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PEER REVIEWED ARTICLE

Family planning progress in 113 countries using a new composite Progress Index

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Abstract

This paper analyses family planning progress in 113 countries in the context of meeting the demand for family planning through a composite progress index that measures progress in three dimensions – demand for permanent methods, demand for modern spacing methods and expansion of method choice – following the progress triangle approach. This paper suggests that in more than forty per cent of countries analysed, family planning progress remains far from satisfactory in meeting the family planning demand and there is substantial inter-country variation in the progress. In some countries, progress appears to have reversed. The inter-country variation in family planning progress is primarily the result of inter-country variation in meeting the demand for permanent methods. The analysis calls for the reinvigoration of family planning efforts to meet the target set under the United Nations 2030 Sustainable Development Agenda and the FP2030 initiative.

Keywords

Sustainable development; family planning progress; composite index; contraceptive prevalence; family planning demand

Introduction

The world population is now estimated to have passed the eight billion mark. The United Nations projects that the world population will increase to around

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10.43 billion by 2086 and then decrease to 10.36 billion by the end of the century (United Nations, 2022). This means that around 2.55 billion people will be added to the world population in the next sixty years. This increase will exert pressure on the environment that sustains life on the planet. Population growth has a negative impact on sustainability as it raises both resource demand and generates more waste on all levels of resource use per capita. The reduction in global emissions of greenhouse gases (GHG) between 1990–2019 as a result of technological advancement has been found to have been seriously compromised by population growth (Chaurasia, 2020a). A number of studies have attempted to estimate the optimal population size the planet can sustain (Dasgupta, 2019; Lianos and Pseridis, 2019; O'Neill et al., 2018) with figures varying from three to seven billion, which suggests that world population beyond seven billion is likely to seriously compromise prospects of sustainable development.

Population growth is primarily the result of individual choices and opportunities to produce children. Regulating individual fertility through family planning has been the mainstay of efforts to control population growth. In 1952, India was the first country to launch an official family planning programme in the context of reducing poverty and hastening social and economic progress. By 1996, as many as 115 countries had adopted explicit family planning policies (Bongaarts et al., 2012). Family planning is also recognised as an essential intervention for universal access to sexual, reproductive and child health care in the United Nations 2030 Agenda for Sustainable Development (United Nations, 2015). The dividends of family planning go beyond the reproductive rights of women and the reduction of unintended pregnancies by contributing to improving the health and nutrition of children and reducing maternal mortality. Family planning is highly cost-effective and has a demonstrable impact on poverty reduction (Bongaarts et al., 2012).

Family planning efforts typically generate and respond to the demand for family planning. Family planning progress can, therefore, be measured in terms of the demand generated and the demand satisfied. An indicator of family planning progress is the ratio of the demand satisfied to the actual demand for family planning, the higher the ratio the more advanced the family planning progress. Family planning demand is contingent upon family building strategy – how many births to have and when to have them – and can be divided into the demand to postpone or space births and the demand to prevent births. The demand satisfied, on the other hand, is contingent upon the efficiency of family planning efforts in meeting the actual demand. The gap between the actual family planning demand and the demand satisfied is called 'the unmet demand' for family planning and occurs either due to demand side or supply side factors (Senderowicz and Maloney, 2022).

The unmet demand for family planning can be further classified into unmet demand for spacing births and unmet demand for preventing births. Different family planning methods are made available to satisfy different family planning demands which may be divided into modern spacing methods, permanent methods and traditional methods. Modern spacing methods (e.g. condom and traditional methods e.g. rhythm method) are reversible. They can be used for both spacing and stopping births. Permanent methods are irreversible and cannot be used for spacing births. The demand for spacing and the demand for preventing births vary with the stages of the family building process. Method choice, therefore, is an important factor in satisfying family planning demand and has been recommended as a guide for optimal family planning services delivery (WHO, 2014). Method choice is also linked with family building strategy that includes family size goals and timing of births. It reflects both demand for and supply of family planning. A dominating factor that influences method choice is the availability of a range of family planning methods. It has, therefore, been emphasised that the charting of family planning progress should not be confined to just counting the users of family planning but should also consider method choice (United Nations, 2019).

Measuring family planning progress in terms of family planning demand satisfied is a multidimensional construct, three dimensions of the progress can readily be identified: 1) progress in satisfying the demand for modern spacing methods; 2) progress in satisfying the demand for permanent methods; and 3) progress in expanding method choice. The progress in the three dimensions can be combined into a single composite progress index which presents the progress in all three dimensions of family planning as one aggregate value. The composite index enables the ranking of countries in terms of family planning progress and also permits analysis of spatiotemporal variations in progress. One argument that has been put forward against the use of a composite index is that it masks the variation in progress in different dimensions of family planning, however this is unavoidable when one looks into the breadth of family planning efforts (Apablaza and Yalonetzky, 2011). It may, however be argued that a composite index reinforces the uniqueness of the progress in different dimensions of family planning.

In this paper, I develop a composite index to chart family planning progress in 113 countries that combines progress in satisfying demand of modern spacing methods, in satisfying demand of permanent methods and progress in expanding method choice. The index presents the 'big picture' by offering a rounded assessment of family planning progress. The change in the composite index can be decomposed into the change in the three dimensions of family planning. This decomposition is important in the context of the action plan adopted at the 1994 International Conference on Population and Development and the United Nations 2030 Agenda for Sustainable Development which advocate a rights-based approach to advancing family planning.

The paper is organised into five sections. The first describes the composite progress index. The second describes the data source. The paper is based on the United Nations database of survey-based estimates of method-specific prevalence and unmet need for spacing and limiting (United Nations, 2020). Following this, section three discusses the family planning progress in 113 countries. Section four groups countries in terms of progress in the three dimensions of family planning, and section five analyses temporal changes in family planning progress. The sixth and final section of the paper summarises the findings of the analysis and discusses their policy and programme implications.

Composite Family Planning Progress Index

Details regarding the construction of the composite family planning progress index are given in the appendix. The composite progress index is based on the progress triangle approach (Nold and Michel, 2016). Let p_s denote the index of the met demand of modern spacing methods, p_p the index of the met demand of permanent methods and p_q the index of method choice such that all the three indexes range from 0 (lowest) to 1 (highest). The composite progress index, p, is then defined as

$$p = \frac{\sqrt{p_s * p_p} + \sqrt{p_p * p_q} + \sqrt{p_q * p_s}}{3} \qquad (1)$$

The index *p* ranges between 0 and 1, the higher the index the more advanced the family planning progress. When $p_s=p_p=p_q$ the index *p* is the simple average of the three indexes. The index *p* is always less than the simple average of the three indexes. The difference between the simple average of the three indexes and the index *p* reflects the inequality in progress in the three dimensions of family planning. If p_i denotes progress inequality, then

$$p_i = \frac{p_s+p_p+p_q}{3} - p \qquad (2)$$

The indexes p_s, p_p and p_q are constructed from the method-specific prevalence and the unmet demand of spacing and limiting in the following manner:

$$p_s = \frac{c_s}{c_s+c_t+u_s} \qquad (3)$$

$$p_p = \frac{c_p}{c_p+u_p} \qquad (4)$$

$$p_q = 1 - \sqrt{\frac{\sum x_j^2-\left(\frac{1}{n}\right)}{1-\left(\frac{1}{n}\right)}}\ when\ n > 1\ and\ s = 1\ when\ n = 1;\ \sum_{j=1}^{n} x_j = 1 \qquad (5)$$

Here c_s is the prevalence of modern spacing methods, c_t is the prevalence of traditional methods, c_p is the prevalence of permanent methods, u_s is the unmet demand for spacing, u_p is the unmet demand for limiting, x_j is the proportionate prevalence of the method *j* or the share of the method *j* in the total family planning use and *n* is the number of family planning methods available. Modern spacing methods include intra-uterine devices (IUD), implant, injectable, pill, male condom, female condom, vaginal barrier methods, lactational amenorrhea method (LAM), emergency contraception and other modern methods. Permanent methods include female and male sterilisation. It is assumed that use of traditional methods is a reflection of the unmet demand for modern spacing methods. The rationale behind the construction of the three indexes is discussed at length in the appendix of the paper.

The index *p* presents a different perspective of family planning progress than the traditionally used contraceptive prevalence (CPR) or modern methods prevalence (mCPR) or the recently recommended demand satisfied by modern methods

(MDM) which is also one of the progress indicators of Goal 3.7 of the United Nations 2030 Sustainable Development Agenda (United Nations, 2015). The rationale for using CPR or mCPR to chart family planning progress may be traced to the strong negative relationship between CPR or mCPR and total fertility rate (TFR) based either on cross-country data (Bongaarts, 1978; Bongaarts and Potter, 1983; Ross and Mauldin, 1996; Jain, 1997; Tsui, 2001; Stover, 1998; United Nations, 2020) or on longitudinal data (Bongaarts and Hodgson, 2022). Many country-specific studies, especially in the context of sub-Saharan Africa, however, have highlighted the inconsistency between CPR and TFR (United Nations, 2020; Westoff and Bankole, 2001; Adamchak and Mbizvo, 1990; Bongaarts, 1987; Thomas and Mercer, 1995; Jurczynska, Kuang and Smith, 2016; Jain et al., 2014). There are studies that have attempted to explain this inconsistency (Bongaarts, 2015; 2017; Biestsch et al., 2021; Choi et al., 2018; Bongaarts and Hodgson, 2022). Srinivasan (1993) has argued that the CPR-TFR relationship may also be influenced by targeting family planning efforts.

