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# Fertility Determinants and Economic Uncertainty

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In a developing country like Pakistan where financial and labor markets are immature, trade is not very much open with low per capita income and high output risk shows economic and financial uncertainty by disturbing behavior of saving and portfolios that changes people s' decisions about family size .In this paper ARDL model is used to examine variations in fertility preferences using time series data by looking into statistical relationship between different demographic and economic variables. The result shows that fertility rate is definitelyassociated with infant death rate, participation of female in labor force while adverselylinked with real income, unemployment, inflation and GDP growth rate. High unemployment rates increase insecurities about labor market, while increases in real income motivate people towards luxuries so their fertility rate decreases. In order to reduce fertility rate the Government of Pakistan has to expand immunization programme and family health clinics to improve child's health to reduce infant/child mortality.

***Keywords:*** fertility, demographic transition, economic uncertainty, ARDL model, labor Market, GDP Per Capita.

Pakistan's territorial area is only 0.67 percent of the whole world but has 2 percent of world's population. Almost all developing and developed countries of the world, experience "demographic transition" which depends on 3 stages. In first stage birth and death rates are equally high due to which population growth is either low or stable. Second stage is followed by decreasing death rates due to medical improvements with high birth rates causing population growth to increase while in third and last stage, again there is equal decrease in both birth and death rates so that growth in population is very slow and steady – this last stage represents industrialized and developed countries at the present time.

In a developing country like Pakistan where financial and labor markets are immature, trade is not very much open, low per capita income exists and high output risk shows economic and financial uncertainty by disturbing behavior of saving and portfolio that changes people's decisions about family size. Because rational, responsible and sensible parents will give birth to children merely when they will be able to meet their expenses or afford both in current economic condition as well as in future because child bearing is a long run phenomenon. Fertility not only depends on present earnings and status but expectation of future income is also important. Thus any economic uncertainty like unemployment, low job security, inflation, etc. will prevent child bearing due to household's doubts about future economic positions.

In this paper we observe empirically, how fertility decisions of the family depends upon economic and demographic variables together with economic uncertainty, further we shall show if a long term relationship exist between fertility, demographic and economic variables.

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**Literature Review**

Notestein (1948) represented parallel vision regarding fertility transition "Decrease in fertility is the result of economic pressures in low income country due to rising cost of children when there is heavy rural-urban migration because in urban context individualistic promotion of child's health and education increases that also increases cost of children so Note stein theory has a strong focus on economic consideration. Ellis (1993) found that educated women will lose expected income due to child bearing so female education and female employment will make child bearing expensive and it will decline fertility levels by the use of more contraception than their counter parts with no education. Bettio and Villa (1998) examined negative link among fecundity & joblessness in Italy. To remain in labour market, female give up child bearing so that their fertility rate can drop. Furthermore. Mammen and Paxson (2000) extended the research of Goldin (1995) and establish U-shaped bond between per capita income of female and their participation in labour market. Fertility rate is high in poor and agricultural economies but lower in urbanized economies where manufacturing sectors is dominant. Herzer et al., (2010) estimated extended effects of fertility, mortality (death rate) and growth of income in 12 developed and 8 underdeveloped countries by using data of 100 years from 1900-1999 through panel co-integration and granger causality test .

Where all variables were expressed in log form. Mortality and income growth contributed in fertility transition. Mortality is positively related with fertility while GDP per capita is negatively related in all poor and rich countries (almost same result). Fertility change is both cause & consequence of economic development. Bongaarts and Sinding (2011) argued that low FR (Fertility Rate) facilitate economic growth in low income counties due to low dependency ratio so low FR shares more saving and investments which increases living standards Chani, et al., (2012) investigated the role of diverse socio financial factors like schooling of women, urbanization and female labour force on fertility level by considering data from 1980-2009 applying ARDL bound test approach and found negative link between fertility and study variables. Female's education and urbanization had significant but role of female labour participation was minor in case of Pakistan. Manan et al., (2013) tried receiving knowledge and understanding of the prevailing situation by creating awareness among the population matter, social and economic phenomenon and also found causes of population expansion and impact of various socio-economic indicators in Pakistan using Co- integration approach from 1972-2012. Time series data from 1972-2012 was collected from World Bank, State Bank of Pakistan, HDI (Human Development Index) and Economic Survey. Population expansion was reliant variable and literateness rate, FDI, joblessness and national saving as independent variables. The result obtained was that home saving and literacy rate had extended relationship with population expansion except FDI (Foreign Direct Investment) and unemployment rate while literacy rate, FDI and unemployment had positive and domestic saving had negative relationship with population growth.

