistan has been devoted to the SDGs agenda since its launch in 2015. In February2016, Pakistan was the first country in the world to approve the SDGs as part of its National Development Agenda through a National Assembly Resolution[5]. Drawing from experience with the Millennium Development Goals (MDGs), Pakistan‟s national and provincial assemblies established SDG units. Improving access to ICT and gender equality are key national priorities for Pakistan.

ICT has the potential to open up numerous opportunities for women in employment,education, access to information, and public service. Therefore, unequal and inadequate access to ICT translates to inequalities in income and education. The COVID-19 pandemic has exposed disparities in access to and use of ICT throughout society (ESCAP 2021). Therefore, more than ever, easy access to ICT and ICT-related skills is required to enhancewomen‟s decision-making power.

The COVID-19 pandemic has highlighted the importance of this gap, which prevents about half of the world's population from accessing ICT. (ITU, 2021). ICT plays a vital role during the COVID-19 pandemic in many countries by enabling online work and education and keeping people well-informed due to easy access to relevant information.

[5] Voluntary national review Government of Pakistan 2019

Hence the uneven access to and use of ICT among different countries and regions has nevermore recognized before the COVID-19 pandemic. Therefore, those who do not have easy access to ICT are at risk of being left further behind (ESCAP, 2021). Moreover, easy accessto ICT and ICT-related skills are required to enhance women‟s decision-making power.

The provision of equal opportunities can empower women in terms of education, employment, and asset ownership, and the provision of easy access to ICT can achieve this. The percentage of the female population in Pakistan is 48.76% (Census, 2017). However, the status of women in different socioeconomic dimensions has remained lower than that ofthe male population. Males continue to be the main breadwinners and occupy the major decision-making roles. Pakistani society is patriarchal, with male preference dominating Pakistani households. In Pakistan total percentage of literate adult women is less than 47%, whereas 71% of adult men are literate (WEF 2017). These statistics highlight the need for significant improvement in the status of Pakistani women.

Urban regions of Pakistan are better in terms of women‟s access to and use of ICT, while the situation is worse in small towns, and rural areas. It is worth mentioning that 62.2% of Pakistan‟s total population is settled in rural areas (WB, 2022). Rural women in Pakistan face high levels of discrimination in almost every facet of life. However, Pakistan has improved in reducing the gender gap in the last two years and has shown remarkable growth in women‟s ownership of cell phones (ITU, 2021), with 50% of women owning mobile phones compared to 38% in 2019 (GSMA, 2021). In addition, 49% of women had access to the internet in 2020 (ITU, 2021).

Prior studies (Ejaz, 2007; Shehnaz & Kizilbash, 2002; Hou & Ma, 2013; Fatima, 2014; Haq *et al.,* 2019a; Jabeen *et al.,* 2020; Khalid *et al.,* 2020) have focused on and analyzed a wide range of determinants of decision-making based on education, employment, and child health. The fifth SDG emphasizes empowering women through ICT. Moreover, the overall theme of SDGs is leaving no one behind. Therefore, women‟s empowerment is essential for the rapid achievement of other SDGs like the quality of education, poverty reduction, and economic productivity. ICT is a crucial indicator for empowering women. Hence, SDGs cannot be achieved without women‟s empowerment, and it is hard to empower women without ICT penetration. So, the present study examines the dimension of women‟s empowerment with respect to ICT and other socioeconomic and demographic variables and incorporates SDG indicators to foster the process of achieving SDGs.

The study aims to examine the role of ICT in achieving SDGs agenda 2030 by using the classification and regression tree analysis and determine the characteristics and circumstances of individuals most likely to be left behind at the provincial level. At the same time, the main objectives are to measure the inequalities in women‟s decisions regarding having more children and women‟s decisions regarding consumption expenditure through ICT penetration at the provincial and regional levels. Therefore, the Classification and Regression Trees (CART) technique and the Logistic regression model are used to analyze the impact of ICT on women‟s decision-making power regarding expenditure at the household level and having more children as a case study of Pakistan.

This Chapter proceeds as follows. Section 2 is about literature. The third section will give detailed information on variables and data sources, while the fourth section will discuss the methodology of the research study. The results of the study are shown in

the fifth section. Section Six covers the conclusions and policy implications of the study.

5.2. Literature Review

The current study reviews the socioeconomic and demographic determinants of women‟s decision-making power. In addition, the study examines other aspects of women‟s empowerment mentioned by previous studies conducted in Pakistan and other parts of the world.

Using the Pakistan Integrated Household Survey 1998-99, (Shehnaz & Kizilash, 2002) analyzed various indicators that affect female decision-making regarding paid employment. The study applied Probit Model and found that income, education, and marital status positively and significantly impacted female decision-making regarding paid employment. The study also found that the socio-economic status of the household is also an important factor in determining the women‟s status among households. It is noticed that the female-headed household will look after the equal rights of all family members regardless of gender (Shehnaz & Kizilash, 2002).

It has been observed by Solomon & Adekoya (2006) in their study in Nigeria about women and power transformation that older women generally have greater involvement in decision-making within the family than younger women. Moreover, Mustafa *et al. (*2008) found the same results in their study for Bangladesh and revealed that women under 20 were less empowered than women between the ages of 40-44. The authors further argued that older women had a better understanding and closer relationship with their husbands because they had more chances to communicate with their husbands on various issues with time. Even in those communities where women were refused to participate, they ultimately started participating as they got older.

Ejaz (2007) identified the indicators of female labour force participation in rural and urban areas of Pakistan. The study used data from PSLM 2004-05 concerning females between the ages of 15-49 and applied the limited dependent variable technique. The study revealed the decision-making power of women in Pakistan according to region and wealth quantile. The results showed that age, educational attainment, living in a nuclear family, and vehicle access were positively associated with female labour force participation. In contrast, the number of children, being married, and women with the availability of all home facilities or belonging to wealthy families reduced the probability of FLFP. The study highlighted the gender and income disparities in Pakistan.

The influence of household decision-making on women‟s maternal health in Pakistan was examined (Hou & Ma, 2013) by using data from PSLM 2005-06. The study found that women‟s decision-making power positively and significantly correlated with women‟s maternal health. That is, when women are empowered. They are most likely to use maternal and child healthcare services, and where men had the decision-making power in households, women were less likely to avail of MCH services. Urban populations in large and small cities and rural populations in districts were considered separate strata using a two-stage stratified sample. By applying the logit model, the study found that the maternal health service uptake indicators have a positive association with women‟s decision-making power in Pakistan.

To analyze the association between education, employment, and decision-making in Pakistan (Fatima, 2014) used, survey data from PSLM 2007-08. The study used the Linear Probability model to examine women‟s decisions regarding family planning and expenditure on food, clothing, medical cost, and recreation. The study found that education and employment positively associated with women‟s say in

household decisions. Moreover,education and employment play a crucial role in intra-household decision-making (Fatima,2014).

The individual, household, and community-level determinants were analyzed to examine women‟s empowerment in Egypt (Samari & Pebbley, 2015). The study used the 2006 and 2012 Egyptian Labour Market Panel Survey (ELMPS) to measure individual decision-making, household decision-making, mobility, and financial autonomy. The results are consistent with those (Shehnaz & Kizilbash, 2002; Mustafa *et al.,* 2008; Fatima, 2014) and found that working women had greater decision-making power. The study found wealth and region were positively associated with women‟s autonomy. Surprisingly, education had no association with women‟s decision-making power at the household level in Egypt and is contrary to expectations. The study analyzed that to empower women in society, it is first necessary to examine how women‟s community, social norms, and their families affect them.

Applying the Ordered Logistic Model to primary data from a sample of 200 female college students in Lahore (Bushra & Wajihah, 2015) found that female education, economic participation, and economic opportunities had a positive and significant impact on women‟s empowerment. However, it has also been observed that poverty is high where most households are illiterate, and women in those families face barriers to empowerment. Overall, Bushra & Wajihah (2015) found that Pakistan is a patriarchal society that causes barriers for women to become empowered.

For addressing the determinants of women‟s empowerment in Pakistan, Awan & Naqvi (2016) used women‟s decision-making about their education and women‟s decision-making about having more children. Binary Logistic Regression was applied to the dataset taken from PSLM (2011-12). The study found that education level

increases the decision- making capacity of women, and age, type of educational institution, and paid work were found to be positively and significantly correlated with empowerment. Moreover, there is hardly any women‟s decision-making power in rural areas of Pakistan households (Awan & Naqvi, 2016), and also, a large proportion of women are excluded from any level of participation in decision-making.

To analyze the socioeconomic, political, and demographic determinants of women‟s empowerment in Turkey (Cinar & Kose, 2018), took a sample of more than 100,000 women and constructed an empowerment index. Empowerment was measured based on health, education, income, social life, and personal care. The study regressed multilevel analysis and found that women‟s empowerment was affected by individual attributes and the locality where women reside. Employment status, education level, income level, religiosity, and marital status had a positive association with women‟s empowerment.

Batool *et al.* (2018) measured the demographic indicators that determined women‟s empowerment using a primary survey of 500 married women from the district of Multan in Pakistan. Control over economic resources was used as a proxy for empowerment, and the Probit model was used in regression analysis. The study found that paid jobs, age, income, and property had a positive and significant association with women‟s economic empowerment.

By applying a multistage random sample technique on primary data from 500 households from four districts of Punjab, Pakistan, (Haq *et al*., 2019a) measured the relationship between employment and women‟s empowerment. The primary determinants of women's empowerment (dependent variable) were decisions about health care and staying with the family, freedom of movement, access to and use of resources, and domestic abuse. In addition, a principal Component Analysis was

conducted to guarantee the indicators' dependability. The outcomes of the multiple regression model demonstrated that working women were more empowered and able to fend off domestic abuse.

To measure household empowerment and poverty incidence with other socio-economic and demographic indicators (Haq *et al.,* 2019b) used, primary data from a survey of 600 household heads in rural southern Punjab, Pakistan. The study used the Probit model and found that HEMI, after controlling other variables like occupation, household size, remittance, and unemployment rate, are significantly associated with poverty incidence. In addition, the study revealed that HEMI had a negative association with rural household poverty incidence.

Jabeen *et al*. (2020), who found similar findings to Awan & Naqvi (2015), found that women living in rural Pakistan face several issues, including a lack of access to high- quality education, low-income levels, and early marriage. The study conducted a micro- survey of 480 women from six rural areas of Khyber Pakhtunkhwa, Pakistan. It analyzed that almost all selected women were participating only in household-level activities and were restricted to participating at even the community level due to the rigid customs of their areas.

To measure women‟s empowerment in Punjab, Pakistan (Khalid, 2020), indexed HIES 2013-14 dataset and applied the Logistic regression model. The study concluded that wage differential and other independent variables positively associated with women‟s empowerment. However, it has also been discovered that empowerment is even worse in areas where education and other facilities are poor.

To measure socioeconomic and demographic factors of women‟s empowerment in Mozambique (Lopes *et al.*, 2021), applied Logistic regression to the survey data from MDHS 2015. The following indicators of women‟s empowerment were taken:

(1) Belief about violence against women, (2) Decision making, (3) control over reproduction. Lopes *et al.* (2021) found that intimate partner violence (IPV), region, rurality, and partner controlling behaviour significantly impact the belief about violence against women. While education, age, wealth, employment, polygamous marriage, religion, and media were positively associated with women‟s empowerment through decision-making and control over the reproductive decision.

The literature review has uncovered several socio-economic and demographic factors that have a direct or indirect influence on women‟s decision-making power at the household level. These factors typically relate to family, women‟s education, age, household headship, paid employment, media, and the number of children. Moreover, from the series of reviews, it has been evident that education level and employment opportunities are essential for reducing the gender gap and empowering women. The present study helps to bridge the literature gap by focusing primarily on the access to and use of ICT by women of Pakistan at the provincial and regional level in the context of Goal 5 and Target 5b, specifically of the SDGs 2030 Agenda. The following section will explain the methodology used to develop relationships between these variables, and operational definitions of the variables are described in the next section.

5.3. Data and Definition of Variables

For empirical analysis, the study uses the cross-sectional data from the Household Integrated Economic Survey (PSLM/HIES 2018-19) conducted by the Pakistan Bureau of Statistics 2020. The survey covers the data at the individual and household levels. The current round of HIES covers 24,809 households and 24 SDG indicators. PSLM/HIES provided cross-sectional data on a large sample of households at Pakistan's provincial, district, and regional levels. The present study focuses on all currently married women (excluding widows and divorced) of reproductive age (15-49)

living in Pakistan. The sample included 23,087 observations in the current empirical analysis.

In the HIES, seven to eight questions on women‟sdecision-making regarding having more children and expenditure on household food, clothing and footwear, medical treatment, and travel and recreation were used in the study. The study constructs the expenditure index by adding all four indicators. The answers to these questions can be categorized as; woman herself=1, head/father decides alone=2, head/father in consultation with his/her spouse=3, head/father in consultation with women=4, head/father and spouse of the head in consultation with the women concerned=5, her spouse decides alone=6, women and her husband jointly decide=7. The study has takenthe data on “who in your family decides whether you should have more children?” is divided into eight categories which are 1=husband alone, 2=woman herself, 3=husband and woman jointly, 4=mother of woman or husband, 5=nobody, 6=menopausal/infertility, 7=other, 8= it is in the hands of God. The study recodes the indicator as 0 and 1. The dichotomous variable is one where the woman says yes to a decision regarding having more children; this is category 2 and 3. While the dichotomous variable stands at 0 if the woman is not included in the decision-making process.