The term 'demand' and the term 'satisfied' used in measuring family planning progress need some clarification. The term 'demand' does not reflect the stated desire of women to use family planning but it is a combination of family planning use and unmet need of either spacing or limiting based upon stated fertility preferences (FP2020, nd). Similarly, the term 'satisfied' does not reflect satisfaction of the user but could be interpreted as the total potential demand met by the use of family planning methods (FP2020, nd). The limitation of CPR or mCPR and MDM is that they do not consider method choice, although method choice is a key principle of both quality of care and rights-based family planning. These indicators do not distinguish between the demand of modern spacing methods and the demand of permanent methods. This distinction is important as the context of using modern spacing methods is different from the context of using permanent methods. Not distinguishing between the demand for modern spacing methods and the demand for permanent methods is equal to the implicit but very strong assumption of perfect substitutability between the two, which may lead to erroneous conclusions about family planning progress.

The index *p* measures family planning progress in terms of family planning outcomes – met demand of modern spacing methods, met demand of permanent methods and method choice. Family planning progress has also been measured in terms of the strength of family planning efforts (Ross and Mauldin, 1996; Ross and Stover, 2001; Rosenberg, 2020). The perspective of family planning progress based on the strength of efforts is different from the perspective based on family planning outcomes. One limitation of this 'effort index' is that it is based on the responses of key informants that may be biased by their knowledge.

Data

The analysis is based on the database on family planning use maintained by the United Nations which contains 1,317 observations from 196 countries from 1950 to 2019 (United Nations, 2020). The present analysis is limited to 113 countries that fulfil the following criteria: 1) the latest survey was carried out during 2010–2019; 2) method-specific prevalence is available for currently married or in-union women aged 15–49 years and 3) estimates of unmet demand are available separately for spacing and limiting. Out of the 113 countries included in the analysis, 47 are in Africa; 30 in Asia; 20 in Latin America and the Caribbean; 11 in Europe and 5 in the Pacific. These countries also include 65 of the 69 lowest-income countries identified as focus countries under the FP2020 Initiative.

Details of the methods, definitions, data sources and data limitations in the database of the United Nations are described elsewhere (United Nations, 2020). Data for different countries available in the database are not strictly comparable because of differences in survey design and implementation and in the representativeness of the sample over time and across countries. Prevalence of different family planning methods, in some cases, is also affected by rounding and the small size of the sample. The database provides survey-based prevalence of 13 methods which are grouped into permanent methods (female sterilisation, male sterilisation); 2) modern spacing methods (IUD, implant, injectable, pill, male condom, female condom, vaginal barrier methods, LAM and emergency contraception and 3) traditional methods (any traditional method). Prevalence of all thirteen methods is, however, not available for all 113 countries. In some countries, prevalence of some methods is either not available or not reported. In all such cases, prevalence is assumed to be zero. The database also provides estimates of unmet need of spacing and limiting. The definition of the unmet need is not consistent across countries, but it is broadly defined as the proportion of currently married or in-union women of reproductive age who want to stop or delay childbearing but are not using any modern method.

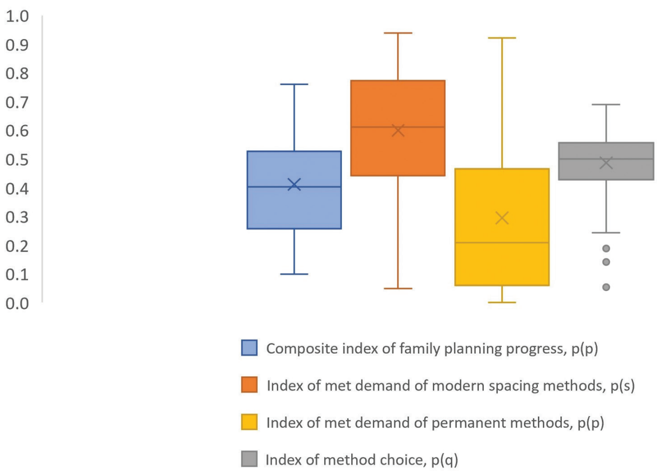
Family Planning Progress in 113 Countries

Appendix Table 1 gives values of indexes p, p_s, p_p and p_q for 113 countries. Inter-country variation in these indexes is summarised in Table 1 and Figure 1. The index p is the lowest in Sudan (2014) but the highest in Nicaragua (2011–2012). In 24 (21.2 per cent) countries, $p< 0.250$ while in 54 (47.8 per cent) countries, $0.250 \leq p < 0.500$. Nicaragua (2011–2012) is the only country where the index is more than 0.750.

Among the three indexes that constitute the index p, the index p_s is the lowest in Albania (2017–2018) but the highest in Democratic Republic of Korea (2017). There are only 5 countries where $p_s < 0.250$ whereas $p_s \geq 0.750$ in 33 countries. On the other hand, there are 7 countries: Benin (2017), Burkina Faso (2018), Côte d'Ivoire (2018), Ethiopia (2018), Guinea-Bissau (2018–2019), Libya (2014) and Sudan (2014), where the index $p_p=0$ while there are only 3 countries: Nicaragua (2011–2012), Colombia (2015–2016) and Dominican Republic (2014), where $p_p \geq 0.900$. In the majority of countries, the index p_s is higher than the index p_p but there are 20 countries where $p_s < p_p$. The most notable example is India where p_p is more than 83 per cent but p_s is only around 50 per cent. Finally, the method choice index, p_q, is the lowest in Democratic Republic of Korea (2017) but the highest in Guinea-Bissau (2014). In Democratic Republic of Korea, IUD alone accounts for more than 95 per cent of the total modern methods use. The index p_q is also very low in Turkmenistan (2015), Morocco (2018), Sudan (2014) and in India (2015–16) which indicates that the mix is highly method skewed. In 57 countries, the index $p_q < 0.500$.

There are four countries: Turkey (2018), Nepal (2016–2017), Sri Lanka (2018) and Pakistan (2017–2018), where p_s, p_p and p_q are very nearly the same but the inequality in progress in the three dimensions of family planning is the highest in Ethiopia (2018) followed by Burkina Faso (2018–2019) and Côte d'Ivoire (2018). There are 68 (60.2 per cent) countries where inequality in progress in the three dimensions is very small. In 13 countries, however, progress in three dimensions is markedly different. The inequality in progress in the three dimensions has implications for meeting the dynamic and diverse family planning needs of the people as it reflects a bias towards specific dimensions at the cost of other dimensions. For example, in Ethiopia (2018), the index p is more than 53 per cent lower than the simple average of the three indexes p_p, p_s and p_q because the met demand of permanent methods is zero and the method choice is very limited. This means that family planning efforts in Ethiopia are biased towards modern spacing methods at the cost of permanent methods.

Figure 1: Inter-country Variation in Different Indexes of Family Planning Across 113 Countries



SOURCE: AUTHOR

The inter-country variation in the three indexes p_s, p_p and p_q is essentially different (Figure 1). The inter-country variation in index p_p explains only about 23 per cent of the inter-country variation in the index p_s and just about 4 per cent of the inter-country variation in the index p_q. Similarly, inter-country variation in the index p_s explains less than 4 per cent of the inter-country variation in index p_q. These observations justify treating met demand of modern spacing methods, met demand of permanent methods and method choice separately in measuring family planning progress. Figure 1 also suggests that there are four countries where the method choice is extremely limited.

