



ISSN-Online : 2520-503X
ISSN-Print : 2523-0026

NUST JOURNAL OF SOCIAL SCIENCES & HUMANITIES

**SPECIAL ISSUE ON POPULATION CHALLENGES
IN A CHANGING WORLD, NOVEMBER '22**



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Editorial

Pakistan is endowed with scientists and scholars of exceptional talent who are engaged in groundbreaking research. Yet, only a limited proportion of the knowledge they produce ends up in publications and reaching people absorbed in research and policy-making. At the 22nd Annual Conference of the Population Association of Pakistan (PAP), held at the National University of Sciences and Technology (NUST), Islamabad, 18 papers were presented in technical sessions and 13 studies were displayed through posters. To share findings of these studies with a wider group of stakeholders, PAP and NUST jointly made efforts to bring out the Special Issue of NJSSH. A number of papers were selected in line with NJSSH's mandate of publishing interdisciplinary original research. Professor Gavin Jones reviewed these submissions and provided comments and suggestions to authors. This *Editorial* was to have been written by Professor Jones, but sadly, he passed away before the Special Issue could be finalized. *In Memoriam of Professor Gavin Jones* describes Professor Jones contributions globally and to population and development research and policy in Pakistan, in particular.

Given the breadth of topics covered in this Special Issue, the Editorial is to introduce the contents briefly rather than discuss in-depth a specific subject. The first paper is an overview, by Arif et al., of the 22nd Population Research Conference of PAP on the theme of *Population Challenges in a Changing World*. The paper eminently covers the population challenges, social, economic and demographic implications of high population growth, opportunities of resilience and climatic change. The Conference presentations and deliberations foretold the devastations due to climatic changes that Pakistan encountered six months later. Thirteen recommendations emerged from the papers presented and the discussions held during the Conference. Perhaps the most important take away message from the Conference was to emphasize the goal of all research for the betterment of society by improving the lives of people through evidence-informed policies and actions. The role of research in providing such evidence is, therefore, critical.

The first of the six substantive papers entitled: *Thirty Years of Consanguineous Marriages in Pakistan* by Bashir and Nazir shows that 50 percent of all marriages continue to be amongst first or second cousins and this pattern has remained relatively constant from 1990-91 to 2017-18 despite an increase in female education and urbanization. In contrast to what is generally perceived, contraceptive use among consanguine marriages of first cousins was higher than those who are unrelated. Also, the mean number of children ever born among consanguine marriages was lower than among unrelated. These

results call for additional research on the pathways to reproductive outcomes by consanguinity status as well as interventions to increase female labour force participation that has potential to empower women to participate in decision-making including when to marry and who to marry.

The paper by Mujahid, Noman and Noman on: “*The Myth of Missing Women: A Case Study of Pakistan*” investigates the absence of women in Pakistan economy as a result of gender inequality. The paper utilizes novel analytical approaches and various datasets to examine the trends in “missing” (from economy) women. The increased in female literacy and other improvements have not translated to increased female work participation and empowerment, thus depriving the nation from enormous economic gains and improving gender equity.

Zafar et al in their paper: “*Patterns of Health Services Utilization During Pregnancy, Delivery, and Postpartum Period: Evidence from Pakistan Maternal Mortality Survey*” show that the utilization of health services varies by province/region as well as by parity, education, and, more importantly, household wealth quintile. For example, while only 3.5 percent of women in Balochistan received ideal antenatal care, the corresponding figures were 35.8 percent for Azad Jammu and Kashmir (AJK) and 27.9 percent for Punjab. However, the percentage of births by skilled attendant was the lowest in AJK - 22.8% - compared to 78 percent in Punjab. Only 26.7% women in Balochistan received postnatal care as compared to 70.8 percent in Punjab. Using a new indicator of Ideal Antenatal Care (IANC)¹, the authors find that women with parity 3-5 and 6 or more compared to those with parity 1-2, women with 1-10 years of schooling and those 10 or higher compared to those with no education and women with higher wealth quintile compared to the lowest, have a higher likelihood to receive IANC during pregnancy. Differentials in the patterns of skilled birth attendant and postnatal care by background characteristics were significant. It is obvious that Pakistan will have to make a substantial improvement in women’s access to maternal, newborn and child health services and in improving quality of these services in order to save women’s and newborns’ lives and to meet the SDG target of reducing maternal mortality ratio to 70 per 100,000 live births by 2030.

¹ IANC is, defined as the percentage of women with four or more ANC visits to a skilled healthcare provider during pregnancy, at least one ANC visit in the first trimester, blood and urine tests carried out and BP measured, iron tablets prescribed and nutritional counselling was given, and at least one TT injection received for their most recent pregnancy that resulted in a live birth, stillbirth, miscarriage or abortion in the last five years.

Going beyond the focus of population and reproductive health, Khan et al consider “*Estimating the Nexus Among Demographic Dividend, Economic Growth, and Environmental Degradation for Pakistan*”. The economic growth potential due to the demographic dividend resulting from the changes in the population's age structure in Pakistan has received considerable attention recently. Khan et al examine the role of Pakistan's demographic dividend by controlling the impacts of technological innovations, capital formation on Pakistan's economic growth, and environmental degradation during 1980-2018. The authors use a complex econometric analytical strategy to disentangle the closely interlinked aspects of demographic dividend, economic growth and environmental degradation. The prospects of economic growth and environmental degradation are measured and their short- and long-term implications are identified. The results call for devising sustainable development policies for the youth to tap their potential in the development of Pakistan. The authors recommend that government must introduce policies that could create awareness for the development of green technologies, sustainable production practices in industry and agriculture, the energy sector, and in other projects like the China Pakistan Economic Corridor (CPEC). The demographic dividend is not a gift, it has to be earned through concerted efforts to strengthen education and skills of young people and to engage them in productive activities.

Another multidimensional topic of “*The Role of Poverty, Food Security, and Rapid Population Growth on Human Development in Pakistan*” was addressed by Mujeeb-ur Rehman et al. Using data from Human Development Index (HDI) reports, the study estimated the impact of food insecurity, poverty, and population growth on the human development of Pakistan over 1990-2018. As expected, food security and increased income in Pakistan tend to raise its human development. There is a mutual causation between human development, poverty and population growth. While human development can play a crucial role in reducing poverty, access to food and reduce population growth, it is also determined by these factors. Reducing Pakistan's high population growth rate is an urgent priority. In addition, investment in mechanization of agriculture is urgently needed to increase production of agricultural commodities to avoid expanding food insecurity due to rapid population growth.

The last paper in this Special Issue by Bari and Kouser addresses the topic of “*Unveiling the Impact of International Migration on the Economic and Subjective Wellbeing of Men and Women in Punjab, Pakistan*”. Using data from the Multiple Indicator Cluster Survey (MICS) 2017-18, the paper

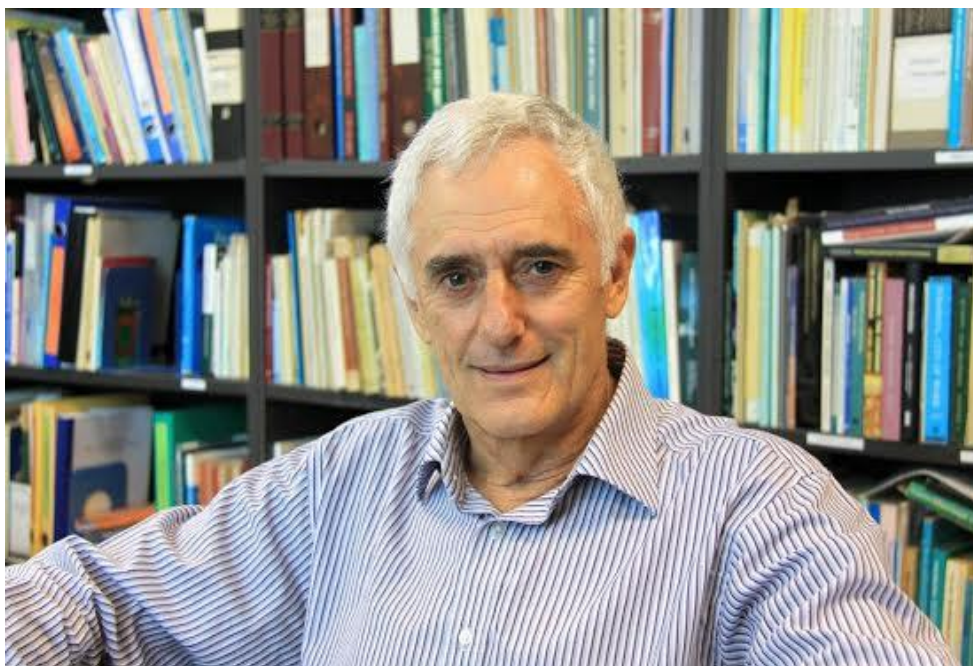
examines the impact of receiving international remittances on the economic and subjective wellbeing of men and women in the same household in Punjab. After controlling for various socio-economic characteristics at individual and household levels, women who received remittances were 1.1 times more likely to report high levels of subjective wellbeing. This association was however not significant for men. The results support encouraging inflow of remittances as they improve wellbeing of people. In addition, these remittances continue to support Pakistan's balance of payment and critical to its domestic economic growth.

Despite the remarkable resilience of people of Pakistan, the country continues to face a number of population, development, and environmental challenges. This Special Issue has provided evidence on these issues, their linkages with each other, their determinants and consequences by using scientifically robust techniques and representative data. All papers provide policy implications based on the evidence generated.

I am grateful to all authors, Dr. G. M. Arif, Dr. Faisal Jamil and to Professor Gavin Jones for their contributions to this Special Issue of NJSSH. The Special Issue brings together an exceptional collection of papers addressing critical issue by employing innovative and scientifically rigorous methods and bring forth important policy and program recommendations which, if acted upon, would improve the lives and well-being of people of Pakistan.

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In memory of Professor Gavin Jones



Professor Gavin Jones, the Editor of this Special Issue of NJSSH passed away on 27 August 2022 at the age of 81. He accepted the invitation of editorship in June 2022 and did the initial review of all articles submitted for the Special Issue. We are deeply saddened by the passing of Professor Gavin Jones. He was Emeritus Professor at the Australian National University (ANU), Canberra, Australia.

Professor Jones was a leading figure in Asian Demography and was widely respected and much admired throughout the international demographic community. He was with the Demography and Sociology Program at the ANU for 28 years, and with the National University of Singapore for 11 years before retiring in 2014. During this illustrious career spanning over 50 years, he published about 30 books and Monographs and 170 refereed journal articles and book chapters. He supervised more than 40 successful PhD candidates. He was the teacher and supervisor of many Pakistani demographers who graduated from the ANU.

In 1966, Professor Gavin Jones was awarded his PhD in Demography from the Australian National University for work on the labour force of Malaysia. His first position in his professional career was with the Population Council in New York City where he moved his family soon after graduation. Over the next decade, he represented the Council in Bangkok and Jakarta

consulting on issues of rapid population growth with government offices and universities. He developed fluency in Thai and Indonesian languages, to the delight of his local colleagues. In 1975, he rejoined the ANU. He was made Professor in 1985.

Professor Jones was a longtime active member of the International Union for the Scientific Study of Population (IUSSP) which he joined in 1967 and served as a member of several IUSSP scientific committees and panels: Member of Committee on Urbanization and Population Redistribution (1976-1980), Chair of the Committee on Economic Consequences of Alternative Demographic Patterns (1985-1989), and Member of the Panel on Process and Dynamics of Cross-border Marriages (2010-2012).

Professor Jones's long career was deeply connected to Southeast Asia. However, he worked across nearly the whole of Asia, he turned out path-breaking analyses of the labour force, education, fertility, mortality, marriage, urbanization, ageing and family planning. He was well known among government planners in Indonesia, Malaysia, Thailand, Pakistan and Bangladesh for his incisive and thoughtful suggestions for their national population policies.

Professor Jones also had a long association with the demographic community of Pakistan. He was the keynote speaker at the launching ceremony of the Population Association of Pakistan (PAP) in 2000 at the Agha Khan University, Karachi. He participated in the PAP's annual conferences in 2018 and 2022 held respectively at the University of Peshawar and National University of Science and Technology (NUST), Islamabad. He also delivered lectures at the annual conferences of Pakistan Society of Development Economists, organized by the Pakistan Institute of Development Economics (PIDE), Islamabad. More recently Professor Jones was a leading member of a UNFPA team who carried out the Population Situation Analysis in 2019-2020. It is sad that he will not be with us, but his legacy of profound impact on national policies and programs and imparting demographic skills and expertise to a large number of professionals will last forever. Professor Jones has left a generation of students including many Pakistanis who continue to excel by implementing the knowledge they gained and skills they acquired from him. While celebrating his life and achievements, we are grateful for his contributions especially in guiding professionals in Pakistan and identifying issues and solutions to improving population well-being and development.

G. M. Arif,
Population Association of Pakistan

Population Challenges in a Changing World: An Overview of the 22nd Annual Research Conference of the Population Association of Pakistan

G. M. Arif, Xaher Gul, Seemin Ashfaq, Mahnoor Fatima, and Tahir Qureshi

1. INTRODUCTION

The Population Association of Pakistan (PAP), established in 2000, continues to emphasize the crucial relationship between population and development. The population and development programs in Pakistan have not progressed as steadily as in most of the countries in the region or other Muslim-majority countries such as Egypt, Indonesia, Iran, and Turkey. PAP provides a platform that offers an opportunity to bridge the various social sciences disciplines including economics, public and social policy, statistics, demography, public health, sociology, geography, and anthropology to deliberate upon solutions for pressing population and development related issues of Pakistan in this changing world.

The 22nd Annual Population Research Conference of PAP was held at the National University of Sciences and Technology (NUST), Islamabad from 7th to 9th December 2021 in a hybrid mode encompassing both virtual and in-person participation at the NUST. The theme of the Conference was “Population Challenges in a Changing World” with three specific sub-themes:

- I. Population, Universal Health Coverage, and Family Planning, in the context of COVID 19;
- II. Social, Economic, and Demographic Implications of High Population Growth; and
- III. Opportunities and Challenges for Resilience to Climate Change.

Spanning these three sub-themes, divided across technical and plenary sessions, 18 research papers were presented and discussed in the technical sessions, while in the four plenary sessions key population challenges in Pakistan were discussed by the experts. Findings of 13 additional research studies were displayed on posters, which provided the respective authors an opportunity to interact directly with conference participants.² All these sessions

¹ The authors are respectively President, Secretary General, Vice President, Research Associate and Administrative Officer of the Population Association of Pakistan.

² For detail on these research papers and studies including their authors, please see Appendix A.

of the conference provided a holistic view of the contemporary challenges to the population and discussed the opportunities available for Pakistan. The President of Pakistan, Dr. Arif Alvi chaired the inaugural session of the Conference.

Based on the presentations and discussions held during different sessions of the conference, the rest of this paper is divided into the following sections: (i) setting the context; (ii) population challenges for Pakistan; (iii) key findings of the plenary sessions; (iv) key findings of the technical sessions, (v) recommendations; and (v) the key take away.

2. SETTING THE CONTEXT

A key highlight of the Conference was the invited lecture on “Population Challenges in a Changing World” by Dr. Adil Najam. His lecture set the context for the Conference, showing that the world is changing, and that the confluence of multiple transformations in economics, politics, globalization, security, health, and human behaviors makes the current change greater, different, and more significant than all changes that have ever been witnessed. Three pertinent changes at the forefront of all discussions, synthesis, and policy directives are: climate change, change in age structure of populations, and the new normal of the world post-Covid19 pandemic.

3. POPULATION CHALLENGES FOR PAKISTAN

Seven key population challenges for Pakistan were highlighted and discussed during the Conference. These include:

- a) Despite considerable political will, and a commitment to raise contraceptive prevalence rate (CPR) to 50% by 2025 by the Council of Common Interests (CCI), CPR has stagnated around 30- 35% since 2007. The progress on the other population targets of reducing total fertility rate (TFR) to 2.8 children per woman and the population growth rate to 1.5% by 2025 set by the CCI is slow as well. Because of the continued ineffectiveness of family planning campaigns, unmet need remains high. There are no perceived incentives for provinces with low populations to reduce population growth due to population-based funding sources.
- b) Although the decline in fertility in Pakistan is slow, the ongoing demographic transition has opened the window of opportunity in the

form of youth bulge and changes in working age population. How to leverage this opportunity, however, continues to be a challenge which remains unaddressed?

- c) Climate change, poverty and food insecurity are the biggest challenges to Pakistan in this century. There is no federal body for supporting a coordinated, national response to climate change. While provincial bodies exist, the response is fragmented, providing discrepant policy actions across the country.
- d) COVID 19 is identified as a big challenge over the past two years. Pakistan fared very well on both health and economic aspects through the revolutionizing formation of its departments and the rapid use of data to take decisions across departments. The challenge is how to switch back to ordinary life after COVID?
- e) The government of Pakistan is planning to conduct a fresh population and housing digital census. Considering the serious issues and concerns related to the 2017 census, the holding of 7th census is a challenge for the country.
- f) Globalization was also identified as a challenge for the country in that Pakistan continues to lag behind other nations in this regard. However, there are various strategies through which Pakistan is becoming global and setting its mark in the larger world through modernization of agriculture, trade liberalization, promotion of science and technology, improving information technology and communication, and upgrading its human development.
- g) Pakistan's slow uptake of digital technology and the consequential digital divide in the country is a challenge for the nation.

4. KEY FINDINGS OF THE PLENARY SESSIONS

Achieving CCI Targets

The first-ever right-based National Narrative on Population that is focused on the balance of resources and responsibilities is acknowledged as a breakthrough in documenting a policy position on population dynamics and providing a national standard for social and behavior change communication for family planning. This narrative has been developed with broad-based political support, is constitutionally sound, and culturally congruent for positive communal reception. The core of the new narrative positions family planning as a right, and underscores the importance of individual choice, rather than

viewing family planning as a policy position that only reinforces prevalent social and religious teachings. The narrative is approved by both the federal and provincial stakeholders as well as the Council of Islamic Ideology.

Pakistan's policy and programmatic approach to family planning in the 1960s used to be cited as a model for other developing countries. After a prolonged period marked by fragmentation and stagnation of a coherent national family planning response, there is a resurgence of coordinated efforts by provinces to accelerate nationwide adoption of family planning. Panelists in the conference presented a province-wise analysis of efforts and progress to achieve the targets set by the CCI. In Sindh, a provincial task force has been established. The annual allocation in budget for population welfare has increased from PKR 2.16 billion to PKR 5 billion. Other initiatives include training of District Population Welfare Officers (DPWOs), capacity building of providers and facilities, and mobilization of support from religious scholars for family planning. Further work on contraceptive commodity security was done through allocation of PKR 9 million which indicate Sindh's commitment to achieving goals set by the CCI. In Balochistan, however, unique challenges related to difficult geographic terrain were identified as barriers to mounting an effective province-wide response. While health and hygiene contents have been included in secondary school education, and legal ramifications for early childhood marriages are in consideration with support from religious scholars, no meeting of the provincial task force could be conducted and the allocation of budget for family planning is low with only PKR 30 million annually. Punjab on the other hand has shown a relatively greater success in making family planning a priority of the government. The panellists identified high turn-over of bureaucratic leaderships and lack of continuity in leadership as a set back to the efforts. Funding and cross programmatic roadblocks were reported as additional hindrances for advancements in Punjab.³

For moving forward, four key questions were raised for the CCI. First, whether services are reaching women at the ground level regardless of the efforts at the top. Second, whether there is contraceptive commodity security which accords women access to a wide choice of methods. Third, what is the role of Lady Health Workers (LHWs) and whether sufficient provisions were being made in order to facilitate the family planning function of their job? Finally, whether provincial health departments were entirely on board with family planning as a component of the larger health service delivery paradigm.

³ No information was presented for Khyber Pakhtunkhwa as no representative of this province was able to attend the plenary session.

Social, Economic, and Demographic Implications of High Population Growth

Four major implications of high population growth in Pakistan were presented and discussed during the Conference. First, parallels were drawn between population growth trends observed in Pakistan and those observed in other Low- and Middle-Income Countries (LMICs) and countries with large Muslim populations, in particular India and Bangladesh. Inadequate public sector infrastructure resources supporting health and education, have resulted in the current population predicament in Pakistan. These include underinvestment in public health measures supporting fertility reduction, addressing preference for large family sizes (with only 20% of women with 2 children and 48% with 3 children expressing a need for family planning respectively), untapped latent demand for contraceptive methods as evident from persistently high unmet need, and preference for short-term contraceptive methods. Second, the population growth in Pakistan was cited as both an asset and a threat depending on whether it is properly managed. Fertility levels in Pakistan are high and managing the population boom is not a short-term goal. Third, it was also argued that the population size in Pakistan is not a threat to the country but represents a mismanaged resource. While Pakistan has high population growth, it does not have high population density. The use of stratified data helped to understand population challenges in Pakistan, e.g. gender and age-based disparities exist within the overall unemployment rates and even those with degrees of higher education are included in the unemployed workforce. However, there are a few consequences of rapid population growth such as increasing inflation, poverty, inequality, unemployment, and inter-generational wealth disparity. There are also social consequences which include tensions and conflicts, rising demands, poor quality of education, political instability, migration, emigration, changing family structures, and demographic factors such as large youth cohort, increasing number of the elderly, and individuals needing quality reproductive healthcare.

Fourth, grass root initiatives that focus on shifting social norms through self-generated incentives and monetary resources were highlighted as a missing element in the current population initiatives - such initiatives serve as a great motivator for women to not only participate in the workforce but also support efforts in increasing contraceptive use.

Opportunities for Resilience to Climate Change

Climate change is an integral part of the Sustainable Development Goals (SDGs) and it is related with all the other 18 SDGs. While all SDGs are interlinked with one another in some manner, climate change is one that impacts all aspects of development. The very real threat of climate change to Pakistan is identified by its status as a continuously impacted country, sharing the title with only Philippines and Haiti. The focus of climate change policy is currently solely on environmental issues which is an opportunity to reprioritize and reinvest in people-centered systems. Climate change justice for food, water, and agriculture are key priority areas of efficient and effective response to climate change.

The participants of the Conference were also briefed on the adverse implications that are being brought on due to rising temperatures such as uninhabitable conditions of the planet, should climate change continue as it is. The water crisis as a consequence of climate change, the rising sea levels and depleting freshwater resources was highlighted. In this context, the immense importance of the Himalayan ice reserves and Pakistan's responsibility as a bordering nation to preserve those reserves was also highlighted. The specific impact of climate change as faced by citizens of Pakistan, include shortening of growing seasons, heat stress, growing need for water, and food insecurity. Pakistan is vulnerable to climate change and there are hotspots in the provinces of Sindh and Punjab impacting 10.2 million and 34 million people, respectively. The climate crisis is also connected with other population challenges and its role as a catalyst for causing internal conflict in the country needs to be understood.

Pakistan's effort in the fight against environmental degradation includes the "10 billion tree plantation" project, protecting reserves, and intentions to invest in water preservation. Pakistan has begun to develop a rich foundation for climate justice in the domestic legal system that is forward looking.

Population and Housing Census

The Pakistan Bureau of Statistics (PBS) has announced that the next population and housing census will be digital and is likely to be held soon. In the Plenary session, E-census experiences of Egypt and Iran were shared and discussed in detail to assess the preparation of PBS for the next census. The benefits of an E-census include enhanced data systems, security systems, data quality and consistency, monitoring, and control of census activities, ensuring

communication among workers, and reduction in overall costs, with improved management of monitoring and control of census activities and reduced time for releasing the findings or outcomes of census.

In Egypt and Iran, the design and planning for the E-Census took two years with several dedicated working groups and committees with a formal organizational structure and organogram. In Iran, two pilot tests were conducted in 2014 and 2015 to test the methodology whereas the formal census data collection occurred in two phases: households completing the online questionnaire and with face-to-face follow-up by enumerators who then conducted a physical visit to the site. Absent households (those who could not complete the online questionnaire) were followed up by telephone. The concerned departments of Egypt and Iran invested heavily into campaigning and messaging for the E-Census. Moreover, popular opinion, traditional, and religious leaders were also encouraged to endorse the census.

For the next population census, the PBS is involving stakeholders into their work planning. It is also considering a National Census Coordination center in the pattern of a National Command and Control Centre. Plans for expansion include geo-tagging every structure for real-time monitoring which will also avoid overlapping of coverage, following the *De Jure* method, and not linking CNIC/Verification with NADRA. Data collection plans include tablets and piloting and extensive testing of self-enumeration. A pilot testing of this E-census is being planned before the census. It was promised that the controversies of the last census will not happen this time.