In PSLM/HIES, the head of household is defined as “If a person lives alone, that person isconsidered the head of the household. If a group of people lives and eats together as definedabove, the head of the household is that person who is considered as the head of the household members. In practice, when husband, wife, married and unmarried children form a single household, the husband is generally reported as the "head.” When parents, brothers, and sisters comprise a household, either a parent or the eldest brother or sister is generally reported as the head of the household. When a

household consists of several unrelated persons, the respondent or the eldest household member is selected as the "head.” In specialdwelling units, the person in charge (e.g., manager) may be reported as the "head.” The Definition and detail explanation of each variable is given in Table 5.1

Table 11 : 5.1: Meta Data

Variable	**Definition of variable**	**Description of variable**
Dependent Variable		
Women decision-making power index	Decision about having more children. Decision about consumption expenditure (food, clothing and footwear, medical treatment, recreation, and travel).	1= if decision is taken by woman or jointly with her husband and with other family member 0= Otherwise
Independent Variables		
Use internet	have used internet during last 12 months	1= if used internet 0= otherwise
mobile phone	Women has her own mobile phone	1= if she has mobile phone 0= otherwise
ICT index	Combine the variable internet userand mobile phone users	1 = use internet or mobile phone2 = use both 0; Otherwise Study recode as 0 if not using ICT and 1otherwise.
Education	Highest level of education attained	0= if below grade one1= primary 2=secondary 3=higher and professional degree

Employment	Job status of a woman	1= if she is working 0= otherwise
Age	Age of a woman	It is a continuous variable, and we calculatethe age of ever married women belonging to age group 15-49.
No. of boys	Number of alive boys	Number of boys of a woman is divided intothree interval i.e zero for no boy, 1-4 and 5- 9
Income	Income of the family	Income is a continuous variable to show thestatus of the household
No. of girls	No. of alive girls in family	number of girls also divided into threeinterval that is zero of no. girls then 1-4 and 5-9.
R/s with head	Relationship with household head	1= if herself; 2= spouse; 3= other family member The study recode relationship with household head into binary variable. That is, 1 = if respondent or husband is the head of house 0; Otherwise
Region	Lived in urban or rural area	1= if lived in urban area0= otherwise
Province	Provinces of Pakistan.	Punjab, Sindh, Balochistan and Khyber Pakhtunkhwa.

5.4. Methodology

There is very much possibility of causality in our model as empowered women mayhave access to ICT. However, from the theory and literature, it has been noticed that cross- section data are taken at a single point in time and considered several characteristics of a population. Several authors state that the primary drawback of cross-section data analysis isthat it lacks a time dimension and does not demonstrate a causal relationship. It does not measure the cause and effect simultaneously (ICT and Women's Empowerment).

Therefore, cross-section studies cannot establish causation but can aid in developing causal hypotheses (Thelle *et al.,* 2015; Jacob & Ganguli, 2016). It is also found from the literature that the major disadvantage of cross-section studies is that identifying the cause and effect of simple association is the biggest challenge (Mann, 2003). Furthermore, it canbe used to define community attributes but not to establish cause-and-effect relations between various factors. This technique is frequently employed to draw conclusions about potential relations or to collect introductory information to encourage additional investigation and experimentation.

Therefore, the current analysis examines the possible association between the dependent variable (women‟s empowerment) and the independent variable (ICT indicators) through univariate (descriptive statistics and graphical presentation) and multivariate analysis Binomial Logistic model and the CART technique).

5.4.1. Logistic Model

The study has identified two key proxies for women‟s empowerment (i) women's decision-making regarding household expenditure (food, clothing, medical costs, travel, and recreation) and (ii) women's decision about having more children. These two

proxies are separate categories. To explain how ICT influences, we construct two models usingimportant determinants based on a literature review and data availability. The functional form of our model is given as:

WDP = (ict index, province, region, education, employment, income, no. of boys, no.of girls age, relation with head) *5.1*

The dependent variables in the study are dichotomous which can take the values1and 0 therefore, we apply the logistic model and CART technique.

As the dependent variable is dichotomous the logistic equation will be written as:

$$\text{Prob (WDP)} = \frac{1}{1+e^{-WDP}} \quad 5.2$$

$$WDP = \beta_0 + \beta_1 ICT + \beta_2 Pro + \beta_3 Reg + \beta_4 Edu + \beta_5 Emp + \beta_6 Inc + \beta_7 Boy + \beta_8 Girl + \beta_9 HHH + \mu \quad 5.3$$

Each β_i is shown by the odds ratio which can be explained as given:

Odds Ratio = p(women taking decision) /p(women not taking decision) = e^{-WDP}

The study uses the HIES dataset for the year 2018–19. The basic motive behind the use of the given data set is the availability of data and variables at the national, provincial, and district levels.

5.4.2. CART Model

CART is visualized as a binary tree, with the partition of data into multiple subspaces, and is extensively used for its ease of interpretation. It is easily interpreted as themost important indicator given in the top node and the least significant indicator in the lowest branch of the tree. Furthermore, the classification tree shows the predictive power ofeach independent variable.

When the inference problem needs to make a discrete prediction about some variable given other details of the variable is easily handled with partitioning classifiers (Buntine, 1991). These classifiers split the space into partitions, CART uses

classification trees to recursively partition the space. Tree algorithms-built trees are shown in Figure 5.1. This tree is called the decision tree as decisions are taken on leaves about yes or no. The left branch of the tree refers to yes as these trees have branches and leaves.

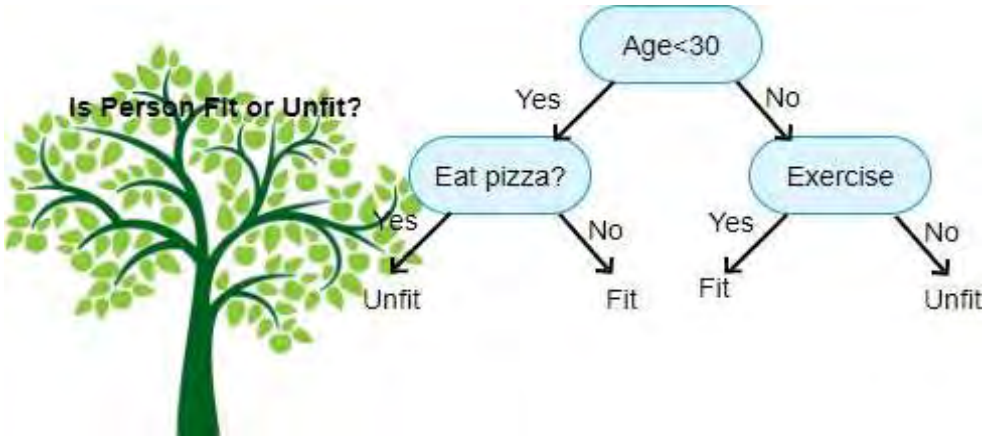


Figure 8 : 5. 1 CART Model

Buntine, (1991) gave a sample with N values while x is known as classification c, which is classified through a conditional probability distribution. Hence the posterior expected values and variances for the proportions ϕ_T can be found through Dirichlet distribution.

The study uses the CART (Beriman *et al.,* 1984) to explain the predictors by building the binary decision tree. CART generates the sequence of sub-trees by growing a large tree and pruning it back untilthe root node is left. Therefore, CART first selects the variable and then selecting its split node, the observation goes to leaf node of the branch (Chipman *et al.,* 1998). CART is a useful nonparametric approach that interprets categorical dependent variable in terms of various independent variables. While explanatory variables could be categorical and independent in nature.

The dependent categorical variable has two attributes “yes” or “no”. If the independent variables are good predictor move to “yes”: node and if not, then node split toright side which is “no” node. Moreover, in CART technique the partition is continuous tillthe end nodes and pruning where necessary. The decision tree starting from the variable with top of the branch has the highest association with dependent variable further splits in form of nodes and branches. The tree is in upside down position that meansthe roots are at the top and leaves are at bottom.

As we have categorical variables in our study, we use Classification Tree technique instead of Regression Tree. In regression we measure the importance or significance level of variables by p value, while in the CART approach, we measure which predictor is important by the stems of tree. There for in the CART approach we draw inverted tree, andthe variable nearer to the Stem of the tree is more significant and has a higher impact on the exogenous variable than other endogenous variables. The study uses the R software for applying the CART approach.

In the current study, the measure of opportunity is women‟s decision-making power regarding the household level consumption expenditure and having more children in the provinces of Pakistan. The outcomes could be used as the target variables for policymakersin target policy tool. ICT penetration and selected variables in the data set are used to definewomen‟s decision-making power.

5.5. Results

5.5.1. Descriptive Statistics

Table 5.2 presents the percentage of women having decision-making power regarding household expenditure and decision-making power regarding having more children has calculated at provincial level region-wise, and women with access to ICT at provincial and regional level. From the Table 5.2, we can see that in Punjab,

percentage of women who have a say in decision making (decision making=1) is greater in both urban and rural areas as compared to Sindh, Khyber Pakhtunkhwa and Balochistan in case of decision regarding expenditures.

In urban Punjab percentage of women taking decisions regarding expenditure is 65% while it is 35% in Sindh and Khyber Pakhtunkhwa and 9% in Balochistan. Regarding women‟s decision-making power with respect to having more children, Khyber Pakhtunkhwa‟s urban women are leading with (75%) of women having a say in decision- making above Punjab with (73%). While women live in Sindh and Balochistan are less to say in decision regarding having more children is about (63%) in Sindh and (33%) in Balochistan.

Table 12 : 5.2 Percentages of Women's Decision Making and ICT Penetration

	Punjab		**Sindh**		**Khyber Pakhtunkhwa**		**Balochistan**	
	Role in Decision Making		**Role in Decision Making**		**Role in Decision Making**		**Role in Decision Making**	
	No	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**
Women Decision Making Regarding Household Expenditure								
Urban	35	65	65	35	65	35	91	9
Rural	42	58	74	26	63	37	96	4
Women Decision Making Regarding Having More Children								
Urban	27	73	37	63	25	75	67	33
Rural	31	69	49	51	39	61	72	28
ICT Penetration								
Urban	43	57	43	57	45	55	63	37
Rural	66	34	89	11	61	39	86	14

Interestingly from the Table 5.2 ICT penetration is the same in urban areas of Punjab and Sindh that is 57%, while in rural region of Punjab 34% of women have access to ICT as compared to 11% in rural Sindh. In urban regions of Khyber Pakhtunkhwa women‟s access to and use of ICT is 55% while it is 37% in urban regions of Balochistan.

Graphical presentation of women‟s decision-making power regarding expenditure at household level and decision-making power of women regarding having more children with respect to ICT access at provincial level is given in Figure 5.1 and 5.2. In the Figure 5.1, ICT-index has measured on x-axis, decision-making power of women regarding consumption expenditure at provincial level has measured on y-axis. In Punjab, 63% women has decision making power regarding household expenditure who has access to ICT and areleading to decision-making power regarding expenditure to rest of provinces. While women residing in Balochistan have least access to ICT and have only 7% decision-making power regarding household level expenditure. Moreover, they are furthest behind in achievingSDGs agenda 2030.

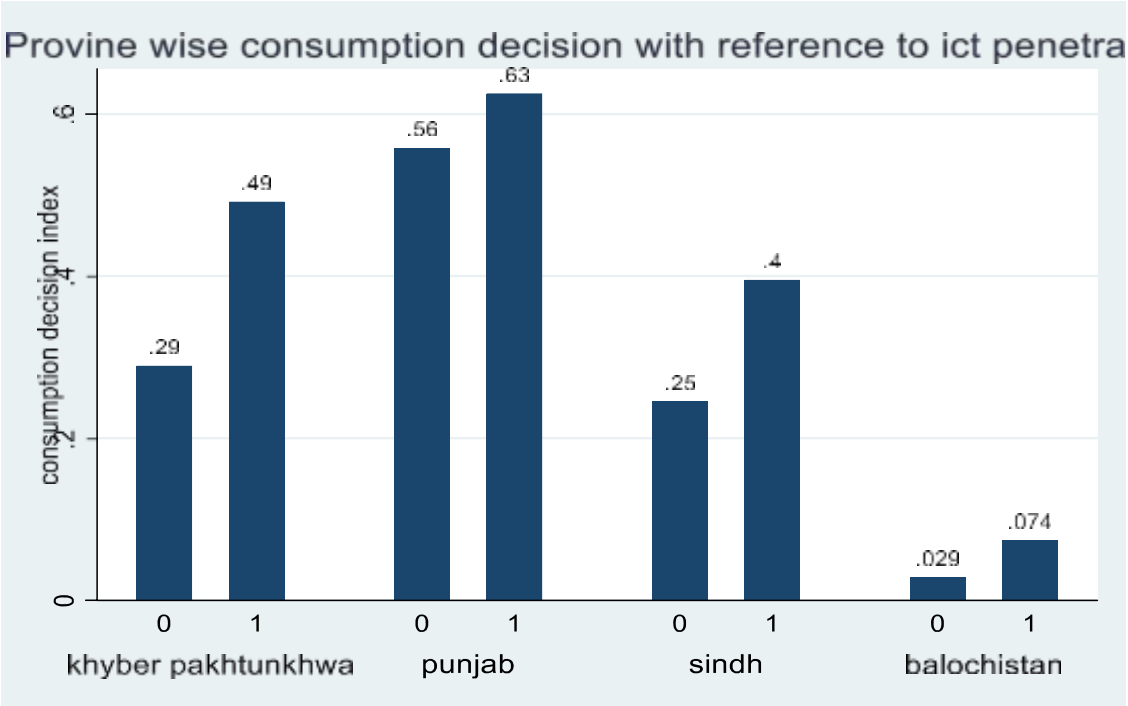


Figure 9 : 5. 2 women's decision-making regarding expenditures with respect to ICT

In Figure 5.2, ICT-index has measured in x-axis while women‟s decision-making power regarding having more children has measured in y-axis. It has been noted from the figure that the women from Punjab and from Khyber Pakhtunkhwa

have more say in decisions regarding having more children as they have more when they have access to ICT about 71% and 72%. While women from Sindh and Balochistan have less access to ICT and have least decision-making power having more children.