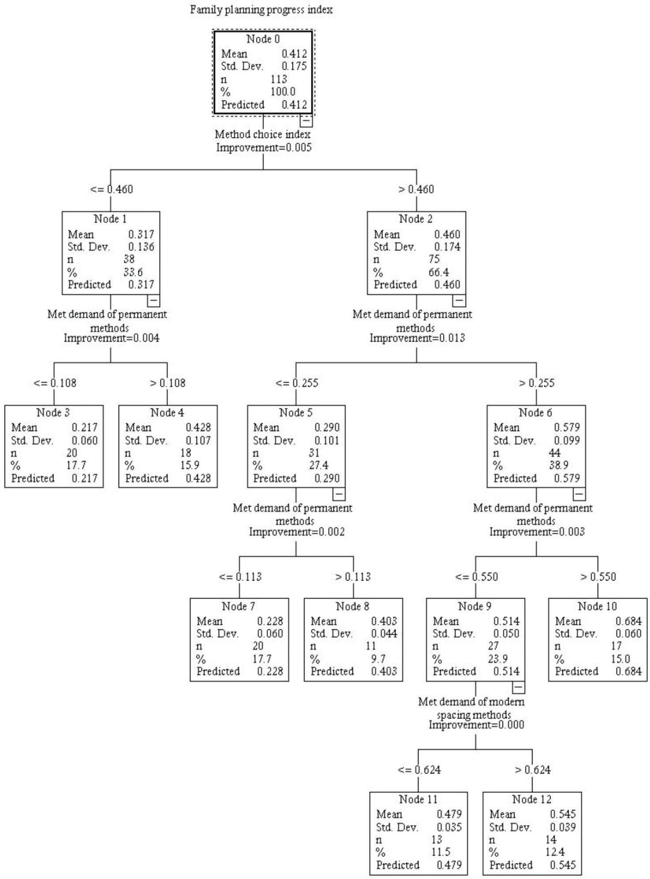
Countries rank different in terms of index p, mCPR and MDM. Nicaragua (2011–2012) is the only country which has the same rank in the index p, mCPR and MDM. Only five countries – Nicaragua (2011–2012), Costa Rica (2018), Colombia

(2015–2016), North Macedonia (2011) and Uganda (2017) – have the same rank in the index *p* and mCPR and only two countries, Nicaragua (2011–2012) and Mali (2018) have the same rank in the index *p* and MDM. In 50 countries, rank in index *p* is lower than that in mCPR. The Democratic Republic of Korea ranks 6 in mCPR but 78 in index *p* whereas Oman ranks 89 in mCPR but 44 in index *p*. In 49 countries, rank in index *p* is lower than that in MDM. Turkmenistan ranks 21 in MDM but only 101 in index *p*. Family planning progress revealed through the index *p* is different from that revealed through either mCPR or MDM.

Classification of Countries

The classification modelling approach (Han et al., 2012; Tan et al., 2006) has been used to group countries on the indexes p_s, p_p and p_q and to analyse the variation in the index *p* across different groups. The classification and regression tree (CRT) method (Brieman et al., 1984) was used for classification modelling (see appendix). Results of classification modelling exercise are presented in Table 2 and the classification tree is depicted in Figure 2. At the first stage of classification, countries are divided based on the index p_q. In 38 countries, $p_q \leq 0.460$ (Node 1) but in 75 countries $p_q > 0.460$ (Node 2). The 38 countries of Node 1 are classified further based on the index p_p. The index *p* in Node 3 is substantially lower than that in Node 4. The countries in Node 2 are divided into four groups based on the index p_p – countries where $p_p \leq 0.113$ (Node 7); countries where $0.113 < p_p \leq 0.255$ (Node 8); countries where $0.255 < p_p \leq 0.550$ (Node 9); and countries where $p_p > 0.550$ (Node 10). The index *p* is the lowest in Node 7 but the highest in Node 10. Countries of Node 9 are further classified based on the index p_s – countries having $p_s \leq 0.624$ (Node 11) and countries having $p_s > 0.624$. The index *p* is lower in Node 11 compared to Node 12. Figure 2 suggests that 113 countries can be classified into 7 mutually exclusive groups based on p_s, p_p and p_q and the index *p* varies across the 7 groups.

Figure 2: The Classification Tree



SOURCE: AUTHOR

Temporal Variation in Family Planning Progress

The temporal variation in family planning progress is analysed for 86 countries where at least two surveys took place during 2000–2019. The temporal variation is measured in terms of annual per cent change (*APC*) in the index *p* between two surveys. When there were more than two surveys, the temporal variation was measured in terms of average annual per cent change (*AAPC)* which is the weighted average of *APC* (see appendix). The temporal variations in the index *p*

Figure 3. Annual Proportionate Change (APC) and Average Annual Proportionate Change (*AAPC*) in the Index *p* in 86 countries

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	AAPC
Africa																					
Algeria							0.315														0.315
Benin		-0.937					-0.718					7.829									-1.266
Burkina Faso				5.429							-6.949						3.355	38.667			1.716
Burundi											1.183										1.183
Cameroon					-2.066							1.812									-0.903
Congo						2.604						9.470									4.893
Côte d'Ivoire												5.896					2.520	-30.451			0.221
DR Congo								12.175			-3.391										4.392
Egypt	-1.520			3.557		-0.961			1.712												0.710
Eritrea			0.188																		0.188
Eswatini							4.589				-2.611										0.989
Ethiopia	0.957					8.706					-3.366				31.009	-2.052	-1.678	-31.675			1.692

<table>
<tr><th>Country</th><th>2000</th><th>2001</th><th>2002</th><th>2003</th><th>2004</th><th>2005</th><th>2006</th><th>2007</th><th>2008</th><th>2009</th><th>2010</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>AAPC</th></tr>
<tr><td>Gabon</td><td colspan="13">-0.694</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-0.694</td></tr>
<tr><td>Gambia</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="6">-1.017</td><td></td><td>-1.017</td></tr>
<tr><td>Ghana</td><td></td><td></td><td></td><td colspan="5">-2.259</td><td colspan="3">6.701</td><td colspan="2">-17.631</td><td>3.717</td><td>32.147</td><td>0.140</td><td colspan="2">20.338</td><td></td><td></td><td>2.135</td></tr>
<tr><td>Guinea</td><td></td><td></td><td></td><td></td><td></td><td colspan="7">-2.022</td><td colspan="7">10.117</td><td></td><td>3.581</td></tr>
<tr><td>Kenya</td><td></td><td></td><td></td><td colspan="5">0.543</td><td colspan="6">1.936</td><td>2.452</td><td>2.959</td><td colspan="2">-5.560</td><td></td><td></td><td>1.013</td></tr>
<tr><td>Lesotho</td><td></td><td></td><td></td><td></td><td colspan="5">2.312</td><td colspan="5">0.617</td><td colspan="5">1.725</td><td></td><td>1.539</td></tr>
<tr><td>Liberia</td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="8">0.182</td><td></td><td></td><td></td><td></td><td></td><td></td><td>0.182</td></tr>
<tr><td>Madagascar</td><td></td><td></td><td></td><td colspan="5">2.861</td><td colspan="10">1.954</td><td></td><td></td><td>2.278</td></tr>
<tr><td>Malawi</td><td colspan="4">1.003</td><td colspan="6">4.118</td><td colspan="3">7.826</td><td colspan="3">1.447</td><td></td><td></td><td></td><td></td><td>3.673</td></tr>
<tr><td>Mali</td><td></td><td colspan="11">0.027</td><td colspan="3">-0.234</td><td colspan="4">7.520</td><td></td><td>2.248</td></tr>
<tr><td>Morocco</td><td></td><td></td><td></td><td colspan="16">-2.051</td><td></td><td>-2.051</td></tr>
<tr><td>Mozambique</td><td></td><td></td><td></td><td colspan="8">-4.703</td><td colspan="5">5.397</td><td></td><td></td><td></td><td></td><td>-1.336</td></tr>
<tr><td>Namibia</td><td colspan="6">1.530</td><td colspan="8">-0.533</td><td></td><td></td><td></td><td></td><td></td><td></td><td>0.419</td></tr>
<tr><td>Niger</td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="6">-2.348</td><td colspan="4">0.911</td><td colspan="2">0.321</td><td></td><td></td><td>-0.920</td></tr>
</table>

Figure 3. Continued

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	AAPC
Nigeria						2.508				-4.209		9.045			-1.856		6.648				0.711
Rwanda			-0.524			18.188			8.674					6.559							6.144
Sao Tome & Principe							7.450					0.368									2.139
Senegal								-2.843			9.548		8.570		2.569		15.324	-6.377			2.795
Sierra Leone															-7.187						-7.187
South Africa											-0.435										-0.435
Togo												2.946				9.195					6.517
Tunisia															-5.364						-5.364
Uganda			-1.838						4.651				-3.878		21.693	-1.488	4.168				1.469
UR Tanzania							2.660						1.878								2.233
Zambia				2.058							2.328										2.193
Zimbabwe								-1.072				2.664			1.218						0.651
Asia																					

<table>
<tr><th>Country</th><th>2000</th><th>2001</th><th>2002</th><th>2003</th><th>2004</th><th>2005</th><th>2006</th><th>2007</th><th>2008</th><th>2009</th><th>2010</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>AAPC</th></tr>
<tr><td>Bangladesh</td><td></td><td></td><td></td><td></td><td colspan="3">-1.690</td><td colspan="4">3.000</td><td colspan="4">-5.121</td><td></td><td></td><td></td><td></td><td></td><td>1.185</td></tr>
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<tr><td>India</td><td></td><td></td><td></td><td></td><td></td><td colspan="2">0.276</td><td colspan="9">0.931</td><td></td><td></td><td></td><td></td><td>0.800</td></tr>
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<tr><td>Kyrgyzstan</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">0.169</td><td colspan="5">0.454</td><td></td><td>0.359</td></tr>
<tr><td>Lao PDR</td><td colspan="5">2.858</td><td colspan="6">0.949</td><td colspan="7">1.341</td><td></td><td></td><td>1.649</td></tr>
<tr><td>Maldives</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="8">-3.567</td><td></td><td></td><td></td><td>-3.567</td></tr>
<tr><td>Mongolia</td><td></td><td></td><td></td><td colspan="5">3.005</td><td colspan="2">-17.369</td><td colspan="3">2.978</td><td colspan="6">-2.664</td><td></td><td>-1.607</td></tr>
<tr><td>Myanmar</td><td></td><td colspan="15">0.182</td><td></td><td></td><td></td><td></td><td>0.182</td></tr>
<tr><td>Nepal</td><td></td><td colspan="5">2.546</td><td colspan="5">0.765</td><td colspan="3">-0.610</td><td colspan="3">-2.098</td><td></td><td></td><td></td><td>0.765</td></tr>
<tr><td>Oman</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="8">10.452</td><td></td><td></td><td></td><td></td><td></td><td>10.452</td></tr>
</table>