Moeeni et al., (2014) analyzed how micro and macroeconomic determinants are associated with child ever born in Iran. Secondary data HEIS (2010), Housing data and Provincial data 1986,1996, 2006 and 2011 were employed on Child Ever Born as independent variable. CEB= f (Real per capita educational expenditure, Wealth index, House rents).Poisson regression was used and it found that fertility decreases when real per capita education expenditure of household increases (Micro effect). Low and high income families have high probability of fertility as compare to middle income families. Gender gap increases the fertility probability and wife's imperfect control over household decision making causes more kids bearing but fertility was lower in provinces where house rent was high (Macro effect). Lakhan (2015) took data from "Statistical Year Book of Pakistan and Federal Bureau of Statistics of Pakistan" from 1975-2013. Auto Regressive Distributive Lag approach was used and certain variables like TFR as dependent variable while child death, participation rate of labour, actual

development rate, secondary ratio of female and contraception were selected as independent variables. He wanted to see short and long run relationship between female schooling and fecundity and result indicated strong short run as well as long run undesirable link between schooling and female fertility rate in Pakistan. Kushum et al., (2016) used national survey data from 1976 to 2011 to find fertility trends, levels and differentials by using decomposition analysis and Bonga arts model of 1978 in Nepal using some socio-economic determinants and found that fertility had a sustained decline from 5.1 per women in 1991 to 2.6 in 2011. This fertility decline is more in urban areas as compare to rural and this was due to contraception use, rising age at marriage, increase in male migration and induced abortion Singh et al.,(2017) did research onfactors of population increase in Rajasthan (India) and came up with the result that there are several demographic and socio – economic aspectsin charge for population expansion and some of them are death rate, crude natal rate, and crude death rate.Nyoni(2018) distinguished that population growth in Pakistan is still very high .Using the Ordinary Least Squares (OLS) method, the study finds the causes in Pakistan from 1960 – 2017. Diagnostic tests were carried out to verify the statistical appropriateness of the model. Amid other outcomes, the study exposed that a 1% risein contraceptive use will approximately decrease 3.53% population evolution in Pakistan so stronglyinspires the government to take steps to reduce population growth in Pakistan.

**Data Description**

The empirical investigation is carried out by use of yearly data from period 1980 – 2018. The dependent variable is fertility rate "the number of children women would bear throughout her life" while Independent variables are Infant Mortality Rate (IMR) "Number of Children aged under one year old who die per 1000",Female Labor Force Participation Rate (FLPR) "Proportion of female in the laborforce", Age Dependency Ratio (ADR) "Ratio of people younger than 15and older than 64 to the working population 15-64 years", Real GDP Per Capita (RGDPPC) "Proxy of family income", all variables are said form of log.

$LTFR_t = ß_0 + ß_1 LIMR_t + ß_2 LADR_t + ß_3 LFLPR_t + ß_4 LGDPPC_t + ECONOMIC\ UNCETAINITY + \mu i$….. (1)

Total fertility rate depends on various demographic and economic variables. Here economic uncertainty includes inflation rate, unemployment rate and real GDP growth (proxy of economic development). Data are extracted from data base of World Development Indicators 2018.

$LTFR = {}_o + {}_1 IMR_t + {}_2 ADR_t + {}_3 LFLPR_t + {}_4 LGDPPC_t$ + Economic Uncertainity + μi…… (2)

$Ln\ (TFR)_t = o + {}_1 Ln\ (TFR)_{t-1} + {}_2 Ln\ (IMR)_{t-1} + {}_3\ (ADR)_{t-1} + {}_4\ (FLPR)_{t-1} + {}_5 Ln(GDPPc)_{t-1} + \alpha i Ln\ (TFR)_{t-1} + {}_i Ln\ (IMR)_{t-1} + i Ln\ (ADR)_{t-1} + \pi i Ln\ (FLPR)_{t-1} + {}_I Ln\ (GDPPC)_{t-1} + Ln\ (Economic\ Uncertainty)_{t-1} + \mu_t$…….(3)

Long run dynamics are represented by 1, 2, 3, while short run Parameters are shown by αi , ${}_i$ ,i ,πi, ${}_I$ and n indicates optimal lag length Δ shows difference operator.