Regarding the use of census data, it was argued in the Plenary Session that population growth rate is the aggregate of many development indicators and showcases the limitation and challenges of the government. An important element of this is the population being led by financial and political dividends. However, it also showcases the lack of accountability afforded to the politicians for not responding to high population growth rates as they fail to link and the media also fails to link the very important relationship between development and population.

5. KEY FINDINGS OF THE RESEARCH STUDIES (TECHNICAL SESSIONS)

Reproductive Health and Maternal Mortality

Over a 30-year period, a shift from at home births to facility-based births was observed. This was highest in Punjab and lowest in Balochistan at

the provincial level. The quality of facility-based services is highly volatile and dependent on region. Treatment patterns also outline certain practices repeatedly resulting in stillbirths. Maternal complications include anemia and nausea as the most common issues whereas care-seeking behavior is dependent on socioeconomic factors including monetary assets and women's education. Women at high risk of maternal mortality were around the 35-39-year age and were more likely to have history of multiple pregnancies with virtually no contraceptive use between each pregnancy. Moreover, women from rural areas and low-income households were more likely to be at high risk of maternal mortality.

Covid-19, Women and Gender Gap

The impact of COVID-19 had severe effects on women by aggravating economic difficulties and growing domestic tensions often leading to abuse. Most women suffered from economic hardships as the Benazir Income Support Program (BISP) funds did not accommodate for major household expenses. Women cited food insecurity as a consequence of economic stress. They also reported suffering verbal, psychological, emotional, and even physical abuse at the hands of the spouses. Contraceptive use also suffered as diminished services from LHWs impacted women's access to modern contraceptives, leading women to return to unreliable traditional methods.

Considering Pakistan's lack of uptake of digital technology and the consequential digital divide that followed, access to remote learning technology was identified as one of the main dividers of education during COVID-19 due to socio economic access of different classes. Private schools were quick to adapt to changes in learning while public schools were not. This translated into an economic divide as public schools are more often frequented by children from marginalized populations. Similarly, for lower income households, affordability of internet services was a challenge for online learning. Additionally, it was found that gender played a role in children's access to technology with girls having limited technological access as compared to boys.

Climate Change

Rising temperatures in Sindh over 40-year periods from 1961 to 2020 was reported by researchers, e.g. a one-degree upstroke in temperature over the years in *Umarkot* and *Thatta* districts of the province. Drought floods, unprecedented rain, frequent cyclones, sea intrusion, and freshwater depletion,

are more common than before. These changes have led to lifestyle changes such as wearing slippers in the farm, and changes in agriculture such as decreased longevity of crops like tomato and chili. Regional crisis such as drowning and sea intrusion in coastal areas, and hot summers, drying crops, food deficiency, livestock deaths, water shortages, and consequent lifestyle changes in inland areas are common. Spillover effects on health, education, and socioeconomic conditions have been heavily experienced especially by women and other marginalized and underserved populations. Consequentially, migration, change in preferred crops, diminished live stocking, loan financing are now common realities.

Participation of Women in Workforce

It was observed that 8-9% of women are routinely excluded from the population censuses. Approximately three-quarters of the employed women of Pakistan engaged in unpaid domestic work. The involvement of women in the workforce led to decreased gender inequality, and increased gender ratio in the household whereas urbanization, with strong evidence from Punjab, also impacted the unequal sex ratios.

Lady Health Workers (LHWs)

Ranging in age from 25-35 years and working within their own communities, LHWs worked with little to no equipment, limited mobility, and a high propensity to harassment from local leaders.

Marriage Market - Consanguinity

Almost half of Pakistani marriages result in consanguinity often with younger, less educated brides who move on to give birth at a young age. A significant relationship between consanguinity and educational assortative mating is established. Consanguineous marriages are more likely to be hypogamous than non-consanguineous marriages. Moreover, contraceptive use is lower among women in consanguineous unions. An inverse relationship between the mean fertility (so far) and cousin marriages has been found. Women in consanguineous marriages are likely to have fewer children than women in non-consanguineous marriages. Overall, consanguinity patterns are stable, and there is no evidence that the societal changes such as improvement in women's education and urbanization over time have led to a decline in cousin marriages in Pakistan.

Poverty, Food Security and Subjective Wellbeing

Pakistan's Human Development Index (HDI) ranking score is 0.557, and it is lagging 153 countries. The likely reasons for this are food insecurity, poverty, and high population growth. Poverty, food insecurity, and high population growth have a negative impact on HDI. Specifically, a 1% rise in per capita income and food production leads to a 0.4947% and 0.3499% increase in HDI respectively. Similarly, a 1% rise in population growth leads to a 1.83% decline on HDI due to a strain on resources.

Women in households receiving remittances were more likely to report higher subjective wellbeing making it positively related with economic wellbeing. However, the same was not true for men sending the remittances home to Pakistan. Migrant working men were highly dissatisfied in terms of subjective wellbeing making it negatively related with economic wellbeing.

Urbanization

The Population Council's work using sensing technology, namely satellite images, of Pakistan determines the population density across the country. This methodology included machine learning algorithms implemented on satellite images of Pakistan obtained between years 2016 and 2018 as two data points conflated with the census documentation from the 2017 census. The results show that machine learning algorithms are highly regular in identifying dense populations in urban and semi urban areas. However, they are not as effective in sparse rural populations. Remote sensing technologies are the future of mapping populations as they provide visual and reliable data.

6. RECOMMENDATIONS

The following recommendations were given during the Conference by the speakers, panelists, authors of research papers, discussants and chairpersons.

- The population policy of Pakistan must adopt a multi-sectoral approach that is fully integrated within comprehensive socioeconomic development plans as such effective population policies will achieve desired outcomes, particularly to meet the CCI recommendations and targets. In line with the current national goals of the country, a four-pronged approach may be adopted: lowering infant and childhood mortality, raising education for all genders, widening employability, and meeting existing family planning needs. Improvements in maternal

and infant mortality would have a direct impact on trust and uptake of contraceptives. Contraceptives may be included in basic health plans and packages. The formation of population task forces, cross-sectoral development through increased funding, and synchronized development across sectors are the other necessary initiatives.

- There is also a need to move beyond just managing population growth, and instead focus on the accommodation of the people that already exist through increased investments in education, health, social services, and human development. Efforts and direct policies to reduce population growth can contribute to development in the long run, but the impact would be limited in the absence of the right macroeconomic policies.
- The youth bulge is identified as a resource rather than a drain.
- There is a need to revisit the services of the LHWs to strengthen the workforce in their essential role as sole penetrative force at the grassroots level. A need for capacity building of LHWs was advised as well as lowering cost burdens on the end consumer.
- Climate change is already happening and will impact every part of life, therefore the state should consider both inhibition and resilience strategies in response to climate change. Each shortcoming in this domain is an opportunity to expand and democratize and improve not only climate resilience but also other aspects of development such as Green Urban Development. For addressing climate change, urgent actions need to be undertaken that includes development of regulatory bodies, legislation, and policy.
 - A switch to alternative means of energy such as hydro, wind, and solar energy generation, is required.
 - Policy level changes from local governance to international levels are important.
 - Changes such as revision of building codes to outlaw carbon dioxide-producing gadgets such as old air conditioners, sustainable energies, solar panel and power, and advocacy on a national level.
 - Pakistan must prepare for worst case scenarios and invest in programs for water preservation and diversification of energy sources.
 - Climate change justice for food, water, and agriculture as key priority areas of efficient and effective response to climate

change. Additionally, investment in technological advancements in all sectors in response to climate change should be carefully considered.

- A short questionnaire may be used for the next digital census. Both a comprehensive pilot survey and a post-enumeration survey will improve the accuracy and quality of the census data. There is a need for mobilizing community support for holding the census.
- There have been serious problems with the development narratives in politics regarding the population census. There is a need to debate, engage media, and understand why civil society does not talk of population issues and why and how to engage them better in this endeavor.
- Pakistan's lack of uptake of digital technology and the consequential digital divide that followed is a challenge. Incorporation of digital technologies and increased investments in this sector to overcome this gap is suggested. The use of remote sensing technologies in conjunction with official records for urban planning and resource allocation is recommended.
- There is a need for exploring missing links such as family in the domain of economics. This point can be a good avenue for new research. Similarly, the perception of children's welfare indicators for low-income households needs to be addressed.
- BISP needs to be revitalized for the supplication of food packages and income support as well as education for children and public service messages for adults.
- The switch back to ordinary life after COVID is an opportunity to also switch towards cleaner and greener programs and to help the population integrate in a better world than was left behind. Mental health service provision and the potential motivators for education as emerging topics requiring attention.
- The need for advocacy of menstrual health as it is an often-undermined component of sexual and reproductive health and rights (SRHR) was highlighted. Its inclusion in the larger public health paradigm is recommended.
- The younger researchers are urged to connect their research with policies as that is a critical juncture to ensure implementation. Researchers can play a role in ensuring that voices are heard by those who are decision-makers by highlighting as such in their research.

7. THE KEY TAKE AWAY

The 22nd Annual Population Research Conference provided an opportunity to share the findings through an invited lecture, four panel discussions and 31 original research papers and posters from all over Pakistan, covering a range of topics related to population and human development, demographic transition, climate change, and policy directions to meet the challenges of a rapidly growing population in this changing world. This is admirable and underscores the need to nurture continuing scholarship on population and indicates increased investments and efforts to improve the utilization of research findings to inform critical policy reforms for the future. The PAP continually strives to look beyond demographic indicators and aim to influence Pakistan 's population and development policies and practices through good quality research to help the government make decisions that are fully-informed and evidence-based. Research also needs to strongly link up with policy direction, policy action, and implementation as simply generating evidence is not enough until it is used to build solutions. In order to fulfil the above recommendations, legislators, policy makers, implementers, and programmers need the right information and evidence to conceptualize and implement adequate policies and systems. The role of Population Research cannot be emphasized enough in this regard.

Appendix A: Research Papers and Posters Presented at the 22nd Annual Population

Research Conference Held on December 7–9, 2021 at NUST, Islamabad.

Technical Session 1: Population, Universal Health Coverage, and Family Planning in the Context of COVID-19		
Sr. #	Presenter	Presented Paper Title
1.	Saleem, Sarah Dr.	Maternal Mortality in Pakistan: Levels, Causes, and Risk Factors
2	Sheraz, Ayesha Dr.	Patterns of Health Services Utilization by Women During Pregnancy and Childbirth in Pakistan: An In-depth Analysis of the Pakistan Maternal Mortality Survey 2019"
3	Omer, Sonia Dr.	The issues and challenges faced by lady health workers in maternal health care in rural communities: evidence from South Punjab
4	Yameen,Sahar Ms	Addressing Menstrual Hygiene Management (MHM) Needs of Adolescent girls and women amidst Pandemic 2019
5	Bashir, Saima Dr.	Marriage Market in Pakistan: Consanguinity, Educational Assortative Mating, and Fertility

Concurrent Session 2a: Social Economic and Demographic Implications of High Population Growth

Sr. #	Presenter	Presented Paper Title
1.	Rehman, Mujeeb ur Mr.	The role of Poverty, food insecurity, and rapid population growth on human development in Pakistan
2	Khalil, Muhammad Mr.	Estimating Urbanization in Pakistan Using Remote Sensing Technology
3	Bari, Ali Musa Mr.	Unveiling the impact of Migration on the Economic and Subjective wellbeing of Gender in Punjab Pakistan
4	Ishtiaq, Sidra Ms.	Impact Of Women's' Empowerment on Household Food and Nutrition Security In Rural Pakistan

Concurrent Session 2b: Social Economic and demographic Implications of High Population Growth

Sr. #	Presenter	Presented Paper Title
1.	Noman, Nargis Ms.	The Myth of Missing Women: A Case Study of Pakistan
2	Kamran, Iram Ms.	Poor Women's Challenges and Needs During the COVID-19 Pandemic: Perspectives from Rahim Yar Khan, Punjab
3	Fatima, Goher Ms.	Gender Gap in Education and Employment: Source of poverty

Technical Session Three: Opportunities and Challenges for Resilience to Climate Change

Sr. #	Presenter	Presented Paper Title
1.	Hussain, Sabahat Mr.	The triggering Effects of Climate Change in Sindh: Risks, Resilience and Adaptation Responses
2	Ammar, Syed Muhammad Mr.	Examining the Impact of Improved Access to Safe Drinking Water and Sanitation on Subjective Wellbeing of adults in Punjab, Pakistan
3	Khan, Naveed R. Mr.	The effect of population, poverty and energy consumption on environmental degradation in Pakistan
4	Shah, Samia Ms.	Tawazun: New National Narrative on Population for Pakistan
5	Riaz, Anisa Ms.	Consumer perception about Climatological impacts on food safety and human health

Poster Presentations

Sr. #	Presenter	Poster Title
1.	Zainab Feroz	Strengthening of District Health Information Systems ² by integrating essential indicators for recording Post-pregnancy Family Planning Services in Punjab
2	Sahar Yameen	The family planning "know-do" gap among married women of reproductive age in urban Pakistan
3	Dr Sidra Azhar	Effect of Covid-19 on the contraception practices and rising rate of population; a KAP survey from the obstetricians of Rawalpindi and Islamabad.

Population Challenges in a Changing World

4	Sonia Umar	The socioeconomic implications of coronavirus pandemic (COVID-19) in district Faisalabad
5	Dr. Naima Nawaz	Health Status of Elderly Women in Socio-Economic and Cultural Context in Punjab, Pakistan
5	Ajmal Khan	Estimating the Nexus Among Demographic Dividends, Economic Growth & Environmental Degradation for Pakistan
6	Dr Samina zafar	Short birth interval A major contributing factor for perinatal mortality and morbidity
7	Farah Atiq	Is Labour Pooling Foundation for Industrial Agglomeration? A Developing Country Perspective
8	Abdur Rehman Shahzad	Factors affecting resettlement of the rural to urban migrants in the city: empirical evidence from Pakistan
9	Fahad khan	The Effect of Rural Urban Migration on Economic Growth in Pakistan
10	Ms. Asmat Safdar	The Role of Women in Food Security and Its Effect on the Family Well Being: A Case Study in Rural Faisalabad District.
11	Dr. Munazzah Manzoor	Socio-economic constraints for women regarding food security at household level in Punjab
12	Mubashir Ali	Technological interventions in agriculture and its impact on women workers in district sheikhupura pakistan
13	Sidra Ishfaq	Impact of Rural Women's Empowerment on Household Vulnerability to Food Insecurity in Pakistan
14	Saira Siddiqui	Cultural values about gender inequalities and their implications for women's health in rural Punjab, Pakistan
15	Maiyadah Shahid	COVID 19 Vaccination Acceptance & Fears: Social Norms, Gender & Inequality A Case study of Pakistan
16	Mr. Irfan Mahmood	Farmer's perception and impacts of climatic impacts on natural resources and coping strategies: Variability in Semi-Arid Tropics of Pakistan

Thirty Years of Consanguineous Marriages in Pakistan

Saima Bashir¹ and Saman Nazir²

Abstract

Almost half of all marriages in Pakistan are consanguineous. Despite its high prevalence, little is known about the change over time in consanguineous unions in Pakistan. Examining the patterns of the cousin marriages is particularly important given the substantial improvement in women's education which is often associated with the decline in consanguineous unions across the world. Our analysis, based on four waves of nationally representative Pakistan Demographic and Health Surveys - PDHS (1990-91, 2006-07, 2012-13, and 2017-18), shows that the prevalence of consanguineous unions remains stable over time. Further, women's education is negatively associated with cousin marriages. Hypergamous (husband is more educated than her wife) unions are more prevalent, but a consistent rise in educational hypogamy (wife is more educated than her husband) is observed during this time. The results show that consanguineous marriages are more likely to be hypogamous than non-consanguineous marriages. Moreover, contraceptive use is lower among women in consanguineous unions. An inverse relationship has been found between the mean fertility and cousin marriages. Women in consanguineous marriages are likely to have fewer children than women in non-consanguineous marriages. Overall, the results show that consanguinity patterns are stable, and there is no evidence that the societal changes such as improvement in women's education and urbanization over time have led to a decline in cousin marriages in Pakistan.

1. INTRODUCTION

Consanguineous union, i.e. marriage between close relatives, is prevalent in many parts of the world. Pakistan is one such society where consanguineous marriages account for over half of all marital unions (NIPS, 2018). Preference for consanguineous unions in society is closely related to a number of cultural and socio-structural factors, including efforts to strengthen family ties, agnatic solidarity, dowry-related financial considerations, family support during marital strife, and significantly lower independence for mate choice in a culture (Agha, 2016; Hussain 1999; Lin, Desai, & Chen 2020; Mobarak et al., 2019). Studies show a strong correlation between consanguineous marriages and high fertility, younger marriage ages for women, early childbirth, and child mortality (Fareed et al., 2017; Islam, 2012). Despite consanguineous unions accounting for a larger share in overall marital

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unions in the country and their interlinkages with gender dynamics, fertility behaviour, and child survival outcomes, recent studies on consanguinity in the country are lacking.

Previously, Hussain (1999) found that a high preference for consanguinity, in Pakistan, is driven by sociocultural issues and not because of financial benefits like family property consolidation or smaller, less expensive dowries. Likewise, Agha (2016) found that the preference for consanguineous marriages is linked to the kinship system. Women prefer consanguineous partnerships for the convenience of remaining close to their parents' families, while parents regard such unions to be socially secure for their children. The study's findings indicate that teenage marriage, low educational attainment for women, and early motherhood are all significant effects of these relationships (Agha, 2016). The contribution of the previous studies on consanguineous unions in the country is valuable (Afzal, Ali, and Siyal, 1994; Hussain and Bittles, 1999, 2000). However, it is expected that social fabric and societal norms-in terms of gender equality, educational attainment, and marriage preferences might have changed during this period. For instant, educational levels across the population have improved over time, but more significantly, a rise in women's higher educational attainment has been observed. At the same time, the labour force participation rate for women remains low; only around one-fourth of Pakistani women with college degrees hold a job outside the home (ADB, 2016). Due to the conventional gender division of roles in Pakistani society, women spend less time working in the paid labour market and more time performing unpaid home duties than men. Even for women with more education, the traditional distribution of labour within the family is under greater stress, which could cause educational differences in mate choice.

In this study, we aim to examine how preferences for consanguineous marriages have or have not changed over time. We also intend to look at the trends for variations in couples' educational differences in consanguineous and non-consanguineous unions. Historically, marital unions in Pakistani society are hypergamous (husband more educated than wife). However, with more women in higher education, it would be imperative to examine if the trend is shifting toward hypogamy (the wife is more educated than the husband). In literature, we find that women who opt for consanguineous partnerships have fewer opportunities to pursue higher education. Therefore, we anticipate that non-consanguineous unions may be moving toward educationally homogamous/hypogamous marriages, while it is likely that consanguineous unions would continue to be hypergamous. We also aim to see how fertility

behaviour and outcomes differ across marital unions. Studies for South Asia show that couples in consanguineous unions have higher fertility (Hussain & Bittles 2004; Nawaz, Zaman & Malik 2021). Also, consanguineous unions are linked to higher mortality, congenital abnormalities, and poor reproductive results (Kanaan, Mahfouz, & Tamim 2008; Rittle et al. 2001).

Educational Assortative Mating in the Marriage Market

Educational hypogamy refers to the unions in which the wife has an educational level that is equal to or higher than that of her spouse, and educationally hypergamous marriages are those in which the wife has less education than her spouse (Esteve, García-Román, & Permanyer, 2012 p. 535). Historically, in developing countries, most marital unions are educationally hypergamous. However, over time, both industrialized and developing countries have seen a drop in educationally hypergamous marriages (Esteve et al., 2016; Esteve, García-Román, & Permanyer, 2012). In literature, we found two probable explanations of the decline in educational hypergamy i.e., evolving gender norms and women's increased access to education globally (Chudnovskaya & Kashyap 2020; Esteve et al., 2016; Lin, Desai, & Chen 2020; Van Bavel, 2012). However, the former reason has been widely contested in literature; especially, in context of developing countries (Lin, Desai, & Chen 2020).

The literature on educational assortative mating is lacking for the country.

Furthermore, studies from Pakistan are not conclusive about the relation of education with consanguinity. A study, conducted in the Rahim Yar Khan district, found that illiteracy is a strong predictor of consanguinity. Women who are more likely to be in a consanguineous union include those whose husbands are manual labourers or unskilled employees, as well as those whose parents were married in the same way (Riaz, Mannan, & Malik, 2016).

On the contrary, Jabeen, & Malik, 2014, in their study in the Bhimber district, reported that consanguinity was much higher in the literate group when compared to the non-literate group. They stated that even when literacy and consanguinity are related, the relationship is not always the opposite. In case of Pakistan, an understanding of the educational dynamics within consanguineous and non-consanguineous partnerships is imperative as 50% of marriages in Pakistan are still consanguineous. In our study, we aim to look how marriage preferences differs with educational dynamics.

Consanguinity and Fertility

Fertility behaviour and childbearing outcomes may vary between unions that are consanguineous or non-consanguineous. Al Kandari (2007) found that women who marry in consanguineous unions have greater rates of pregnancy termination and stillbirth. The study shows that Muslim women and those in consanguineous marriages had greater fertility rates. In literature, consanguinity is also associated with the primary effect of raising the proportion of homozygotes for autosomal recessive genetic diseases. For example, Tadmouri et al. (2009) found a high prevalence of recessive illnesses among Arabs and argued that many such illnesses were linked to consanguinity. Furthermore, Omer, Farooq & Jabeen S. (2016) also found a link between cousin marriages, poor maternal and child health outcomes.

Women who marry their first cousins have greater fertility rates than those who marry non-relatives in India and Pakistan. Consanguinity has been connected to several direct and indirect fertility predictors, such as lower mother education, younger maternal age at marriage, the low use of contraceptives, and residing in rural areas (Hussain, R., & Bittles, 2004). Consanguineous couples tend to have greater fertility rates, which may be related to unfavourable pregnancy or child health outcomes. However, as indicated by some studies, the increased fertility in consanguineous marriages may also be associated with general familial or kin support, particularly that related to child-rearing (Agha, 2016; Do & Joshi, 2013; Hussain, 1999). However, the findings are not always consistent.

Similarly, a woman's age is also a significant predictor of consanguineous unions. Women marry earlier in consanguineous unions than in non-consanguineous unions (Agha, 2016; Audinarayana & Krishnamoorthy, 2000; Donbak, 2004). Because reproductive cycles last longer in younger women, it may be a contributing factor to the greater fertility rate in consanguineous unions. Additionally, research shows that contraception use is less among consanguineous couples than among non-consanguineous couples, which may also be a reason for high fertility rates among the former group. In our study, we look at how fertility preferences differ among consanguineous and non- consanguineous unions.

Data and Methods

The data from four rounds of Pakistan Demographic Health Survey 1990-91, 2006-07, 2012-13, and 2017-18 were used for this study. DHS data

were collected by ICF International in collaboration with National Institute of Population Studies (NIPS) and are publicly available. These surveys are nationally representative and cover women of ages 15–49. DHS collects detailed information on mother and child health, fertility history, family planning, reproductive health, nutritional and immunization status, marriage and sexual activity, and husband's background. The analysis spans almost 30 years from 1990 to 2018. The sample size of ever-married women aged 15–49 is 6, 611 in 1990–91, 10,023 in 2006–2007, 13,558 in 2012–2013 and 12, 364 in 2017–2018.

Various pre-analysis exclusion criteria were applied. We excluded women who reported more than one marital union and those had missing information on number of unions. Further, we dropped women whose information on relationship with husband is missing. We also excluded women who either did not provide information on husband's education or did not know about their husband's education. The final analytical sample across four waves thus is 6,438 for 1990–91; 9,715 in 2006–07; 13, 179 in 2012–13, and 11,618 in 2017–18.

2. METHODS

Descriptive statistical techniques were used to observe the prevalence and trends of consanguinity. Further, we performed the comparative analysis of consanguineous and non-consanguineous marriage types by husband/wife's educational attainment. Third, we looked at the association between consanguinity and fertility. We used age at marriage, mean number of living children, and contraceptive use as our measures. The statistical significance of associations between consanguinity and various determinants is assessed by applying the chi-squared test. We applied the sample weights to account for the clustering and complex survey design. The analysis is weighted and done by using `svy` command in Stata 13.