Figure 3. Continued

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	AAPC
Pakistan			1.887							2.253					0.428						1.587
Philippines						-0.655				2.305		-1.267				0.525					0.229
Sri Lanka			3.391									0.508									1.589
S Palestine													-1.359								-1.359
Tajikistan															2.286						2.286
Timor-Leste														9.707							9.707
Turkey						2.039					1.809					-1.236					0.871
Turkmenistan									-2.184												-2.184
Viet Nam						2.200						-4.202									0.454
Yemen											-0.033										-0.033
Europe																					
Albania														-4.310							-4.310
Armenia			-6.801					0.373						7.414							0.329
Bolivia PS						0.058							1.980								1.241

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	AAPC
Montenegro																4.532					4.532
R Moldova										2.169											2.169
Serbia													-5.075								-5.075
Ukraine											9.894										9.894
Latin America and The Caribbean																					
Colombia		0.775					0.719						0.496								0.645
Costa Rica															-0.823						-0.823
Côte d'Ivoire														5.896			2.520		-30.451		0.221
Cuba													0.408								0.408
Dominican Republic					1.221						1.140				0.260						1.101
Guatemala					2.416							1.481									1.948
Guyana												-0.804									-0.804
Haiti			0.036							-1.157											-0.660

Figure 3. Continued

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	AAPC
Honduras									1.466												1.466
Mauritania									2.138					2.138							2.138
Mexico												1.981			0.931						1.806
Nicaragua				0.555						0.905											0.730
Panama															-12.971						-12.971
Peru			-0.670			-0.232			0.639	0.233	1.131	-0.223	2.161	0.963	4.146	0.941	-0.504	0.799			0.420
Suriname															-3.781						-3.781
Trinidad & Tobago										0.846											0.846
Pacific																					
Samoa													2.991								2.991
Solomon Islands												-2.561									-2.561

SOURCE: AUTHOR

Remarks: The AAPC period differs depending on the country, as shown through the coloured cells. For example, AAPC in Peru refers to the period 2000–2018 whereas AAPC in Panama refers to the period 2013–2015.

in 86 countries are summarised in Figure 3 (see p. 12). The period of negative *APC* is shown in red while the period of positive *APC* is shown in green. The period of *APC* and *AAPC* varies by country as shown in Figure 3. The negative *AAPC* in 26 countries indicates a reversal in family planning progress. In Panama, the index *p* decreased by more than 12 per cent per year during 2013–2015. The decrease in the index *p* was also substantial in Sierra Leone during 2013–2016; Tunisia during 2011–2018 and Serbia during 2010–2014. By contrast, *AAPC* was 5 per cent and above in only five countries: Rwanda during 2000–2015, Togo during 2010–2017, Timor-Leste during 2009–2016, Ukraine during 2007–2012 and Oman during 2007–2014. In 31 countries, the *APC* in the index *p* was negative in one period but positive in other periods. There are only 37 countries where *APC* in the index *p* was positive in all periods and in only five countries: Bolivia, Cambodia, Congo, India and Zambia – *APC* in the index *p* increased consistently. The temporal variation in the three indexes that constitute the index *p* was inconsistent in most of the countries. There is no country where all the three indexes improved consistently.

The contribution of the change in indexes p_s, p_p and p_q to the change in index *p* in each country is presented in the appendix Table 2 and the variation in the contribution is summarised in Table 4. There are only 27 countries where change in all the three indexes contributed to the increase in the index *p* whereas there are 6 countries where change in all the three indexes contributed to the decrease in the index *p* (Table 5). In the remaining 53 countries, contribution of the change in the three indexes to the change in the index *p* was mixed. In these countries, there was progress in some dimensions but reversal in other dimensions. In 14 countries, the index *p* increased despite a decrease in the index p_q. In these countries, family planning progress improved despite reversal in progress in the dimension of method choice. Similarly, in 10 countries family planning progress reversed despite improvement in meeting the demand of permanent methods because the progress reversed in meeting the demand of modern spacing methods and in expanding the method choice. The change in the index *p* varied across the countries because of the variation in the change in the three indexes related to the met demand of modern spacing methods and permanent methods and the change in method choice. The inter-country variation in the index p_p is substantially larger than the inter-country variation in the change in the index p_s (met demand of modern spacing methods) and in the change in the index of method choice. The contribution of the inter-country variation in the change in the index p_p to the inter-country variation in the index p, therefore, is more than the contribution of the inter-country variation in the change in either the index p_s or the index p_q (progress in expanding the method choice).

Discussions and Conclusions

This paper uses a composite index to measure family planning progress that considers progress in meeting the demand of modern spacing methods, progress in meeting the demand of permanent methods and the progress in expanding the method choice. The index offers a holistic assessment of family planning progress in terms of the demand satisfied for family planning by considering both quantitative and qualitative aspects of family planning. The index may serve as the basis for monitoring family planning progress and for spatiotemporal comparisons from multidimensional perspective. The advantage of the index is that it can be constructed from the already available data and does not require the collection of any new data. The decomposition of the change in the index to the change in its constituent dimensions helps in taking appropriate policy and programme level action.

The present analysis reveals that, in most of the countries, family planning progress remains far from adequate in satisfying the demand for family planning. This appears to be one reason why the ambitious target of recruiting 120 million new recipients of family planning by 2020 set under the FP2020 Initiative could not be achieved (FP2020, 2020). In many countries, progress appears to have reversed in some or in all the three dimensions of family planning demand. Family planning efforts in almost all countries are essentially a prerogative of the government. As such, the analysis presented here calls for a reinvigoration of efforts to meet the family planning demand.

The analysis also reveals that, in the majority of the countries, family planning method choice has not expanded. This is not a welcome feature of family planning progress and indicates that family planning needs of a substantial proportion of women and men may have remained neglected or unmet. Similarly, progress in meeting the demand for modern spacing methods and in meeting the demand for permanent methods has differed in most of the countries examined suggesting that family planning efforts are biased towards either modern spacing methods or permanent methods. There are only a few countries where progress in the three dimensions of family planning is nearly equal. This is important since the inequality in progress in different dimensions of family planning has implications for meeting the demand for family planning.

The global family planning movement is now almost seven decades old (Robinson and Ross, 2007). The genesis of the movement was grounded in the proposition that regulating fertility and curtailing population growth through family planning would contribute significantly towards addressing a range of development concerns facing the poorer countries of the world. Following this premise, substantial efforts were put in place, resources mobilised and commitments made to mainstream family planning in the development discourse of almost all developing countries of the world. These efforts have resulted in substantial increase in the use of family planning methods and decrease in fertility (Bongaarts and Hodgson, 2022). The present analysis, however, suggests that when it comes to satisfying the diverse and the dynamic demand for family planning, international, national, local and individual commitments appear to have fallen short of expectations. Family planning needs to be treated as a development strategy for the realisation of the goal of planned family that is critical to sustainable development and human well-being rather than just an intervention to reduce fertility.