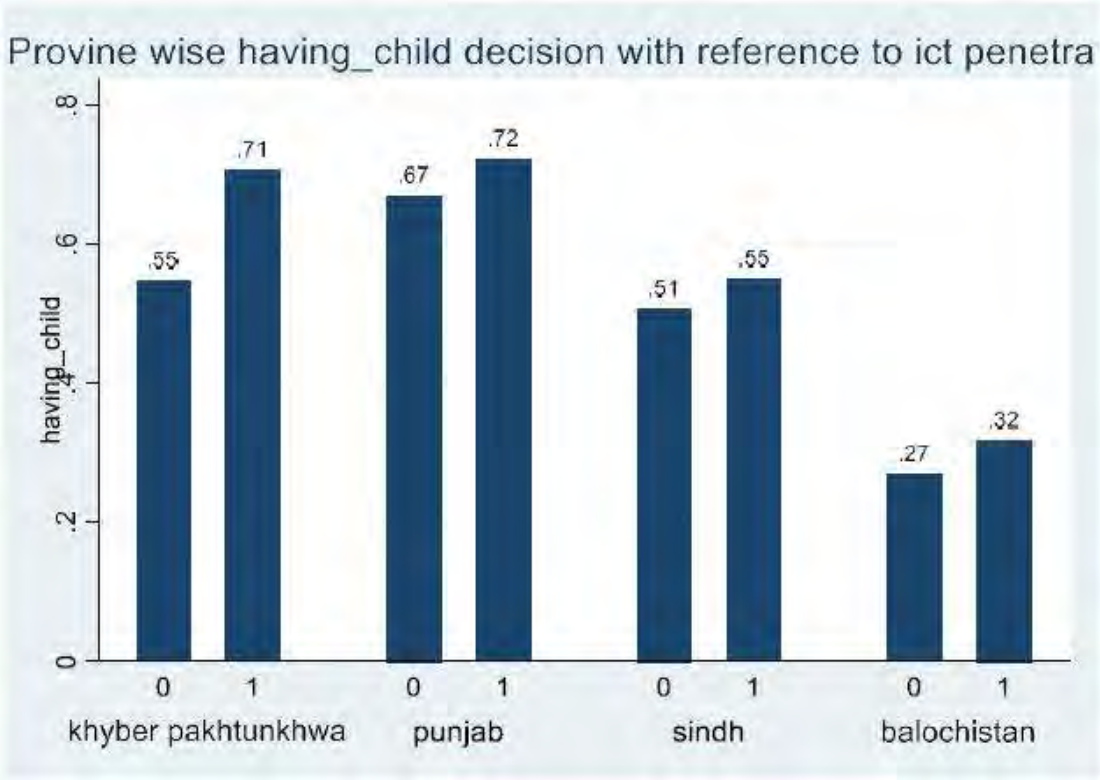


Figure 10 : 5. 3 women decision regarding having more child: x-axis measures the ICT-index

5.5.2. Logistic Model Results

There is very much possibility of presence of causality in our model as empowered women may have the access to ICT, but from the theory and literature it has been noticed that cross section data are taken at single point in time and considered several characteristics of population. Several authors state that the primary drawback of cross-section data analysis is that it lacks a time dimension and does not demonstrate a causal relationship, that is, it does not measure the cause and effect at the same time (ICT and Women's Empowerment). Therefore, cross-section studies are unable to

establish causation but can aid in developing causal hypotheses (Thelle *et al,* 2015; Jacob & Ganguli 2016). It is also found from the literature that the major disadvantage of cross-section studies is identifying the cause and effect of simple association is the biggest challenge (Mann, 2003). Furthermore, it can be used to define community attributes but not to establish cause-and-effect relations between various factors. This technique is frequently employed to draw conclusions about potential relation or to collect introductory information to encourage additional investigation and experimentation.

Odds Ratio represent how much the odds of the dependent variable change by unit change in the independent variable. Table 5.3 shows that odds ratio is significantly high forICT index, which is the main variable of our interest in the study. The study found that odds of having decision-making power are 1.4 times more for ICT access. Hence, there is a positive and significant association between ICT index and women‟s decision-making power regarding household expenditure index and found a robust effect of ICT on women‟s decision-making power regarding expenditure.

The results also support that possessing a mobile phone and using of internet by womenwill help in achieving SDG 5 and SDG 17 as the ICT index is composed of owning mobile phone and using the internet. The study also tries to find the impact of ICT at provincial and regionallevels by applying the interaction between the ICT index and provinces and between the ICT indexand region.

Table 5.3 indicates that Punjab has 3 times more odds than Khyber Pakhtunkhwa in women‟s decision-making power regarding expenditure index and has a positive and significant association. Odds for Sindh and Khyber Pakhtunkhwa are almost 1 and results are not significant, while Balochistan has lower odds than

Khyber Pakhtunkhwa, which are consistent with (Hou & Ma 2012; Hussain *et al.,* 2016). The odds ratio with respect to region in Pakistan are insignificant.

The estimated result of education shows that the odds of women having decision- making power are quite high for being educated at any level compared to women who haveno education and education has a positive and significant impact on women‟s autonomy. Itseems that educated women have more say and ultimately are more empowered than uneducated women, though we understand correlation does not imply causation in all aboutmentioned coefficients.

Table 13 : 5. 3 Logistic Regression on Women Decision-Making Power

	CONSUMPTION EXPENDITURE INDEX				HAVINF MORE CHILDREN			
	Odds Ratio	**p value**	**Odds Ratio**	**Pvalue**	**Odds Ratio**	**p value**	**Odds Ratio**	**p value**
ICT index	1.41***	0.000	1.71***	0.000	1.31***	0.000	1.68***	0.000
Province								
Punjab	3.12***	0.000	4.01***	0.001	1.1	0.48	1.24*	0.068
Sindh	0.961	0.61	0.88	0.399	0.63***	0.001	0.7***	0.009
Balochistan	0.35***	0.001	0.17***	0.002	0.34***	0.001	0.28***	0.001
Province*ict								
Punjab*ict			0.67***	0.005			0.763*	0.087
Sindh*ict			1.13	0.7			0.86	0.423
Balochistan*ict			3.07***	0.005			1.17	0.592
Region								
Urban	1.11	0.14	1.11	0.201	1.14**	0.026	1.31***	0.003
Region*ict								
Urban*ict			0.99	0.503			1.34***	0.003
Education								
Primary	1.3**	0.044	1.131**	0.04	1.16	0.264	1.2	0.261
Secondary	1.44***	0.004	1.51***	0.004	1.31**	0.041	1.3**	0.044
Higher	1.31	0.1	1.33	0.093	1.35**	0.049	1.36**	0.047
relation with head								

Spouse	0.24***	0.001	0.241***	0.001	1.92***	0.003	1.9***	0.003
Other	0.42***	0.001	0.414	0.001	1.61**	0.033	1.59**	0.037
Income	1	0.11	1*	0.09	1***	0.003	1***	0.002
Employed								
Yes	1.11	0.13	1.11	0.18	1.2	0.937	1.17**	0.047
	CONSUMPTION EXPENDITURE INDEX				**HAVING MORE CHILDREN**			
number of boys								
1 –4	1.21**	0.023	1.71**	0.023	1.32***	0.000	1.32***	0.001
5 –9	1.23**	0.031	1.23**	0.028	1.52***	0.000	1.51***	0.001
number of girls								
1–4	0.95	0.454	0.95	0.473	1.41***	0.001	1.41***	0.001
5 –9	0.91	0.415	0.94	0.472	1.25	0.022	1.31**	0.023
Age								
25–34	1.1	0.556	1.05	0.563	1.23*	0.068	1.16*	0.075
35–44	1.3***	0.009	1.3**	0.01	0.89	0.264	0.89	0.246
45–54	1.34**	0.013	1.34**	0.01	0.488**	0.001	0.48***	0.000
Constant	0.84	0.52	0.74	0.3	0.64	0.118	0.561**	0.045

Our results are consistent with previous studies (Naqvi & Shehnaz 2002; Shehnaz & Kizilbagsh 2002; Hou & Ma 2012; Hussain *et al.,* 2016). It is also observed that women relationship with the head of household is positively and significantly associated with expenditure index. If the woman herself is the household head, then odds of women‟s decision-making power regarding expenditure increase. Results are consistent with previous studies (Shehnaz & Kizilbagsh 2002; Khan & Khan 2002; Hou & Ma 2012). Having a male child has a significant and positive impact on women‟s decision making andodds are 1.2 to 1.3 times more than the odds for women who do not have a son.

Similarly, the odds ratio is in favor of women in the age group from 34 to 54 comparedto women in the age group 15-24. It is observed that older women are more empowered than younger women in a society such as Pakistan, where a family system prevails (Naqvi & Shenaz 2002; Khan & Khan 2010; Awan & Naqvi 2016; Hussain *et al* 2016).

From Table 5.3 (second panel), it is observed that odds ratio of ICT index in favor of women‟s decision-making power for having more children is 1.68. It shows that access to ICT and use of ICT increases women‟s decision-making power and helps in fostering theprocess of achievement of SDGs 2030 agenda as women say to decision for having more children is considered as the proxy for women‟s empowerment. It is also found that ICT index has robust, positive, and highly significant association with decision of having more children.

The results of Table 5.3 illustrate that when the response variable is women‟s decision-making power regarding household-level expenditure, if a husband and other family members head the house, then the odds of women‟s decision-making power are likely to decrease by 0.24 and 0.42 times or it can be explained as each increase of male head of household is associated with 0.24 times decrease in the odds of women‟s having decision regarding household expenditure. While in the case of women‟s decisions regarding having more

children, women‟s decision-making power is more likely to increaseby 1.9 times and 1.6 times if the husband and other family members are the head of the household.

By looking at the provinces, Punjab has 1.24 times more odds than Khyber Pakhtunkhwa, which indicates that women who live in Punjab have more decision-making power regarding having more children. Sindh and Balochistan have low odds as compared to Khyber Pakhtunkhwa. Hence Pakistan has disparities at provincial level and results are consistent with those of (Awan & Naqvi 2016). Similarly, region has positive and significant impact on women‟s decision-making power regarding having children. The oddsratio of urban women is 1.3 times more than that for rural women which indicates that urban women have more power to take decisions regarding having more children or not than women who live in rural areas (Awan & Naqvi, 2016; Khalid *et al*., 2020).

For empowerment, both access to resources and control over income were considered prerequisites. Income has shown positive and significant impact on women‟s decision-making power regarding having more children. In a similar vein, being in paid employment has a positive and significant impact on women‟s decision-making regarding having more children. The number of boys and girls in the family also has positive and significant impact on women‟s decision-making power about having more children.

5.5.3. CART Results

As the model is discrete variable regression in which the goal is to predict a 0-1 outcome base on given predictors. This classification problem can be solved by logit and probit model but sometimes these models showed that variable is barely significant, in the case where variables are categorical like region, provinces, education, employment and many others. CART model helps to indicate which variable is the more powerful predictor.Variables at the top of the tree are more powerful predictor than those of at the bottom of the tree note/branches.

Classification tree for consumption /expenditure for Punjab in Figure 5.4, shows that region is the most important predictor in women"s decision-making power. Urban women in Punjab are more empowered than rural women. The node is further splits into number ofboys in the family, ICT, number of girls, education and then age in matters regarding decisions about household level expenditures. Women of Punjab who have sons, are educated and using ICT are further ahead than those who lived in rural areas and do not have access to ICT. Therefore, we can say that rural women of Punjab are furthest behind in achieving the SDGs 2030 Agenda compared to urban women.