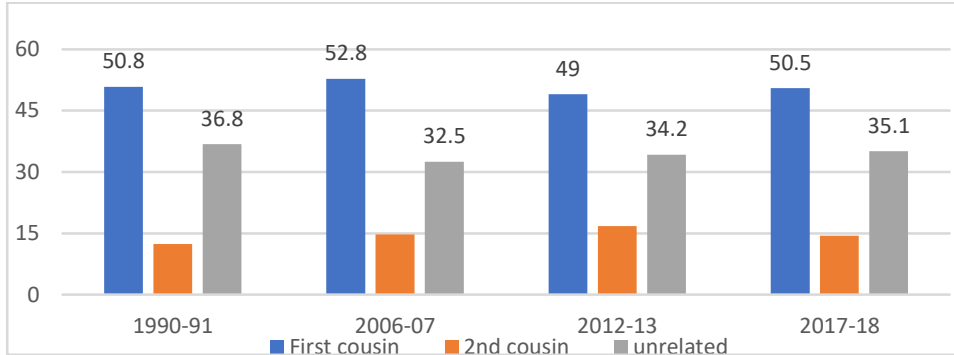
3. RESULTS

Trends Over Time in Consanguineous Marriage

Figure 1 shows the prevalence of consanguineous marriages in Pakistan from 1990–2018. During the last three decades, the patterns of cousin's marriages remain stable. More than 50% of the marriages are among the first cousins either from maternal or paternal side. Only one third of the marriages are non-consanguineous unions while the remaining with the second cousins. This trend is contrary to expectations that increase in women's education and

other societal changes such as urbanization leads to decline in cousin marriages. However, there is no evidence that these societal changes are associated with reduction in first cousin marriages. In fact, the prevalence of first cousin marriages remained mostly stable.

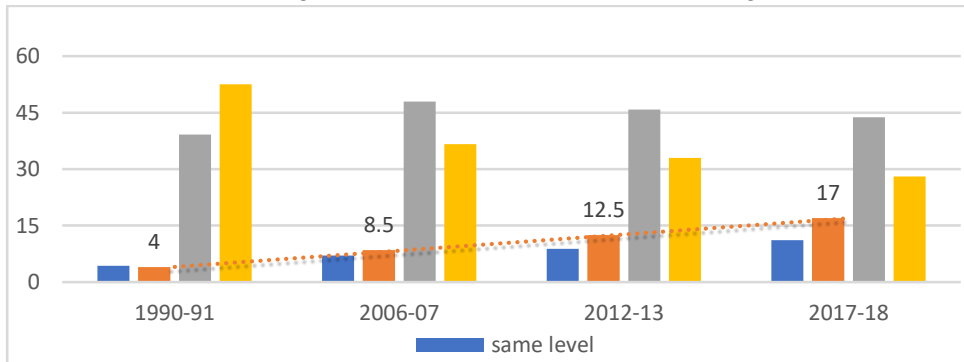
Figure 1. Type of Relationship with Husband



Educational Assortative Mating and Consanguinity

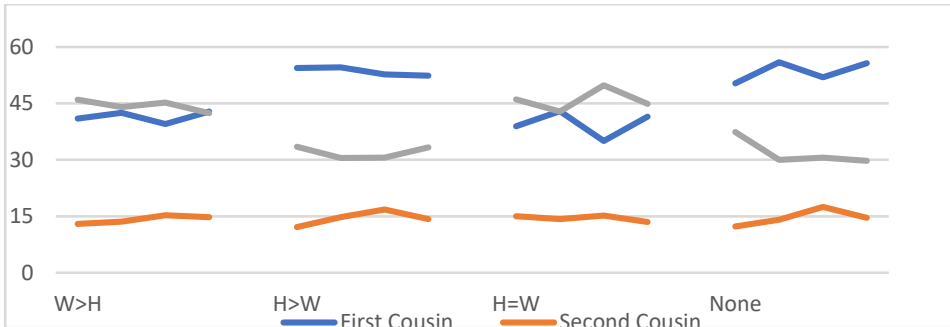
However, some interesting changes are observed in spousal educational differences. As mentioned above, since 1990 there is a substantial improvement in women's educational attainment. This pattern of increase in women's education is reflecting in the marriage market as well. Though, educational hypergamy—i.e. when husbands are more educated than wives still persist, a consistent pattern of educational hypogamy is emerging over time. There are only 4 percent couples in which wife was more educated than her husband in 1990. This percentage has increased to 17% in 2017-18. Similarly, there is a considerable decline in couples with no formal education (Figure 2).

Figure 2. Educational Assortative Mating



The association between formal education and consanguinity is still prevalent. The phenomenon of educational hypogamy or homogamy is more common among non-cousin marriages. Whereas consanguineous marriages are more common in couples in which husband is more educated than his wife or both spouses have no formal education (Figure 3). However, we do not see any substantial variation in educational assortative mating by relationship type over time.

Figure 3. Educational Assortative Mating by Relationship Type

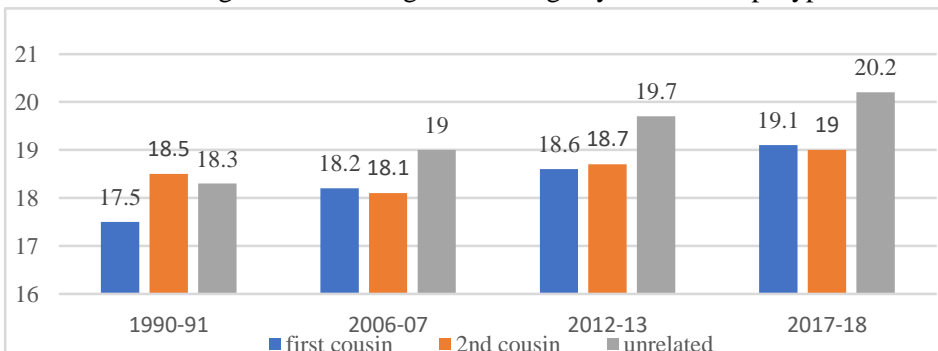


Consanguinity and Fertility

Mean Age at Marriage

The mean age at marriage has significantly increased over time across all relationship types. However, the increase is much higher among non-cousin marriages. In 1990, the mean age at marriage among unrelated couples was 18.3 years and has increased to 20.2 years in 2017-18. The mean age at marriage is 1.1 year higher among non-cousin marriages than cousin marriages in 2017-18 (Figure 4).

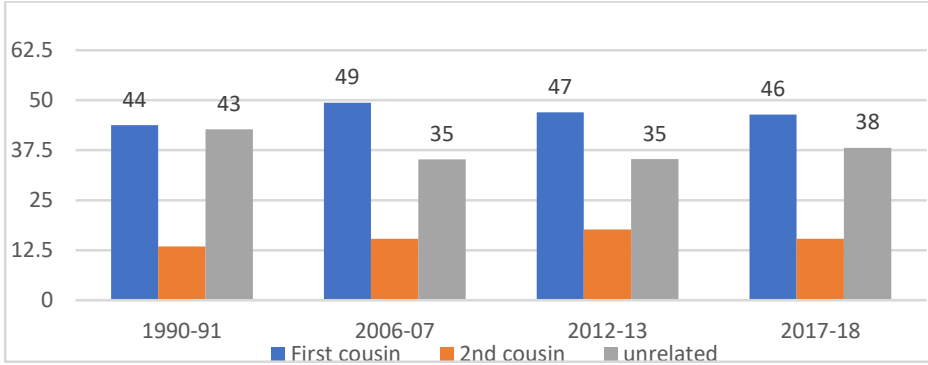
Figure 4. Mean Age at Marriage by Relationship Type



Contraceptive Use

Interestingly, the use of contraception showed a different pattern. Contrary to our expectation, contraception is significantly higher in first cousin marriages than non-cousin marriages over time. Though a decline is observed in contraceptive use among cousin marriages and catch-up trend in contraception is observed recently among non-cousin relationships (Figure 5).

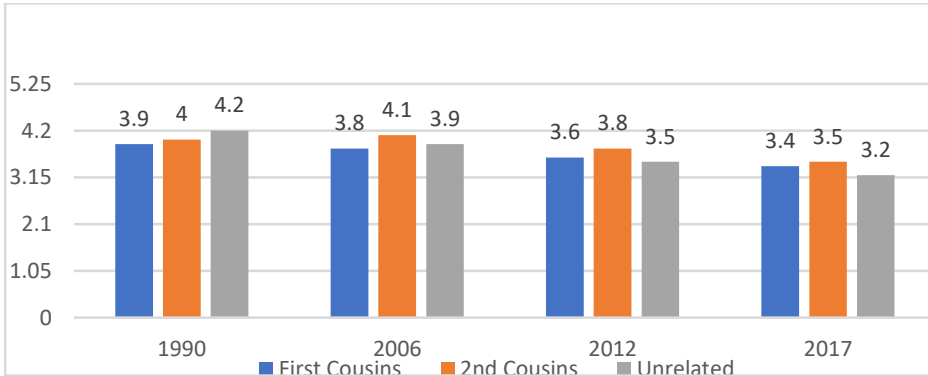
Figure 5. Contraception by Type of Relationship



Mean Number of Children Ever Born

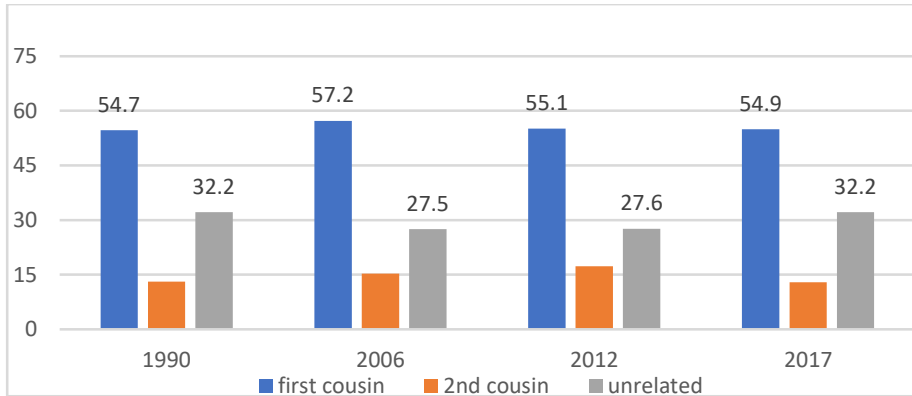
The relationship between consanguinity and mean number of children ever born have changed over time. In 1990, the mean number of children ever born were higher among non-consanguineous couples as compared to consanguineous marriages (Figure 6). However, this relationship has reversed over time and now mean number of children ever born are higher in cousin marriages than among unrelated couples.

Figure 6. Mean Number of Children Ever Born by Relationship Type



The higher mean number of children ever born in cousin marriages could be the result of high child mortality among cousin marriages. This is confirmed by experience of child loss by relationship type (Figure 7). The pattern of child mortality remains consistent over time with predominantly higher child mortality in first cousin marriages and lower in marriages among unrelated couples.

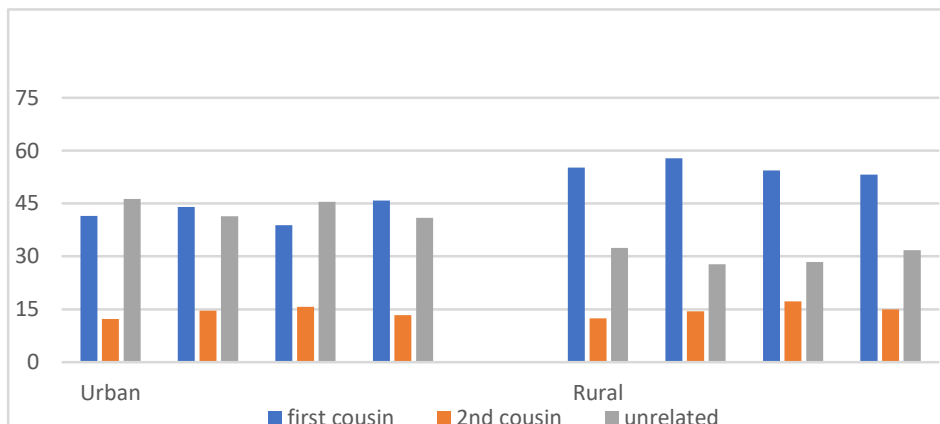
Figure 7. Experience Child Loss by Relationship



Other Correlates of Consanguineous Marriages

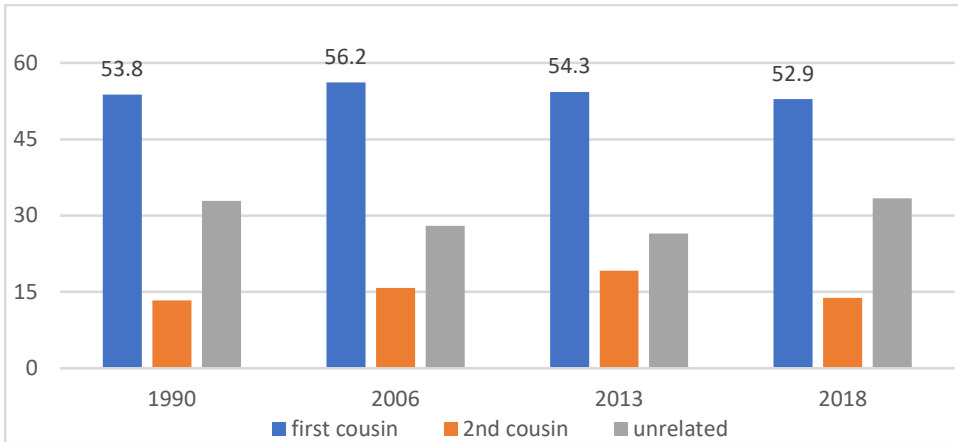
Similarly, the incidence of cousin marriages by urban rural areas shows minor changes during the same period. Marriages among first cousins are more common in rural areas whereas in urban areas non-consanguineous relationships are more common (Figure 8).

Figure 8. Urban-Rural Pattern of Cousin's Marriages: 1990-2017



The prevalence of cousin marriages exhibits minor change with respect to women's employment over time. First cousin marriages are more common among working females as compared to unrelated marriages (Figure 9).

Figure 9. Women's Work Status by Relationship Type



4. DISCUSSION

Consanguineous marriages are a less researched area in the demography though it is prevalent in many parts of the developing world. The practice of consanguineous unions is common in Pakistan. Around 50% of the marital unions are among first or second cousins. Despite the high prevalence of cousin marriages, only few studies have looked at the sociodemographic dynamics of consanguineous unions (Afzal, Ali, and Siyal 1994; Hussain and Bittles, 1999, 2004). Most studies are either dated, localized, or looked at the biological consequences of consanguineous marriages.

We looked at the trends in consanguineous marriages and its relationship to women's own education and spousal educational homogamy. Overall, the results show that the pattern of consanguineous marriages remains stable over time with almost half of the women married to their cousins from 1990-2018. The same pattern is observed in some other countries such as Yemen (Jurdi & Saxena, 2003; Tfaily, 2005), Turkey (Tfaily, 2005) and Iran (Givens & Hirschman, 1994).

Association between women's education and spousal educational homogamy and consanguineous unions was also examined. The association between formal education and consanguinity is still prevalent. Though educational hypergamy still persists, a consistent educational hypogamy pattern

is emerging over time. The phenomenon of educational hypogamy or homogamy is more common among non-cousin marriages than cousin marriages. Whereas consanguineous marriages are more common in which the husband is more educated than his wife or both spouses, have no formal education. The findings are consistent with other studies done in similar contexts that educated women are more likely to marry non-relatives than women with no formal education (Assaf and Khawaja, 2008; Hussain and Bittles, 2000; Jurdi and Saxena, 2003; Givens and Hirschman, 1994).

Interestingly, we observed that a consistent pattern of educational hypogamy is emerging over time. Though insignificant, the results indicated that hypogamy is positively associated with consanguineous marriages, as found in other studies (e.g., Lin, Desai, Chen, 2020). Though surprising in Pakistan's cultural context, it makes sense. Mostly, marriages in Pakistan are arranged by parents, and women have little say in these decisions irrespective of their educational status (Hussain and Bittles, 1999). This norm significantly reduces the pool of marriageable men, and given the universal nature of marriage, “marrying men with lower education could be more of a necessity” (Lin, Desai, Chen, 2020).

In the second part of this paper, we looked at how fertility behaviours, namely age at marriage, contraceptive use and children ever born, are influenced by consanguineous marriages. As expected, and observed in other studies, women in related unions are marrying at younger ages and contraceptive use is lower among women in cousin marriages than non-cousin marriages. Moreover, consanguineous marriages are more common among rural couples, women with no formal education, and those who experience child loss. All these factors are associated with lower use of contraception (Hosseini-Chavoshi, Abbasi-Shavazi, & Bittles, 2014; Islam, 2013; Hussain and Bittles, 1999).

The study found an inverse relationship between the mean number of children ever born and cousin marriages. Women in consanguineous marriages are likely to have fewer children than women in non-consanguineous marriages. This result contradicts the studies that found higher fertility in consanguineous unions as a replacement strategy among parents for child mortality. However, when it comes to Pakistan, Hussain and Bittles (1999) found a similar result. They argue that this may result from “random under-reporting of fertility figures or some misclassification of women by consanguinity status” (Hussain and Bittles, 1999, p.136).

5. CONCLUSION

Overall, the study results show that consanguinity patterns are stable, and there is no evidence that the societal changes such as improvement in women's education and urbanization over time have led to a decline in cousin marriages in Pakistan. The study contributes to the existing literature on consanguinity, educational assortative mating, and fertility. The study is particularly relevant to the family planning, education, and gender policies in the country. The study's findings indicate that without a substantial social change, the decline in consanguineous marriages is unlikely. The cultural preference for consanguineous unions is untestable, as the country has a weak institutional support for childcare, or for women who experience family conflicts, separation, or divorce. Moreover, expansion of education, particularly in the context of the gender gap, is not enough; participation of young women in formal job market is crucial. Until the opportunity cost of having children for women is not high, a shift in fertility behaviour cannot be observed. Formal job market raises the opportunity cost for women and exposed them to more marriageable pool of men with modern family ideals. Similarly, a shift from family support to institutional support in terms of childcare could be one major step in encouraging the participation of women in the job market, hence, directly, or indirectly raising the opportunity cost for having more children. Availability and accessibility of educational opportunities, women labour market participation, institutional support for childcare, parallel attention to demand-side factors in family planning programs may lead towards a desirable social change in Pakistani society.

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The Myth of Missing Women: A Case Study of Pakistan

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Abstract

In the contemporary era, women's empowerment promises enormous gains ensuring a vigorous socio-economic boost for the economy. Further, the persistently changing world demands equity for both men and women as restrictions to women's rights and opportunities cost an economy in terms of income losses. Hence, overcoming gender discrimination and inequality remains a challenge for developing economies. The idea of "missing women" is linked to the appalling absence of women in substantial parts of an economy. The prime objective of the study is to evaluate the myth of missing women for the economy of Pakistan. The study investigates whether the missing women problem exists in the economy or not. For this purpose, a multidimensional approach would be utilized to figure out various gender inequalities considered in the missing women paradigm. Given the available data and statistics opacity, the study would employ both time series (tentatively for the era of 1990-2020) and cross-sectional data of the Pakistan Social and Living Standards Measurement (PSLM) survey of 2019-20. The former would be collected from the websites of World Bank indicators while the latter would be gathered from the Pakistan Bureau of Statistics. Using a mixed approach, the study qualitatively investigates the aggregate indicators associated with the concept of missing women including the sex ratio, fertility rate, and population dividend of Pakistan with a comprehensive regional comparison. Whereas a quantitative analysis would be performed to examine different gender inequalities through the novel context of missing women. The authorities of Pakistan have made strides in reducing the gender gap through better educational enrolment rates and access to health care services. However, these improvements have not been well transmuted into an enhancement of equity and quality of women's life. There is a dire need to broaden the horizon of gender equality and hence this study views gender inequality with the dimension of "missing women."

Keywords: Missing Women, Inequality, Women Empowerment, Gender Inequalities

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1. INTRODUCTION

1.1. Background

The idea of “missing women” revolves around identifying the difference between the women who ought to be living and women who are living. The paradigm of missing women had been pioneered by Sen (1992) who considered sex ratio to cater to gender disparities in Indian society. For this purpose, he presumed that millions of women who should be in the labour force were not part of Asian economies. Based on this assumption, he estimated a 6 to 11 percent of women deficiency in the total women population which he later termed a “Terrible story of Inequality and Neglect”. He concluded that persistent gender inequalities society account for these missing women.

Principally, there exist two techniques to examine the problem of missing women. The first method allows comparing the real mortality rates (based on age and sex) with the expected rates alleviating all genders as equal. If the actual rate exceeds the expected estimates for females, it would be an indication of excess female mortality. Turning to the academic background, this technique has been adopted for microdata analysis to determine the extent of gender bias including the work of Klasen and Lamanna (2003), Murthi et al. (1995), and D’Souza and Chen (1980). The second method proposed by Sen in 1990, is to evaluate the actual and “expected” sex ratios⁴ of the total population because of equal treatment for all genders. If the difference between the actual and estimated sex ratios persists, then it would indicate “missing women.” This strand of literature includes studies by Saikia et al. (2021), Jayachandran (2017), Klasen and Wink (2002, 2003), and Retherford and Roy (2003). This technique is more reliable as it is contingent on demographic figures allowing the cumulative impact of gender inequalities that are more frequent in developing economies. It is worth mentioning here that the method is equally applicable for female fatalities caused by gender-based abortions among the missing women. Both techniques are complementary yet crucial to comprehensively analysing the missing women phenomenon.

1.2. The Demographic Transition

The myth of missing women has been widely followed by the demographic transition that appeared since the end of the 19th century. Later in

⁴ Male to female ratio.

the century, the exceptional increase in the population had been reversed bringing about pivotal reductions in fertility and population growth rates in divergent regions of the world (Galor, 2012). This global demographic change has induced economies to enjoy the gains from technological progress and factor accumulation enhancing labour productivity and growth activities. This, in turn, accelerated the significant channels of resource per capita, fertility rates, and age distribution that led to high fractions of the working-age population and high productivity per capita. Here a question arises whether this transition has always been seen through the lens of positive gain or not. The answer to the question is yet ambiguous as decreasing fertility rates have also triggered the problems of gender-based abortions surging female fatalities in certain settings, and single-child strategies. Hence, to trace the problem of missing women, it is first essential to look at the demographic structure of the economy.

Looking at the demographic profile of Pakistan, the recent population census in 2017 revealed that the population is endowed with 207.6 million individuals out of which 106.3 million were men and 101.3 million were women. According to the Pakistan Bureau of Statistics (PBS), the population experienced a growth rate of 2.4 percent per year from 1998 to 2017. Out of the total population, 63.6 percent live in rural areas while the rest cluster in urban regions. Further, the sex ratio was found to be 104.9 males to 100 females, and it is higher in urban regions (107.2) as compared to rural regions (103.6). The economic characteristics of the population showed that 447.9 percent of 15-64 who were economically active with the proportion of working population comprised of 56.4 percent men, 6.1 percent women, and 35.3 percent transgender. The rest of the economically inactive population was dominated by women engaged in domestic work making up 72.3 percent of the women population. Hence, this brief review of the demographic factors points out the striking features of the economy endeavouring to cope with the increasing gender disparities.

1.3. Problem Statement

Given the luminous literature and extensive debate on gender inequality and women's empowerment, the academic domain of gender economics in Pakistan still has not addressed the missing women problem. Intuitively, this could be attributed to scant datasets and government negligence to develop policies for missing women. Additionally, it is also a matter of disagreement regarding whether identification and estimation of missing women are possible or not. Therefore, this study is an endeavour to figure out

the problem of missing women in the economy of Pakistan through a meticulous research approach. This design allows broadening the research horizon of gender economics by employing divergent socio-economic factors with an innovative perspective on missing women.

1.4. Research Objectives

The prime objective of the study is to evaluate the myth of missing women for the economy of Pakistan. For this purpose, three research objectives have been developed. The first objective of the study is to figure out the demographic indicators of Pakistan taking into account the regional divergences. The second objective encompasses the quantitative measurement of sex ratio at the household level with a set of socio-economic aspects. Third, to determine the fact that whether the missing women problem is a myth or a serious economic issue by employing mixed-method approach.

1.5. Research Questions

Based on the stated research objectives, the following research questions, have been developed.

- Question I: How the demographic indicators of Pakistan have been changed over time?
- Question II: How the sex ratio at the household level is affected by a set of gender inequalities?
- Question III: Are the missing women issue a myth or reality given the variety of gender inequalities in the economy of Pakistan?

2. METHODS

To analyse the stated research questions, the paper follows the mixed-method approach. The approach is employed to integrate the qualitative and quantitative data which permits a researcher to perform a synergistic data analysis (Wisdom & Creswell, 2013). For the qualitative analysis, the trend analysis of the selected demographic indicators has been performed whereas the cross-sectional data have been employed to perform a quantitative exercise.

2.1. Sampling Procedure

The study utilizes the published data resources to perform the analysis.