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Table 1: Inter-country Distribution of Different Indicators of Family Planning

Progress	Index				Progress inequality p_i	
	p_p	p_s	p_q	P		
	Frequency distribution (number of countries)					
Very slow (<0.250)	60	5	5	24	Very high (≥0.150)	3
Slow (0.250-0.500)	30	34	52	54	High (0.150-0.100)	13
Good (0.500-0.750)	10	41	56	34	Low (0.100-0.050)	29
Very good (≥0.750)	13	33	0	1	Very low (<0.050)	68
Number of countries	113	113	113	113	113	
	Summary measures					
Minimum	0.000	0.049	0.054	0.100	0.001	
Q1	0.066	0.450	0.429	0.258	0.012	
Median	0.209	0.611	0.500	0.403	0.038	
Q3	0.465	0.767	0.552	0.525	0.078	
Maximum	0.921	0.939	0.689	0.760	0.187	
Inter-quartile range	0.399	0.317	0.122	0.267	0.066	
Coefficient of variation	0.919	0.343	0.234	0.424	0.880	

SOURCE: AUTHOR

Table 2: Classification of Countries in Terms of the Index p Based on Indexes p_s, p_p and p_q

	Node ID						
	3	7	8	4	11	12	10
	Defining characteristics of the cluster						
p_s	*Any value*	*Any value*	*Any value*	*Any value*	*≤0.624*	*>0.624*	*Any value*
p_p	*≤0.108*	*≤0.113*	*(0.113, 0.255)*	*>0.108*	*(0.255, 0.550)*	*(0.255, 0.550)*	*>0.550*
p_q	*≤0.460*	*>0.460*	*>0.460*	*≤0.460*	*>0.460*	*>0.460*	*>0.460*
	Mean values of progress indicators						
p	0.217	0.228	0.403	0.428	0.479	0.545	0.684
p_s	0.478	0.373	0.592	0.761	0.502	0.787	0.763
p_p	0.044	0.043	0.189	0.324	0.402	0.398	0.756
p_q	0.374	0.565	0.540	0.357	0.557	0.512	0.556
MDM	0.403	0.317	0.516	0.720	0.481	0.713	0.763
mCPR	0.228	0.154	0.333	0.513	0.317	0.517	0.614
N	20	20	18	11	13	14	17
Countries	Burundi	Angola	Ghana	Algeria	Mauritius	Eswatini	Malawi
	Ethiopia	Benin	Lesotho	Egypt	Tanzania UR	Kenya	Bhutan
	Gabon	Burkina Faso	Rwanda	Madagascar	Cambodia	Namibia	Iran IR

Table 2: Continued

Gambia	Cameroon	Uganda	Morocco	Iraq	South Africa	Nepal
Liberia	Central African Republic	Zambia	Zimbabwe	Oman	Bangladesh	Sri Lanka
Libya	Comoros	Afghanistan	Korea DPR	Pakistan	Indonesia	Thailand
Mozambique	Congo	Maldives	India	Philippines	Qatar	Turkey
Niger	Côte d'Ivoire	Timor-Leste	Jordan	Bolivia PS	Viet Nam	Belize
Sierra Leone	Congo DR	Yemen	Kazakhstan	Papua New Guinea	Belarus	Colombia
Sudan	Equatorial Guinea	Georgia	Kyrgyzstan	Samoa	Republic of Moldova	Costa Rica
Tunisia	Eritrea	Guyana	Lao PDR	Solomon Islands	Barbados	Cuba
Tajikistan	Guinea		Mongolia	Tonga	Panama	Guatemala
Turkmenistan	Guinea-Bissau		Myanmar	Vanuatu	Saint Lucia	Honduras

Armenia	Mali	State of Palestine	Trinidad & Tobago	Mexico
Bosnia & Herzegovina	Nigeria	Ukraine		Nicaragua
Montenegro	Sao Tome and Principe	Dominican Republic		Paraguay
North Macedonia	Senegal	El Salvador		Peru
Serbia	South Sudan	Suriname		
Haiti	Togo			
Mauritania	Albania			

SOURCE: AUTHOR

Table 3: Average Annual Per Cent Change (*AAPC*) in Different Indexes of Family Planning Progress in 86 Countries During 2000–2019

Trend	Frequency of AAPC value range in			
	p_s	p_p	p_q	p
Progress reversed (*AAPC*<0)	19	33	37	26
Marginal progress (0≤*AAPC* <1.0)	17	10	21	23
Mild progress (1.0≤*AAPC* <2.0)	17	4	12	15
Moderate progress (2.0≤*AAPC* <3.0)	8	6	4	11
Substantial progress (*AAPC*≥3.0)	25	33	12	11
Number of countries	86	86	86	86
Minimum	-6.196	-36.823	-4.341	-12.971
First quartile	0.064	-2.514	-0.750	-0.686
Median	1.364	0.996	0.154	0.721
Third quartile	3.168	5.282	1.385	2.088
Maximum	16.198	98.295	12.796	10.452
Inter-quartile range	3.104	7.996	2.134	2.774
Coefficient of variation	1.704	4.099	4.349	4.378

SOURCE:AUTHOR

Table 4: Direction of Change in Indexes p_s, p_p and p_q and the Direction of Change in the Index p

Contribution of			Direction of change in p		
p_s	p_p	p_q	Positive	Negative	Total
Negative	Negative	Negative	0	6	6
Negative	Negative	Positive	1	5	6
Negative	Positive	Negative	6	10	16
Negative	Positive	Positive	6	4	10
Positive	Negative	Negative	3	0	3
Positive	Negative	Positive	3	1	4
Positive	Positive	Negative	14	0	14
Positive	Positive	Positive	27	0	27
Total			60	26	86

SOURCE: AUTHOR

Appendix Table 1: Indicators of Family Planning Progress in 113 countries, Latest Available Data

Country	Period	p_s	p_p	p_q	p
Africa					
Algeria	2012–2013	0.798	0.185	0.141	0.294
Angola	2015–2016	0.315	0.008	0.531	0.176
Benin	2017–2018	0.313	0.000	0.541	0.137
Burkina Faso	2018–2019	0.595	0.000	0.494	0.181
Burundi	2016–2017	0.494	0.042	0.460	0.254
Cameroon	2014	0.464	0.027	0.590	0.253
Central African Republic	2010–2011	0.337	0.029	0.481	0.207
Comoros	2012	0.316	0.090	0.581	0.275
Congo	2014–2015	0.424	0.041	0.488	0.242
Côte d'Ivoire	2018	0.434	0.000	0.524	0.159
Democratic Republic of the Congo	2013–2014	0.164	0.104	0.560	0.225
Egypt	2014	0.901	0.129	0.429	0.399
Equatorial Guinea	2011	0.254	0.077	0.657	0.258
Eritrea	2010	0.237	0.029	0.584	0.194
Eswatini	2014	0.906	0.282	0.540	0.532
Ethiopia	2018	0.709	0.000	0.348	0.166
Gabon	2012	0.383	0.072	0.349	0.230
Gambia	2018	0.434	0.046	0.446	0.242
Ghana	2017	0.547	0.123	0.617	0.372
Guinea	2018	0.428	0.039	0.602	0.264
Guinea-Bissau	2014	0.454	0.029	0.689	0.272
Kenya	2017	0.850	0.269	0.463	0.486

Country	**Period**	p_s	p_p	p_q	p
Lesotho	2018	0.901	0.181	0.531	0.468
Liberia	2013	0.450	0.032	0.389	0.217
Libya	2014	0.276	0.000	0.434	0.115
Madagascar	2017	0.668	0.182	0.382	0.372
Malawi	2015–2016	0.798	0.582	0.467	0.604
Mali	2018	0.475	0.053	0.498	0.269
Mauritius	2014	0.399	0.465	0.580	0.477
Morocco	2018	0.788	0.120	0.188	0.281
Mozambique	2015	0.580	0.029	0.455	0.253
Namibia	2013	0.831	0.444	0.500	0.574
Niger	2017	0.467	0.042	0.456	0.246
Nigeria	2018	0.416	0.029	0.652	0.255
Rwanda	2014–2015	0.733	0.144	0.491	0.397
Sao Tome and Principe	2014	0.662	0.037	0.537	0.298
Senegal	2017	0.589	0.068	0.529	0.316
Sierra Leone	2016	0.545	0.011	0.426	0.210
South Africa	2016	0.872	0.485	0.547	0.619
South Sudan	2010	0.070	0.014	0.598	0.108
Sudan	2014	0.370	0.000	0.243	0.100
Togo	2017	0.457	0.083	0.594	0.313
Tunisia	2018	0.786	0.089	0.398	0.338
Uganda	2017	0.572	0.202	0.479	0.392
United Republic of Tanzania	2015–2016	0.566	0.347	0.578	0.488
Zambia	2013–2014	0.700	0.209	0.534	0.443
Zimbabwe	2015	0.903	0.154	0.383	0.401

Country	**Period**	p_s	p_p	p_q	p
Asia					
Afghanistan	2015–2016	0.470	0.205	0.607	0.399
Bangladesh	2014	0.778	0.468	0.485	0.565
Bhutan	2010	0.903	0.741	0.552	0.721
Cambodia	2014	0.609	0.307	0.525	0.466
Democratic People's Republic of Korea	2017	0.939	0.265	0.054	0.281
India	2015–2016	0.502	0.834	0.257	0.490
Indonesia	2016–2017	0.864	0.311	0.461	0.510
Iran (Islamic Republic of)	2010–2011	0.616	0.890	0.619	0.700
Iraq	2018	0.594	0.270	0.533	0.448
Jordan	2017–2018	0.632	0.161	0.437	0.370
Kazakhstan	2018	0.855	0.117	0.416	0.378
Kyrgyzstan	2018	0.724	0.173	0.407	0.387
Lao People's Democratic Republic	2017	0.811	0.331	0.424	0.493
Maldives	2016–2017	0.325	0.242	0.501	0.344
Mongolia	2018	0.762	0.191	0.426	0.412
Myanmar	2015–2016	0.888	0.309	0.437	0.505
Nepal	2016–2017	0.557	0.564	0.634	0.584
Oman	2014	0.371	0.444	0.653	0.479
Pakistan	2017–2018	0.463	0.533	0.535	0.509
Philippines	2017	0.623	0.404	0.480	0.496
Qatar	2012	0.758	0.271	0.546	0.494
Sri Lanka	2016	0.735	0.758	0.667	0.719
State of Palestine	2014	0.686	0.281	0.408	0.436
Tajikistan	2017	0.659	0.066	0.338	0.276