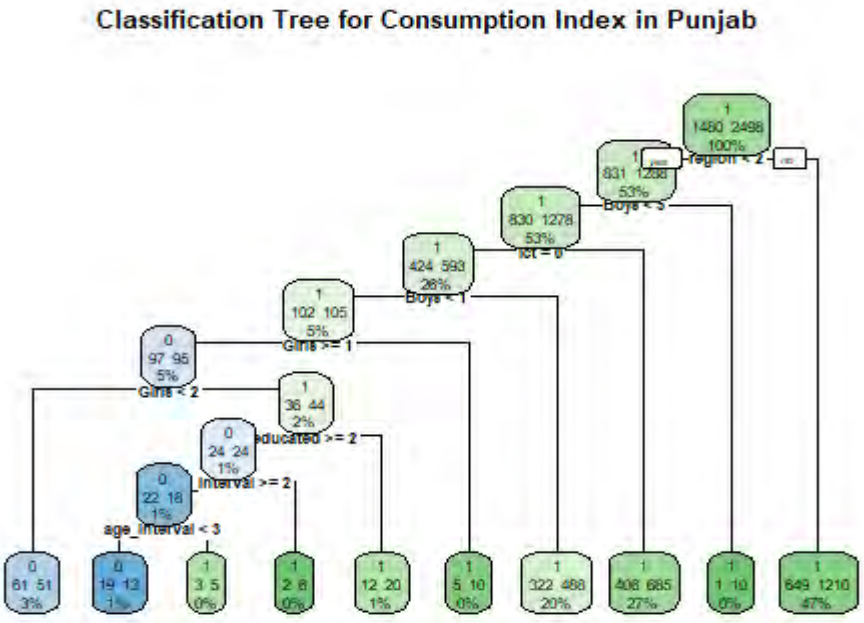


Figure 11 : 5. 4 CART Expenditure Model for Punjab

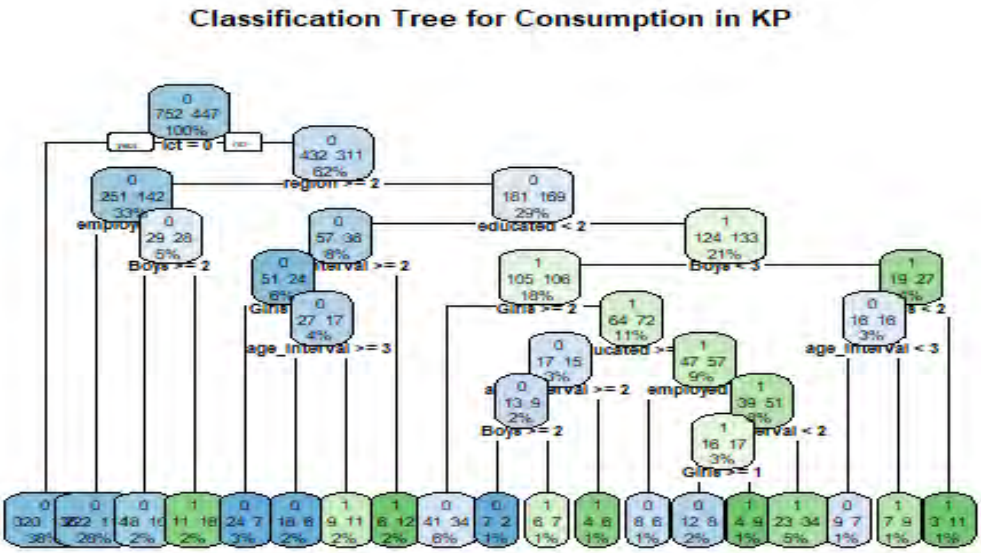


Figure 12 : 5. 5 CART Expenditure Model for Khyber Pakhtunkhwa

Figure 5.5 is about women‟s decision-making power regarding the expenditure index for the province of Khyber Pakhtunkhwa using the CART model shows that the ICT index is the most important predictor for women who live in urban areas and are employed. Then node is further split for education level, age of women, and the number of boys and girls, women have.

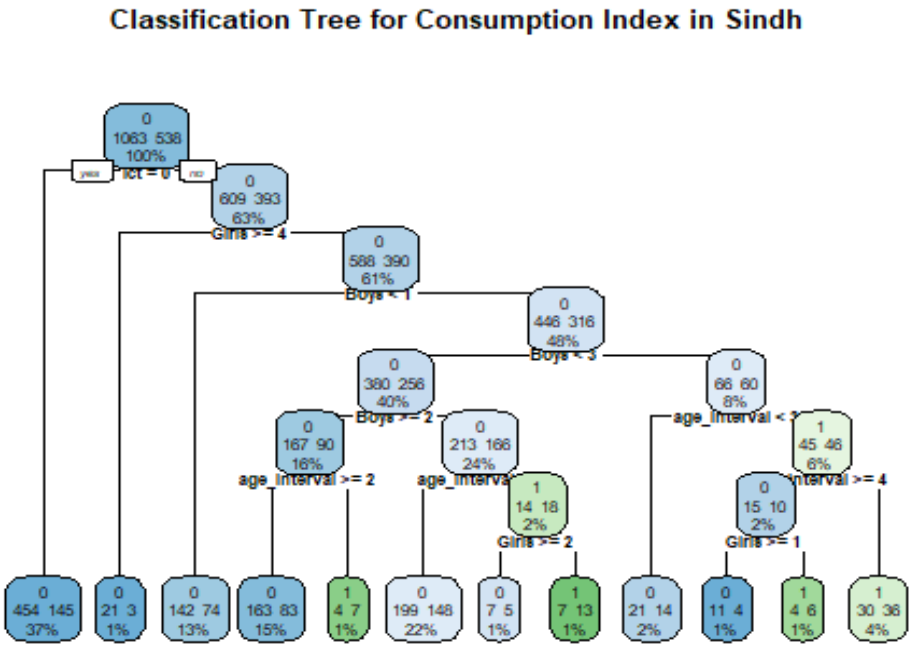


Figure 13 : 5. 6 CART Expenditure Model for Sindh

Figure 5.6 classification tree for women decision regarding household expenditure in Sindh shows that ICT is the most important predictor for women decision-making power. Then the branches further split for number of girls and number of boys women have and the age of women, it shows that younger women and who have more boys and less number of girls in the family have more decision making power..

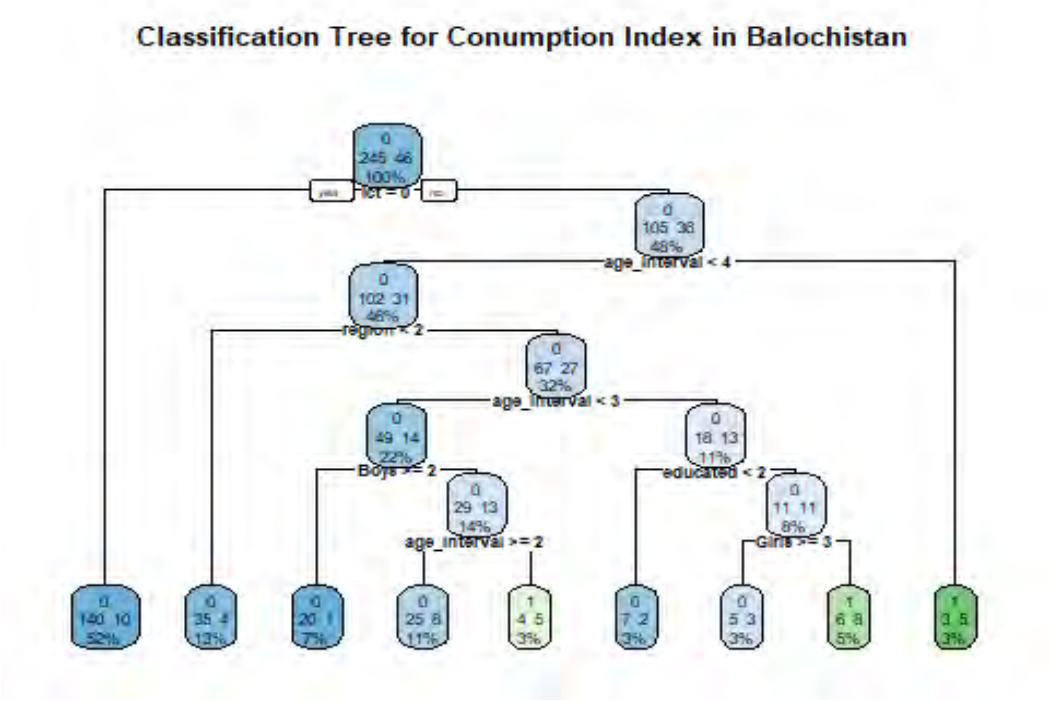


Figure 14 : 5. 7 CART Expenditure Model for Balochistan

Age and geography, after ICT penetration is the most important predictor in Balochistan regarding decision that have been made about household-level expenditure in the family, according to Figure 5.7. While the left node indicates that there is no ICT penetration in the area and is no significant predictor other than ICT=0 in Balochistan, and it does not impact on women have a say in decisions regarding expenditures at the home level. The fact that the nodes for Balochistan have been further divided into nodes for number of boys, education level, and girls younger than three in the family demonstrates that women now have the ability to make decisions about household spending on consumption.

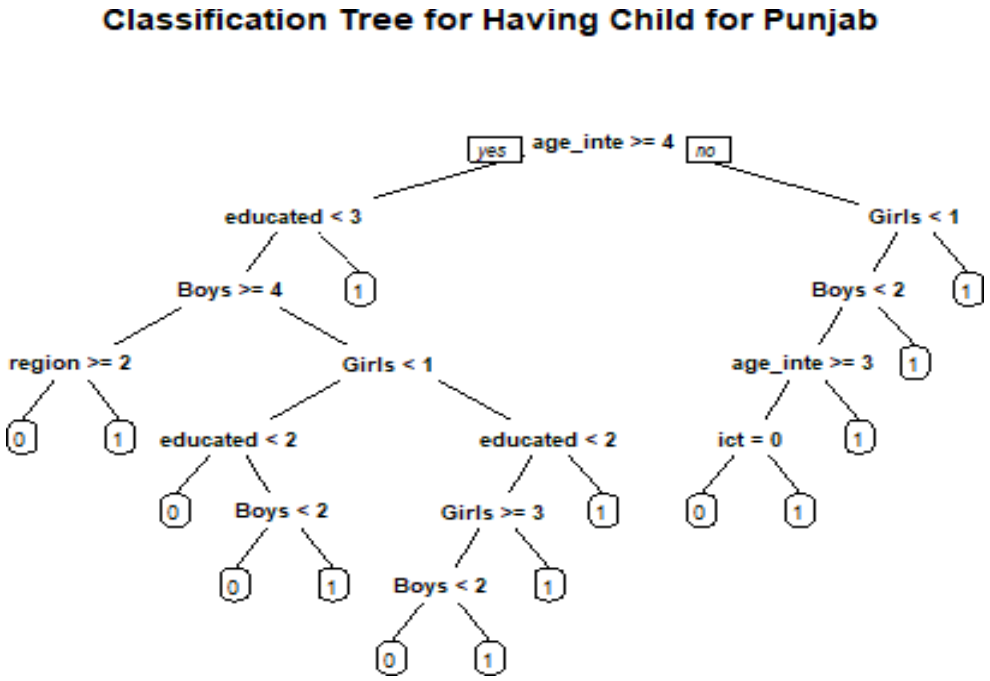


Figure 15 : 5. 8 CART Model Punjab

Figure 5.8 illustrates the classification tree for decision made by women in Punjab regarding having children. According to the CART model diagram, the study discovered that middle-aged women, educated women, and families with fewer than four boys are the most significant predictors, followed by the fact that women have more control over household spending decisions. The fourth significant signal is the region, where urban women have more influence over whether or not to have further children. The node is further divided by the number of girls.