2.2. Sample Size

Given the opacity of the available data and statistics, the study employs both time series (maximum available years) and cross-sectional data of the Pakistan Social and Living Standards Measurement (PSLM) survey for the year 2019-20. The former would be collected from the website of World Bank indicators while the latter would be gathered from the Pakistan Bureau of Statistics.

2.3. Data Analysis

As it is mentioned earlier that the qualitative insight would be discussed through the time series data and trend analysis of mortality rate, survival rate, fertility rate, and regional comparison given the available data. A detailed description of the indicators has been provided in the appendix. Whereas the cross-sectional data has been processed through the technique of Ordinary Least Square (OLS). The standard OLS model for the cross-section data is a linear model with a dependent variable (scalar) and several regressors given N observations. According to Cameron & Trivedi (2005), this data are defined as (y, X) , where y denotes the dependent variable and X represents a matrix of explanatory variables. The regression model with errors (vector representation) is created as;

$$Y = E[y|X] + u \quad \dots (1)$$

where $E[y|X]$ is the conditional expectation of y given X (vector of random and unobserved errors (u)). The expression $E[y|X]$ produces the average value of the conditional estimated function. Consequently, a linear model is obtained when $E[y|X]$ is specified with the condition of X to also be a linear function.

The following equation denotes the vector notation of i^{th} observation.

$$y_i = x_i' \beta + u_i \quad \dots (2)$$

where x_i' is a $K \times 1$ regressor vector and β is a $K \times 1$ is the parameter vector. In the matrix form, the N observations are arranged by row to generate equation 3.

$$y = X\beta + u \quad \dots (3)$$

where y is a vector of regress ($N \times 1$) and X is a regressor matrix ($N \times K$). u is an error vector ($N \times 1$). The linear model can be uniformly articulated by equations 2 and 3 and could be utilized respectively while the latter delivers an appropriate description as it is more abridged.

The OLS assessment provides estimators that exhibit the least error values or least residual sum of squares.

$$\sum_i^N u_i^2 = u'u = (y - X\beta)'(y - X\beta) \quad \dots (4)$$

In this respect, the partial derivative of equation 4 provides the projected value of beta.

$$\beta_{OLS} = (X'X)^{-1} X' y \quad \dots (5)$$

The model for sex ratio in this study is estimated by the following OLS model;

$$y = X^f \beta + u \quad \dots (6)$$

Here, y is the household sex ratio (hhsr) and X^f is a vector of independent explanatory applied in the model.

3. RESULTS AND DISCUSSION

Initiating with the trend assessment of the aggregate data, it is evident from figure 1 that Pakistan has experienced a subsequent decline in the overall infant mortality rates (IMRT) since 1960. This could be attributed to divergent indicators including improvement in childbearing and child practices and better health care interventions such as immunization. Referring segregated rates for females and males (IMRF and IMRM), the respective rates were also declining. Consequently, the survival rates⁵ for both females and males (SRF and SRM) in figure 2 also increased over the years for both genders.

⁵ Find the population size and death toll reported for the given time. Subtract the total death rate from the total population. Pick the exponent n . To obtain the result per 10n individuals, multiply the outcome by 10^n .

Figure 1. Overall Infant Mortality Rates (IMRT), Infant Mortality Rate for Females (IMRF) and for Males (IMRM)

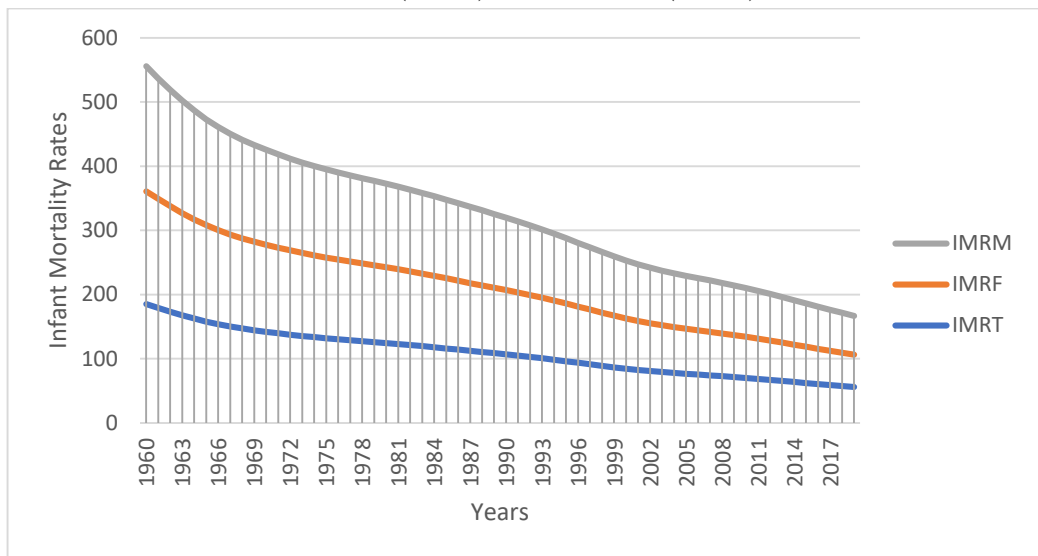


Figure 2. Survival Rate of Males (SRM) and Females (SRF), Pakistan

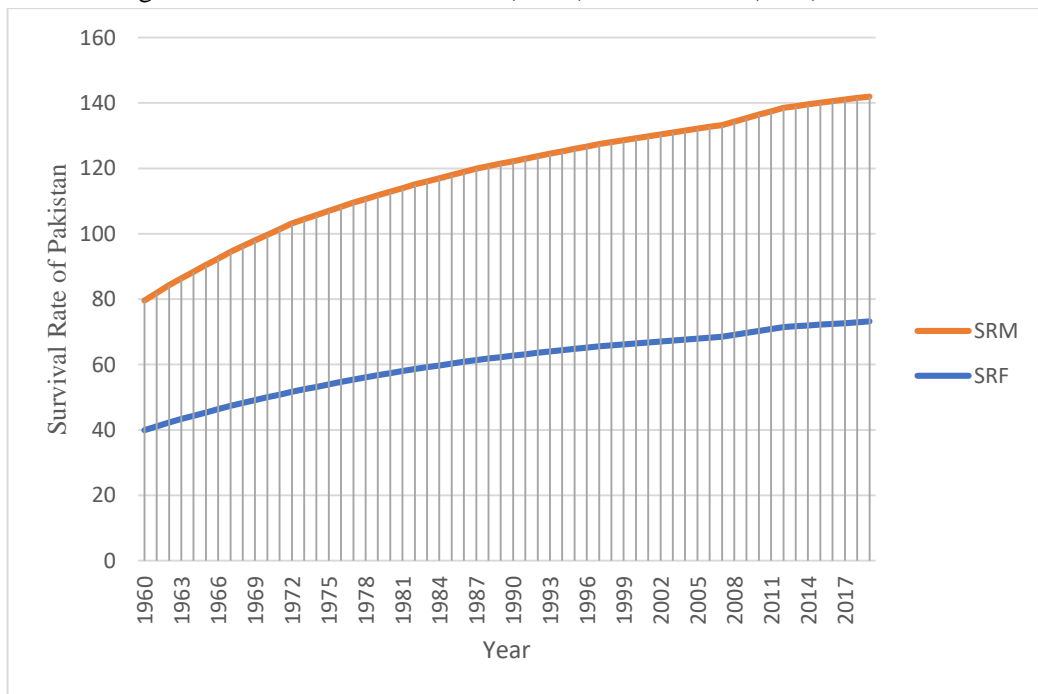
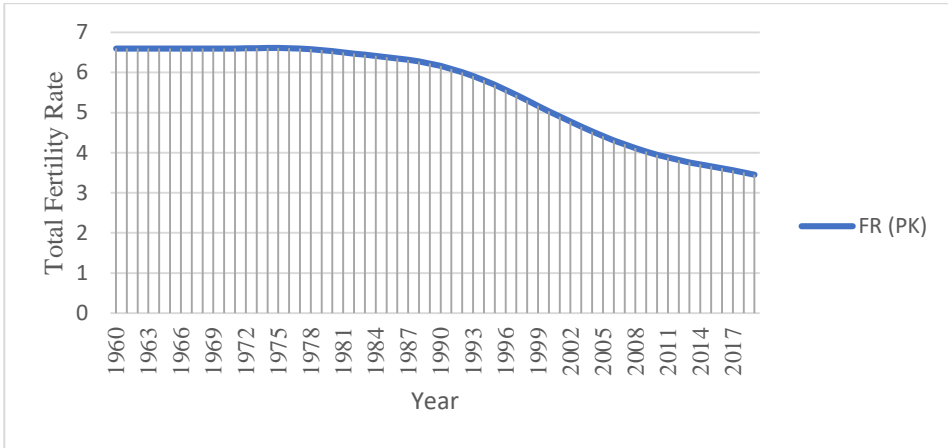


Figure 3. Total Fertility Rate of Pakistan



Pakistan also experienced a comparatively consistent high fertility rate over the years from 1960 to 1990 whereas the rate has been declining since 1990. Nargund (2009) argued that declining birth rates are a matter of concern for both developed and developing economies.

Turning to the regional context, the sex ratio of Pakistan had increased from 1.06 to 1.08 from 1962 to 2019. The ratio for India was initially 1.05 in 1962 however, for the year 2019, it increased to 1.1. Additionally, the population of China leads in terms of sex ratio inequality as it was the highest from the two neighbouring countries. The economy experienced a hike from 1.07 to 1.12 for the same period under consideration. Given the fact that Pakistan exhibits the highest fertility rate (3.45), the other two economies have relatively low fertility rates i.e., 2.2 for India and 1.69 children per woman for China. This situation could be attributed to the fact that both India and China may have the issues of self-selective abortions and son preference (Saikia et al., 2021; Hesketh and Xing, 2011).

The regional disparities and ambiguity in the available statistics indicate a state of a quandary regarding the issue of missing women. Further, it is worth mentioning here the argument presented by Barro (2005) that the missing women puzzle in Asia would better be explained through biological reasoning. He further elaborated that Sen may have overstated the issue of missing women due to prevailing diseases (hepatitis B virus) rather than due to discrimination.

Thus, the brief discussion on mortality and associated factors points out the fact that the technique of mortality rate would not be appropriate enough to explain the issue of missing women. This technique demands a rigorous

approach to evaluate the problem as the available aggregate information is not sufficiently precise for developing economies.

Turning to the other part of the data analysis, the estimation findings are elucidated in Table 1. The findings reveal that all selected indicators are statistically significant at a 1 percent level except the category of joint ownership of household. Additionally, it is worth mentioning here that for this study the sex ratio is derived by dividing the total by women at the household level.

Table 1: Coefficient Estimates of OLS Regression

	Coefficient	Std. Err.	t-value	P>t	95% Confidence Interval	Std.Err.
hhaa6	0.9009602	1.23E-02	73.34	0.000	8.77E-01	9.25E-01
hhfp7	-21.65307	1.83E+00	-11.85	0.000	-2.52E+01	-1.81E+01
hhfi8	0.0000035	2.85E-07	12.28	0.000	2.94E-06	4.06E-06
hhhf9	-37.3317	0.779617	-47.88	0.000	-38.85973	-35.80367
hhus10	-2.594847	0.396784	-6.54	0.000	-3.372533	-1.81716
hhpr11	-1.218721	0.43482	-2.8	0.005	-2.070957	-0.3664852
hhsr12	14.29809	0.579591	24.67	0.000	13.16211	15.43407
Hhbr13	22.85586	0.77232	29.59	0.000	21.34213	24.36958
Hhos14	-29.93731	1.019398	-29.37	0.000	-31.93531	-27.93932
Hhoj15	-0.8933849	0.836235	-1.07	0.285	-2.532383	0.7456128
Hhon16	3.795076	1.29739	2.93	0.003	1.252227	6.337925
_cons	153.3655	0.295556	518.91	0.000	152.7862	153.9447
Number of Observations: 252862						
F(12,630089)	903.72			R-squared		0.088
Prob > F	0			Root MSE		86.588

⁶ Average Age of Household Members.

⁷ Household Female Participation.

⁸ Household Family Income.

⁹ Household Head Female.

¹⁰ Household Urbanization Status.

¹¹ Household Lives in Punjab Region.

¹² Household Sex Ratio.

¹³ Household Birth Rate.

¹⁴ Household Ownership.

¹⁵ Joint Ownership of Household.

¹⁶ Household Numbers in Occupation.

The table explains that the household sex ratio (hhsr) is positively associated with the average age of household members (hhaa). Zhang and Li (2020) associated this with demographic consequences of increasing population which may also induce the phenomenon of missing women.

Source: Estimated by Authors

The negative association of household female participation (hhfp) in the labor market can be explained from extensive marriage academic models. These models declare that if married women are less likely to participate in the labour market, then there would be a high sex ratio or scarer women relative to men (Grossbard & Amuedo-Dorantes, 2007). While discussing the household family income (hhfi), it is a well evident fact that this variable is firmly associated with the socio-economic stability of a family. However, Schacht and Kramer (2016) claimed that it is progressively unclear to determine the exact link of sex ratio with the socio-economic stability or with the family income. To incorporate the gender differentials in household structure, the household head female (hhhfi) has been included in the hhsr model. The indirect connection between the two indicators reveals the fact that if a household is headed by a female in Pakistan, then she would assure a more balanced gender ratio or a maintained family (Dungomaro, 2008).

This household urbanization status (hhus) has been included in the model as the economic progress of a country has been widely linked with the modernization of society reducing poverty, enhancing urbanization, and improving literacy and medical facilities. The striking negative alliance of hhus with sex ratio implies that rapidly increasing urbanization has assessed to reduce the gender imbalances at the household and in turn in the society. This finding contradicts with the study of Murthi et al. (1995) who found no such evidence in the context of India. The authors stated that the urbanization in India had adversely affected women as it lowered poverty and enhanced male literacy and accessibility to medical services pertaining to more women deficit. The result of regional disparities showed better estimates of sex ratio if the household lives in Punjab region (hhpr). The variable has a negative coefficient with a value of 1.2 as compared to other provinces of Pakistan. The idea of household ownership (hhos) originates from the concept of agency which considers an individuals' ownership and control over her endowments and access to economic opportunities. Hence women's agency at household level provides her the autonomy to participate in the decision-making and family

formation. The coefficient value of 29.9 with a negative sign endorses the fact households with women ownership reduce the gender imbalances at the household level. Meanwhile, the joint ownership had no significant impact in this respect (ADB, 2016).

Referring the average estimates of the overall sample, it has been found that the average sex ratio for the period of 2019-2020 was 1.53, which is much higher than the aggregated sex ratio (1.08). In the appendix, Table B1 explains the post estimation of the model under consideration to check the problem of multicollinearity whereas table B2 shows the correlation matrix which endorses the section criteria of the opted variables.

4. CONCLUSION

The mixed-method approach used in the study had pointed out that missing women is a prominent phenomenon in the economy of Pakistan which is trending over the years. The inclusion of different datasets in the study has provided support to the argument. Further, another main finding of the study had indicated that at a disaggregate level, the rising sex ratio is a matter of concern for the authorities and patrons supporting women empowerment. In the nutshell, it can be concluded that given the demographic transition and rising sex ratio at both aggregate and household levels, the problem of missing women would severely affect the gender balance in the economy of Pakistan.

The authorities of Pakistan have made strides in reducing the gender gap through better enrolment rates and access to health care services. However, these improvements have not been well transmuted into an enhancement of gender equality. There is a dire need to broaden the horizon of gender quality and hence this study views gender inequality with a different dimension i.e., “missing women.” Therefore, it is high time to integrate the domains of economics, health, and family behaviour to broaden the horizon of gender economics.

4.1. Policy Recommendations

- Given the restricted domain of the study, it is suggested that analysis may be extended by incorporating more gender inequalities in the sex ratio model used in this study.
- Though gender sensitized policies in Pakistan have been rigorously discussed, the implication of such policies has been widely considered.

Therefore, consideration of doable policy options would provide better results.

- The academic literature on gender economics clusters around empowering the women in Pakistan, avoiding the factors affecting the sex ratio at the household level. Hence, focusing on the issues of women would surge the process of identifying real problems of women.

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ANNEXURE: A

Table A1. Description of Variables

Variable	Description
Mortality rate, infant (per 1,000 live births)	The infant mortality rate is the number of infants dying before reaching one year of age, per 1,000 live births in a given year.
Mortality rate, female infant (per 1,000 live births)	The infant mortality rate is the number of female infants dying before reaching one year of age, per 1,000 live births in a given year.
Mortality rate, male infant (per 1,000 live births)	The infant mortality rate is the number of male infants dying before reaching one year of age, per 1,000 live births in a given year.
Sex ratio at birth (male births per female births)	Sex ratio at birth refers to male births per female births. The data are 5-year averages.
Fertility rate, total (births per woman)	The total fertility rate represents the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children by age-specific fertility rates of the specified year.
Survival to age 65, female (% of cohort)	Survival to age 65 refers to the percentage of a cohort of new-born infants that would survive to age 65 if subject to age-specific mortality rates of the specified year.
Survival to age 65, male (% of cohort)	Survival to age 65 refers to the percentage of a cohort of new-born male-female infants that would survive to age 65 if subject to age-specific mortality rates of the specified year.

Source: World Bank Indicators, 2021.

ANNEXURE: B

Table B1. Correlation Matrix of the Selected Variables

	<i>hhsr</i>	<i>hhaa</i>	<i>hhfp</i>	<i>hhfi</i>	<i>hhhf</i>	<i>hhus</i>	<i>hhrs</i>	<i>hhao</i>
<i>hhsr</i>	1							
<i>hhaa</i>	0.1174	1						
<i>hhfp</i>	-0.0274	0.0387	1					
<i>hhfi</i>	0.0341	0.0098	-0.0283	1				
<i>hhhf</i>	-0.0925	0.1569	0.1018	-0.0896	1			
<i>hhus</i>	0.0016	0.0103	-0.0508	0.143	-0.027	1		
<i>hhrs</i>	0.0867	0	0.0447	0.0069	-0.0959	0.1581	1	
<i>hhao</i>	-0.0173	0.001	0.0197	0.0001	0.0519	0.0808	0.0069	1

Table B2. Post Estimation test for Multicollinearity

Variable	VIF	1/VIF
<i>hhaa</i>	1.03	0.973502
<i>hhfp</i>	1.03	0.971391
<i>hhfi</i>	1.03	0.968255
<i>hhhfh</i>	1.08	0.925406
<i>hhus</i>	1.13	0.882881
<i>hhps</i>		
2	1.77	0.566303
3	1.73	0.578423
4	1.31	0.766209
<i>hhao</i>		
2	1.04	0.961504
3	1.01	0.988648
4	1.01	0.990735
Mean VIF	1.2	

Patterns of Health Services Utilization During Pregnancy, Delivery, and Postpartum Period: Evidence from Pakistan Maternal Mortality Survey

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Abstract

Utilization of health services is a multidimensional behavioural phenomenon, particularly when it comes to pregnancy and delivery concerns. The importance of maternal health care services in reducing maternal mortality and morbidity has received a significant recognition. Most of the maternal deaths can be prevented if women have access to basic antenatal, delivery and postnatal care. However, uptake of maternal health care services is very low even in the areas where they are extensively available. The aim of this study is to assess the pattern and identify underlying factors on maternal health care utilization in Pakistan. Data is taken from Pakistan Maternal Mortality Survey (PMMS) 2019. Logistic regression was performed and adjusted odd ratios were calculated by using three dependent variables – Ideal Antenatal Care (IANC), birth assisted by Skilled Birth Attendant (SBA), and Postnatal Care (PNC). Impact of biological and socio-demographic variables were computed, and findings revealed that with the increase in age, education and household wealth, women are more likely to have better opportunities to use ANC, SBA and PNC. The focus of policy considerations should be on the provision of high-quality services as well as on educating women about the value of receiving such services during pregnancy and the postpartum period through education and awareness campaigns. Moreover, skilled staff and voluntary health workers can be recruited to make future agendas in reducing maternal mortality and morbidity more successful.

1. INTRODUCTION

Health care services during pregnancy, childbirth, and after delivery are important for the mother's and baby's survival and well-being. There is significant evidence that good antenatal care (ANC), postpartum care (PNC), and increased skilled birth attendance (SBA) during and after pregnancy protects mother's and new-born's lives from maternal and neonatal morbidity (Budu et al. 2021). These are considered as an integral components of maternal

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and child health care (NIPS & ICF 2018). However, the postnatal period is frequently regarded as the "most neglected stage" in the continuum of mother and child health care (WHO 2013). In this regard, the most important health services required to reduce the maternal mortality ratio to less than 70 per 100,000 live births are ANC visits (four or more), in-facility deliveries, and skilled birth attendance (Kassebaum 2016; WHO 2016).

ANC provides an opportunity to effectively prepare moms for birth and for optimal childcare by addressing essential information and education for health promotion and disease prevention. Ideal antenatal care (IANC) is defined as receiving at least four ANC appointments, getting at least one tetanus toxoid (TT) injection, and taking 100 iron-folic acid (IFA) syrup/tablets during pregnancy. It is advised that all pregnant women have their first ANC visit at or before 16 weeks of gestation, and that they have a minimum of four ANC visits throughout their pregnancy (Basha, 2019). ANC is a critical opportunity for identifying and managing any medical complications (Tunçalp et al., 2017). Globally, 86% of pregnant women receive at least one visit with qualified health staff, and 65% receive at least four visits (UNICEF 2019). In South Asia, however, just 49% of women had received at least four ANC visits (Basha, 2019). The World Health Organization (WHO) recommends that mothers and new-borns undergo PNC within 24 hours of birth if the birth happens in a health facility. The initial PNC for home births should happen as soon as possible, preferably within 24 hours of the birth. In addition, all mothers and new-borns should have at least three PNC visits: on day 3 (48-72 hours), between 7-14 days, and six weeks following birth. WHO recommends all women to have a health check within 24 hours after birth (WHO 2016).

Utilization of health services is a multidimensional behavioural phenomenon, particularly when it comes to pregnancy and delivery concerns. Approximately half of all maternal and neonatal deaths occur during the first 24 hours (WHO 2016). In developing countries, a vast number of women face life-threatening and other serious reproductive health issues. Maternal deaths are approximately 415 per 100,000 live births and maternal mortality is approximately 18 times higher in developing countries as compared to the developed countries (WHO 2017). Although maternal mortality had dropped by more than 40% from 1990 to 2015 but the utilisation of health care remains far below any acceptable threshold. Given its significance, the United Nations used the maternal mortality ratio (MMR) as a measure of maternal health and set a target to lower the MMR in both the Millennium Development Goals (MDG's) and Sustainable Development Goals (SDGs).

To meet the SDG target, Pakistan aims to reduce its MMR from 276 in 2007 and 186 in 2019 to less than 70 maternal deaths per 100,000 live births in 2030. Pakistan has achieved success in reducing its MMR from 276 in 2007 to 186 in 2019 (Sadia et al. 2022). The Pakistani government is committed to enhance the availability and quality of antenatal care (ANC) services by increasing access to institutional deliveries and skilled birth attendants. Moreover, government is also determined to improve timely referrals of complicated pregnancies to higher-level health facilities. For this purpose, government adopted comprehensive national framework for maternal, neonatal, and child health (MNCH) in 2005, that provided the vision and guidelines to develop MNCH interventions. The programme focused on two major areas: first is improving access to skilled birth attendance (SBA) by deploying community midwives and promoting institutional delivery and emergency obstetric and neonatal care (Golding, Hall, and Shah 2011). Primary health care services were also extended via the Lady Health Workers (LHWs) Programme to provide MNCH services through home visits in rural areas. LHWs promote and counsel about hygienic practices, contraceptive use, antenatal care (ANC), iron and folic acid supplementation during pregnancy, growth monitoring of children, and vaccination of pregnant women and children (Abir et al. 2017).

Numerous studies on the use of maternal health care services in various countries have found that factors such as maternal age, number of living children, education, place of residence, occupation, religion, and ethnicity are significantly associated with maternal care use (Aziz Ali et al. 2020; Tizazu et al. 2020; Uldbjerg et al. 2020). The utilization level of maternal services in Pakistan varies between urban and rural areas, and access to facilities also varies by area, which influences the frequency of services used. Health services utilization is particularly poor in rural areas of Pakistan where 41% of deliveries take place at the home and 38% are assisted by unskilled birth attendants (Sadia et al. 2022). A skilled birth attendant (SBA), according to WHO is “a person who assists a mother during childbirth and who initially acquired her skills by delivering babies herself or through apprenticeship to other traditional birth attendants”. A certified health care provider, such as a midwife, doctor, or nurse, who has received the necessary education and training to manage normal (uncomplicated) pregnancies, childbirth, the immediate postpartum period, as well as the identification, management, and referral of women, is referred to as a skilled birth attendant.