Country	Period	p_s	p_p	p_q	p
Thailand	2015–2016	0.893	0.895	0.483	0.736
Timor-Leste	2016	0.507	0.189	0.480	0.368
Turkey	2018	0.607	0.578	0.531	0.571
Turkmenistan	2015–2016	0.817	0.078	0.071	0.190
Viet Nam	2013–2014	0.717	0.446	0.477	0.537
Yemen	2013	0.495	0.148	0.510	0.349
Europe					
Albania	2017–2018	0.049	0.103	0.571	0.16
Armenia	2015–2016	0.435	0.099	0.425	0.281
Belarus	2012	0.766	0.5	0.501	0.58
Bolivia (Plurinational State of)	2016	0.561	0.37	0.677	0.524
Bosnia and Herzegovina	2011–2012	0.241	0.034	0.426	0.177
Georgia	2018	0.638	0.221	0.545	0.437
Montenegro	2018	0.376	0.054	0.44	0.235
North Macedonia	2011	0.27	0.056	0.356	0.191
Republic of Moldova	2012	0.624	0.484	0.477	0.525
Serbia	2014	0.289	0.036	0.325	0.172
Ukraine	2012	0.692	0.333	0.451	0.475
Latin America and Caribbean					
Barbados	2012	0.792	0.316	0.526	0.518
Belize	2011	0.729	0.735	0.543	0.664
Colombia	2015–2016	0.82	0.919	0.545	0.748
Costa Rica	2018	0.864	0.751	0.594	0.73
Cuba	2014	0.903	0.845	0.537	0.748
Dominican Republic	2014	0.757	0.907	0.383	0.652
El Salvador	2014	0.735	0.894	0.421	0.66

Country	**Period**	p_s	p_p	p_q	p
Guatemala	2014–2015	0.576	0.797	0.5	0.615
Guyana	2014	0.63	0.218	0.645	0.461
Haiti	2012	0.611	0.075	0.39	0.291
Honduras	2011–2012	0.725	0.834	0.569	0.703
Mauritania	2015	0.374	0.01	0.304	0.152
Mexico	2015	0.812	0.814	0.492	0.693
Nicaragua	2011–2012	0.884	0.921	0.526	0.76
Panama	2014–2015	0.767	0.474	0.548	0.587
Paraguay	2016	0.89	0.563	0.594	0.671
Peru	2018	0.657	0.709	0.602	0.655
Saint Lucia	2011–2012	0.802	0.447	0.542	0.583
Suriname	2018	0.655	0.272	0.385	0.416
Trinidad and Tobago	2011	0.687	0.372	0.56	0.528
Pacific					
Papua New Guinea	2016–2018	0.538	0.395	0.574	0.498
Samoa	2014	0.473	0.28	0.483	0.403
Solomon Islands	2015	0.37	0.395	0.546	0.432
Tonga	2012	0.434	0.537	0.491	0.486
Vanuatu	2013	0.522	0.477	0.581	0.525

SOURCE: AUTHOR

Appendix Table 2: Decomposition of *AAPC* in the Index *p*

Country	Period		*AAPC* in index *p*	AAPC attributed to the change in		
				p_s	p_p	p_q
Africa						
Algeria	2006	2012	0.315	-0.130	1.043	-0.598
Benin	2001	2017	-1.266	1.448	-2.307	-0.407
Burkina Faso	2003	2017	1.716	3.154	-0.833	-0.604
Burundi	2010	2016	1.183	1.625	-1.077	0.635
Cameroon	2004	2014	-0.903	1.605	-3.735	1.228
Congo	2005	2014	4.893	2.957	0.356	1.579
Côte d'Ivoire	2011	2018	0.221	1.582	-2.788	1.427
Democratic Republic of the Congo	2007	2013	4.392	1.809	0.132	2.450
Egypt	2000	2014	0.710	0.014	0.109	0.587
Eritrea	2002	2010	0.188	-0.077	0.000	0.265
Eswatini	2006	2014	0.989	0.529	0.692	-0.232
Ethiopia	2000	2018	1.692	3.038	-0.890	-0.457
Gabon	2000	2012	-0.694	1.364	-0.835	-1.223
Gambia	2013	2018	-1.017	3.615	-3.824	-0.808
Ghana	2003	2017	2.135	1.302	0.812	0.021
Guinea	2005	2018	3.581	2.402	1.080	0.098
Kenya	2003	2017	1.013	1.220	0.080	-0.288
Lesotho	2004	2018	1.539	0.583	0.880	0.076
Liberia	2006	2013	0.182	2.775	-1.256	-1.337
Madagascar	2003	2017	2.278	1.145	1.597	-0.464
Malawi	2000	2015	3.673	1.124	2.047	0.502

Country	**Period**		***AAPC* in index *p***	**AAPC attributed to the change in**		
				p_s	p_p	p_q
Mali	2001	2018	2.248	1.796	0.582	-0.129
Morocco	2003	2018	-2.051	-0.046	-1.281	-0.723
Mozambique	2003	2015	-1.336	0.472	-1.560	-0.247
Namibia	2000	2013	0.419	0.284	0.272	-0.136
Niger	2006	2017	-0.920	0.647	-1.563	-0.005
Nigeria	2003	2018	0.711	0.615	0.029	0.068
Rwanda	2000	2014	6.144	5.075	1.735	-0.666
Sao Tome and Princ-ipe	2006	2014	2.139	-0.326	0.316	2.149
Senegal	2005	2017	2.795	2.578	0.439	-0.222
Sierra Leone	2013	2016	-7.187	2.123	-7.603	-1.707
South Africa	2003	2016	-0.435	-0.100	-0.599	0.264
Togo	2010	2017	6.517	1.678	4.236	0.603
Tunisia	2011	2018	-5.364	0.157	-5.315	-0.205
Uganda	2000	2017	1.469	0.918	0.945	-0.394
United Republic of Tanzania	2004	2015	2.233	0.876	1.040	0.317
Zambia	2001	2013	2.193	1.150	0.958	0.086
Zimbabwe	2005	2015	0.651	0.200	-0.753	1.204
Asia						
Bangladesh	2004	2014	1.185	0.331	0.476	0.378
Cambodia	2000	2014	3.214	1.218	2.404	-0.408
India	2005	2015	0.800	0.612	0.030	0.158
Indonesia	2002	2016	-0.224	0.004	-0.070	-0.158

Country	**Period**		***AAPC* in index *p***	**AAPC attributed to the change in**		
				p_s	p_p	p_q
Iraq	2011	2018	-1.751	0.216	-2.294	0.327
Jordan	2002	2017	-0.862	-0.026	-0.868	0.032
Kazakhstan	2010	2018	0.698	-0.210	-0.112	1.020
Kyrgyzstan	2012	2018	0.359	0.389	-1.102	1.072
Lao People's Demo-cratic Republic	2000	2017	1.649	0.551	1.475	-0.377
Maldives	2009	2016	-3.567	-1.030	-2.340	-0.197
Mongolia	2003	2018	-1.607	-0.255	-1.296	-0.055
Myanmar	2001	2015	0.182	0.573	-0.093	-0.298
Nepal	2001	2016	0.765	0.377	0.038	0.350
Oman	2007	2014	10.452	3.098	7.210	0.144
Pakistan	2000	2017	1.587	0.262	1.487	-0.161
Philippines	2003	2017	0.229	0.662	-0.171	-0.262
Sri Lanka	2000	2016	1.589	0.851	0.351	0.387
State of Palestine	2010	2014	-1.359	-0.056	-1.154	-0.149
Tajikistan	2012	2017	2.286	0.209	1.056	1.022
Timor-Leste	2009	2016	9.707	0.600	4.800	4.307
Turkey	2003	2018	0.871	0.235	0.498	0.138
Turkmenistan	2000	2015	-2.184	0.071	-1.355	-0.900
Viet Nam	2002	2013	0.454	0.225	-0.728	0.957
Yemen	2006	2013	-0.033	0.591	-0.709	0.084
Europe						
Albania	2008	2018	-4.310	-1.827	-2.495	0.012
Armenia	2000	2015	0.329	0.805	-0.126	-0.351