If evidence of long run relationship predictes among variables so ECM (Error Correction Model) is used to locate rate of adjustment at which regressed variables will adjust towards regressor, through $ECT_{t-1}$ we have.

$Ln(TFR) = \beta o + + + + + + + + (ECT)_{t-1.}$

It shows the speed of adjustment and co-integration exists between variables if the value of coefficient of ECT is negative and significant.

Infant mortality rate (IMR) is anticipated to have positive sign because when a child's survival chances decreases, parents would like to give more births but when a child's survival chances are more due to medical advancement fertility will decreases. Because households are interested in

targeting numbers of children not in numbers of births. When parents set target number of children or to avoid risk enhanced survival chances of children be likely to shrink fertility. Age Dependency Ratio (ADR) is expected to be negative. Participation of female in labour market rate (FLPR) is likely to be negative on fertility because if woman spends more time in professional life, she will spend less time in child bearing and rearing so opportunity cost of children increases. Participation of female in labor marketplace and child rearing and nurturing both decisions move in opposite direction (Substitution Effect given by Becker).

If we assume family income variable by LGDPPC so expected sign is positive on fertility. If children are considered to be normal goods i.e Increase in income increases demand for kids (Income effect given by Becker).

Economic uncertainty includes unemployment rate (UER). High unemployment creates insecurities in labor market, economy, present plus future income so responsible parents will postponed their child bearing and wait till the labor market becomes certain or when they are able to financially support their families so unemployment rate is expected to have negative relation with fertility. Second measure of uncertainty is production or GDP growth which is related with economic development of the country. Productivity risk is a measure of uncertainty since it alters saving and investment decision in the economy. Changes in saving and investment behavior related with economy's production may effect future earnings and postpone child bearing decisions so it is expected to have negative relation with fertility. Third factor of economic uncertainty is consumer price index (CPI) shown by inflation, because when inflation increases it becomes difficult for people to fulfill even basic needs of life, cost or expenditure per child increases then they usually prefer quality upon quantity. So inflation is also expected to have negative relation with fertility.

**Empirical Evidences**

**Stationarity Test:**

Stationarity test is used to confirm moreovervariables are significantly connected to its past or not given in table #1. Usually time series analysis are non-stationary so to avoid "spurious" or "non-sense regression", variables are made stationary by unit root test by "Augmented Dickey fuller (ADF) (1979-88) and Phillip-Perron test PP (1988)". We shall use both Tests to check stationarity level. Results of both tests confirm that some variables of the model like LTFR,LCPI and LRGDP are stationary at level while LIMR, LUER, LADR, LFLPR and LRGDPPC are stationary at first difference. Therefore, we have altered order of integration i.e. I(0) and I(1) and nothing of order I(2).

Since we can see from table #1that there is a mixture of I(1) and I(0) of variables and nothing of I(2) so it is required to use bound test approach or autoregressive distribution Lag (ARDL) model for co integration.

**Table 1**

*Unit Root Test*

| Variables | ADF Test (with intercept) | | PP Test (intercept) | | Order of integration |
|---|---|---|---|---|---|
| | Level | First difference | Level | First difference | |
| LTFR | 4.97* | -4.31* | 18.92* | -4.31* | I(0) |
| LIMR | 1.35 | -3.90 | -0.52 | -18.61* | I(1) |
| LFLPR | -0.78 | -6.26* | -3.12 | -10.58* | I(1) |
| LADR | -2.90 | -5.61* | -0.60 | 10.92* | I(1) |
| LGDPC | -2.37 | 6.57* | -2.37 | 28.37* | I(1) |
| LUER | -1.51 | -9.71* | -1.78 | -9.71 | I(1) |
| LCPI | -.432* | -6.12 | 3.80* | -6.12 | I(0) |
| LRGDP | -4.19* | -2.29 | -49.87* | -2.29 | I(0) |

**Auto Regressive Distributive Lag**

Since variables are combination of I(0) and I(1) so ARDL bound test shows superior results in case of small sample because we can use it irrespective of "order of integration" (Pesaran & Pesaran, 1997).