Despite this mounting evidence, no single study has explored the multi-faceted indicators to maternal and new-born health service utilization in rural-urban Pakistan. Previous studies have determined the rates of service utilization without exploring the sociocultural determinants of health-seeking behaviour (Ayalew and Nigatu 2018; Uldbjerg et al. 2020). Addressing this gap, we designed this explanatory study to assess the patterns of health service utilization during pregnancy, delivery, and postpartum period and to assess the socio-demographic determinants of antenatal and childbirth care services in Pakistan.

2. DATA AND METHODOLOGY

Data are taken from the Pakistan Maternal Mortality Survey (PMMS) conducted in 2019 in urban-rural Pakistan. It is the first exclusive nationwide survey on maternal mortality implemented by the National Institute of Population Studies (NIPS) of the Ministry of National Health Services, Regulations and Coordination (MoNHSR&C). The survey interviewed ever-married women of reproductive ages (15-49 years) about health services utilization during pregnancy, childbirth, and the postpartum period in the last three years. Rates of maternal health services utilization were computed by women's biological and socio-demographic characteristics. Logistic regression analysis was carried out to estimate the likelihood of maternal health services utilization after adjusting for the socio-demographic variables. Description of dependent and independent variables are listed in Table 1.

Table 1. List of Dependent and Independent Variables used in the Analysis

Variable	Definition
Dependent variables	
Ideal antenatal care (IANC)	Percentage of women with four or more ANC visits to a skilled healthcare provider during pregnancy, at least one ANC visit in the first trimester, blood and urine tests carried out and BP measured, iron tablets prescribed and nutritional counselling was given, and at least one TT injection received for their most recent pregnancy that resulted in a live birth, stillbirth, miscarriage or abortion in the last five years.
Women whose birth was assisted by a skilled birth attendant (SBA)	Percentage of women whose most recent live birth, stillbirth, miscarriage, or abortion in the last five years was assisted by an SBA.

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Postnatal care (PNC) for the mother	Percentage of women who received a postnatal check-up in a health facility within 42 days of their most recent live birth, stillbirth, miscarriage, or abortion in the last five years.
Key independent variables	
Parity	1-2 births
	3-5 births
	≥ 6 births
Age at birth	<25 years
	25-34 years
	≥ 35 years
Education	No schooling
	<11th grade
	> 10th grade
Region	Punjab
	Sindh
	Khyber Pakhtunkhwa
	Balochistan
	Gilgit Baltistan (GB)
	Azad Jammu and Kashmir (AJK)
Place of Residence	Urban
	Rural
Wealth Quintile	Lowest
	Second
	Middle
	Fourth
	Highest

3. RESULTS AND DISCUSSION

3.1. Descriptive Statistics

Table 2 presents the descriptive analysis of all variables used in the analysis. As shown in Table 2, only 21 percent of women with at least one pregnancy have received ideal antenatal care. Bivariate results show that mothers having 1 to 2 births are almost four times more likely to receive ideal ANC (27 percent) compared to mothers having 6 or more births (7 percent). With regards to the age of women, use of ideal ANC peaks in the 25-29 years' age- group (23 percent). Younger women (<25 years) and older women (35+ years) are less likely to use ideal ANC.

Only 8 percent of women with no education have received ideal antenatal care while the ideal antenatal care increased with the increase in the education level of the women. The data reveal that women's education brings

variations in the use of ideal antenatal care. For example, 43 percent of educated women with 10th grade or higher-level education received ideal ANC than women with 1 to 9-grade education (23 percent). Still, the proportion of educated women using Ideal ANC is small.

Ideal antenatal care utilization is highest (36 percent) in AJK and lowest in Balochistan (4 percent). Whereas in other regions, the ideal antenatal care use varied between 17 percent and 28 percent. Along the same lines, urban women are almost twice as likely to receive ideal ANC as their counterparts (28 percent and 15 percent respectively). The household's wealth status has an impact on the utilization of ideal antenatal care, showing a steady increase from 3 percent in the lowest quintile to 47 percent in the highest quintile. Ideal antenatal care utilization increased with the increase in wealth.

Assistance during delivery outcomes by a Skilled Birth Attendant (SBA) is considered effective in reducing maternal and neonatal mortality (NIPS & ICF 2018). Table 2 exhibits assistance from a skilled provider during delivery, abortion, or miscarriage. More than two-thirds (70 percent) of pregnancy outcomes take place with the assistance of a skilled birth attendant (obstetrician/specialist, doctor, nurse/ midwife/lady health visitor (LHV), or community midwife).

The utilization of SBA decreases with the increase in several pregnancy outcomes. SBAs are more likely to attend first-second order births or pregnancy outcomes to mothers aged less than 25 years and 25-35 (76 percent and 71 percent each respectively) than births of higher birth order (53 percent) and mothers 35+ years (64 percent). There is a strong relationship between a mother's education and pregnancy attendance by an SBA. Eighty-five percent of pregnancies of women with 10th grade or higher education were assisted by skilled birth attendants while 58 percent were for women with no education.

Among regions, births in Punjab (78 percent) and AJK (77 percent) are most likely to be attended by an SBA. Pregnancy outcomes in urban areas are 15 percent more as likely to be assisted by an SBA (78 percent) than pregnancy outcomes in rural areas (63 percent). Similarly, assistance during pregnancy outcomes by a SBA varies by women's economic status, pregnancy outcomes to women in the highest wealth quintile are much more likely to be assisted by an SBA (89 percent) than pregnancy outcomes for women in the lowest wealth quintile (50 percent).

Table 2. Percentage of women who received ideal antenatal care (IANC), skilled birth attendance (SBA), and postnatal care (PNC) in a health facility by demographic and socio-economic characteristics

Characteristics	Received Ideal ANC	Assisted by SBA	Received PNC in a facility	No. of women
Parity				
1-2	27.3	76.2	64.2	2448
3-5	19.0	69.1	53.4	2393
≥ 6	6.5	53.2	38.6	942
Age at birth				
<25	18.9	70.9	56.0	1621
25-34	22.5	70.7	57.8	3062
≥ 35	17.1	64.3	49.3	1155
Education				
No schooling	7.5	58.0	-	2860
<10th grade	22.6	76.6	-	1481
> 10th grade	43.2	84.6	-	1497
Region				
Punjab	27.9	78.3	70.8	1628
Sindh	16.8	32.7	64.5	1145
Khyber Pakhtunkhwa	17.2	29.7	43.3	1238
Balochistan	3.5	48.7	26.7	709
GB	18.9	38.7	42.3	525
AJK	35.8	22.8	68.6	593
Place of Residence				
Urban	27.9	78.1	64.7	2465
Rural	15.1	63.2	48.9	3373
Wealth Quintile				
Lowest	3.0	45.9	-	1257
Second	10.0	62.0	-	1262
Middle	17.7	74.0	-	1218
Fourth	31.2	82.9	-	1104
Highest	47.2	88.6	-	997
Total	20.5	69.5	55.6	5838

Table 2 also reveals information on postnatal care in a health facility according to the mother's background characteristics. More than half of mothers (56 percent) received postnatal care in a health facility in Pakistan. The use of PNC in a facility decreases when parity increases. Mothers with 1-2 births (64 percent) are more likely to receive PNC than mothers with 6+ births (39 percent). Small differences are found in the use of PNC in a health facility

by age at birth. Younger and middle-aged group mothers are more likely to have PNC (56 percent and 58 percent respectively) than older mothers (49 percent). Mothers with 10th grade or higher education, those who belong to Punjab province, those in urban areas, and those from the wealthiest households are more likely to receive postnatal care from a health facility

3.2. Statistical Analysis

Depicting the likelihood of utilization of Ideal ANC, SBA, and PNC in a health facility for each variable shown, after adjusting for the effects of age, parity, woman's education, residence (urban/rural), and wealth quintile. The results depicting Adjusted Odd Ratios (AOR) and their 95 % confidence interval reflecting the likelihood of utilization of health care services by women are presented in Table 3.

Table 3: Adjusted Odds Ratios (AOR), and 95% Confidence Intervals (CI) of Receipt of 3 Critical Maternal Health Services

Predictors	Received Ideal ANC		Assisted by SBA		Received PNC in a facility	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Parity						
1-2 (ref)						
3-5	2.71***	1.94 - 3.79	1.72***	1.38 - 2.14	1.30	0.98 - 1.74
≥6	1.81***	1.32 - 2.47	1.33***	1.11 - 1.60	1.03	0.80 - 1.32
Age at birth						
<25 (ref)						
25-34	0.80	0.67 - 0.96	0.98	0.83 - 1.16	0.89	0.68 - 1.18
≥35	1.31*	1.06 - 1.62	1.14	0.96 - 1.36	1.12	0.90 - 1.39
Education						
No schooling (ref)						
<10 th grade	1.88***	1.53 - 2.31	1.32*	1.13-1.55	0.63***	0.50 - 0.79
10 th grade or higher	3.24***	2.63 - 3.99	1.28	1.04-1.56	0.87	0.70 - 1.09
Place of Residence						
Rural (ref)						
Urban	0.95	0.82-1.11	1.10	0.95 - 1.26	0.88	0.74 - 1.04
Wealth Quintile						
Lowest (ref)						
Second	2.75***	1.88 - 4.02	1.67**	1.41 - 1.97	0.86	0.68 - 1.09
Middle	4.18***	2.87 - 6.08	2.52***	2.08 - 3.05	1.06	0.82 - 1.37
Fourth	7.17***	4.91 - 10.48	3.45***	2.74 - 4.33	1.64**	1.23 - 2.19
Highest	11.48***	7.76 - 16.99	4.37***	3.30 - 5.80	2.16**	1.55 - 3.05

Note: p-value significance of the covariate in each health service utilization, *p<0.05, **p<0.01, ***p<0.001.

Use of Ideal Antenatal Care

Table 3 depicts that parity is a good predictor of the use of ideal ANC. The odds ratios for women having 3-5 births are 2.7 times more likely to receive ideal ANC than those having 1 to 2 births. Parity has highly significant effects on IANC. Our results are consistent with the findings of Abebe et al. 2019. In contrast to the bivariate results, women in the 35 years or older age group are significantly more likely to receive ideal ANC compared to the women in the reference category of less than 25 years. In a similar vein, another study also confirmed our results by stating that women between the ages of 25 and 29 are less likely to use antenatal care facilities than those between 35 and 44 (Tekelab et al. 2019). The odds ratio of having ideal ANC is much higher for more educated women having 10th grade or higher education than those with no education. Other studies also investigated that the effect of education is statistically significant on the use of Ideal ANC implying that education brings rationality to women's attitude toward the utilization of health services (Raru et al. 2022).

Similar to bivariate results, rural women are less likely to receive IANC than urban women, but the effect of residence is not significant on IANC. The odds show that women from the highest quintiles are 11.5 times more likely to adopt IANC than the poorest women. Tsegaye and Ayalew 2021 also found similar results in Ethiopia that showed that with an increase in wealth women are more likely to have better opportunities to use ideal antenatal care and other maternal health care utilization.

Assistance by Skilled Birth Attendant

Appropriate medical care and hygienic conditions during delivery, abortion, or miscarriage reduce the risk of complications and infections that may cause death or serious illness for the woman, the baby, or both. Assistance from a skilled birth attendant during delivery or pregnancy outcome is considered a key factor in reducing maternal and neonatal mortality (Ayele, Melku, and Belda 2019).

Adjusted odds ratios for skilled birth attendance show that women having 3-5 births are 1.7 times more likely to be attended by SBA as compared to the reference category (1-2 births). Our results are consistent with the findings of Manyeh et al. 2017, in which they stated that parity is statistically significant with the utilization of services from skilled birth attendants. Moreover, SBA is more likely to be received by older women (> 35 years) than

younger women (<25 years). It was found that education is an important indicator for the utilization of SBA. The odds ratio of having skilled birth attendance is 1.3 times higher for more educated women (<10th grade) than those with no education. Previous studies also examined this relationship and found the significant impact of education on the utilization of SBA (Bhowmik, Biswas, and Ananna 2020).

Urban women are more likely to have SBA than rural women, but the effect of residence is not significant. As expected, the effect of the wealth quintile on SBA was found significant and increased with household wealth, richest women are 4.3 times more likely to have SBA than the poorest women from the lowest quintile. The outcomes of Rana and Khan, 2022 also confirm our conclusions.

Utilization of PNC in a Health Facility

The postnatal period is important for mothers, as they are more likely to get life-threatening complications. Postnatal care visits can help to prevent or treat complications. It is recommended that a woman receive at least three postnatal check-ups, the first within 24 hours of delivery, the second on the third day after delivery, and the third on the seventh day after delivery (NIPS & ICF 2018).

Regression results in Table 3 show adjusted odds ratios for PNC in a health facility by background characteristics. Parity is a good predictor of utilization of PNC by women. The likelihood of receiving PNC is 1.3 times higher for those women who have 3-5 births than those having 1-2 births. Women in the 35+ years or older age group are more likely to receive PNC compared to the younger women. The effects of parity and age are not found not significant. Unexpectedly, the odds ratios of PNC are significantly lower for more educated women than those with no education. This shows that more educated women are less likely to be used for postnatal care in a facility. This unique result is validated by previous study of Sebayang et al., 2022 which states that infants born at a health care institution had a higher risk of having any PNC than those born elsewhere, but the difference in probabilities was smaller when their mother had a high knowledge level (Sebayang et al. 2022). Urban/rural residence has no significant effect on the use of PNC. Contrary to bivariate results urban women are less likely to be used PNC than rural women. As expected, the use of PNC increased with an increase in household wealth, richest women are 2 times more likely to have PNC than the poorest women

from the lowest quintiles. Our findings are consistent with the results of Tsegaye and Ayalew 2021.

4. CONCLUSION AND POLICY IMPLICATIONS

This study made an attempt to find out the factors associated with maternal health care service utilization and helps to understand the complex associations between them in Pakistan. We designed this explanatory study to assess the patterns of health service utilization during pregnancy, delivery, and postpartum period and to assess the socio-demographic determinants of these healthcare service utilization in Pakistan. The health service utilization includes the use of ideal antenatal care (IANC), skilled birth attendant (SBA) and postpartum care (PNC). Findings revealed that IANC utilization is highest in AJK and lowest in Balochistan, SBA utilization is high in Punjab and AJK, whereas PNC service utilization is high among Punjab province. Urban women are almost twice as likely to receive IANC, PNC and SBA and the utilization of these services increases with the increase in wealth. More than half of mothers received postnatal care in a health facility in Pakistan. The use of PNC in a facility decreases when parity increases. Mothers with 10th grade or higher education, those who belong from the wealthiest households are more likely to receive ANC, SBA and PNC from a health facility. In addition, ANC, SBA, and PNC are more likely to be received by older women than younger women. However, the effects of parity and age are not found significant for PNC. Unexpectedly, the odds ratios of PNC are significantly lower for more educated women than those with no education. This shows that more educated women are less likely to use postnatal care in a facility.

For the well-being of mother and her child, utilization of maternal care services is of vital concern. Our results can aid both policymakers and researchers to gain a more nuanced picture of the indicators where policy solutions are needed, saving time and resources. Government and other related institutions should make efforts to develop better general community-based education/training program so that women can have better understanding of the importance of maternity health care services and its utilization. Awareness for utilization of ANC, SBA, and PNC during and after pregnancy can be achieved by collaborating with the traditional and religious leaders in the communities. More qualified staff and voluntary health workers can be recruited to support these enlightenment campaigns. Educational knowledge and financial empowerment of women will also need to be focus that will equally go a long way to strengthen the utilization of maternal health care services. Moreover,

targeted strategies to overcome barriers such as there are four main obstacles to access are lack of transportation, lack of services, inadequate medications or equipment, and expenses, should be focused while designing policies. Moreover, strategies should be devised through awareness raising programs that must focus on educating women about the timely care for complications in pregnancy and postpartum period. Such strategies should be incorporated into future agendas of health care worker training, community engagement activities, policy development and research. With these efforts, women will be able to take proper measures by recognizing that only healthy mother can give a healthy child and a healthy community.

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Estimating the Nexus Among Demographic Dividend, Economic Growth, and Environmental Degradation for Pakistan

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Abstract

Sustainable developmental goal eight (SDG-8) focuses on economic growth and decent work, the primary key to accelerating any country's economic growth. Likewise, reaping the demographic dividend of any country to its optimum level may exacerbate the level of sustainable cities and communities (SDG-11) through the responsible group of production and consumption (SDG-12) hence to raise the economic pace. However, neglecting the environment by focusing on economic growth may induce environmental issues, a significant climate change agent. To achieve the set targets of sustainable development, the reorientation of policies in Pakistan is required to address the climate-based problems by not halting the economic growth process. Accordingly, this study aims to analyze the role of Pakistan's demographic dividend by controlling the impacts of technological innovations, capital formation on Pakistan's economic growth, and environmental degradation-based climate issues from 1980-2018. Therefore, the study plans to use heterogenous econometric algorithms. After identifying the degree of integration between the variables, the study tests the cointegration and found that the variables are cointegrated in the long run. The empirical estimates from the dynamic ARDL estimator reveal that economic growth and innovations are still rising the environmental degradation, while the role of demographic dividend is declined its impact on the environment. Further, the role of demographic dividend and innovations are increasing the economic pace, while more degradation tends to raise concerns about the economic performance of the country. Based on the results obtained from the study, new and updated policies are provided to the policymakers of Pakistan for theory and practice.

Keywords: Demographic dividends; Economic growth; Environmental degradation; Technological Innovations; Pakistan

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1. INTRODUCTION

The debate on the relationship between economic growth and the environment remains contentious. Some are of the view that the emergence of new environmental problems and the rising population in the under-developed world is a failure in coping with the global warming issues, while some are of the view that technological development and economic growth have improved the standard of living (Brock and Taylor 2005). However, environmentalists believe that economic development cannot be achieved without affecting the environment (Cohen 2020). Economists recognized that with the involvement of physical capital, environmental and natural resources should be observed because of their economic significance. Thus, the key question is whether the environment plays a prominent role in sustainable economic growth and the welfare of human beings. The theory of the Environmental Kuznets Curve (EKC) has given an Inverted U-shaped connection among the indicators of environmental pollution. It has also been argued that the countries with low-income economies having a large amount of natural resources will develop fast as compared to the economies that have less amount of natural resources (Shabbir, Kousar, and Kousar 2020).

The rise in temperature and global warming has attracted researchers to find out the factors that are contributing to environmental degradation in the short and long run. A vast majority of the researchers have tested the outcome of environmental degradation using various economic factors including population growth, foreign direct investment (FDI), urbanization, and level of income. Environmental economists have discovered a nonlinear relationship between CO₂ emission and income (A. Khan, Chenggang, et al. 2020). The changes in the global environment have highly adverse consequences for human well-being and is raised serious questions about the world, whether they are on a sustainable path or consuming too many resources by reducing important natural capital. The upsurge in economic growth and the impacts on limited earth arises from demographic changes that include the growth in the population, the changes in age structure, urbanization and the rise in per capita income has change the pattern of consumption (Polasky et al. 2019). In this age of economic consideration, every state wants to maximize its economic growth and the human activities in achieving that maximum growth are the responsible elements that are involved in ecological and environmental degradation. The last two decades have observed a rise in the global temperature up to 0.9 C. The

CO₂ emission is continuously increasing day by day which is increasing the global temperature (Bano et al. 2021).

The pessimist and optimist approaches to population growth have prominence in the 20th century. After a thorough investigation it has been observed that population growth does not have significant positive or negative implications on the economic growth. The results from the population neutralists are surprising and they divide them into two different components that is mortality and fertility and tested their independent impacts on the growth of the economy (Bloom et al. 1998). The overall change in the structure of a nation's population due to a decline in fertility will enhance the economic growth through the rise in working age population output which will boost their per capita income. The importance of the demographic dividend is that the young and the old age populations consume more than their share in production while the working age population consumes less and contributes more to the output and savings.

The demographic dividend is a temporary phenomenon and a time bond window of opportunity that will not last forever (Durr-e-Nayab 2006). The changes in age structure have both direct and indirect effects on the consumption of energy and environmental deterioration. The direct effect on the environmental quality due to age structure can be seen through the behavior of young people (youth) because of their preferences and choices for travel and other goods that leads to a large quantity of carbon emission. While the aged population consumes less energy and produces less carbon emission. The imbalance between these two-age structure may change the pattern of carbon emission, and economic pace. The indirect effect due to the age structure on environmental degradation occurs through a shift in the per capita income of the individuals. Per capita when increases consumers consume more energy and thus share a lot in the emission of greenhouse gases and pollution (Jafrin et al. 2021).

The significance of selecting Pakistan for this study is based on several principles, for example, the rising environmental degradation based on ecological footprints (which is the index of six different indicators, including the fishing grounds, forest products, built-up land, cropland, grazing land, and carbon footprints) developed by Wackernagel and Rees (1996) is very alarming and in the year 2016 Pakistan was ranked 184th in the world having ecological footprints of 0.79 global hectares per person and the average biocapacity remained at 0.35 global hectares per person. The ecological deficit can be seen as 0.44 global hectares per person. In the year 2018, it doubled and reached

0.89 global hectares per person. The CO₂ emissions in the same were 0.87 metric tons per capita and in 2018 it has been raised to 0.98 metric tons. It is growing at an average annual rate of 3.31% (L. Zhang et al. 2021). The environmental degradation could be observed in 2010 and the recent floods of 2022. The key player in both the disasters is La Nina. In the 21st century, the two strongest La Nina years are 2010 and 2022. La Nina works as a catalyst and intensifies the spring heat that precedes the monsoon period across the country. on 5th May Jeff Masters stated that the pre-monsoon heat in the country was fierce as the city of Nawab shah observed 49.5 degree Celsius on May 1 (Henson, 2022). As global warming continues, the fear of its impact will increase and an increase of 1 degree Celsius could observe a 5.3 percent increase in precipitation during the monsoon period. The 2010 floods affected more than 20 million people and displaced millions for quite a few months. The 2022 floods have exceeded the devastation caused by the 2010 floods. It has washed away 45% of the cropland. More than 33 million people have been affected by the recent floods (Khan, 2022).

Since 2005, the Gross Domestic Product (GDP) in Pakistan has been growing on average at 5% a year, and it is not sufficient to fulfil the demand of the whole population (Trading Economics 2021). The economic growth rate of Pakistan in 1961 was 6% while the growth rate in December 2018 was 5.84% and growth rate for 2019 was observed as 0.99% and the 4.85% decline was observed in 2018, 0.53% in the year 2020, and a decline of 0.46 from 2019 has been observed (Trading Economics 2021). Likewise, Pakistan has been ranked 6th in the world with a population of about 211.17 million and it will further increase to 344 million in 2050 if not controlled. Pakistan has been ranked 5th in terms of having a young age population (Hafeez and Fasih 2018). Having the issues of population growth Pakistan has the opportunity of the demographic dividend that started in 1990 and will be available up to 2045 (Durr-e-Nayab 2006). If the demographic dividend is not materialized or utilized properly it will have negative impacts on the economic growth of Pakistan (Chishti 2020).

This study contributes to the knowledge on the nexus among demographic dividends, economic growth, and environmental degradation for Pakistan in multiple ways; that include, quantifying the role of demographic dividends on economic development and the environmental deterioration of Pakistan. Secondly, the study further tests the impression of technological innovation and its role in the country's environmental degradation and economic growth. Thirdly, this study adopted a novel dynamic ARDL

simulation model, which the previous studies have overlooked. Finally, this study produces new and updated policies that will guide Pakistan's policymakers for theory and practice.

The study is organized as follows. The next section presents a review of the literature on the nexus among demographic dividend, economic growth, and environmental degradation. The third section explains the data used, methods adopted, and econometric approaches employed for the estimation of the variables. The fourth section of the study explains the results in line with previous studies, and the final part gives the conclusion, recommendations, and limitations of the study.

2. LITERATURE REVIEW

Since 1902 studies have started shedding light on demographic dividends and their role in economic growth, and the role of demographic dividend is becoming prominent (Hosan et al. 2021). The studies which are highlighting heterogenous impacts of the demographic dividend are yet to be studied. Therefore, the following review of literature sheds light on three strands of research, the first highlights the role of demographic dividends on economic growth. The second strand discusses the role of demographic dividend and its impact on the environment, while the final strand highlights the impact of technological innovations and their role on economic growth and environmental degradation.