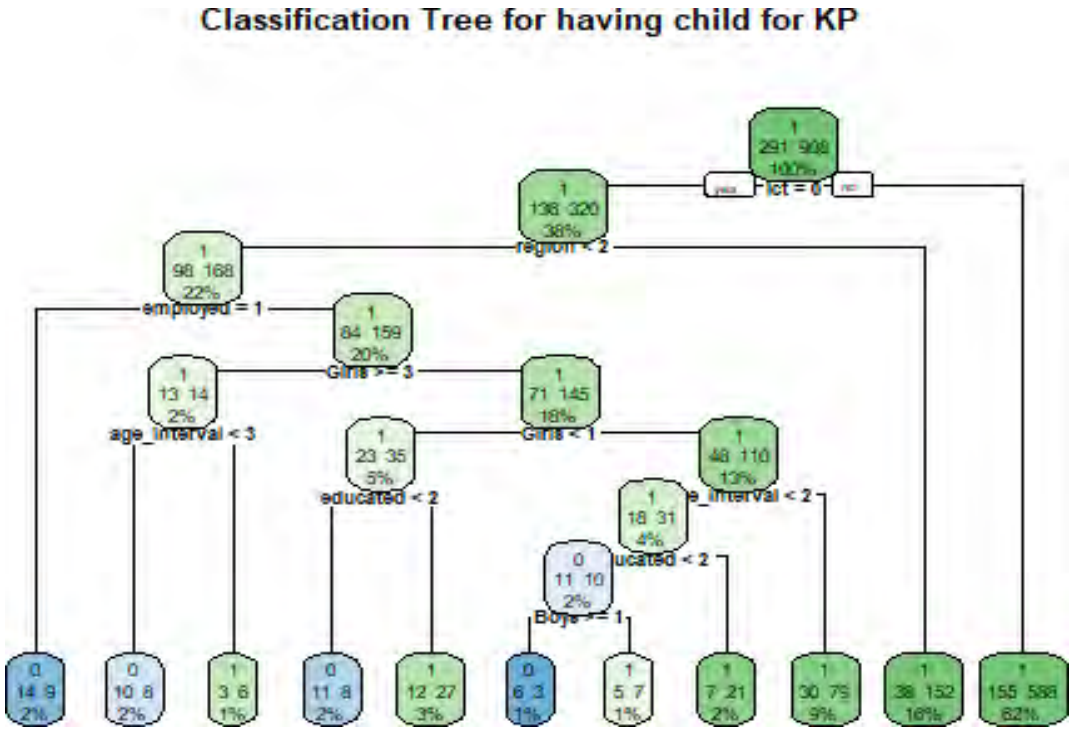


Figure 16 : 5. 9 CART Model for Khyber Pakhtunkhwa

In figure 5.9 the classification tree for women‟s decision regarding having more children for Khyber Pakhtunkhwa is given. The most important indicator is the ICT index, then node split for the region. Women who live in Khyber Pakhtunkhwa have no access to ICT, and she live in the urban area are employed and can take decisions independently. The second most important predictor is number of girls in the family. If number of girls in the family are three or more than women would take decision regarding having more children. The next important predictor is the age interval, if age 15 to 33 then women have decision-making power regarding having more children. If ICT penetration is occurs then no other predictor is needed to predict the decision regarding having more children.

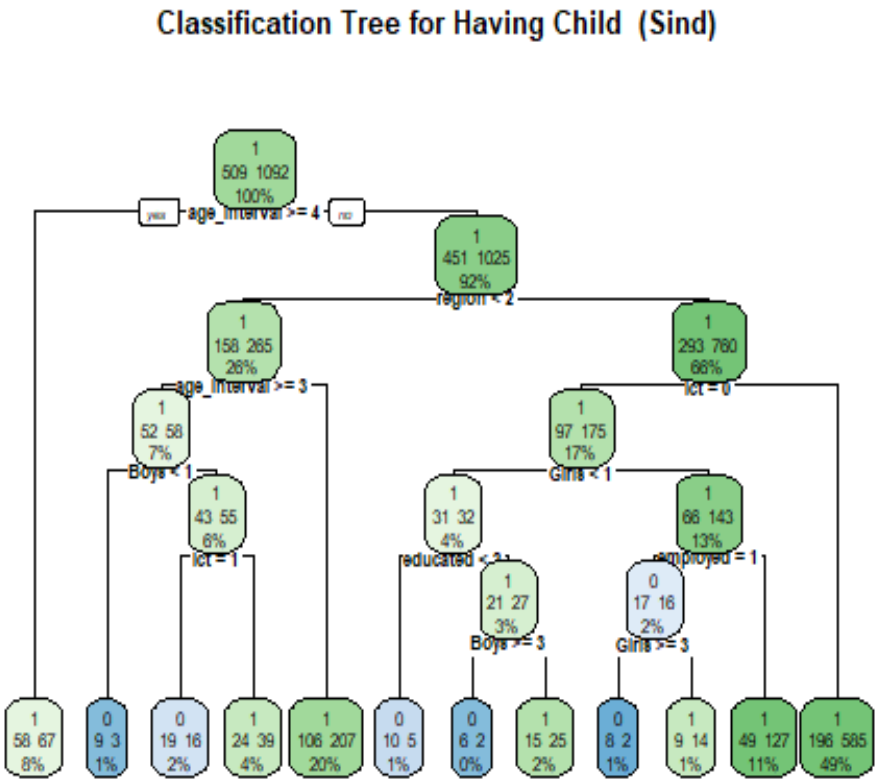


Figure 17 : 5. 10 CART Model for Sindh

In Figure 5.10 the CART model for Sind has been given, which shows that women aged30 and above are the most important predictor regarding the decision for having more children. And there is no other node split on the left side. When the node split on the right side the region is the most important predictor, women who live in the urban region are take more part in decision making rather than which who live in rural areas. Women age and less than and equal to one boy in the family are also an important predictor of decision-making power.

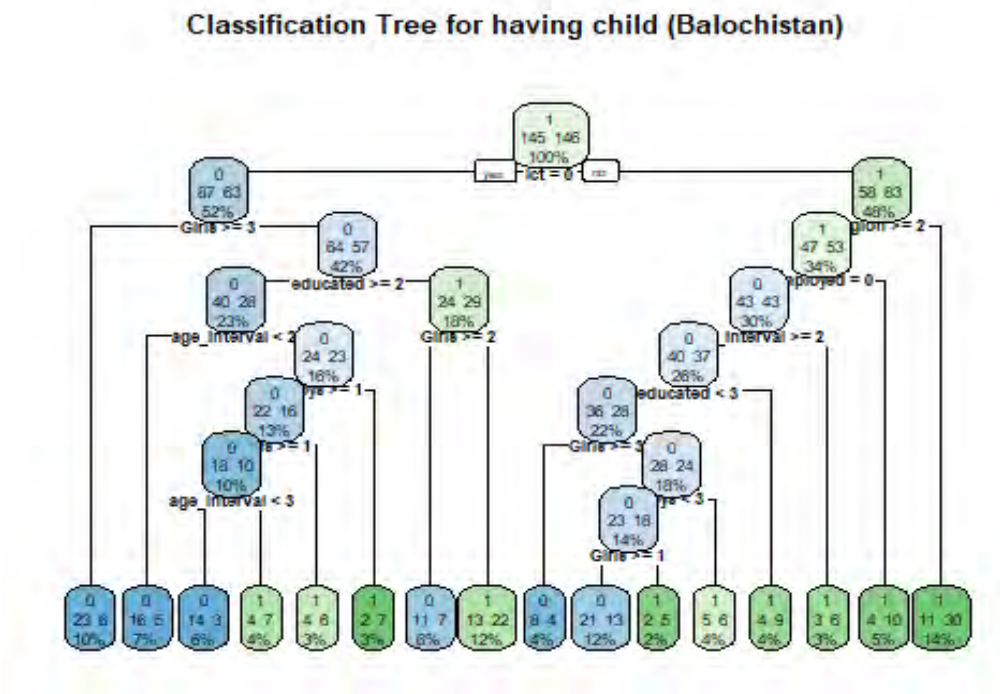


Figure 18 : 5. 11 CART Model for Balochistan

Figure 5.11 shows the decision-making tree for women live in Balochistan, the CART model depict that ICT is the most important predictor for the women to take decisionregarding having more children or not. The nod then split to predictor number of girls, if women have three or more girls than women would take the decision regarding having more children. The tree further split the node for predictors like education, number of boys and age interval. Which shows that if women have; education level is secondary or higher, number of boys in the family are greater than on and age is between 30 to 49 would have more power to take decision-making power.

5.6. Summary

The given study tries to investigate the impact of ICT and other socio-demographicfactors on women‟s decision-making power regarding expenditure (food, clothing, health, travel, and recreation) and having more children. The data has been

taken from Household Integrated Economic Survey (HIES) for the year 2018-19. The data was analyzed through CART technique and binary logistic regression analysis. The study constructed two indices: the expenditure index and ICT index. The results show that women from Punjab have more decision-making power and better access to ICT as compared to women who live in Khyber Pakhtunkhwa, Sindh and Balochistan.

The classification tree shows the predictive variable from amongst the significant independent variables. ICT index turned out to be most predictive then region and age of women followed by education of women and employment status. For Sindh the most important predictor of decision regarding expenditure by women is ICT then the node further splits for number of children and then the age interval. Likewise, for Khyber Pakhtunkhwa the most important predictor is ICT, employment status and education. Therefore, in Khyber Pakhtunkhwa women used ICT, lived in urban region, are educated, and employed have more decision-making power. Surprisingly, in Balochistan ICT is the most important predictor of women‟s decision-making power regarding household level expenditures.

The estimation results of logistic regression showed ICT has positive and significant impact on women‟s decision-making regarding household expenditure and having more children The findings of the study support the policies in favour of ICT penetration and improving women‟s access to education and employment opportunities to enhance women‟s autonomy in Pakistan. As women have a pivotal role in the development of society. Furthermore, from the findings the study could suggest that ICT access for women may be a good measurement tool of women‟s empowerment in Pakistan.

CHAPTER 6

Conclusion and Recommendations

Women constitute about half of the world‟s population, but their share in development is very low. As they are being deprived of most of their social rights in developing countries, and Pakistan is no exception. Due to lower levels of empowerment, women lag behind men in educational attainment, employment status, and knowledge. Furthermore, social, and cultural norms restrict women from participating in various development activities. ICT is considered one of the most important developments for women‟s empowerment. Women can be more independent through ICT penetration by getting online jobs, online education, and health facilities. It reduces the cost and inconvenience of traveling time and reduces workplace harassment which helps women to work from home without going out and earn handsome amounts for themselves and their family.

Agenda 2030 is an overarching development agenda, and this is incomplete without women participation. This agenda covers the gender dimension very comprehensively goal 5 of 17 goals are directly related to women‟s empowerment. Moreover, women's participation and empowerment are crucial for the achievement of all 17 goals. Therefore, it can be easily said that the path to achieving SDGs passes through the awareness of women‟s empowerment. The study analyzed the role of ICT in women‟s empowerment in the case of selected developing countries and Pakistan. Also, it disaggregated the data at provincial and regional level for looking the status of achieving SDGs.

In the first part of the study, examines the interaction between women‟s empowerment and ICT penetration and how it helps in fostering the process of

achieving the SDGs 2030 precisely goal 5, in the case of developing countries. The study's primary purpose is to answer the main research question: how ICT impacts women‟s empowerment? The study has measured women‟s empowerment through the female labour force participation rate and constructed the ICT index from four ICT indicators (internet users per 100 persons, broadband users per 100 persons, telephone lines per 100 persons, and own mobile phone users per 100 persons) by using the data from the WDI from the year 2000-17.

Findings derived from the study are based on econometric analysis, including descriptive statistics, OLS, Pooled OLS, and GMM. The study found that the ICT index has a significant and positive impact on the female labour force participation rate, which also helps in fostering the process of achieving SDGs. In addition, the study found that other control variables like GDP, trade openness, Government consumption expenditures, and fertility rate have a significant impact on the female labour force participation rate.

In the second study, it has been found that women at all decision-making levels are under-represented and poorly engaged in development processes in Pakistan. This implies that the equal right of participation for women in the decision-making process is excluded because of various cultural, regional, and social reasons. The study took the data from PDHS 2017-18 and measured the impact of ICT on women‟s empowerment in Pakistan. The study has taken ever-married women aged 15-49 and constructed the women empowerment index by taking four different dimensions of women‟s decision-making at household level (decisions regarding their health, husband‟s earnings, household purchases, and visits to family & friends). Similarly, the ICT Index has been formulated by summing up two variables: „Number of women owning mobile phones‟ and „Number of women using the Internet.‟ The study also

included several socioeconomic and demographic determinants and applied a Binomial Logistic regression model to measure women‟s decision-making power. The study found that women's mobile ownership and internet usage positively and significantly impact the women‟s empowerment index. This indicates that woman who has access to and uses ICT has more decision-making power than those who do not. The results support the SDGs Agenda 2030, in which goal 5b indicates that ICT helps empower women and girls.

Moreover, from the results, it has been noticed that women‟s education level has a positive and significant impact on the women‟s empowerment index, which shows that educated women have more independence in decision-making than uneducated women. Middle-aged and older women are more empowered than young women in Pakistan. It might be that, in Pakistan, a joint family system is established in which the mother-in-law makes the decisions at the household level. It has been found that husbands‟ education and employment also significantly impact the women‟s empowerment index. Employed and educated husbands are more open-heartedly accepting women‟s empowerment. The study found a high disparity in rural and urban women‟s decision-making power and even at provincial levels in Pakistan.

In the third study, two leading crucial indicators where women are challenged to take their decisions have been taken. These are the women's household consumption expenditure and reproduction decisions, respectively. The study applied the CART technique and binomial logistic model to see how ICT and other socio-demographic factors determine women‟s empowerment. Findings indicate that hardly any women‟s autonomy prevails within Pakistan at the provincial and regional levels. Hence empirical results show that there exists highly constrained autonomy of females in contrast with males within the household. This suggests that a large proportion of

women are excluded from participation in any level of decision-making even at household level. Further, there is a vast difference in the level of participation in decision-making between urban and rural women.