The ARDL bound test consists of two steps. In first step co-integration between variables is based on computed F- Statistics value compared with critical bounds tabulated by Pesaran et al., (2001). The Upper Critical Bound (UCB) is built on expectations that variables are integrated at I(1) and Lower Critical Bounds (LCB) assumed that variables are integrated at I(0). If F-statistics is larger than UCB, it shows presence of long run correlation among variables and vice versa.

Since we are using Eviews 9 with automatic maximum lag- length of 4, both for dependent & independent variables based on (AIC) Akaike information criteria the optimum lag order is (4,3,4,3,3,3,2,4). The results are given in table #2

**Table 2**

*Bounds test for co-integration*

| F-Statistics | 26.21 | |
|---|---|---|
| Optimum lag length | (4,3,4,3,3,3,2,4) | |
| Significant level | Critical values T= 17.34 | |
| | LCB | UCB |
| | I(0) | I(1) |
| 1 percent | 4.4 | 5.72 |
| 5 percent | 3.47 | 4.57 |
| 10 percent | 3.03 | 4.06 |

Since we can see from table 2 that T-statistics value is 17.34 for K=8 (K refers to digits of variables of model) which is greater than UCB value of 5.72 so we can infer that there may exists co-integration among variables and discard the null of no co-integration.

In second step we calculate co-integration and long run form we get value of co-integration equation with one Lag length.

| | |
|---|---|
| Co-integration Equation (-1) | coefficient value= -0.24<br>t-value= -2.28 |

Value of Co-integrating equation is both negative and significant which again rejects the null hypothesis of no co-integration and approves strong long run bond between dependent and independent variables. We get to know about long run relationship but to track the way of correlation (positive or negative) and magnitude we have to evaluate long run affiliation given in table # 3.

**Table 3**

*Long Run relationship*

| **Dependent Variable = LTFR (2,2,0,1,2,0,1,1)** | | | |
|---|---|---|---|
| **Variables** | **Coefficient** | **t-Statistics** | **Probability** |
| Constant | -11.95 | -8.44 | 0.00 |
| LIMR | 3.45 | 9.35 | 0.00 |
| LADR | -9.36 | -1.8 | 0.03 |
| LFLPR | 0.24 | 1.6 | 0.31 |
| LGDPPC | -3.89 | -2.55 | 0.0 |
| LUER | -0.03 | -3.63 | 0.02 |
| LCPI | -0.09 | -1.25 | 0.12 |
| LRGDP | -5.04 | -1.5 | 0.01 |
| | | | |
| R-Squared | | = | 0.88 |
| Adj R- Squared | | = | 0.78 |
| AIC | | = | -7.69 |
| SIC | | = | -6.65 |
| F-Statistic | | = | 3185.55 |
| Prob of F-statics | | = | 0.00 |
| Durban Watson | | = | 3.21 |
| Sensitivity Analysis | | | |
| LM | | | 0.30 (0.74) |
| ARCH Test | | | 0.32 (0.57) |
| Normality Test | | | 2.05 (0.35) |
| Heteroscedasticity Test | | | (0.44) (0.81) |
| Ramsay Test | | | 1.97 (0.15) |

The result in table 3 shows what 1 percent increase in IMR increases TFR by 3.45 percent. Among all variables effecting TFR, IMR is most significant in Pakistan because when parents experience infant/child mortality they try to minimize their risk by expanding their family size. According to Kreider et al., (2010 “Increase in mother education and reduction in child and infant