2.1. Demographic Dividend and Economic Growth

The demographic transition in many countries in determining the course of economic growth that brings both opportunities and challenges. The aging problem is a matter of great concern for the developed economies while the population growth will rise in the poor economies in the coming years. The developing countries will observe a rise in the working-age population and their share in the production cycle. The shifts in the working-age population will uplift the economic growth and prosperity of the country (Cruz and Ahmed 2018). Two aspects measure the impact of demographic dividends on economic growth. The first aspect emphasizes the factor of fertility acting as an independent variable that influences the working age population and in return gives high productivity and uplifts the economy. The second aspect stresses education that will decrease the fertility rate and will boost production. Both

education and fertility play a prominent role in the economic growth of a country (Jafrin et al. 2021).

The fertility rate has been declining in the developed regions of the world from 2.5-3.5 to a level of 2.1 (1960-2015). In Africa, the fertility rate was 6.7 in the 1960s and it decreases to 6 children per woman in the 1990s and in 2015 it has been declined to 4.7 and in comparison, with the developed regions it is still higher than they have in the 1960s. The transition over a period of time shows that the dependent population will be replaced by the working-age population in the coming years. The decline in the young dependent population will create various economic profits that will create an opportunity for what we call the Demographic Dividend. Africa has the potential for a great demographic dividend and Africa will enjoy the benefits of this demographic dividend to boost their economic growth if they properly materialize and utilize this opportunity (Bloom, Kuhn, and Prettnner 2017).

East Asian countries were the first to witness the demographic transition in Asia and got the opportunities to materialize the demographic dividend for their economic growth. The fertility rate in India is on a continuous decline and this decline has a vital role in the age structure of the country. Three important factors are observed due to the demographic transition in India i.e., life expectancy has increased, the household number has increased, and the population growth rate is changed in different regions. The demographic shift in India has created various economic opportunities and significantly boosted their economy. All these developments like the decrease in fertility rate, urbanization, number of households, and the age structure of the population, had an adverse impact on the environment. The demographic dividend has changed consumption patterns across the country. The working-age population has opportunities to earn more money and spend them on buying motor vehicles and electronic devices which has a direct impact on the environment (Lakshmana 2016). Pakistan is also going through a phase of demographic transition with a major decline in mortality and a modest decline in fertility rates. The demographic dividend is a limited-time opportunity and if correct policies are not implemented it will go away and there will be an adverse effect on the economic growth of the country. Pakistan estimated time for the demographic dividend is from 1990-2045 which means that Pakistan has spent almost half of the demographic dividend phase without any fruitful results (Durr-e-Nayab 2007).

2.2. Demographic Dividend and Environmental Degradation

A vast number of environmentalists acknowledged that population and environment are interconnected. The ARDL framework used to examine the impact of greenhouse gases emission (without considering economic growth variables) in Nigeria shows that adults and children consume more energy and are environmentally intensive, while the aged population has a negative impact which shows that the aging population will have slightly good environmental impacts. The age structure's effect on CO₂ emission has an inverse U-shaped structure (Emmanuel O. Okona 2019).

The rapid aging society and decline in labor force growth have been observed in China. The study was conducted in 29 provinces of China on the relationship between the age structure of the population and environmental degradation. The carbon emission in the low-income provinces due to the working-age population is strong and with the current phase of economic development, the higher ratio of the working-age population has an unfavorable effect on the quality of the environment (Z. Zhang et al. 2018).

Studying the 7 South Asian countries in the STIRPAT framework from 1985-2016 (A. Khan et al. 2021) found the negative role of demographic structure on environmental degradation. The rise in the income of the youth population may change their preferences to buy durable goods and travel that are highly energy consuming, and highly toxic to the environment. The age structure affects economic growth by using fossil fuels which are the main source of greenhouse gases (Hamza and Gilroy 2011).

2.3. Technological Innovations, Growth, and Environment

There is a vast set of literature, which has already determined the relationship between technological innovation, economic growth, and environmental degradation. For instance, a study conducted in 30 countries from 1980-2014 shows that advancement in technological innovation has a vast impact on the countries that produce higher CO₂ emissions. Consequently, the countries must introduce technological innovations and financial support to produce renewable energy resources at a minimum price. Furthermore, the transformation in the economic growth approach is helpful to shift from non-renewable to renewable energy resources to overcome the demand for energy (Chen and Lei 2018).

Studying the 18 states from the developed and underdeveloped world from 1990-2016 using the cross-sectional augmented Dickey-Fuller (CADF) unit root, Dauda et al (2019) found that the consumption of energy produces

CO₂ emissions in almost all the countries. Though, technological innovation in G6 countries decreases CO₂ emissions while the emissions have increased in the case of BRICS and MENA. In studying the 23 growing economies of the world from 1996-2014 using the Generalized Methods of Moments (GMM) method, Omri and Bel Hadj (2020) found that both technological innovation and foreign direct investment decrease the CO₂ emissions in almost all the projected models except those that produce CO₂ from heat and electricity and as a result the quality of the environment is enhanced.

Using the Dynamic ARDL simulations model the research focused on the effects of economic aspects, energy consumption, and globalization on CO₂ emissions from 1971-2016 in Pakistan and the results show that FDI, trade, financial growth, globalization, and energy consumption on CO₂ emissions have positive effect whereas, economic growth, urbanization, and technological innovation have a negative effect on the CO₂ emissions (M. K. Khan et al. 2019). Studying the OECD countries using the STIRPAT models of the OECD countries through the period 1999-2014 Hashmi and Alam (2019) showed that CO₂ emissions decreased by 0.017% with an increase of 1% in environment friendly patent and also CO₂ emissions are reduced by 0.03% with an increase in 1% of environmental tax revenue per capita.

The discussion in the literature indicated that demographic dividend plays a vital role in economic growth of any economy; similarly, the role of technology in boosting economic growth cannot be ignored. Therefore, this study aims to find the role of demographic dividends and technological innovations on economic growth and environmental degradation in Pakistan over the 1980-2018 period. The findings of the study are likely to provide specific guidelines to policymakers in devising policies for sustainable economic growth in Pakistan.

3. MATERIALS AND METHODS

3.1. Data

For an empirical estimation of the study, we obtained the relevant data for the 1980-2018 period. The demographic dividend (DD) is measured with the working-age population between 15 & 64 ages, economic growth in real per capita GDP at 2015 US\$ is taken from, capital formation as gross domestic capital formation (CF), a patent application by residents is used as a proxy for Technological Innovation (IN). All those chosen variables have been adopted by following the studies of (Hosan et al. 2021; Danish and Ulack 202; Zaman

et al.2016; A. Khan, Muhammad, et al. 2020). Data on all the indicators are drawn from the online database of (World Bank 2021) excluding the ecological footprints which are gathered from the (Global Footprint Network 2021). Before proceeding toward the formal analysis of the data, we transformed the variables into a logarithmic form to reduce any chances of heteroscedasticity (Danish and Ulucak 2021). For a clear understanding of the nature of variables, Table 1 shows the descriptive statistics, normality, and definition of the chosen variables. For the demographic indicators, we have plotted some variables and given them in Fig. 1 & 2 for clear understandings. From the descriptive statistics, we may see significant disparities between the minimum and maximum values of the considered variables. Based on the economic condition the average per capita of Pakistan is 1062.0980 for the study period, with a maximum value of 1502.8910, and a minimum of 693.3505 US\$ per annum. These values indicate the significant economic disparities in the country over time. The ecological footprints of the country are not so huge; however, effects of the environmental degradation have been widely visible in the country. For example, the maximum footprints are recorded as 0.9124 and the minimum as 0.6223 with an average of 0.7690 for the study period. For the study period, the average demographic dividend of the country is recorded as 55.2746, with a maximum of 60.4174 and a minimum of 52.8059. this indicates there is a visible rate of the demographic dividend to be reaped for the economic progress of the country. The average technological innovation has been observed as 75.0183, with a maximum of 306.0000 and a minimum of 16.0000. Similarly, Jarque-Bera's (J-B) insignificant probability values (for most of the modeled variables) imply the data is normal, so we can continue estimating the variables by applying the linear approaches of the econometric algorithm.

Table 1. Variables, Definition, and Descriptive Measurement

Variables	Average	Maximum	Minimum	J-B	Probability	Source
EF (Ecological; Footprints	0.7690	0.9124	0.6223	1.9135	0.3841	GFN
Y (GDP US \$	1062.0980	1502.8910	693.3505	1.2935	0.5238	WDI
DD (Demographic Dividend)	55.2746	60.4174	52.8059	5.3837	0.0678	WDI
CF (Capital Formation)	16.0233	19.1293	12.5206	1.8374	0.3990	WDI
IN (Technological Innovation)	75.0183	306.0000	16.0000	1.3895	0.0003	WDI

Note: J-B stands for Jarque-Bera normality test, WDI is World Development indicators.

Figure 1 indicates that from 2000 to 2020 there is a continuous increase in the population growth of the country. But a decline in the population growth of the country has been observed from 3.5 in 1980 to 2.8 in 2020. Also, the proportion of the male and female population has been given in the graph. Fig. 2 explains the fertility and mortality rates in the country and the results indicate that a decline in fertility and mortality rates has been observed. The fertility rate in 1980 was observed at 6.5 children per woman, while in 2020 it was reduced to 3.3. The infant mortality rate was observed at 122 per 1000 live births in 1980 and it has reduced to 58 in 2018. The life expectancy rate has improved from 56 in 1980 to 64 in 2018.

3.2. Model Construction

Growing environmental problems, associated with climate change, are putting tremendous challenges on environmental safety. By not halting the economic progress, environmental sustainability becomes more challenging. Therefore, some measure coupled with economic growth to ensure environmental improvement is necessary. Therefore, efforts are needed to address these issues by investing in energy efficiency and innovative measures to curtail environmental problems. (Blázquez-Fernández, Cantarero-Prieto, and Pascual-Sáez 2019; Lee and Min 2015).

Figure 1. Plots of the Demographic Variables

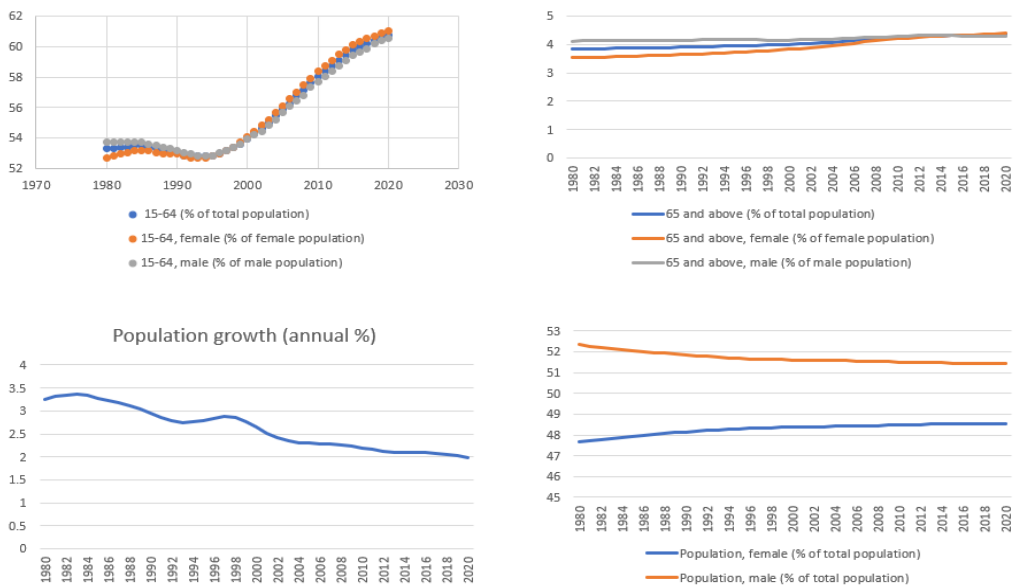
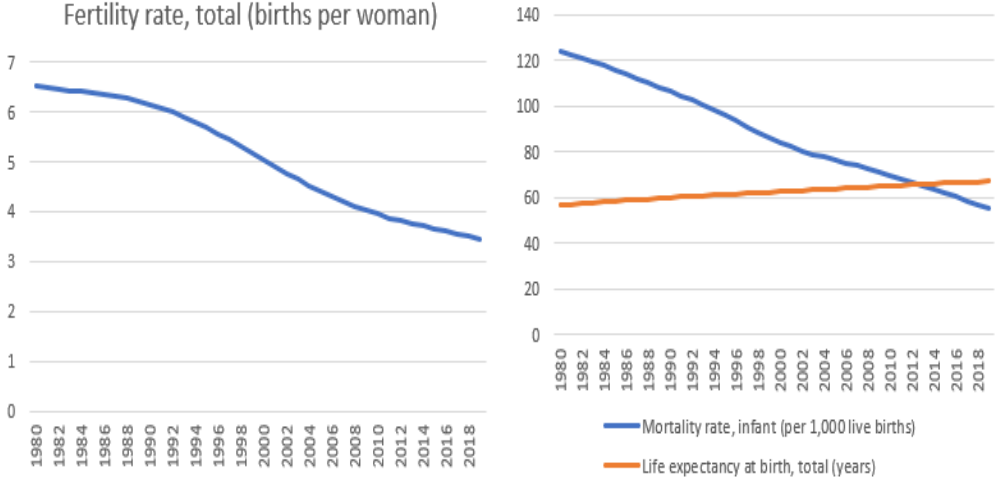


Figure 2. Fertility Rates, Mortality Rates, and Life Expectancy at Birth



Therefore, in line with the studies of (Danish and Ulucak 2021) and (Du, Li, and Yan 2019) we develop a functional form of the model to explore the economic and environmental role of demographic dividend and technological innovations in Pakistan;

$$LnEF_t = \alpha_{0t} + \beta_{1t}LnDD_t + \beta_{2t}LnY_t + \beta_{3t}LnIN_t + \beta_{4t}CF_t + \mu_t \quad \dots 1$$

$$LnY_t = \alpha_{0t} + \beta_{1t}LnDD_t + \beta_{2t}LnEF_t + \beta_{3t}LnIN_t + \beta_{4t}CF_t + \mu_t \quad \dots 2$$

Where $LnEF$ stands for the logarithmic value of ecological footprints, $LnDD$ is the logarithmic value of the demographic dividend. Likewise, $LnIN$ is the technological innovations, LnY is the real GDP per capita to measure the economic growth; finally, $LnCF$ stands for the capital formation in the country. μ is error term of the regression equation, α_0 is the slope coefficient, $\beta_{1,...,4}$ are the coefficients of the explanatory variables to be estimated, and t indicates the time dimension of the study (here it is 1980-2018).

3.3. Econometric Approaches

Following the recent studies by (Danish and Ulucak 2021; M. K. Khan et al. 2019; M. K. Khan, Teng, and Khan 2019; Sarkodie et al. 2019), we adopted the recently developed dynamic ARDL (Autoregressive Distributed Lags model) by (Jordan and Philips 2018) in the current study. The advantage of using the dynamic ARDL (DynARDL) simulation model over ARDL reduces the difficulties in the interpretation of estimations often countered in

the ARDL approach for the variables (Danish and Ulucak 2021). ARDL simulation approaches are an easy way to give practical results of nonintuitive interpretations; that's why they are becoming more popular in recent times (Jordan and Philips 2018). Simultaneously, the dynamic ARDL can estimate, simulate, and automatically generate the plots of the actual negative and positive shocks in regressors and regressands, keeping other factors constant. For the empirical estimation of dynamic ARDL, it is required to have first-order integration of the dependent variable. Secondly, the integration order of the regressors must not be higher than I(1), while mixed integration order is acceptable in the regressors (Danish and Ulucak 2021). The standard form of the dynamic ARDL model is given as;

$$\Delta Y_t = \phi_0 + \alpha_{1t} Y_{t-1} + \vartheta_{1t} X_{1,t-1} + \dots \dots, \theta_m K_{m,t-1} + \sum_{i=1}^l \alpha_{1t} \Delta Y_{t-1} + \sum_{i=1}^j \vartheta_{1t} \Delta X_{1,t-1} + \dots \dots \dots, \sum_{i=1}^l \theta_m \Delta K_{m,t-1} + \varepsilon_t \quad \dots 3$$

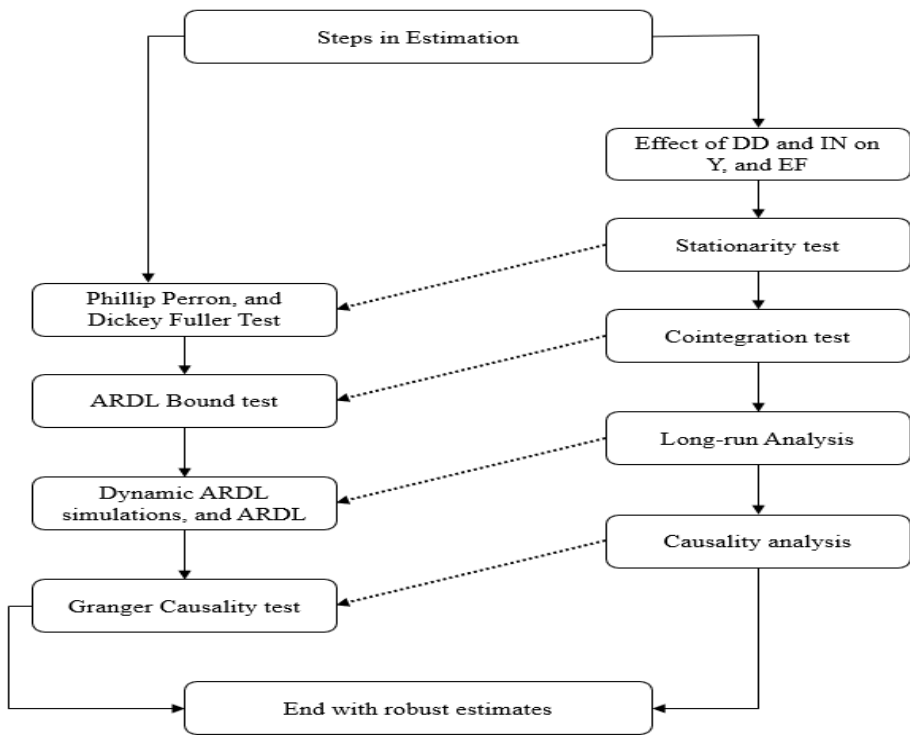
While ΔY indicates the changes occur in dependent variables, Y_{t-1} indicates the one lag period of the dependent variable, similarly, ϕ_0 is the regression slope. Here X indicates a set of independent variables, Δ is the difference operator, and ε_t is the regression error term, and superscript is the time operator. Before estimating the short and long-run analysis, the ARDL bound approach of cointegration introduced by (Pesaran, Shin, and Smith 2001) is adopted in the study. The critical values for the Bound test are calculated by Kripfganz and Schneider (2020) and are used in the study. The rejection of the null hypothesis of no cointegration is based on the F-statistics of the Bound test. If the value of the F test lies below the lower bound limit, it indicates no cointegration. If the value lies between the upper and lower bound limits it implies the indecisive phenomenon, and if the F-test value is found to be greater than the upper bound limit I (1), we conclude the variables are cointegrated in the long run . Finally, the error correction mechanism of equations 4 & 5 is given below;

$$\Delta \text{Ln}EF_t = \alpha_{0t} + \pi_{0t} \text{Ln}EF_{t-1} + \beta_{1t} \text{Ln}DD_t + \gamma_{1t} \text{Ln}\Delta DD_t + \beta_{2t} \text{Ln}Y_t + \gamma_{2t} \text{Ln}Y\Delta_{t-1} + \beta_{3t} \text{Ln}IN_t + \gamma_{3t} \text{Ln}\Delta IN_{t-1} + \beta_{4t} \text{Ln}CF_t + \gamma_{4t} \text{Ln}\Delta CF_{t-1} + \mu_t \quad \dots 4$$

$$\Delta \text{Ln}Y_t = \alpha_{0t} + \pi_{0t} \text{Ln}Y_{t-1} + \beta_{1t} \text{Ln}DD_t + \gamma_{1t} \text{Ln}\Delta DD_t + \beta_{2t} \text{Ln}EF_t + \gamma_{2t} \text{Ln}EF\Delta_{t-1} + \beta_{3t} \text{Ln}IN_t + \gamma_{3t} \text{Ln}\Delta IN_{t-1} + \beta_{4t} \text{Ln}CF_t + \gamma_{4t} \text{Ln}\Delta CF_{t-1} + \mu_t \quad \dots 5$$

In the equations 4 & 5, $\beta_{1,\dots,4}$ and $\gamma_{1,\dots,4}$ are long and short-run coefficients to be estimated. Where μ is the residual of the regression, and t in the models stands for time dimension, which is from 1980 to 2018 in the current study. The systematic view of the estimation process is given in Figure 3 for easiness of the readers.

Figure 3. Estimation Plan



4. RESULTS AND DISCUSSIONS

4.1. Unit Roots

In the estimation process, it is mandatory to test the unit roots in the variables since the dynamic ARDL supplies efficient outcomes if the dependent variables under the study provide order one integration, and independent variables must not be greater than $I(1)$ (Sarkodie and Owusu 2020). On these grounds, we tested the chosen variables for the unit roots by applying the conventional unit root approaches, including the Augmented Dickey-Fuller and updated version of (Dickey and Fuller 1979), and (Phillips and Perron 1988) tests. Results summarized in Table 2 imply that the dependent variable is $I(1)$,

and the integration level of all independent variables does not exceed I (1). Therefore, we found that the study's first objective was verified, and we turned towards determining the cointegration relationship between the variables.

Table 2. Unit Root Test

Variables	Statistics	Probability	Statistics	Probability
Augmented Dickey Fuller (ADF)				
EF	-1.7157	0.4155	-5.9344	0.000
Y	0.8327	0.9933	-3.1341	0.033
DD	-0.0410	0.9476	-3.9380	0.005
CF	-1.8705	0.3422	-5.2828	0.000
IN	2.4304	1.0000	-6.9830	0.000
Phillip Perron (PP)				
EF	-1.7138	0.4164	-5.9344	0.000
Y	0.5766	0.9872	-3.1341	0.033
DD	1.7003	0.9995	-5.2880	0.000
CF	-2.0245	0.2755	-5.2828	0.000
IN	2.5731	1.0000	-6.9883	0.000

4.2. Cointegration Test

After meeting the first criteria of unit roots, the further step tests an equilibrium relationship between the variables, including the ecological footprints, economic growth, demographic dividends, innovations, and capital formation. In line with the study of (Danish and Ulucak 2021), the bound testing approach instrumented by (Pesaran, Shin, and Smith 2001) together with (Jordan and Philips 2018) for critical values is adopted in the study. This test calculated the F-statistics, which are to be compared with the critical values given. If the computed values of F are higher in absolute than the critical values, we conclude a cointegration relationship between the variables. The reason for using the critical values by (Jordan and Philips 2018) is based on their efficiency in the small samples. The bound test results are given in Table 3. The results support the cointegration relationship because the calculated F-statistics are greater than the upper bound limits at the 5% level for both the growth and environmental degradation model. This supports a cointegration relationship between the variables in both models; hence we may further proceed towards applying the dynamic ARDL model in the next step.

Table 3. Results of Cointegration Test

Models tested	Test	Probability	at 5%		at 10%		Decision
		Statistics	I (0)	I (1)	I (0)	I (1)	
For EF model	F	5.323	3.548	4.803	2.933	4.020	Cointegrated
	T	-4.316	-3.43	-4.803	-2,860	-3.78	Cointegrated
For Growth model	F	5.760	3.05	3.97	2.68	3.53	Cointegrated
	T	-5.743	-3.43	-4.803	-2,860	-3.78	Cointegrated

4.3. Dynamic ARDL Results

The estimated results of the environmental degradation model are given in Table 4; the significant value of lagged ecological footprints indicates a dynamic relationship between the variables in the long run. Similarly, the role of economic growth on ecological footprints generates a positive impact with 0.558 explanatory power; this indicates that a one percent rise in the economic growth in Pakistan is associated with a 0.558% rise in the ecological footprints of the country. These results are not unique, and many previous studies have exhibited similar results, for example, Danish et al. (2019). Further, the role of technological innovations in environmental degradation is positive, which indicates that a one percent rise in technological innovations tends to increase the ecological footprints by 0.075% in the long run. This association between the two variables is based on the energy used to adapt to technological innovations, which is fossil energy-intensive. While the role of demographic dividends based on the working-age population disclosed a negative response. For example, a one percent rise in the country's demographic dividend improves the environment by 2.379% in the long run. There are reasons for having a negative response to a demographic dividend of ecological footprints, firstly the working-age people feel the environment more attractive towards health, and government programs on environmental consciousness is raising awareness among the masses so that the people become environment friendly. Second may be the reason that the working age population is directly not engaged in the consumption of environmental products at large therefore, its role is becoming environmentally friendly. This decline may also contribute to improving the environment. These results contradict the studies of Anwar et al. (2020) and Tarazkar et al. (2020). The study of Hosan et al. (2021), indicated that an increase in the working-age population raises economic growth and energy consumption. In our case, we cannot deny energy consumption for economic growth; however, with time, people feel conscious about renewable energy consumption instead of focusing on fossil-based energy in production. To supplement the results obtained from the current study, we estimated the

error correction model. The lagged value of the error correction term indicates a negative sign with a significant value, which implies that an impulse to the model, in the long run, tends to return towards its equilibrium position with a speed of 90.5%, which explains that the given model restores its equilibrium with high speed. Hence, the obtained outcomes are efficient and can be used for forecasting and policy implications.