As it has been noticed in the empirical exercise, access to and use of ICT generally improves women‟s decision-making power. The study reveals that the ICT index significantly impacts women‟s decision-making about household expenditure. This indicates that women who own mobile phones or use the internet are making decisions about household consumption expenditure more frequently regarding food, clothing & footwear, travel & recreation, and medical treatment. The study also concludes that women‟s age, education, and work are significant factors in women‟s decision-making about expenditure. The study also finds that an increasing number of male child (boys) enhance the level of women‟s empowerment in the house. The study also concluded from the graphical presentation that women from Punjab and Sindh have more decision-making power in all dimensions of household-level participation.

From the results it can be concluded that women those have the easy access to and use of ICT, more empowered than those who do not have the penetration of ICT easily. While at the national and provincial levels, studies found that middle-aged women were more empowered than those young women. The studies also found huge disparities among women‟s decision-making power at national, provincial, and regional levels. As in urban regions, women are more empowered as it is found that in an urban region, ICT penetration is more frequent than in the rural region. Likewise, women living in Punjab and Sindh havemore decision-making power. From the results, it has been observed that in these provinces,ICT penetration is high compared to other provinces. Therefore, a large proportion of women is excluded from participation in

any decision-making level.

Studies conclude that through ICT penetration, women‟s decision-making can be enhanced at aggregated and disaggregated levels. From the national and provincial level study, the results showed that women from the province of Punjab depict greater empowerment than women from other provinces of Pakistan due to the high level of ICT penetration in the province. Hence to promote women‟s empowerment, greater attention must be paid to show and examine how women operate in their communities and how social norms affect women and their families with and without ICT penetration. Even though the government is running several programs to address the issue but still the situation has remained gloomy mainly because there exists constrained in autonomy of females in contrast with males within the society. Therefore, there is a dire need to extend awareness to empower women across all the country‟s provinces to fasten the development process.

Recommendations

The present studies aim to suggest the policy maker with some recommendations about how to enhance the role of ICT in women‟s empowerment in developing countries, especially Pakistan. Government should make policies through whichthe penetration of ICT expands, for example, IT education, uninterrupted access to broadband services for all. Encouragement and inclusion of women in IT-based economic activities will provide financial and economic emancipation and enhances their decision-making ability and empowerment. This will help in achieve the SDGs 2030 agenda, whose objectiveis no one left behind. As the theme of SDGs is leaving no one behind & empowering women and girls and the current study found that ICT penetration is very low in developing countries, the international organization emphasizes the structural development of ICT in developing countries, so that they

could be further ahead with developed countries and hence empowered women and girls. In the case of Pakistan, at the provincial level, Balochistan is furthest behind. Therefore, policymakers should make such policies that enhance the ICT penetration in Balochistan and make it further ahead. At the regional level, urban women are more empowered than rural women and for achieving the SDGs Agenda 2030 focus should be more in rural women.

The ownership of ICT equipment and, more broadly access to new technology, should be a goal of the policy-makers in the shape of affordable gadgets especially for women and girls. The focus of the current study is on the crucial role that ICT plays in empowering women, which is a novel component of Pakistan's provincial and regional ICT policies. In order to improve girls' and women's ability to participate actively in the growth and development of the Pakistani economy, more IT education and training should be provided at all levels of school. This is encouraged by open jobs for them in teleworking, call centers, the software industry, and freelance services.

Therefore, there is a need to extend awareness to empower women nationwide especially lower wealth quintiles living in the society. In addition, free internet and 4G services should also be provided at the household level. Moreover, the public and private sectors should introduce ICT training and skills-learning programs for women.

There should be ample room for ICT to mainstream gender equality in Pakistan. There is need to promote ICT training, encourage ICT-related employment, and increase ICT access and usage among women. All these policies related to ICT would further empower women and reduce the gender gap that exists in Pakistan as well as in many other countries. The recommendations for policymakers made in light of the study's findings place a strong emphasis on the value of education, home structure, and

other elements that influence women's empowerment through ICT. The following strategies can be used to promote women's access to ICT: increasing girls' and women's educational opportunities; creating demand for ICT education; making IT education and training accessible to women and girls; ensuring that women acquire the necessary skills; and providing microfinance to women.

This study on ICT and women's empowerment has sparked a conversation about changes to include ICT to empower women and meet SDGs in accordance in both the public and commercial sectors of developing nations, particularly Pakistan. The use of ICT will transform the conventional public and government sectors into ones that are streamlined and effective. Hence, ICT penetration will not succeed if it is seen as solely a matter of implementing new technology. By empowering women, we can work towards the SDGs while simultaneously improving everyone's quality of life in the nation. Political, social, and organizational prosperity would result from the role of ICT in empowering women.

Future research will also concentrate on the labour force of women employed in the IT industry, especially in lower-level positions like contact centres, freelancers, etc. To determine if ICT helps to maximise involvement in the labour market, it may be useful to compare these women's positions to those of other professions. Other factors that might be taken into account for future empirical investigation include access to credit as well as ownership and operation of a SME. Research can also examine the factors that link ICT to education, such as how eLearning affects young Pakistani women's ability to make decisions. Incorporate the causality aspect between ICT use and access and women's empowerment as well in the future, as it's possible that the only women who have access to ICT are the ones who are empowered.

REFERENCE

Abrarul Haq, M., Akram, F., Ashiq, U., & Raza, S. (2019a). The employment paradox to improve women‟s empowerment in Pakistan. *Cogent Social Sciences*, *5*(1).

Abrarul Haq, M., Jali, M. R. M., & Islam, G. M. N. (2019b). Household empowerment as the key to eradicate poverty incidence. *Asian Social Work and Policy Review*, *13*(1), 4-24. Acharya, D. R., Bell, J. S., Simkhada, P., Teijlingen, E. R., & Regmi, P. R. (2010). Women‟s autonomy in household decision-making: A demographic study in Nepal. Reproductive Health, 7(15), 1–12.

Afifi, M. (2009). Women's empowerment and the intention to continue the practice of female genital cutting in Egypt. *Archives of Iranian Medicine* 12 (2), 154-160.

Akram, N. (2018). Women‟s empowerment in Pakistan: its dimensions and determinants. *Social Indicators Research*, *140*(2), 755-775

Alavi, M. (1994). Computer-mediated collaborative learning: An empirical evaluation. *MISquarterly*, 159-174.

Ambujam, N. K., & Venkatalakshmi, K. (2009, August). The function of information and technology in empowerment of women. In *2009 2nd IEEE International Conference on Computer Science and Information Technology* (pp. 385-387).

Anitha, L., & Sundharavadivel, D. (2012). Information and communication technology (ICT) and women empowerment. *International Journal of Advanced Research in Management and Social Sciences*, *1*(4), 143-152.

Arellano, M., & Bover, O., (1995), “Another look at the instrumental variable estimation oferror components models”, Journal of Econometrics, 68(1), pp. 29-52.

Arellano, M., Bond, S., (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *The Review of Economic Studies,* 58(2), 277-297.

Asongu S., & Odhiambo N. M., (2018). "ICT, Financial Access and Gender Inclusion in the Formal Economic Sector." African Finance Journal, 22(2), 45-65.

Asongu, S. (2015). The impact of mobile phone penetration on African

Asongu, S. A., & Le Roux, S. (2017). Enhancing ICT for inclusive human development in Sub-Saharan Africa. *Technological Forecasting and Social Change*, *118*, 44-54.

Asongu, S. A., Nnanna, J., & Acha-Anyi, P. N. (2020). Inequality and gender economic inclusion: the moderating role of financial access in Sub-Saharan Africa. *Economic Analysisand Policy*, *65*, 173-185.

Atasoy, H. (2013). The effects of broadband internet expansion on labor market outcomes. *ILR Review*, *66*(2), 315-345.

Awan, A., & Naqvi, S. K. H. (2016). Determinants of Women Empowerment in Pakistan: Some New Evidence from PSLM (2011-12). *Kashmir Economic Review*, *25*(1), 12-30.

Azra Batool, S., Ahmed, H. K., & Qureshi, S. N. (2018). Impact of demographic variables on women‟s economic empowerment: An ordered probit model. *Journal of women & aging*, *30*(1), 6-26.

Baarimah, A.O.; Alaloul, W.S.; Liew, M.S.; Kartika, W.; Al-Sharafi, M.A.; Musarat, M.A.; Alawag, A.M.; Qureshi, A.H. A Bibliometric Analysis and Review of Building Information Modelling for Post-Disaster Reconstruction. Sustainability 2021, 14, 393.

Backhans, A., Fellström, C., & Lambertz, S. T. (2011). Occurrence of pathogenic

Yersiniaenterocolitica and Yersinia pseudotuberculosis in small wild rodents. *Epidemiology & Infection*, *139*(8), 1230-1238.

Badran, M. F. (2010). Is ICT empowering women in Egypt? An empirical study. In

Bankar, R.S.; Lihitkar, S.R. Science Mapping and Visualization Tools Used for Bibliometric and Scientometric Studies: A Comparative Study. J. Adv. Libr. Sci. 2019, 6, 382–394.

Batliwala S., 1995: Defining women‟s empowerment: a conceptual framework, education for women‟s empowerment. In ASPBAE Position Paper for the Fourth World Conference on Women, Beijing, September 1995, New Delhi, Asia-South Pacific Bureau of Adult Education.

Becker, G. S. (1975). Investment in human capital: effects on earnings. In *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education, Second Edition*(pp. 13-44). NBER.

Beyond Access, (2012). Empowering Women and Girls through ICT at Libraries. Retrievedfrom www.beyondaccess.net.

Black, S. E., & Spitz-Oener, A. (2010). Explaining women's success: technological changeand the skill content of women's work. *The Review of Economics and Statistics,* 92(1), 187-194.

Bushra, A., & Wajiha, N. (2015). Assessing the socio-economic determinants of women empowerment in Pakistan. *Procedia-Social and Behavioral Sciences*, *177*, 3-8.

Cagatay N. & Ozler S., 1995, “Feminization of the Labor Force: The Effect of Long-term Development and Structural Adjustment.” World development, 23(11), 1883-1894.

Castro Lopes, S., Constant, D., Fraga, S., Bique Osman, N., Correia, D., & Harries, J.

(2021). Socio-economic, demographic, and behavioral determinants of women‟s empowerment in Mozambique. *PloS one*, *16*(5).

Chaudhry, I. S., & Nosheen, F. (2009). The determinants of women empowerment in Southern Punjab (Pakistan): An empirical analysis. *European Journal of Social Sciences*, *10*(2), 216-229.

Chen, D.H.C., 2004. Gender Equality and Economic Development: The Role for Information and Communication Technologies. Policy Research Working Paper Series (3285), the World Bank.

Cinar, K., & Kose, T. (2018). The determinants of women‟s empowerment in Turkey: A multilevel analysis. *South European Society and Politics*, *23*(3), 365-386.

Coleman, P. K., & Karraker, K. H. (1998). Self-efficacy and parenting quality: Findings andfuture applications. *Developmental review*, *18*(1), 47-85.

Cornwall, A., & Edwards, J. (2010). Introduction: negotiating empowerment. *ids Bulletin*, *41*(2), 1-9.

Department of Economics at LakshmiBai College, Delhi University.

Dixon R. B., Mueller, 1978. Rural Women at Work: Strategies for Development in South Asia. Taylor and Francies.

Dlodlo N. (2009). "Access to ICT Education for Girls and Women in Rural South Africa: A Case Study." Technology in Society.31(2), 168-175

Doumar, A., 2018. Empowering women through new ICT‟s technologies for a faster implementation of the Sustainable Development Goals and a more inclusive Information Society.

Dyson, T. Moore. 1983. "On kinship structure, female autonomy, and demographic behavior in India," Population and Development Review 9(1): 35–60.

Efobi U. R., Tanankem B. V., & Asongu S., (2018). "Female Economic Participation with Information and Communication Technology Advancement: Evidence

from Sub-Saharan Africa" South African Journal of Economics, 86(2), 231-246.

Ejaz, M. (2007). Determinants of female labor force participation in Pakistan: An empirical analysis of PSLM (2004-05) micro data. *The Lahore Journal of Economics*, *12*(1), 203-235. ESCAP, 2021. Inequality in Access to Information and Communication Technologies (ICTs) in East and North-East Asia and South-East Asia. Policy Paper; Social Development Division 1-32 (2021).

Fatima, D. (2014). Education, Employment, and Women‟s Say in Household Decision- Making in Pakistan. CREB Working paper No. 04-14.

Friedman, J. (1992). The past in the future: history and the politics of identity. *American anthropologist*, *94*(4), 837-859.

Geldof, M. (2011). Earphones are not for women: Gendered ICT use among youths in Ethiopia and Malawi. *Information Technologies & International Development*, *7*(4), pp-69. Ghaleb, H., Alhajlah, H. H., Bin Abdullah, A. A., Kassem, M. A., & Al-Sharafi, M. A. (2022). A scientometric analysis and systematic literature review for construction project complexity. *Buildings*, *12*(4), 482.

Global Digital Report, (2019). Digital 2019: Global Internet Use Accelerates, GDR 2019. Guerrero Barreto, M. E., & Ritter Burga, P. I. (2014). The effect of internet and cell phoneson employment and agricultural production in rural villages in Peru.

Gujrati, D.N. (1995). Basic Econometrics 3rd Edition. McGraw-Hill International Edition.New York.