mortality have contributed to rapid decline in fertility in 47 countries of Caribbean, Latin AfricaLatin America, , Asia, and Sub-Saharan Africa. Based on this, we can suggest that more and more steps should be taken by government to reduce infant and child mortality to go aheadfor more decline in the long run fertility in Pakistan. Adhikar (2010) said that "a child loss is almost translated into doubling-up of child ever born for women with no child loss. Increase in ADR (ratio of people below 14 years and above 64+ to the working population between 15-64 years of age) by 1 percent decreases TFR by 0.20 percent because ADR negatively effects both per capita expenditure and living standards and per capita expenditure is negatively related with fertility. Increase in per capita expenditure decreases the expected number of kids born by 0.3 percent in urban and 0.4percent in rural areas in Iraq (site resource Worldbank.org/menaxt) but it is not a very significant factor in case of Pakistan because in Pakistan joint family system and kin support system are common although on decline but in kin support system children expenditure are distributed and elderly people in Pakistani society are considered to be blessings. In most aspect, Pakistan has solidstimulus of feudal and agronomicculture with strong pledge of casts, strong actions and symbol of family. One percent increase in FLPR increases TFR by 0.04 percent (substitution effect is positive incase of Pakistan) because in Pakistan majority of females are employed in low status manual work like cottage industries, agriculture setup or house maids so they consider kids as a source of more income. "Percentage of educated and employed women in economic activity is undersized so it does not affect their fertility decision" said by Sathar in (2001). Fertility is negatively related for women in high status job while for low status job fertility was positively related also found by Sathar and kazi (1989). Fong (1974) and Darocha and Fuster (2006) also found positive relation between female work and fertility in Malaysia except in subgroup of women who are educated and in economies with low probabilities of finding jobs as far Pakistani society is male dominated society so here female employment opportunities are negligible. Similarly 1 percent increase in LGDPPC decrease TFR by 0.20 percent so it can be due to two reasons first when per capita income increases women enter more in labor force so their willingness to give births decrease second when per capita income increases it mean there is more development in the economy so new methods of family planning and contraception will be available in country.This is significant factor in case of Pakistan. Similarly if we see the effect of economic uncertainty we see fertility rate and unemployment holds negative relation because rational parents will be bearing children only when they are capable to afford them, this is related to moral behavior. Mocan (1990) and Schaller (2012) also found negative relation between unemployment of males and females of USA and fertility. Female unemployment induces them to give space or delay their child bearing causing fertility to decline (Darocha &Fuster 2006). Inflation which is presented by Consumer price index is also negatively related with fertility decision although not significant it is due to the fact that Pakistan's government is putting too many taxes every year due to which demand for children decreases due to increasing expenditure cost of living.When the government expenditures increase in the economy with no change in the tax rate so this expansionary policy is linked with increase in demand for kids. But when the economy is smash with increase in tax rate (but no change in government spending), the demand for offspring reduce, Result similar to Saleem abo- zaid (2013). The relation between fertility and economic growth although negative but not significant and ambiguous because if growth rate increases it shows development is taking place in Pakistan so income are increasing people will substitute children to

work more in labor market to earn more money but on other side development also needs people to produce more goods and services i.e. more labor force which is only possible with more population so in Pakistan this relationship is negative although not significant. In the last the intercept is negative and significant which shows that average impact on dependent variable TFR is excluded from model.

The high value of $R^2$ = 0.88 and diagnostic tests approves goodness of fit of model and constancy of long run relation. The short run relation between independent variables and fertility are tested by VECM (Vector Error Correction Model) method shown in table 4. All the variables have expected sign except for relation between fertility rate with income or GDPPC and growth rate of GDP which shows positive relation in short run because in short run when family income increases demand for children also raises but with the passage of time parents adjust their expenditure and in long run they decrease their demand for children so in long run quality elasticity of income dominates quantity elasticity of income. Also in initial phase of development demand for labor is more to produce more but in second phase more educated labor is needed to keep pace with development process due to which people will get more and more education to increase their skills so per capita educational expenditure will increase and demand for additional children will decline in long run. Coefficient value of lagged ECM is together negative and important so it leads dependent variable" Total Fertility rate" to converge towards stable long run equilibrium due to the differences in independent variables.

**Table 4**

*Short Run relationship*

| | Dependent Variable =D LTFR | | |
|---|---|---|---|
| **Variables** | **Coefficient** | **t-Statistics** | **Probability** |
| **Constant** | -10.87 | -0.74 | 0.46 |
| **DLIMR** | 5.78 | 2.5 | 0.05 |
| **DLADR** | -0.69 | -0.60 | 0.55 |
| **DLFLPR** | 0.01 | 1.18 | 0.24 |
| **DLGDPPC** | 1.14 | 2.1 | 0.07 |
| **DLUER** | -0.00 | -2.10 | 0.01 |
| **LCPI** | -0.10 | -2.34 | 0.02 |
| **LRGDP** | 1.03 | 1.95 | 0.03 |
| Ecmt-1 | -0.122 | -2.32 | 0.02 |
| R-Squared | | | 0.84 |
| Adj R-square | | | 0.74 |
| AIC | | | -6.07 |
| SIC | | | -5.45 |
| F-Statistic | | | 8.68 |
| Prob of F-Statistic | | | 0.00 |
| Durban Watson | | | 2.00 |
| Sensitivity Analysis | | | |
| LM | | | 0.58 (0.45) |
| ARCH Test | | | 0.009 (0.92) |
| Normality Test | | | (0.95) (0.6) |
| Heteroscedasticity Test | | | (0.44) (0.81) |