Country	**Period**		***AAPC* in index *p***	**AAPC attributed to the change in**		
				p_s	p_p	p_q
Bolivia (Plurinational State of)	2003	2016	1.241	0.381	0.690	0.170
Montenegro	2013	2018	4.532	-1.547	6.218	-0.140
Republic of Moldova	2005	2012	2.169	0.285	1.394	0.490
Serbia	2010	2014	-5.075	-1.603	-1.909	-1.563
Ukraine	2007	2012	9.894	0.265	8.855	0.773
Latin America and Caribbean						
Colombia	2000	2015	0.645	0.448	0.238	-0.042
Costa Rica	2011	2018	-0.823	-0.172	-0.798	0.147
Cuba	2010	2014	0.408	-0.224	0.585	0.046
Dominican Republic	2002	2014	1.101	0.478	0.050	0.573
Guatemala	2002	2014	1.948	0.944	0.937	0.067
Guyana	2009	2014	-0.804	-1.205	0.018	0.384
Haiti	2000	2012	-0.660	0.682	-0.612	-0.730
Honduras	2005	2011	1.466	0.434	0.968	0.064
Mauritania	2007	2015	2.138	0.928	0.666	0.544
Mexico	2009	2015	1.806	0.570	-0.563	1.799
Nicaragua	2001	2011	0.730	0.210	0.760	-0.240
Panama	2013	2014	-12.971	0.014	-14.128	1.143
Peru	2000	2018	0.420	0.117	0.393	-0.091
Suriname	2010	2018	-3.781	-0.839	-2.338	-0.604
Trinidad and Tobago	2006	2011	0.846	-0.494	1.420	-0.080

Country	**Period**		***AAPC* in index *p***	**AAPC attributed to the change in**		
				p_s	p_p	p_q
Pacific						
Samoa	2009	2014	2.991	0.049	2.184	0.758
Solomon Islands	2006	2015	-2.561	-0.910	-2.209	0.557

SOURCE: AUTHOR

APPENDIX

Composite Family Planning Progress Index

The family planning progress is measured in terms of the progress in three dimensions: 1) met demand of modern spacing methods; 2) met demand of permanent methods; and 3) expanding method choice. Let c_s denote the prevalence of modern spacing methods, c_p denote the prevalence of permanent methods, c_t denote the prevalence of traditional methods, u_s denote the unmet need for spacing and u_p denote the unmet need for limiting. Then, assuming that the prevalence of traditional methods reflects the unmet need of modern spacing methods, an index p_s of the met demand of modern spacing methods can be constructed as

$$p_s = \frac{c_s}{c_s + c_t + u_s} \qquad (1)$$

Similarly, an index p_p reflecting the met demand of permanent methods can be constructed as

$$p_p = \frac{c_p}{c_p + u_p} \qquad (2)$$

Both p_s and p_p range from 0 to 1 and the higher the index the better the progress and vice versa.

On the other hand, there is no standard indicator to measure method choice (Bertrand et al., 2014). The method mix is recommended as one of the key indicators of method choice (Measure Evaluation, 2018). Method-mix is also one of the outcome indicators of the FP2030 Measurement Framework (FP2020, nd). A dispersed method-mix reflects an expanded method choice whereas a skewed method-mix reflects limited method choice. Method-mix is influenced by many factors including poor capacity of family planning efforts in providing methods of choice to potential users, poor counselling and policy and provider bias. Method-mix is also influenced by user preferences which are shaped by cultural norms and societal practices. It has, however, been argued that cultural and social barriers or myths or misconceptions about different methods can be overcome through effective counselling (Yeakey and Gilles, 2017). It is also naïve to believe that just one or two family planning methods can meet the entire family planning demand during different stages of the family building process. It can, therefore, be argued that method-skew can serve as an indicator of method choice, the higher the method skew the more limited the method choice.

Different approaches have been suggested to measure method-skew. The method-mix is termed as skewed if the proportionate share of a single method in total family planning use is at least 50 per cent (Bertrand et al., 2014; Seiber et al., 2007; Sullivan et al., 2006). This approach classifies the method-mix in only two categories: skewed and not skewed. It does not measure skewness on a scale and, therefore, has limited use in measuring family planning progress. Another approach is based on comparing the observed method-mix with some pre-specified standard or benchmark (Bertrand et al., 2000). There is, however, no universal benchmark so that measuring skewness, in this approach, is contingent upon the benchmark adopted. This approach also does not measure method-skew on a scale. The third approach uses average deviation in the prevalence of different family planning methods (Ross et al., 2015; Bertrand et al., 2020). Average deviation, by definition, is a measure of dispersion, not concentration, and is influenced by both the degree of concentration and the number of units (Foldvary, 2006).

Chaurasia (2021) has proposed a method-skew index that measures skewness on a scale and is based on the concept of the dominance of one family planning method over others. If x_j is the proportionate prevalence of method *j* among *n* methods available, then the method skew index, *s*, (Chaurasia, 2021) is defined as

$$s = \sqrt{\frac{\sum x_j^2 - \left(\frac{1}{n}\right)}{1 - \left(\frac{1}{n}\right)}} \; when\, n > 1 \; and\; s = 1 \; when\, n = 1; \; \sum_{j=1}^{n} x_j = 1 \qquad (3)$$

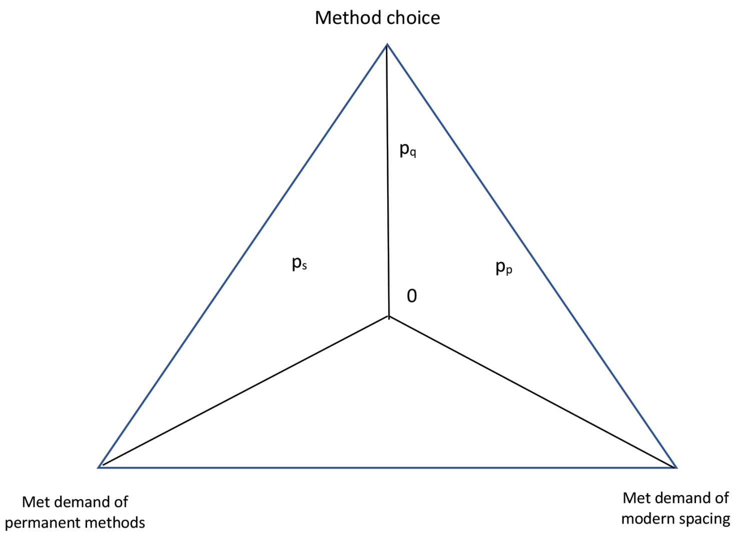
When entire family planning use is confined to one method only, *s*=1, while *s*=0 when family planning use is evenly distributed across different methods available. Using the index, *s*, an index to measure progress in method choice may be defined as

$$p_q = 1 - s \qquad (4)$$

The index p_q ranges between 0 and 1 and the higher the index, the more expanded the method choice and vice versa.

A composite index of family planning progress may now be constructed by combining p_s, p_p and p_q through an appropriate aggregation function. The commonly used aggregation function is the arithmetic mean. The geometric mean, or the generalised mean can also be used. The value of the composite index, however, depends upon the aggregation function used, although, the upper and lower limits of the composite index remain unchanged. Using the same values of p_s, p_p and p_q, the composite index is the highest when the simple arithmetic mean is used as the aggregation function but the lowest when the three indexes are multiplied. When the geometric mean is used, the composite index is lower than the composite index obtained by using the simple arithmetic mean. When generalised mean is used, the composite index is sensitive to the power of the mean.

Figure 1: The Family Planning Progress Triangle



SOURCE: AUTHOR

Alternatively, the three indexes reflecting the progress in the three dimensions of family planning may be combined to constitute the family planning progress triangle as shown in Figure 1 and the area of the triangle may serve as a composite progress index that reflects, simultaneously, the progress in the three dimensions of family planning. This approach of measuring progress is widely used in economics and in private sector management (Albach and Moerke 1995; Bogan and English 1994; Domptin 1997). It has also been used in the measurement of labour-market performance (Schütz, Speckesser and Schmid, 1998) and in measuring the external adaptability of the higher education institutions (Zeine et al., 2014) and can also be used to construct a composite index of family planning progress.

Figure 1 suggests that family planning progress triangle comprises of three sub-triangles, all of which have the common vertex and the same angle at vertex. The area, A, of the triangle is then the sum of the area of the three sub-triangles. In other words,

$$A = \frac{1}{2}\left(p_s * p_p + p_p * p_q + p_q * p_s\right) * \text{Sin}(360^o/3) \tag{5}$$

When $p_s = p_p = p_q = 0$, $A = 0$. When $p_s = p_p = p_q = 1$, the area of the family planning progress triangle is the maximum and is given by

$$A_{max} = \frac{1*1*\text{Sin}\,(360^o/3)}{2} + \frac{1*1*\text{Sin}\,(360^o/3)}{2} + \frac{1*1*\text{Sin}\,(360^o/3)}{2} = \frac{3}{2}\text{Sin}\,(360^o/3) \tag{6}$$

Dividing (5) by (6), the normalised area of family planning progress triangle, A_n, which varies between 0 (minimum) to 1 (maximum) is given by

$$A_n = \frac{A}{A_{max}} = \frac{\frac{1}{2}(p_s*p_p+p_p*p_q+p_q*p_s)*\text{Sin}(360^o/3)}{\frac{3}{2}\text{Sin}(360^o/3)} = \frac{(p_s*p_p+p_p*p_q+p_q*p_s)}{3} \tag{7}$$

It may be noted that the increase in A_n with the increase in the indexes p_s, p_t and p_q is not linear but concave so that with the increase in the indexes p_s, p_t and p_q the increase in A_n also increases. For example, when p_s=p_p=p_q=0.200, A_n=0.040 and when p_s=p_p=p_q=0.300, A_n=0.090 which means that an improvement of 0.100 in each of the three indexes leads to an increase of 0.050 in A_n. However, when p_s=p_p=p_q=0.700, A_n =0.490 and when p_s=p_p=p_q=0.800, A_n =0.640 so that the same improvement of 0.100 in each of the three indexes leads to an increase of 0.150 in the index A_n. This is not the desirable property of any progress index. Moreover,

A_n gives equal weight to three dimensions irrespective of the progress in the dimension. From the perspective of measuring progress, it is imperative that more weight should be assigned to that dimension in which progress is lagging.