Hafkin, N. (2000). Convergence of concepts: Gender and ICT in Africa. Gender

and theinformation revolution in Africa, 1-18.

Hafkin, N. J., & Huyer, S. (2007). Women and gender in ICT statistics and indicators fordevelopment. *Information Technologies & International Development*, *4*(2), pp-25.

Hafkin, N. J., & Taggart, N. (2001). *Gender, information technology, and developing countries: An analytic study*. Office of Women in Development, Bureau for Global Programs, Field Support and Research, United States Agency for International Development.

Hafkin, N., & Huyer, S. (2006). Cinderella or Cyberella? Empowering women in theknowledge Society. Bloomeld, CT: Kumarian Press.

Hansen, L.P., (1982). Large Sample properties of Generalized Method of Moments Estimators. *Econometrica.,* 50(4), 1029-1054. Published by The Econometric Society.

Heeks, R. (2006). Health Information Systems: Failure, Success and Improvisation.

Hussain, M., Anwar, S., & Huang, S. (2016). Socioeconomic and demographic factors affecting labor force participation in Pakistan. *Journal of sustainable development*, *9*(4), 70-79.

Huyer, S. & Sikoska, T. (2003). *Overcoming the gender digital divide: understanding ICTsand their potential for the empowerment of women*. Santo Domingo: INSTRAW, 2003 Hou, X., & Ma, N. (2013). The effect of women‟s decision-making power on maternalhealth services uptake: evidence from Pakistan. *Health policy and planning*, *28*(2), 176-184.

Huyer, S., & Carr, M. (2002). Information and communication technologies: A priority forwomen. *Gender, Technology and Development*, *6*(1), 85-100.

ICT and Economic Development ILO (International Labour Organization (2018). Annual Report

ILO (International Labour Organization (2020). World Employment and Social Outlook: Trends 2020. Annual Report.

Islam M. S. (2015). “Impact of ICT on Women Empowerment in South Asia”. Journal of Economic and Financial Studies. Vol 3, No. 3, 80-90.

ITU (International Telecommunication Union) (2014). The 2014 Annual Report of International Telecommunication Union.

ITU (International Telecommunication Union) (2017). Measuring the information Society:The ICT development index 2017. Annual Report.

ITU (International Telecommunication Union) (2021). The Need for Increased Digital Accessibility during COVID-19 and beyond.

ITU (International Telecommunication Union) (2022). Global Connectivity Report 2022: Achieving universal and meaningful connectivity in the Decade of Action. Annual Report.

Jabeen, S., Haq, S., Jameel, A., Hussain, A., Asif, M., Hwang, J., & Jabeen, A. (2020). Impacts of rural women‟s traditional economic activities on household economy: Changing economic contributions through empowered women in rural Pakistan. *Sustainability*, *12*(7),2731.

Jain, S. (2006). ICTs and women's empowerment: Some case studies from India.

Joseph, S. (2011). Political familism in Lebanon. *The Annals of the American Academy of Political and Social Science*, *636*(1), 150-163.

Journal of Economic Perspectives., 15(4) 87-100.

Kabeer N. (1994) “Reverse Realities: Gender Hierarchies in Development Thought. London: Verso Publications.

Kabeer, N. (1999). Resources, agency, achievements: Reflections on the measurement of women's empowerment. *Development and change*, *30*(3), 435-464.

Kabeer, N. (2001). Reflections on the measurement of women‟s empowerment. In

Discussing Women‟s Empowerment-Theory and Practice. Sida Studies 3. Novum GrafiskaAB: Stockholm.

Kabeer, N. (2005). Gender equality and women's empowerment: A critical analysis of the third millennium development goal 1. *Gender & Development*, *13*(1), 13-24.

Karl, M. (1995). Women and empowerment: Participation and decision making. Business and Economics., Zed Books 1995.

Khalid, M. W., Samargandi, N., Shah, A. H., & Almandeel, S. (2020). Socio-Economic Factors and Women‟s Empowerment: Evidence from Punjab, Pakistan. *International Economic Journal*, *34*(1), 144-168.

Klasen & Pieters, (2012), "Push or Pull? Drivers of Female Labor Force Participation duringIndia‟s Economic Boom." IZA Discussion Paper No. 6395.

Klonner, S., & Nolen, P. J. (2010). Cell phones and rural labor markets: Evidence from South Africa. Proceeding of the German Development Economics Conference.

Laizu, Z., Armarego, J., & Sudweeks, F. (2010). *The Role of ICT in Women's Empowerment in Rural Bangladesh.* Proceedings Cultural Attitudes towards Communication and Technology 2010, Murdoch University, Australia.

Lennie, J. (2002). Rural Women's Empowerment in a Communication Technology project;some Contradictory effects. *Rural Society,* 12(3), 224-254.

Levis, M. (2011). Working toward women‟s economic empowerment: Using information and communication technology in developing areas to market traditional crafts. In *International Conference on Human-Computer Interaction* (pp. 266-273).

Longwe, Sara H. (1990). „From Welfare to Empowerment", Office of Women in

International Development, Working Paper 204, Michigan State University

Mackey, K. A. (2012). Mobile Phones and Gender Inequality: Can We Hear Her Now?

Mahmud, S., Shah, N. M., & Becker, S. (2012). Measurement of women‟s empowerment in rural Bangladesh. *World development*, *40*(3), 610-619.

Malhotra, A. Sidney R. S. & Carol B. (2002). “Measuring women‟s empowerment as a variable in international development,” mimeo, International Center for Research on Women

Mann, C. J. (2003). Observational research methods. Research design II: cohort, crosssectional, and case-control studies. *Emergency medicine journal*, *20*(1), 54-60.

Mansell, R. (2014). Empowerment and/or disempowerment: The politics of digital media. *Popular Communication*, *12*(4), 223-236.

Mansell, R., & Wehn. (1998) “Knowledge Societies: Information Technology for Sustainable Development.” Oxford University 1998.

Marcelle, G. M. (2002). Information and Communication Technologies (ICT) and theirImpact on and use as an Instrument for the Advancement and Empowerment of Women.

Martin Hilbert. 2010. Digital Gender Divide or Technologically Empowered Women in Developing Countries? Women‟s Studies International Forum, 3(6), 479-489.

Mason, L. (2006). Mixing Methods in a Qualitatively Driven Way. Qualitative Research, 6(1), 9-25.

Mehra, R. (1997). Women, empowerment, and economic development. *The Annals of the American Academy of Political and Social Science*, *554*(1), 136-149.

Mitchell, M., & Gillis, B. (2007). Making Sense of the Relationship between ICT and

Economic Development Retrieved March 14, 2008, from

Mitra, A. (2019). “Women Work in Response to Urbanization: Evidence from Odisha”. ANTYAJAA: *Indian Journal of Women and Social Change,* 4(1), 92-106.

Mitter, S., 2006. Globalization and ICT: Employment Opportunities For Women. Part III Mosedale, S. (2005). Assessing women's empowerment: towards a conceptual framework.*Journal of international development*, *17*(2), 243-257.

Mushtaq, A., Mohsin, A., & Zaman, K. (2013). Effects of health on changing labor forceparticipation in Pakistan. *Springerplus*, *2*, 1-10.

Ndaimani A, Mhlanga M, Dube-Mawerewere V. (2018). The association between women‟s empowerment and uptake of child health services: a demographic and health survey-basedsynthesis. Rockville, Maryland, USA.

Nikulin, D. (2017). The impact of ICTs on women‟s economic empowerment. In Catalyzingdevelopment through ICT adoption (pp. 15-24). Springer, Cham.

Obayelu A. & Ogunlade, 2006. “Analysis of the Uses of Information Communication Technology (ICT) for Gender Empowerment and Sustainable Poverty Alleviation in Nigeria.” International Journal of Education and Development, 2 (3), 45-69.

OECD (Organization for Economic Co-operation and Development) (2002). Measuring theinformation economy 2002 (pp. 94).

OECD (Organization for Economic Co-operation and Development) (2017). “The Pursuit of Gender Equality: An Uphill Battle, OECD.

Ogato, G. S. (2013). The Quest for Gender Responsive Information Communication Technologies (ICTs) Policy in Least Developed Countries: Policy and Strategy Implications for Promoting Gender Equality and Women‟s Empowerment in

Ethiopia. International journal of information technology and business management, 15(1): 23-44.

Perryman L.A., & Arcos B. L., (2016). “Women Empowerment through Openness: OER, OEP and the Sustainable Development Goals. Open Praxis, 8(2), 163-180.

Political Science Theses. Paper 52. Prasad, P. N., & Sreedevi, V. (2007). Economic Empowerment of Women through Information Technology: A Case Study from an Indian State. *Journal of International Women's Studies,* 8(4), 107-119.

Proceedings of the Research Voices from Africa Workshop, IFIP WG (Vol. 9).

PTA (Pakistan Telecommunication Authority) 2022. Global PTA Market Research Report2022.

Rahman, M. H., & Naoroze, K. (2007). Women empowerment through participation inaquaculture: Experience of a large-scale technology demonstration project in Bangladesh.

Riaz, S., & Pervaiz, Z. (2018). The impact of women‟s education and employment on theirempowerment: empirical evidence from household level survey. *Quality & Quantity*, *52*(6),2855-2870.

Raja, V. P., Prabhu, H., and Revathi. S., (2013), construction and validation of attitude towards information and technology scale (ATICTS), “International Journal of teacher‟s educational research, 2(3), Pp.14-24.

Romer, P. M. (1990). Endogenous technological change. *Journal of political Economy*, *98*(5, Part 2), S71-S102.

Samari, G., & Pebley, A. (2015). Individual and Household Determinants of Women‟s Autonomy: Recent Evidence from Egypt. *UCLA CCPR Population*

Working Papers.

Sen, G. (2019). Gender Equality and Women's Empowerment: Feminist Mobilization for the SDGs. *Global Policy, 10*(1).

Shahnaz, L., & Kizilbash, Z. (2002). Commenting on the causal factors controlling female decision making" a study of female decision making regarding paid employment: Punjab, Pakistan. *The LAHORE Journal of Economics, 7(1), 75-88.*

Shehata A. M. H., (2017). "Role of Information and Communication Technology in closing Gender Employment Gap in MENA Countries." The Business and Management Review, 8(4), 168-178.

Shultz, T. W., 1961. "Investment in Human Capital". *The American Economic Review,*

Suhaida, M. A., Nurulhuda, M. S., & Yap, S. F. (2013). Access to ICT as moderating factor to women's participation in the labor force: A conceptual framework. *International Journalof Trade, Economics and Finance*, *4*(4), 197.

Thandar, M., Win, N., & Moe, H. H. (2019). Women's Empowerment in Myanmar: An Analysis of DHS Data for Married Women Age 15-49. *Demographic and Health Survey's*,*143*, pp. 1-32.

U. N., (1995). Fourth world conference on women. *United Nations Women. September*.

U. N., (2013). Large Gender Gap Exists among Internet Users Worldwide. Report by Broadband Commission Working Group.

U. N., 2015. The World‟s Women: Tends and Statistics. Economic and Social Affairs.

UN. 2019. Human Development Report 2019, United Nations.UNDP., (2016). Gender and Indicators. *Annual Report.*

UNESCO. (1995). Some reflections on the empowerment of women. *Women, Education and Empowerment: Pathways towards Autonomy., Hamburg,*

Germany: UNESCO Institutefor Education, 23-37.

UNESCO. (2009). Guide to measuring information and communication technologies (ICT)in education.

UNICEF., (2006). Empowering Women, Changing Children Live. UNICEF *Annual Report*. United Nations *Annual Report* 2015.

Verick, Sher (2014). "Female labor force participation in developing countries." *IZA Worldof Labor* (2014).

WB (World Bank) (2019). The World Bank Annual Report 2019: Ending Poverty, Investingin Opportunities.

WB (World Bank) (2022). The World Bank Annual Report World bank 2022.

WEF (World Economic Forum) (2017). Global Gender Gap Report 2017.

WEF (World Economic Forum) (2021). Global Gender Gap Report 2021.

Wood, A. (1998). "Globalization and Rise in the Labour Market Inequalities." *The Economic Journal,* 108(450), 1463-1482.

Wooldridge, J.M., (2001). Application of Generalized Method of Moments Estimation.

World Bank (2007). Empowerment in practice: Analysis and implementation. A WorldBank Learning Module. Briefing paper, 72 pages.

World Summit on the Information Society (WSIS) (2003) Declaration of Principles. Building the Information Society: A Global Challenge in the New Millennium. Geneva 2003.

Yalcinkaya, M.; Singh, V. Patterns and trends in Building Information Modeling (BIM) research: A Latent Semantic Analysis. *Automation in Construction.* 2015, 59, 68–80.