| | |
|---|---|
| Ramsay Test | 0.37 (0.54) |

All diagnostic tests likes LM test of serial association, ARCH test, normality test of residual term white heteroscedasticity and model measurement test have been conducted for both bound test of long and short run. The pragmaticoutcome shows that both LR bound and LR coefficient model passes all post estimation test and no evidence of heteroscedasticity, series relationship and autoregressive conditional. Furthermore, Cumulative sum (CUSUM) and Cumulative sum of squares(CUSUMQ) is used to probe long run and short run constancy of model's parameters given by brown et al (1975) so figure 1 and figure 2 plotting of CUSUM and CUSUMQ falls between critical values of 5% significance level confirming strength of long run and short run stability of parameters.

**Figure 1**

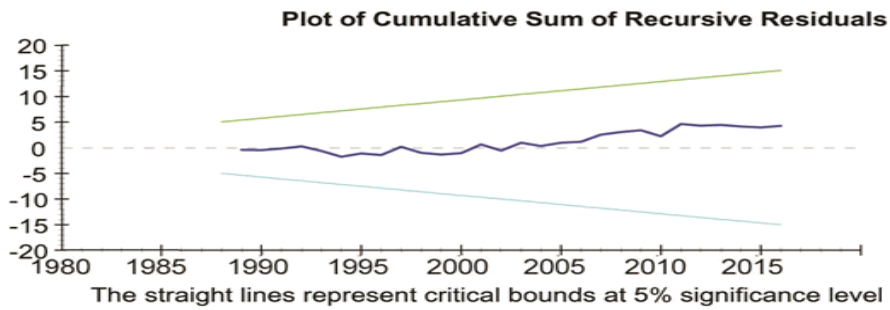
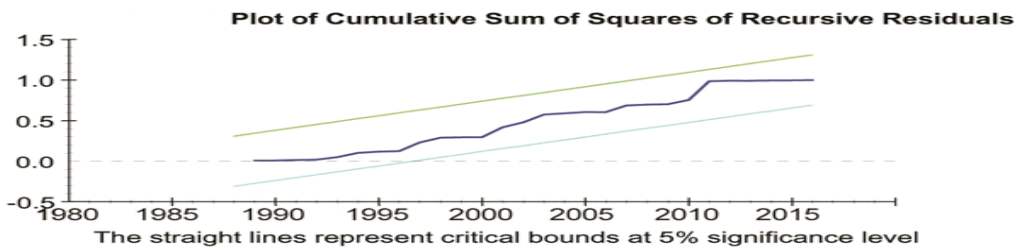



**Figure 2**




**Conclusion**

We have used empirical form of model to examine variations in fertility preferences or decisions using time series data by looking into statistical relationship between demographic and economic variables. This paper examines static properties of the figures by using unit root test.

The result supports that fertility rate in Pakistan are significantly explained by infant mortality rate, income , further more macroeconomic indicators like unemployment rate, inflation rate and GDP growth which can be used as proxies of economic uncertainty in labor market.

The result shows fertility rate is positively related with infant death rate,participation rate of female while fertility is negatively related with real income, unemployment rate, inflation rate and GDP growth rate.

The findings suggest that high unemployment rates increase insecurities about labor market because children are long period obligation so labor market uncertainty might affect adult's decision for partnership because rational and wise parents will bear children only when they will be in a

position to secure their present and future income, when real income increases people move towards luxuries so their fertility rate also decreases. Increase in income decreases fertility in long run and lastly infant mortality rate positively affects fertility rate in Pakistan both in short & long run so if the government wants to lessen fertility rate it has to increase immunization programme and family health clinics in order to improve child health to decrease infant/child mortality.

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