Problems associated with A_n can be addressed by using the positive square root of three indexes p_s, p_t and p_q. This modification gives more weight to that dimension in which the progress is lagging comparative to other dimensions. The composite family planning progress index, *p*, may now be defined as

$$p = \frac{\sqrt{p_s * p_p} + \sqrt{p_p * p_q} + \sqrt{p_q * p_s}}{3} = \frac{p_{sp} + p_{pq} + p_{qs}}{3};\ p_{sp} = \sqrt{p_s * p_p}, \text{ etc.} \tag{8}$$

Since the indexes p_s, p_p and p_q range between 0 and 1, the index *p* also ranges between 0 and 1 and the lower the index *p* the poorer the family planning progress. It may, however, be emphasised that the upper and lower limits of the index *p* are the technical limits. It is rare that the index *p* will be either 0 or 1 in any country. The upper and lower theoretical limits of the index *p* actually serve as the goal posts to measure family planning progress.

The temporal change in any index in a period is measured in terms of annual per cent change (*APC*) under the assumption that *APC* is constant throughout the reference period. When *APC* is not constant throughout the reference period, it may lead to an erroneous conclusion about the temporal change. A segmented approach is, therefore, needed in which the reference period is divided into smaller time segments and in each time segment, *APC* is assumed to be constant but *APC* in different time segments may be different. The weighted average of *APC* in different time segments with weights proportional to the length of the time segment then gives average annual per cent change (*AAPC*) during the reference period (Clegg et al., 2009). In this approach, the relative contribution of *APC* in a time segment to *AAPC* is a function of the length of the time segment. A high *APC* in a short time segment has only a small contribution to *AAPC* whereas a moderate *APC* in a long time segment has substantial contribution. If the time period t^b (beginning) to t^e (end) is divided into *k* time segments such that $t^b<t^1<t^2<\ldots<t^k<t^e$ and p^1 is the composite index in the year t^1 and p^2 is the composite index in the year t^2, then the *APC* in the time segment (t^1, t^2) is calculated as

$$APC = \frac{(p^2 - p^1)}{p^1 \times (t^2 - t^1)} \qquad (9)$$

and the *AAPC* is calculated as

$$AAPC = \sum_{i=1}^{k} w_i * APC_i \qquad (10)$$

where

$$w_i = \frac{t^{i+1} - t^i}{t^e - t^b};\ \sum w_i = 1 \qquad (11)$$

An $AAPC>0$ indicates positive change while $AAPC<0$ indicates reversal in the progress. When $AAPC=0$, progress remains unchanged.

The *APC* in the index *p* can be decomposed into three components, one each attributed to p_s, p_p and p_q. The difference $p^2–p^1$ may be decomposed as

$$p^2 - p^1 = \frac{p_{sp}^2 + p_{pq}^2 + p_{qs}^2}{3} - \frac{p_{sp}^1 + p_{pq}^1 + p_{qs}^1}{3} = \frac{1}{3}\left[\left(p_{sp}^2 - p_{sp}^1\right) + \left(p_{pq}^2 - p_{pq}^1\right) + \left(p_{qs}^2 - p_{qs}^1\right)\right]$$
(12)

We can write

$$\left(p_{sp}^2 - p_{sp}^1\right) = \frac{(p_{sp}^2 - p_{sp}^1)}{ln\left(\frac{p_{sp}^2}{p_{sp}^1}\right)} * ln\left(\frac{p_{sp}^2}{p_{sp}^1}\right) = LM_{sp} * \ln\left(\frac{p_{sp}^2}{p_{sp}^1}\right) = LM_{sp} * \left[ln\left(\frac{\sqrt{p_s^2}}{\sqrt{p_s^1}}\right) + ln\left(\frac{\sqrt{p_p^2}}{\sqrt{p_p^1}}\right)\right]$$
(13)

where

$$LM_{sp} = \frac{(p_{sp}^2 - p_{sp}^1)}{ln\left(\frac{p_{sp}^2}{p_{sp}^1}\right)} \qquad (14)$$

is the logarithmic mean (Carlson, 1972). Similarly,

$$\left(p_{pq}^2 - p_{pq}^1\right) = LM_{pq} * \left[ln\left(\frac{\sqrt{p_p^2}}{\sqrt{p_p^1}}\right) + ln\left(\frac{\sqrt{p_q^2}}{\sqrt{p_q^1}}\right)\right] \qquad (15)$$

$$\left(p_{qs}^2 - p_{qs}^1\right) = LM_{qs} * \left[ln\left(\frac{\sqrt{p_q^2}}{\sqrt{p_q^1}}\right) + ln\left(\frac{\sqrt{p_s^2}}{\sqrt{p_s^1}}\right)\right] \tag{16}$$

so that

$$p^2 - p^1 = \left\{\frac{(LM_{sp}+LM_{qs})}{3} * \ln\left(\frac{\sqrt{p_s^2}}{\sqrt{p_s^1}}\right)\right\} + \left\{\frac{(LM_{sp}+LM_{pq})}{3} * \ln\left(\frac{\sqrt{p_p^2}}{\sqrt{p_p^1}}\right)\right\} + \left\{\frac{(LM_{pq}+LM_{qs})}{3} * \ln\left(\frac{\sqrt{p_q^2}}{\sqrt{p_q^1}}\right)\right\} \tag{17}$$

$$p^2 - p^1 = \partial p_s + \partial p_p + \partial p_q \tag{18}$$

Substituting from (18) into (9), we get

$$APC = \frac{\partial p_s}{p^1 \times (t^2 - t^1)} + \frac{\partial p_p}{p^1 \times (t^2 - t^1)} + \frac{\partial p_q}{p^1 \times (t^2 - t^1)} = S + P + Q \tag{19}$$

Where S is the contribution of the change in the index p_s; P is the contribution of the change in p_p; and Q is the contribution of the change in p_q. The *AAPC* in the index p is now decomposed as

$$AAPC = \sum_{i=1}^{k} w_i * S_i + \sum_{i=1}^{k} w_i * P_i + \sum_{i=1}^{k} w_i * Q_i = C_S + C_P \tag{20}$$

Equation (20) holds for every country so that inter-country variation in *AAPC* in the index p can be decomposed as

$$Var(AAPC) = \sum Var(C_i) + 2\sum_{i \neq j} Cov\left(C_i, C_j\right),\ i,j = S,P,Q \tag{21}$$

Equation (21) suggests that the contribution of inter-country variation in C_i to the inter-country variation in *AAPC* may be small because either $Var(C_i)$ is small or covariance terms $Cov(C_i, C_j)$ are negative so that equation (21) may not reflect the true importance of inter-country variation in the change in the three indexes to the change in the index p. This problem can be circumvented by using absolute values of covariance terms in equation (21). Thus, the relative importance of the inter-country variation in the change in the indexes p_s to the inter-country variation in the change in the index p can be calculated as (Chaurasia, 2020b; Horvitz et al., 1997; Rees et al., 2010: Rees et al., 1996)

$$I(p_S) = \frac{Y(p_S)}{Y(p)} \tag{22}$$

where

$$Y(p_s) = Var(C_S) + |Cov(C_S, C_P)| + |Cov(C_S, C_Q)|, \text{etc.} \tag{23}$$

and

$$Y(p) = Y(p_s) + Y(p_p) + Y(p_q) \tag{24}$$

It may be noted that contribution of indexes p_s, p_p and p_q to the index p is not additive. As such, the classification modelling exercise (Han et al., 2012; Tan et al., 2006) was carried out to classify countries based on indexes p_s, p_p and p_q. The classification and regression tree (CRT) method (Brieman et al., 1984) was used for this purpose. CRT is a non-parametric recursive partitioning method that divides countries into mutually exclusive clusters in such a way that within-group homogeneity in the index p is the maximum. A cluster in which all countries have the same value of the index p is termed as 'pure'. If a cluster is not pure, the impurity in the cluster can be measured through the Gini index. If the dependent variable is a categorical one, the method provides cluster-specific distribution of the dependent variable. If the dependent variable is a scale variable, the method provides estimates of arithmetic mean and standard deviation of the dependent variable for each cluster (Chaurasia, 2018). The TREE routine of the SPSS software package was used for classification modelling.