Table 5 explains the empirical relationship of the economic growth model. In the first case, the role of capital formation in economic growth seems positive and significant. Similarly, innovations also indicate a positive sign, with a considerable response; this association discloses that a one percent rise in technical innovations may improve economic growth by 0.025% in the long run. Similarly, the role of demographic dividend is positive and significant; it indicates that a one percent rise in the working age of the population (between ages 15 & 64) may increase the country's economic growth by 0.101% in the long run. This is in line with the latest study by Hosan et al. (2021). The results support the view that the younger age population tends to adopt new and innovative ideas in production, technological innovations, and skills. Similarly, young people have greater intensity towards gaining new knowledge and skills to update themselves in the race of the technological world. On these grounds, the working-age population impact both energy consumption and economic growth simultaneously. While the role of ecological footprint in economic growth is negative, which indicates that a rise in environmental degradation tends to diminish the economic growth of the country by 0.168% in the long run.

Table 4. Results with Dyn ARDL for Environmental Degradation (EF-model)

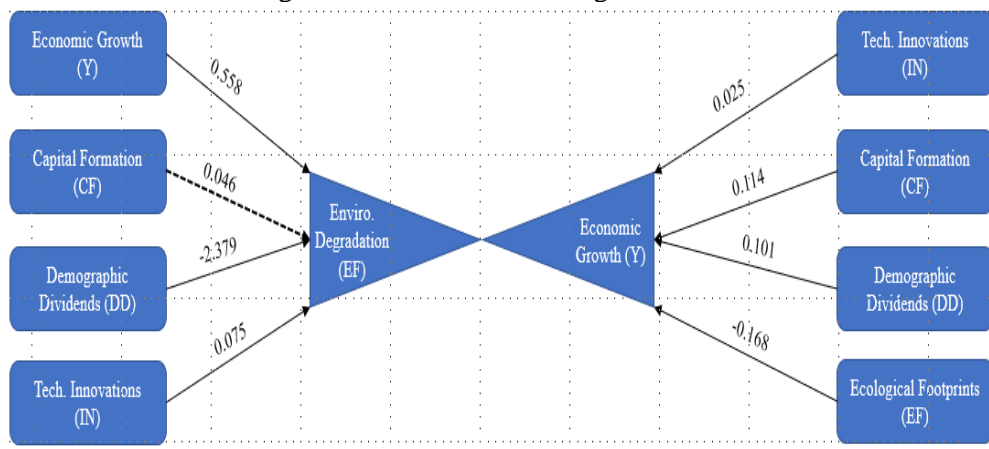
DynARDL				ARDL		
Regressors	Coefficient	t-score	probability	Coefficient	t-score	probability
LnEF ₋₁	-0.867	-6.310	0.000	-0.905	-5.073	0.000
ΔLnCF	0.003	0.040	0.969	-0.144	-1.320	0.200
LnY ₋₁	0.558	5.430	0.000	0.661	9.381	0.000
LnCF ₋₁	0.046	0.780	0.440	0.056	0.614	0.546
LnIN ₋₁	0.075	4.170	0.000	0.084	2.736	0.012
LnDD ₋₂	-2.379	-5.480	0.000	-2.685	-4.993	0.000
ECT ₋₁				-0.905	-7.087	0.000
Diagnostics						
ARCH	1.215	--	0.270	0.263	--	0.608
BG-LM	1.539	--	0.463	4.007	--	0.135
Normality (J-B)	2.225	--	0.328	0.415	--	0.813
Stability test	Stable			Stable		
Simulations	5000					

Table 5. Results with Dyn ARDL for Economic Growth (Y-model)

DynARDL			
Regressors	Coefficient	t-score	Probability
LnY ₋₁	0.110	2.830	0.008
ΔLnCF	0.114	3.1	0.004
LnEF ₋₁	-0.168	-2.36	0.025
LnCF ₋₁	0.009	0.280	0.778
LnIN ₋₁	0.025	2.700	0.011
LnDD ₋₂	0.101	1.990	0.057
ECT ₋₁	-0.824	2.270	0.001
Diagnostics			
ARCH	1.215	--	0.27
BG-LM	1.538	--	0.463
Normality (J-B)	2.225	--	0.328
Stability test	Stable		
Simulations	5000		

Results at the end of Tables 4 & 5 for diagnostics analysis explain that the residuals are homoscedastic, have no autocorrelation, and the estimated model is stable. Since the COSUM and CUSUMSQ results show, the parameters are inside the 5% band. Similarly, the application of the estimated models is also robust because the insignificant normality results obtained from the Jarque Bera (J-B) test state the residuals are normally distributed. The pictorial view of long-run results is given in Fig. 4 for easy understanding.

Fig. 4. Pictorial View of Long-run Results



4.4. Causality Analysis

There is a drawback of long-run estimators: they give coefficient estimates of the regression and fail to provide the direction of causal

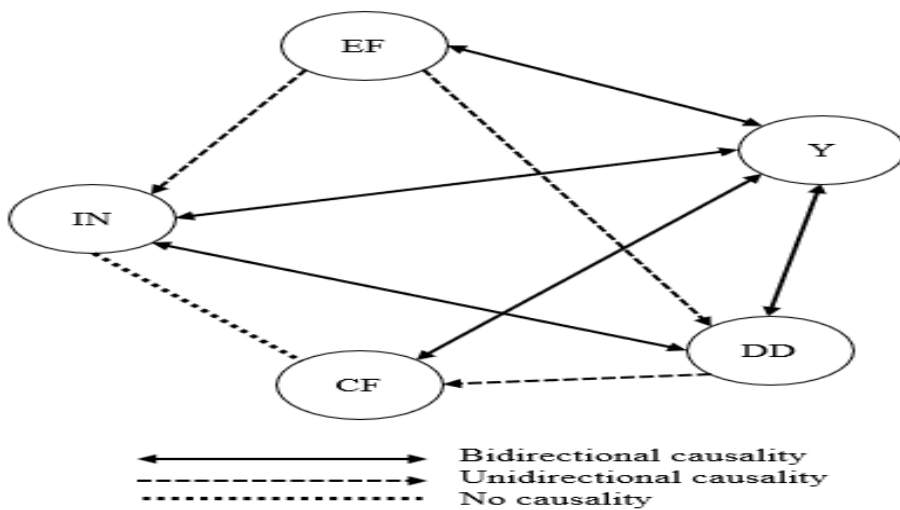
relationships. Therefore, to provide the causal dimensions, we further tested the variables for causality using the Granger causality test. The causality test results shown in Table 6 indicate that economic growth is causing the ecological footprints, not vice versa. Similarly, we found bidirectional causality between ecological footprints and economic growth. Further, the results showed a unidirectional causality from environmental degradation based on ecological footprints towards demographic dividends and technological innovations in Pakistan. Simultaneously, the bidirectional causality is detected between the country's economic growth and demographic dividends, between capital formation and economic growth, and between technological innovations and economic growth. The empirical results further supported the bidirectional causality between the demographic dividends and technological innovations of Pakistan. To the easiness of the readers, we have summarized the causal linkages between the variables in Figure 5.

Table 6. Causality Test Results

Variables	EF	Y	DD	CF	IN
EF	--	5.505 ^b	30.147 ^c	1.143	3.980 ^c
Y	3.161 ^c	--	9.132 ^a	2.087 ^c	9.927 ^a
DD	0.055	7.205 ^a	--	2.879 ^c	3.977 ^c
CF	0.033	5.243 ^b	1.015	--	1.594
IN	0.747	8.853 ^a	24.220 ^a	2.040	--

Note: Superscripts a, b, and c are the level of significance at 1, 5, and 10%.

Figure 5. Causal Linkages



5. CONCLUSIONS AND RECOMMENDATIONS

The main goal of this study was to find out the role of demographic dividend, capital formation, and technological innovations in economic growth and environmental degradation based on the ecological footprints of Pakistan. To this end, the study adopted the novel dynamic Autoregressive Distributed Lags (DynARDL) simulations model to explore the existing relationships between the considered variables. Before going to the short and long-run dynamic, the study tested the variables for the stationarity properties and the existence of an equilibrium relationship among the variables as major steps before applying the DynARDL model. As per requirement, the unit root test results imply that all the considered variables are stationary of the first order. Further, the bound testing approach explored that the chosen dimension of variables is cointegrated in the long run. We then applied the DynARDL model. The empirical outcome indicated that the role of demographic dividend in environmental degradation is negative, while economic growth and technological innovations are increasing the ecological footprints of the country. The results obtained from the dynamic ARDL approach are roused by applying the linear ARDL approach.

Hence the explored outcomes are unique with respect to Pakistan, the research implies putting forth policy options in the context of the study. First, Pakistan needs concrete steps to get benefit from the working-age population for the economic betterment of the country. The government must invest in education, health, skills acquisitions, provide loans and entrepreneurial capacity building, and bring reforms in job-creating economic sectors in agriculture, industry, and services sectors to accommodate the demographic dividend in productive activities. The government must create job opportunities by facilitating the youth with human capital formation and engage them to uplift the economic conditions of the country as the already half-life span of this demographic dividend opportunity has lapsed. The government must provide technical skills to utilize the youth bulge in the production cycles of industry and agriculture to enhance the nation's economy. The existing unskilled labor may not uplift the country to reap the socioeconomic advantages of competitiveness; so, labor market reforms are strongly recommended to engage the youth bulge into life-earning activities. The problems of poverty, malnutrition, low levels of living, and social unrest could be solved through investing in the development of the existing youth bulge of Pakistan.

The economic growth with less environmental degradation may materialize via devising sustainable development policies for our youth to

contribute their parts to the process of healthy development of Pakistan. The government must introduce policies that could create awareness for the development of green technologies, sustainable production practices in industry and agriculture, the energy sector, and other projects like the China Pakistan Economic Corridor (CPEC), and other projects of national interests in Pakistan. The model of economic growth via the mediating channels of the productive demographic dividend to ensure environmental sustainability and preservation is recommended that is binding to all the economic productive processes in the agriculture, industry, and services sectors of Pakistan's economy.

Finally, the study, besides efficient results, has also some limitations. The first limitation of the study is adding energy consumption variables in the future so that the link between environmental degradation and the mediating role of the demographic dividend can be explored. Similarly, multiple structural breaks have been observed due to the 9/11 incident and the 2008 global recession that may have affected the country, flexible economic models to absorb such external shocks are not covered in this study. Furthermore, for the empirical estimation, the reliable data on the demographic dividend by estimating over time series may give a closer look to policymakers for devising major sustainable developmental policies to the country specifically and the region in general.

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The Role of Poverty, Food Security, and Rapid Population Growth on Human Development in Pakistan

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Abstract

This study examines the relationships among poverty, food security, rapid population growth, and human development in Pakistan over 1990-2018 to achieve the targets of Sustainable Development Goals (SDGs) 1: No poverty and 2: Zero Hunger. The study applies time series based econometric approaches, which have the ability to incorporate regime shifts in the estimation process. The Zivot and Andrews unit root test is supplied for first-order integration, Bound, and Gregory Hansen cointegration tests to support the cointegration relationship among the variables. Similarly, the results obtained from autoregressive distributed lags (ARDL) stated that food security and income growth simultaneously increase human development in Pakistan. In contrast, the role of rapid population growth is negatively affecting human development in the country. The results from fully modified ordinary least squares (FMOLS) and canonical cointegrating regression (CCR) are simultaneously supporting the results of ARDL. The estimates of Granger causality revealed that income is unilaterally, and population growth is bi-directionally, causing human development in Pakistan. Similarly, the causality from human development to food security is also unidirectional. Finally, the study informs policymakers to devise effective policy guidelines for achieving the targets of SDGs 1 and 2 for Pakistan.

Keywords: Food insecurity, Human development, Population Growth, Poverty, Autoregressive distributed lags, Pakistan.

1. INTRODUCTION

Human development depends upon many factors including food security, adequate income, education and livelihood earning. The development of humans, including cognitive, emotional and psychological development in children and adults, requires adequate quantity and quality of food to ensure

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smooth life (Cook and Frank 2008). There are various reasons for the lack of food security in Pakistan, including poverty, rapid population growth, and inadequate levels of human development (Pakistan-Vision-2025, 2015). Lack of access to sufficient food for the public remains an obstacle, forcing the researchers to think about its security and availability for poverty reduction and human development in Pakistan. Similarly, these indicators are interlinked and can cause one another in the state of interrelationships in developing countries, including Pakistan (Smith et al., 2000; UNDP, 2019). Therefore, to understand the nature of likely causality and linkages among these indicators pertaining to SDGs 1 and 2, the following study is undertaken.

Human development is considered one of the most critical aspects of the social, economic, and political development of any country in the world. Pakistan's human development index (HDI) value for 2019 is 0.557 that depicts Pakistan's HDI as low as 154th out of 189 countries, indicating lower levels of human development in Pakistan. The reasons may include food insecurity due to lower agriculture productivity, inadequate and disrupted supply chains of food distribution, the prevalence of malnutrition, fluctuation in food items prices, market imperfections, and rapid population growth in Pakistan (FAO, 2021; McGuire, 2015). The frequent and non-terminating prevalence of food insecurity, widespread poverty and higher population growth are considered the most pressing determinants mentioned in the global reports giving impetus to researchers to explore its evidence in terms of data supported development programs for poverty reduction and access to food security for human development in developing countries (World Development Report, 2021)

Population growth and poverty are interlinked in terms of low per capita income. The case of Pakistan also presents the same relationship in terms of rapid population growth, lower per capita income, poverty and lower levels of human development (Mallick et al., 2005).

The Case and Novelty of the Study

This study adds in the plethora of knowledge about the phenomena of the study in the context of Pakistan in the following ways: (1) it is a maiden attempt that analyzes the data of food insecurity and poverty to see the impact on human development of Pakistan; (2) it further analyzes the role of rapid population growth on human development in Pakistan; and (3) further utilizes the updated panel econometric approaches like ARDL and its methodological underpinnings, which can undertake the regime shifts in the data and, therefore, giving unbiased and efficient conclusions about the nexus among poverty, food

insecurity, rapid population and human development. Finally, this study attempts to give informed policy guidelines to policymakers in achieving the targets of SDGs in Pakistan.

2. LITERATURE REVIEW

This section of the paper covers a literature review confined to the existing literature about the relationship among the variables of the interests and hypothesizes a theoretical model in line with the relevant literature. The literature review is precise in three sub-sections covering food security and human development, poverty and human development, and population growth and human development. The model is hypothesized based on the three sub-sections of the literature review and supported by relevant literature.

Food Security and Human Development

Food security ensures reducing poverty and diminishing stunting in children are the indicators of good health and different indices of human development in multi-directional relations (Cafiero et al., 2018; FAO, 2021; McGuire, 2015; Misselhorn & Hendriks, 2017; Smith et al., 2000; Smith et al., 2017) (FAO, 2004). There is evidence that human development is possible only by having a long, healthy life and through education. Quality of food, availability of proteins, clean drinking water is essential for significant improvement in human health and development (Junaidi & Umiyati, 2021; Linhartova, 2021; Lundahl, 2021; Mihalache, 2019; Odusola, 2021; Saidov, 2020). Thus, human development may be strengthened by ensuring access to food by the mass population and reducing poverty of a country or territory (Abah et al., 2020; Alamgir, 1980; Arrow, 1982; Bardhan, 1984; Kårlund et al., 2020; Ranis et al., 2000).

Poverty and Human Development

The literature also shows the nexus between poverty indices and human development. The evidence of selected studies shows that poverty is negatively related to human development indicators across the countries over the years. Human development reduces poverty and its different indicators showing the consensus-based nexus between the two both in theory and practice across the globe. Thus, the evidence is replete in showing negative relationships between poverty and human development (A. Banerjee & E. Duflo, 2020a; A. V. Banerjee & E. Duflo, 2020b; House, 2018; Initiative, 2018; Lundahl, 2021;

Mallick et al., 2005; NUREEV, 2020; Poverty & Initiative, 2019; Ranis et al., 2000; Shymanska, 2020; Wodon, 2017).

Population Growth and Human Development

Population growth is one of the essential variables to affect multi-aspects of human development and economic growth. The literature shows bi-directional relationships directly and indirectly to give strong evidence of the relationship between rapid population growth and human development. The association is significantly demonstrated in the context of cross-sectional, time-series and panel databases in the latest version of studies about the nexus under debate. Many aspects of socioeconomic development under SDGs and its targets of human development, poverty, health and access to food are also present in the binding relationship between human development and population growth in most of the territories and countries of the world (Crist et al., 2017; Ghislandi et al., 2019; Güney, 2017; Herrero et al., 2019; Mensah, 2019; O’Sullivan, 2018; Shaheen et al., 2021).

Theoretical Setting

The above-cited literature gives insights to hypothesize the nexus among the variables of poverty, food security, rapid population growth, and human development. The hypothesized theoretical model of the nexus among the variables of interest is confined and sub-theoretically modelled in the context of the universal theory of SDGs (particularly SDG 1 & SDG 2). The hypothesized theoretical model is not against the contents of the theories of development paradigms (Dills & Romiszowski, 1997; Gilbert & Lennox, 2019; Midgley, 1984; Schuurman, 2000), articulated in different shapes and has relevancy with the studies of well-versed development theorists (Banerjee & Duflo, 2011; Drèze, 2004; Easterly, 2008; Easterly et al., 2004; Sachs, 2014; Sen & Dreze, 1999; Sen et al., 1997; Ul Haq, 1995).

3. DATA, MODELS, AND METHODS

Data Collection

We found relevant data on the HDI from HDI reports, the food production index to calculate the food security from:

www.theglobaleconomy.com¹⁸. At the same time, for the rest of the variables (poverty, population growth, and real GDP per capita), we draw data from World Bank Indicators (World Bank 2021) and the global economy.com. Due to missing values in the data of poverty over the selected period, we have interpolated some values for the variables following the study (A. Khan et al. 2019). The descriptive analysis of the data is shown in Table 1 below.

Table 1. Variables and Descriptive Statistics

Variable's definition	Acronym	Data	Descriptive statistics			
			Mean	Max.	Min.	J-B test
--	--	--	Mean	Max.	Min.	J-B test
Human Development Index (0 - 1)	HD	GE	0.48	0.56	0.40	2.57(0.27)
Poverty ratio, per cent living on less than 1.90 USD a day	POV	WDI	20.93	60.60	4.00	4.39(0.11)
GDP per capita constant at 2010 US\$	Y	WDI	1151.52	1502.89	924.63	2.02(0.36)
Population growth, percent	PG	WDI	2.44	2.96	2.06	3.27(0.19)
Food production index ((2004-2006 = 100)	F	GE	75.22	108.10	45.76	1.56(0.45)

Note: GE indicates Theglobaleconomy.com, WDI stands for World Development Indicators, J-B is Jarque Bera test, while the values in parenthesis are probability scores.

Empirical Model

We developed the following functional form of empirical model (equation 1) for the empirical estimation based on the hypothesized theoretical model mentioned above. It indicates the theoretical model to test for short and long-run relationships between the dependent and independent variables.

Human development

$$= f(\text{Poverty}, \text{Food insecurity}, \text{population growth}) \dots 1$$

While turning this functional form into the econometric equation, firstly, we added the variables of interest; secondly, we transformed the variables into logarithm except for population growth, which is already in percentage form (to reduce chances of econometric issues and harmonizing data for proper estimation). The empirical form of the model becomes (equation 2);

$$\text{LogHD}_t = \alpha_t + \beta_1 \text{LogPOV}_t + \beta_2 \text{LogFS}_t + \beta_3 \text{PG}_t + \beta_4 \text{LogY}_t + \varepsilon_t \dots 2$$

¹⁸ <https://www.theglobaleconomy.com/download-data.php> on payment.

Where HD is human development, POV indicates poverty; FS is used for food security, PG stands for population growth; and Y shows real GDP per capita at 2015 prices. In addition, t , α , and ε explains the time interval, slope coefficient, and the corresponding error term, and $\beta_{1, \dots, 4}$ are associated with the coefficients of independent variables to be estimated with the help of the following procedures of estimations.

Econometric Estimation

We adopted five simple steps for empirical estimation to explore the impact of independent variables on the dependent variables. The first step involves identifying the stationarity of the variables for the given period. In the second step, based on the order of integration, we utilized cointegration analysis. In the third step, we further carried out the long-run estimation of the dependent and independent variables. The fourth step tests the causal relationships between the variables under study. Finally, we again tested the variables for their possible long-run relationship, applying various estimators for robustness (Enders, 2015; Nkoro & Uko, 2016).

Unit Root Tests

By considering the complexities in structural breaks in the data, we started to determine the unit roots in time series by applying the (Zivot and Andrews 1992) unit root test. Following this unit root test, we again turned towards using the standard unit root test to supplement the results obtained from the former test. To this end, we further adapted the Augmented version of (Dickey and Fuller 1979) (ADF) test of unit root, which will help us know the order of integration in the time series.

Cointegration Analysis

After the unit root test, we apply the ARDL bound cointegration test (Pesaran, Shin, and Smith 2001) between the variables of interest. In a further step, we used the ARDL cointegration algorithm to determine the short, and long-run dynamics of the dependent and independent variables for the given models (N. H. Khan, Ju, and Hassan 2019). The choice of the ARDL approach is due to its statistical priority compared to other parallel tests (Phillips and Hansen 1990). For instance, the ARDL approach gives unbiased results in case of I (0), I (1), and mixed order of integration, except the higher integration

cases, i-e I (2) (Danish, Wang, and Wang 2018). Similarly, this method is best and performs well while addressing the endogeneity problem in the model and is equally suitable for small and finite samples of poverty and food security.

To check the existence of a cointegration relationship, we calculated F-statistics to see the correlation with critical bound values (Pesaran, Shin, and Smith 2001). The F statistics is used to elaborate the support or rejection of the null hypothesis in the study. If the F-statistics values lie greater than upper bound values, it supports cointegration. In contrast, if the values lie below the lower bound values imply there is no cointegration, and if the F-statistics lies in between the lower and upper bound limits indicates an indecisive zone. Finally, for the efficiency of results and stability of the parameters, various post estimation tests have been conducted (Autocorrelation, Heteroscedasticity, and Jarque-Bera).

Robustness Analysis

To the equilibrium relationship between the variables, we applied (Gregory and Hansen 1996) cointegration test, which best accounts for the possible breaks in the data which the Bound cointegration test cannot counter. In line with the studies of (Ahmad and Du 2017; Ur Rahman et al. 2020) and (Jiang, Khattak, and Rahman 2021), for the robustness of the estimated results, we again apply the Fully modified OLS (FMOLS) and canonical cointegration analysis (CCR) of time series algorithms. There are multiple advantages of using the FMOLS, including that it is more appropriate in controlling the autocorrelation and endogeneity issues in the data (Jiang, Khattak, and Rahman 2021; Ur Rahman et al. 2020). Therefore, this study applied the FMOLS and CCR on the data to explore the long-run elasticities between dependent and independent variables. Hence to verify the results obtained from the standard ARDL estimator.

4. RESULTS AND DISCUSSIONS

Table 2 explains the unit-roots presented in the data; we have elaborated that all the variables have non-stationarity properties at levels. After taking the first difference, the variables considered in the study turned stationary with and without breaks in the data. This process has followed the study's first objective, which allowed us to determine cointegration relationships between the variables.

Table 2. Unit Root Tests

Symbols	ADF statistics ^{level}	P-values	ADF statistics ^{1st}	P-values
HD	-0.417	0.893	-3.456	0.018
POV	-0.981	0.742	-3.974	0.025
Y	1.052	0.996	-6.517	0.000
PG	-1.100	0.700	-5.047	0.000
F	0.412	0.980	-6.712	0.000
Zivot-Andrews	Statistics	Break Year	Statistics	Break Year
HD	-3.128	2004	-4.65	2005
POV	-4.263	1995	-4.669	1998
Y	-2.726	2002	-6.929	1998
PG	-5.336	2009	-8.944	2000
F	-3.372	2004	-7.152	2002

Note: Critical values: 1%: -4.93 5%: -4.42 10%: -4.11.