Appendix: A

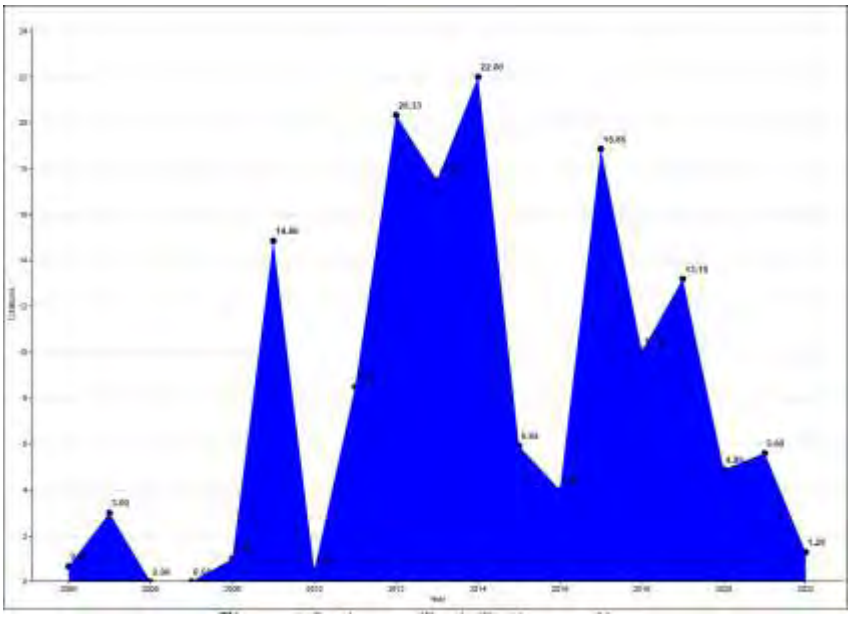


Figure 19 : Average Total Citation per Year

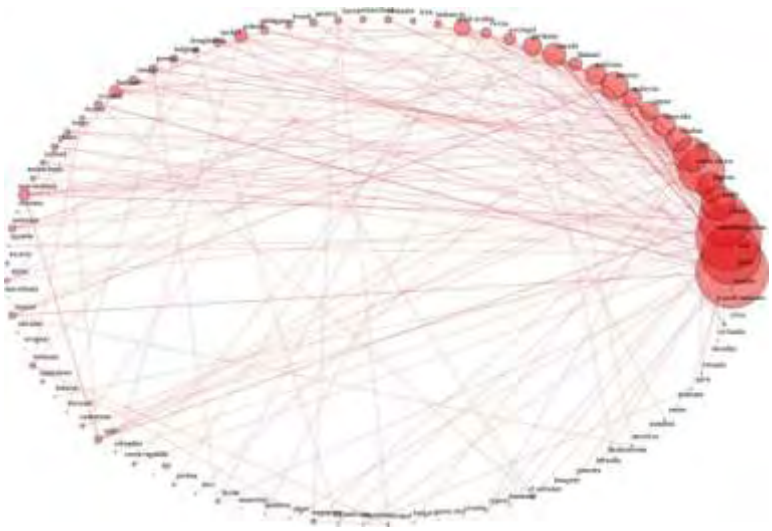


Figure 20 : Country Scientific Collaboration

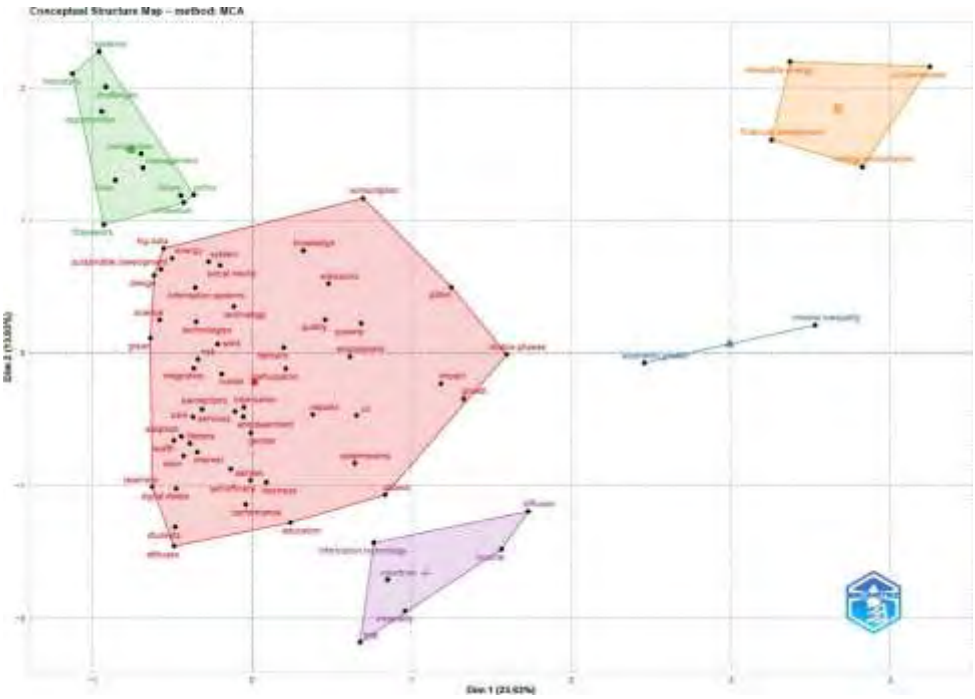


Figure 21 : A Structure Map

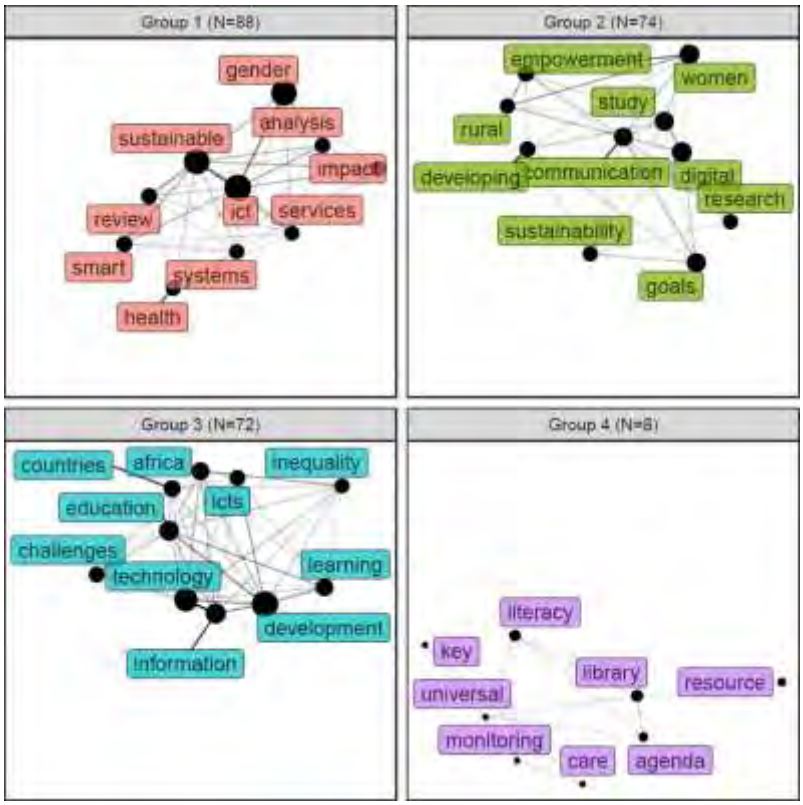


Figure Word Cloud Plot

APPENDIX: B

Table Countries with ICT Development Index Rank 2015 and Global Gender Gap Ranking 2018:

No.	Countries	IDI-2015	GGGI-2018	No.	Countries	IDI-2015	GGGI-2018
1	Albania	4.60	20	27	Kyrgyz Republic	3.90	93
2	Algeria	3.70	132	28	Lao PDR	2.20	43
3	Argentina	6.20	30	29	Lebanon	5.90	145
4	Armenia	5.30	98	30	Mexico	4.50	25
5	Bangladesh	2.30	50	31	Moldova	5.60	23
6	Bulgaria	6.40	49	32	Morocco	4.30	143
7	Belarus	7	29	33	Mauritius	5.30	115
8	Belize	3.30	110	34	Malaysia	5.60	104
9	Bolivia	3.50	42	35	Namibia	3.20	12
10	Brazil	5.70	92	36	Nicaragua	2.70	5
11	Bhutan	3.10	131	37	Pakistan	2.20	151
12	Botswana	3.80	73	38	Peru	4.20	66
13	Cambodia	2.80	89	39	Philippines	4	16
14	Cameroon	2.10	96	40	Paraguay	3.90	100
15	Colombia	5	22	41	Romania	5.90	55
16	Costa Rica	6	13	42	Russian-Federation	6.80	81
17	Cuba	2.60	31	43	South Africa	4.70	17
18	Dominican	4	86	44	Sudan	2.60	
19	Ecuador	4.50	48	45	Senegal	2.40	99
20	Egypt	4.30	134	46	Sri Lanka	3.60	102
21	El Salvador	3.60	80	47	Serbia	6.50	39
22	Guatemala	3.10	113	48	Thailand	5.10	75
23	India	2.50	112	49	Turkey	5.50	130
24	Indonesia	3.60	85	50	Ukraine	5.20	59
25	Iran	4.70	148	51	Venezuela	5.20	67
26	Kenya	2.80	109				

Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) FLFP	1.000									
(2) flfp_1	0.997	1.000								
(3) ict_index	0.047	0.048	1.000							
(4) GDP	0.077	0.076	-0.249	1.000						
(5) GCE	0.082	0.080	-0.158	0.230	1.000					
(6) GEE	-0.006	-0.006	0.109	0.005	0.022	1.000				
(7) GFCF	0.033	0.035	-0.117	0.398	0.100	0.017	1.000			
(8) tradeopennes	0.282	0.281	0.209	0.007	-0.014	0.029	-0.022	1.000		
(9) fertility	0.032	0.030	-0.453	0.045	0.167	-0.009	0.008	-0.186	1.000	
(10) urban_ratio	-0.038	-0.044	0.433	-0.223	-0.180	0.163	-0.054	-0.015	-0.458	1.000

Table Time Series Analysis of 12 Countries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	**LAO**	**SEN**	**SWI**	**BLR**	**BWA**	**CUB**	**IRN**	**NAM**	**ROU**	**RUS**
flfp_1	1.195***	0.703***	0.841***	1.469***	0.154	0.0837	-0.536**	-0.501	0.788***	-0.378*
	(0.0937)	(0.0450)	(0.206)	(0.0854)	(0.161)	(0.154)	(0.194)	(0.348)	(0.139)	(0.188)
ict_index	0.0104**	-0.00926	0.0266**	-0.0291***	0.319	-0.0377	-0.406***	0.695***	-0.349	0.0633**
	(0.003)	(0.007)	(0.001)	(0.006)	(0.184)	(0.0574)	(0.110)	(0.171)	(0.239)	(0.0173)
GDP	-0.000	-0.001*	0.000	7.33e-05	-0.00342*	0.003***	-8.09e-05	0.002	0.001	0.000
	(0.000)	(0.000)	(0.000)	(6.18e-05)	(0.001)	(0.000)	(0.00126)	(0.002)	(0.001)	(0.000)
GCE	-0.000	0.0110**	0.001	0.005	0.0267	-0.0951*	0.177***	-0.001	-0.0526	0.0853**
	(0.000)	(0.004)	(0.002)	(0.005)	(0.0441)	(0.0426)	(0.0360)	(0.0518)	(0.061)	(0.0305)
GEE	-0.007	0.005	-0.0235	-0.0159	-0.0622**	0.0492	4.627***	-1.429***	-1.172	0.355
	(0.0145)	(0.011)	(0.0504)	(0.0273)	(0.0221)	(0.0700)	(0.719)	(0.373)	(1.759)	(0.379)
GFCF	0.001**	0.001***	-0.001	-0.00140	-0.0757***	-0.0317***	-0.0335	0.0181	0.0911*	-0.00044

	(0.004)	(0.000)	(0.003)	(0.000)	(0.0176)	(0.00776)	(0.0219)	(0.0122)	(0.0390)	(0.00334
UR	-4.741	3.335	-2.264	-22.30***	-123.7	-104.3	276.8**	-210.9**	1,185*	-241.6**
	(4.404)	(6.113)	(9.316)	(4.293)	(76.68)	(68.47)	(95.67)	(63.80)	(610.1)	(87.63)
Trade	0.352**	-1.217**	-0.136	-0.353**	13.44***	12.52**	13.61	3.061	-12.72	-9.012*
	(0.116)	(0.471)	(0.419)	(0.104)	(2.913)	(4.739)	(10.06)	(3.153)	(10.59)	(4.401)
Fertility	-0.626	-1.171***	-0.066	0.391**	-69.80**	-25.12***	-3.601	-16.38*	15.31*	-1.416
	(0.430)	(0.252)	(1.603)	(0.131)	(21.53)	(5.585)	(6.705)	(8.446)	(7.986)	(0.825)
Constant	-12.07	16.20***	5.523	-8.845**	325.1**	139.7**	-173.6**	201.0***	-632.8*	251.6**
	(6.585)	(3.050)	(13.43)	(3.590)	(109.3)	(53.58)	(73.41)	(56.05)	(327.2)	(73.18)
Obs.	17	17	17	17	17	17	17	17	17	17
R-squared	1.000	1.000	1.000	1.000	0.993	0.997	0.975	0.971	0.948	0.983

Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1