Cointegration results obtained from the bound testing approach and Gregory and Hansen 1996 test are summed up in Table 3. The F-statistics from the bound test are higher than upper bound limits, thus concluding that the variables have an equilibrium relationship. The results of the bound test are further supplemented by (Gregory and Hansen 1996) cointegration, which helps account for the regime shifts indicated the similar results, that the chosen dimension of variables is cointegrated since the calculated statistics of two of the tests (ADF, & Zt) are more significant than critical values at 5% level. The results are robust as the error correction term holds a negative sign and is strongly significant. Thus, any impulse to the model restores its equilibrium position with a speed of 0.446% in the long run. Finally, the model is tested for any possible econometric issues, including the heteroscedasticity (ARCH test), Autocorrelation (BG-LM), and stability (CUSUM & CUSUM sq tests). The non-existence of Hetro and autocorrelation with insignificant probability values are provided in the table's diagnostic section, and the model produced stable results.

After finding that all the variables are I (1) integrated and have an equilibrium relationship with both conventional Bound test and (Gregory and Hansen 1996) test with regime shifts, thus allowed us to test the magnitude of linkages towards the dependent variable. Therefore, we applied the ARDL estimator.

Table 3. Cointegration Analysis

Bound test		Diagnostics			
Lag order	(3, 1, 0, 2, 1)	Decision	Stability	ARCH	BG-LM test
F-test	8.360041	Cointegrated	Stable	0.354(0.551)	4.597(0.104)
Upper bound values I (1) at 5%	3.48				
Lower bound values I (0) at 5%	2.26				
ECT (-1)	-0.446(0.000)				
Gregory Hansen test					
Test	Test Statistics	Break Point	1%	5%	10%
ADF test	-33.88	1997	-6.36	-5.83	-5.59
Zt-test	-14.82	2003	-6.36	-5.83	-5.59
Za-test	-28.27	2003	-76.95	-65.44	-60.12

The results given in Table 4 imply that food and poverty positively contribute to human development in the short run, while income growth and population simultaneously negatively affect human development in Pakistan. While turning towards the long-run impacts, the statistics exhibit that increased food production is positively related to human development in Pakistan with explanatory power of 0.4947%, which indicates that a one percent rise in food production improves human development by 0.4947% in the long run. On the other hand, the role of poverty in human development remains insignificant. Similarly, a rise in income is positively associated with human development; it indicates that a one per cent rise in income implies a 0.3499% increase in the country's human development. In comparison, population growth tends to decrease the human development in the country by 0.1823% by keeping other covariates of the model constant.

Table 4. ARDL Estimates

Variable(s)	Coefficient	Std. Error	t-Statistic	P-values
LogHD(-1)	-0.4469	0.0999	-4.4734	0.00
Log(F(-1))	0.2211	0.0512	4.31757	0.00
Log (POV)	0.0121	0.0058	2.0604	0.05
Log (Y(-1))	-0.1564	0.0368	-4.2497	0.00
PG(-1)	-0.0815	0.0158	-5.1449	0.00
Δ Log(F)	0.09871	0.0436	2.2634	0.03
Δ Log(Y(-1))	0.1251	0.0636	1.9632	0.06
Δ (PG)	0.0842	0.0346	2.4334	0.02
Long Run analysis				
Log(F)	0.4947	0.0618	7.9952	0.00
Log(POV)	0.0271	0.0155	1.7440	0.10
Log(Y)	0.3499	0.0421	8.3065	0.00
PG	-0.1823	0.0184	-9.8624	0.00

To the robustness of the results given in Table 4, we again analyzed the variables with FMOLS and CCR; the obtained results are similar in magnitude and direction with that of ARDL, thus confirming the existence of long-run relationships between the variables. Therefore, we can say that the estimated results are efficient and robust; we can use them for forecasting and policy guidelines.

Table 5. Robustness of Long-run Results

Variables	Coefficient	t-Statistic	P-Values
Fully Modified-OLS	--	--	--
Log(F)	0.3017	36.0527	0.00
Log(POV)	0.0009	0.5035	0.61
Log(Y)	0.0338	2.5053	0.01
PG	-0.1272	-31.8664	0.00
Constant	-1.4851	-14.7074	0.00
Canonical cointegration Regression	--	--	--
Log (F)	0.2633	8.5219	0.00
Log(POV)	0.0093	1.6199	0.11
Log(Y)	0.1056	2.4632	0.02
PG	-0.1161	-8.1314	0.00
Constant	-2.3513	-7.5006	0.00

The results given in Table 6 depicts various causal linkages between the variables. We can see that there is one-way causality from human development to poverty and food security in Pakistan. At the same time, the two-way causal run was detected between population growth and human development. The results further reveal that poverty is caused by income, and food production, while bidirectional causality was seen between population growth and poverty. Similarly, the results indicate a one-way causality from income to population growth, while bidirectional causality between food security and population growth for Pakistan.

Table 6. Granger Causality Test

Variables	HD	POV	Y	PG	F
HD		4.997(0.01)	1.330	34.512(0.00)	2.565(0.00)
POV	0.07025		0.211	20.209(0.00)	1.262
Y	8.522(0.00)	3.662(0.04)		6.487(0.00)	2.954(0.00)
PG	6.214(0.00)	8.762(0.00)	1.2396		4.693(0.02)
F	0.33842	3.926(0.03)	1.437	12.784(0.00)	

Note: F-statistics is given with probability values in parenthesis.

5. CONCLUSIONS AND RECOMMENDATIONS

The primary purpose of this study was to estimate the impact of food insecurity, poverty, and population growth on the human development of Pakistan over 1990-2018. To this end, the study hypothesized a theoretical framework in the context of development and SDGs relevant theories adopted updated econometric algorithms to account for structural shifts in the data. The empirical results obtained from the study have identified that food security in the country tends to raise the human development in Pakistan. Similarly, the role of income is also positive. With rising income, people get better off, which improves their living standards, investment in education, and health, thus resulting in the country's human development.

This study proposes various policies for development policymakers in Pakistan, thus ensuring human development by not neglecting the country's poverty, population, and food production. To achieve the targets of SDGs 1 of No poverty and 2 of Zero Hunger, human development is likely to play a crucial role in reducing poverty, access to food, and reducing population growth rate strategies for Pakistan. Pakistan being agriculturally based economy must ensure to produce sufficient food and make it available to its population as well as investing in mechanization of agriculture to boost up the production of agricultural commodities. Similarly, the government should focus on reducing the pressure of poverty through enhancing youth skills that may boost up their income level hence to improve the human development of the country. Importantly, Pakistan will need to stem its high population growth rate as a priority for achieving SDG targets and improving its HDI. By applying these policies, Pakistan can resolve its intractable concomitant issues of poverty, food insecurity, and rapid population growth that hamper achievement of better quality of life and higher HDI.

The study is efficient in its estimation. However, the study has some limitations. For example, first, the data are limited to only four study variables confined to the targets of SDGs 1 and 2 for human development. Secondly, some updated econometric approaches may also be integrated to better and more reliable regime shift estimates. Finally, such studies must also be conducted in panel structures to ensure food security and give more robust evidence and policy guidelines to reduce hunger and poverty for achieving the targets of SDGs 1 and 2 in the context of human development for developing countries.

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Unveiling the Impact of International Migration on the Economic and Subjective Wellbeing of Men and Women in Punjab Pakistan

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Abstract

International remittance inflow is still under debate regarding its effects on the economic and subjective wellbeing of relatives left behind in Pakistan. This study aimed to evaluate the impact of receiving international remittances on the economic and subjective wellbeing of men and women of the same household in the most populous province, Punjab, of Pakistan. The study makes efficient use of the latest multiple indicator cluster survey (MICS) dataset for Punjab Pakistan, whose hierarchical structure allows us to use the multi-level mixed effects logistic regression for evaluating these impacts at an individual and community levels. The ladder scale of life satisfaction was used in generating a dependent binary variable to represent subjective wellbeing, while wealth score was used for economic wellbeing. After controlling for various socio-economic characteristics at individual and household levels, our findings presented that the women who received remittances were 1.1 times more likely to report high levels of subjective wellbeing, however, this relationship tested insignificant for the men. For women the wealth score improved by 1 score if they reported to receive remittances and for men this figure was 0.1 scores. Government should encourage inflow of international remittances as they promote wellbeing for people at all ages according to goal 3 of Sustainable Development Goal (SDG).

Key Words: Subjective wellbeing, remittances, gender, MICS, Punjab, Pakistan

1. INTRODUCTION

In the world that we live in today where globalization and labor mobility is much higher than it was ever before, the impact of international remittances (IRs) on the lives of people and communities has gone beyond the spectrum of their economic wellbeing (EWB) and has thus brought their subjective wellbeing (SWB) into the mix as well. IRs originate or occur through the phenomena known as migration or more specifically labor migration. Most cases concerning migration involve people moving from rural areas to more urban settlements (Stark, 1984) or from less developed/developing nations such

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as Pakistan and India to highly developed nations such as the USA and UK (Hanson, 2010). It is important to note here that international migration has only been on the rise in the last few decades. The proportion of immigrants in Northern America has risen from 9.9% in 1990 to 16% in 2019. (United Nations, 2019)

Economic wellbeing (EWB) is a multidimensional concept that includes various economic indicators that are largely monetary. In brief, it's a term used to describe one's sense of financial security based on access to economic resources, and employment opportunities that are necessary to sustain future expenditures. Wealth, the primary indicator of a nation's economic wellbeing, is largely assessed through GDP or GNI. Alternative wealth measures such as wealth scores are far more appropriate for such analyses and offer a clearer picture of the sense of financial security felt at the individual level. (Kennedy et al., 2006).

To measure one's life satisfaction or subjective wellbeing (SWB), researchers primarily make use of self-report surveys and questionnaires (Thomas et al., 2018). One question included in these surveys is a self-report-scale, in which participants of the study are asked to place themselves on a hypothetical scale measuring their happiness at any given moment, or their overall satisfaction with life. The 0-10 scale, most commonly associated with the Cantril-ladder—in which each scale is visually expressed as a step in a ladder—is amongst the most commonly applied in SWB studies and is also the one used in this study and one by Ivlevs et al. (2019).

In the case of Pakistan, the received remittances have been on the rise for many decades now. They have increased from US \$2.048 billion in 1980 to \$22.245 billion in 2019. Similarly, the GDP per capita in the country has risen from the US \$303 in 1980 to \$1,248 in 2019 (World Bank, 2020). Both statistics show that rising remittances over the years are going hand in hand with the rising wealth and economic stability of the population. However, policy makers are still confused about whether to encourage them or not. Therefore, this study aims to find the impact of these IRs on the EWB and SWB of men and women separately in Punjab Pakistan. A gendered view of both types of wellbeing with regards to remittances has not been done before, as EWB and SWB have combined in the same paper for the first time

Our paper also contributes to the existing literature by conducting a two-level analysis, one at the individual level and one at the community level while controlling for various socio-economic and household characteristics. Single level studies with regards to wellbeing and remittances are in abundance

but this study will be the first of its kind. For this very purpose this study takes advantage of the hierarchical structure of the MICS 17-18 latest data set from Punjab and applies the multi-level mixed effects logistic regression for the analysis.

2. METHODOLOGY

2.1. Data Source

The study at hand is currently based on the data sets from the Multiple Indicator Cluster Survey (MICS) 2017-18 for Punjab province of Pakistan. A multi-stage stratified cluster sampling method was adopted for the collection of the data. The survey was conducted from 2017 till early 2018 and covered, a total of 51,660 households. Out of these households, 74,010 women and 27,097 men (both aged 15-49 years) were successfully interviewed. For the community analysis, the sample of households was divided into clusters of 20 each and thus 2,692 clusters were formed with 1,893 rural-based and 799 urban-based.

2.2. Variables of the Study

2.2.1. Dependent Variables

Since our study has considered both EWB and SWB we have formed dependent variables for each of them separately. For the SWB we constructed a binary variable from the Cantril-ladder scale of life satisfaction where people were asked to place their life satisfaction on a scale from 0 to 10. The score of 5 and above was denoted by 1 (high satisfaction) and below 5 was denoted by 0 (low satisfaction). However, we chose a continuous variable for the EWB in the form of the individual wealth score as provided by the MICS 2017-18 dataset. This variable was also used in papers by Ivlevs et al. (2019) and Sulemana et al. (2019).

2.2.2. Independent Variables

At the individual level for all models, we picked several socio-economic variables that we believed could have confounding effects on the SWB and EWB. These included age of each individual along with binary variables for their marital status, level of education, health insurance, discrimination on the lines of gender, discrimination on the lines of race/ethnicity and their safety levels which were represented by how safe they feel to go out in the neighborhood after night. Aside from age, all these

variables were made in the form of binary variables with their results being in the form of 0 and 1.

The household characteristics included for our main independent variable and the most important variable in this whole study is the international remittances (IRs) for which we used the variable from the MICS dataset that stated whether the household receives remittances or not. For this, we formed a binary variable where 1 was denoted where the individuals in the households did receive remittances in the last year and 0 for the ones who did not. Papers which also used remittances as their main independent variable included those by Semyonov and Gorodzeisky (2008), Cohen (2011) and Henry (2013). We made dummy variables for the other household characteristics as well which include family size, donations, the wealth quintiles were also added for which we made 2 separate variables one represented the households which fell into the elite or high wealth class and one represented the households that were part of the middle-income wealth class, the poor wealth class was added to the control variables.

The community level variables we chose was the type of community the individual lived in rural or urban, community higher education (if 60% or more individuals in the community had higher education), along the 9 divisions of Punjab (Bahawalpur, DG Khan, Faisalabad, Gujranwala, Lahore, Multan, Rawalpindi, Sahiwal) and Sargodha was added to control list.

2.3.3. Multi-level Multivariate Regression Analysis

The structure of the MICS data is hierarchical which means that the individuals are present within the households and the households are further present within communities. Therefore, it is believed that multi-level models are best to use in a hierarchical dataset such as the MICS which considers the absence of independence among observations in different clusters (Kamanda et al., 2016). Due to this, we used the two-level Mixed-effects logistic regression model to better estimate the impact of individual, household (especially remittances), and community factors on their subjective and economic wellbeing.

We fitted four models for our analysis. In the first model, the SWB of women has been chosen as the dependent variable and her characteristics along with the individual, household, and community characteristics discussed above have been chosen as the independent variables. The second model has chosen the economic well-being of women as the dependent variable with the same

independent variables as the first model. The third model and fourth model are identical to the first and second respectively and are for the men.

Our data was fitted mainly into the two-level model as shown below

$$\log\left(\frac{\pi_{ij}}{1-\pi_{ij}}\right) = \beta_0 + \beta_1 I_{1ij} + \beta_2 I_{2ij} + \dots + \beta_k I_{kij} + \alpha_1 H_{1ij} + \alpha_2 H_{2ij} + \dots + \alpha_L H_{Lij} + \gamma_1 CC_{1ij} + \gamma_2 CC_{2ij} + \dots + \gamma_m CC_{mij} \quad \dots (1)$$

$$\beta_{oij} = \beta_o + v_{ok} + e_{oij} \quad \dots (2)$$

Where

Individual-level variables (Women or Men): I_1, I_2, \dots, I_k

Household-level variables: H_1, H_2, \dots, H_L

Community-level variables: CC_1, CC_2, \dots, CC_m

3. RESULTS AND DISCUSSIONS

3.1. Results for International Remittances and Subjective Wellbeing of Women

When we look at the table, we can see in the case of the women in the households who receive international remittances, there are higher odds of reporting increased SWB by 1.1times (OR=1.105) compared to those who did not showing that the IRs and SWB of women share a significant (at 0.01 or 1%) and positive link with each other. These results are consistent with previous research such as (Anderson, 2014) and (Sulemana et al., 2019); these studies also tested similar positive relationship between the two variables in question.

3.2. Results for International Remittances and Economic Wellbeing of Women

Our IRs variable was found to be significant at the 1% level and appears to share a positive relationship with the EWB as if the woman is receiving remittances from outside the country her EWB will rise by 1 score. There is an abundance of studies that support this finding and establish positive significant links between IRs and EWB such as (Rapoport, 2004) and (McKay and Deshingkar, 2014). Belonging to the rich quintile raised the wealth score of women more than those in the middle wealth quintile.

3.3. Results for International Remittances and SWB of Men

In the case of the men in the households who receive international remittances, there are higher odds of reporting increased SWB, but this variable

was insignificant at all levels meaning that IRs had no real impact on the SWB of men (OR=1.067). This may be because some studies show that men are not the ones who benefit from IRs as they are usually earning themselves and sending the money back to their wives, children, and parents which also explains lower male immigrant life satisfaction (De Jong et al., 2002). Men in the rich wealth quintile had better chances of reporting high SWB than those in the middle wealth quintile. This result shows that higher wealth leads to enhanced life satisfaction (Carbionell, 2005).

Table 1. Results for IRs with SWB and EWB of Women

Women's Characteristics	Model 1 SWB dependent (Odds Ratio)	Empty model 1	Model 2 EWB dependent	Empty model 2
Individual characteristics				
Age	0.979*** (0.001)		0.002*** (0.000)	
Education Level	1.390*** (0.031)		0.197*** (0.004)	
Marital Status	1.127*** (0.029)		0.006** (0.004)	
Safety of going out in neighborhood after dark	1.056 (0.020)		-0.005*** (0.003)	
Gender discrimination	0.545*** (0.028)		- 0.037*** (0.008)	
Racial discrimination	0.606*** (0.033)		- 0.079*** (0.009)	
Health insurance	1.231*** (0.068)		0.069*** (0.008)	
Household characteristics				
Number of household members (No.)	1.027*** (0.003)		0.009*** (0.000)	
International Remittances	1.105*** (0.037)		1.003*** (0.005)	
Wealth quintiles	-		-	
Poor	1.643*** (0.043)		0.760*** (0.004)	
Middle	2.426*** (0.075)		1.439*** (0.005)	
Rich				
Donations	0.728*** (0.037)		- 0.030* (0.008)	
Community Characteristics				

Place of Residence Rural or Urban	0.791*** (0.030)		0.270** (0.010)	
Community Higher education	1.512** (0.250)		0.633*** (0.034)	
Divisions				
Bahawalpur	1.451*** (0.102)		-0.046*** (0.193)	
DG Khan	1.827** (0.131)		- 0.257* (0.019)	
Faisalabad	1.196*** (0.077)		0.085*** (0.018)	
Gujranwala	2.127*** (0.133)-		0.182*** (0.017)	
Lahore	1.786*** (0.118)		0.194*** (0.018)	
Multan	1.050 (0.068)		0.080*** (0.018)	
Rawalpindi	1.352*** (0.089)		0.249*** (0.018)	
Sahiwal	0.581*** (0.044)		0.077*** (0.021)	
Sargodha	-		-	
Random Effects	For model 1 (SWB)	Empty model 1	For model 2 (EWB)	Empty model 2
Cluster-level OR	0.420	0.636	0.042	0.609
Cluster variance (SE)	0.019	0.048	0.001	0.017
Chi-square test	3613.36	0	149461.97	0
Residual intra-cluster correlation (ICC)	0.113	0.162	0.248	0.648
ICC (SE)	0.004	0.005	0.006	0.006

***, **, * Significant at the 1%, 5% and 10% level, respectively.

Note: Odds Ratios with 95% confidence intervals are shown with standard errors in parenthesis. Data Source: Multiple Indicator Cluster Survey 2017-18.

3.4. Results for International Remittances and EWB of Men

Our main IR variable was tested to be significant at the 1% level and has been found to be positively related with the EWB. Men receiving remittances from outside the country have EWB increased by 0.1 scores (0.092). National policies should be formed in a way that supports the inflow of international remittances as they promote individual and household economic wellbeing (Hass, 2007) and reduce the severity of poverty in many nations (Adams, 2004). Belonging to the rich quintile raised the wealth score of men more than those in the middle wealth quintile (Wolff and Zacharias, 2007).

Table 2. Results for IRs with the SWB and EWB of Men

Men's Characteristics	Model 3 SWB dependent	Empty model 3	Model 4 EWB dependent	Empty model 4
Individual characteristics				
Age	0.942*** (0.01)	- -	0.003* (0.002)	
Education Status	1.414*** (0.060)	-	0.205*** (0.006)	
Marital Status	1.158** (0.051)	-	0.002 (0.006)	
Safety of going out in neighborhood after dark	2.081 (0.126)	-	0.034*** (0.009)	
Gender discrimination	0.937 (0.129)	-	- 0.062*** (0.020)	
Racial discrimination	0.536*** (0.047)	-	- 0.083*** (0.014)	
Health insurance	1.487*** (0.134)	-	0.077*** (0.012)	
Household characteristics				
umber of household members (No.)	1.023*** (0.005)	-	0.007*** (0.001)	
International Remittances	1.067 (0.067)	-	0.092*** (0.009)	
Wealth quintiles	-		-	
Poor	1.491*** (0.067)	-	0.794*** (0.007)	
Middle	2.122*** (0.110)	-	1.504*** (0.008)	
Rich		-		
Donations	0.850* (0.078)	- -	0.008 (0.014)	
Community Characteristics				
Place of Residence Rural or Urban	0.883** (0.053)	-	0.258*** (0.011)	
Community Higher education	1.292* (0.175)	-	0.361*** (0.025)	
Divisions				
Bahawalpur	1.988*** (0.226)	- -	-0.044* (0.022)	
DG Khan	0.805* (0.091)	-	- 0.230*** (0.023)	
Faisalabad	2.062*** (0.212)	-	0.129*** (0.020)	
Gujranwala	2.387***	-	0.205***	

Lahore	(0.240) 1.889*** (0.196)	- - -	(0.019) 0.226*** (0.020)	
Multan	1.436*** (0.150)	- -	0.085*** (0.021)	
Rawalpindi	1.671*** (0.180)	- -	0.260*** (0.021)	
Sahiwal	2.126*** (0.044)	- -	0.114*** (0.024)	
Sargodha	-	-	-	
Random Effects				
Cluster-level OR	0.901	1.102	0.046	0.621
Cluster variance (SE)	0.049	0.055	0.002	0.018
Chi-square test	1043.01	0	66697.42	0
Residual intra-cluster correlation (ICC)	0.215	0.251	0.278	0.661
ICC (SE)	0.009	0.009	0.008	0.007

***, **, * Significant at the 1%, 5% and 10% level, respectively.

Note: Odds Ratios with 95% confidence intervals are shown with standard errors in parenthesis. Data Source: Multiple Indicator Cluster Survey 2017-18.

4. CONCLUSION AND POLICY RECOMMENDATIONS

The argument surrounding IRs has always been controversial as researchers have never truly been able to come to a consensus regarding its relationship with SWB and EWB. The reason for this is because many have believed that the process of international migration causes skilled workforce to leave their home countries to fulfil their future aspirations or to find better work opportunities. This is termed as brain drain, which as a result leaves the home country with a less skilled workforce causing its production and efficiency levels to fall greatly. However, our results show that the inflow of remittances has greatly improved not only the economic conditions of economies and households but also aided in increasing their overall life satisfaction. Punjab is Pakistan's most populated province and thus also sees higher rates of international migration which is the reason it was selected for our analysis.

Using the multi-indicator cluster surveys 2017-18 (MICS 17-18) we applied multilevel mixed-effects logistic regression (non-logistic for the EWB models) for men and women separately and found the IRs were positively affecting the SWB of women in Punjab. This was not true for the men as no significant relationship was tested as men's SWB does not rise much as in majority they are the ones who are sending the remittances not receiving them,

unlike the women. The IRs had a positive and significant relationship with the EWB of men and women both which helped us deduce that rising IRs were leading to economic and financial stability for the men and women in Punjab.

4.1. Policy Recommendations

The SWB and EWB of men and women in the Punjab province of Pakistan remain an issue yet to be solved. Through this study, we found that the increased inflow of remittances was leading to improvements in the levels of SWB and EWB of the people. Therefore, this study encourages the relevant policymakers to make decisions in a form that enhances the SWB and EWB among the people and the communities further. For this reason, we recommend designing their policies in the following ways:

- 1- Easing the process/red tape for its potential migrant workers to leave and work in foreign countries. According to the World Bank statistics Pakistan received a boost in the remittance levels in 2020 by 23%. Considering they represent 8% of the entire GDP it is very important to make sure that their inflows remain stable.
- 2- Promoting channels that deal with the inflow of remittances through specially designed departments and systems in various financial institutions
- 3- According to SDG 3 of the United Nations all members of economy deserve higher wellbeing so for the men who are less satisfied working outside the country, special incentives and tax reductions can be provided to encourage higher remittances.
- 4- Creating awareness and educating the public about the opportunities they can have in foreign countries to earn a better living for themselves and their families (either through nationwide workshops or awareness campaigns).

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