Note: Charts below are illustrative placeholders and should be replaced with official series before publication.

Chapter 5

Fertility Determinants and Differentials (Ethiopia focus plus global lens)

Aynalem Adugna, October 2025

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CONTENT

11. **Abortion & Unintended Pregnancy**
    – Induced abortion (measurement challenges), pathways from unmet need to unintended births and abortions; legal/service context.

12. **Child Health & Mortality Feedbacks**
    – Replacement and “insurance” effects, under-five mortality gradients, immunization and survival improvements.

13. **Male Involvement, Gender Power & Decision-Making**
    – Spousal communication, decision authority, GBV/IPV links to contraceptive use and fertility outcomes.

14. **Access, Geography & Service Readiness**
    – Distance/travel time, stock-outs, method availability, provider mix; health-facility readiness and outreach (incl. pastoral areas).

15. **Shocks: Conflict, Displacement & Climate**
    – Conflict events, internal displacement/refugees, drought/price shocks; short-run vs persistent fertility effects.

16. **Modeling Differentials & Decompositions**
    – Multilevel/logit/Poisson/hazard models; Oaxaca–Blinder/Kitagawa/Das Gupta decompositions; Bongaarts component decomposition; causal inference notes (selection, measurement error).

5.1) Framework & Core Concepts

Purpose. Define a coherent framework for fertility differentials and determinants in Ethiopia, linking distal drivers to proximate determinants (Bongaarts) and to observed fertility (TFR).

Key identity

TFR = TF × C_m × Cc × Ci × Ca

TF is the natural fecundity level; the indices C_m, Cc, Ci, and Ca (in [0,1]) reduce TF through exposure, contraception, postpartum insusceptibility, and sterility, respectively.

Figure 5.1-1. Proximate determinants schematic (Bongaarts framework)

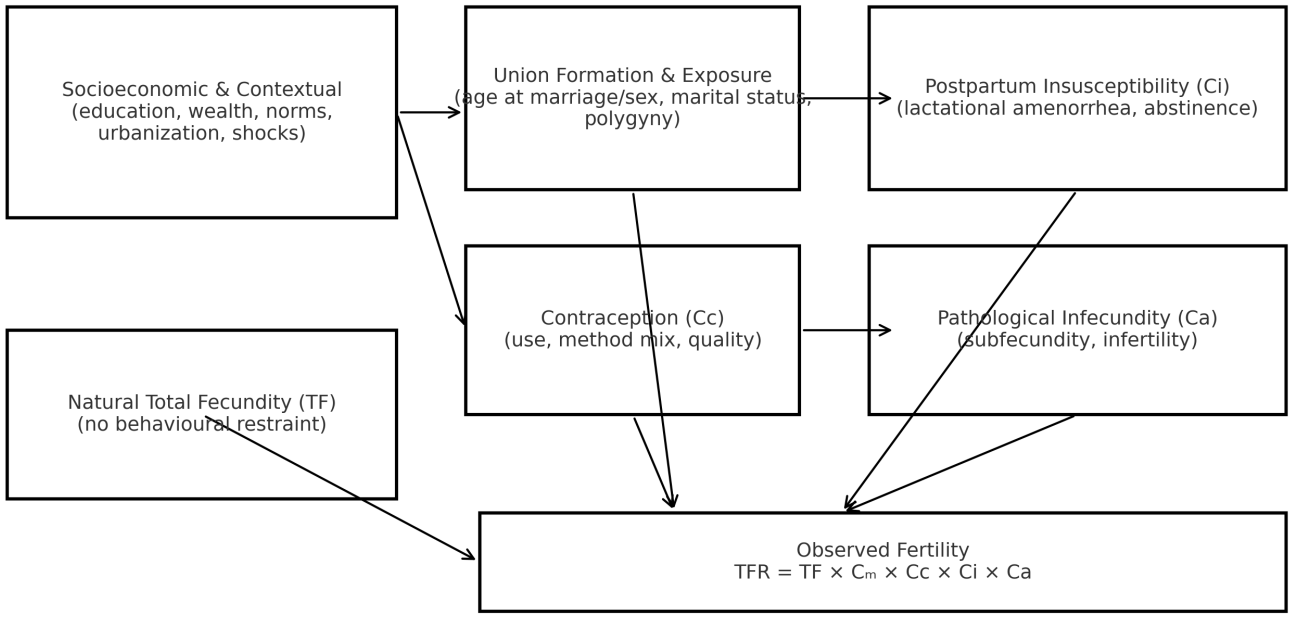

Figure 5.1-2. Conceptual contributions to fertility reduction (illustrative)

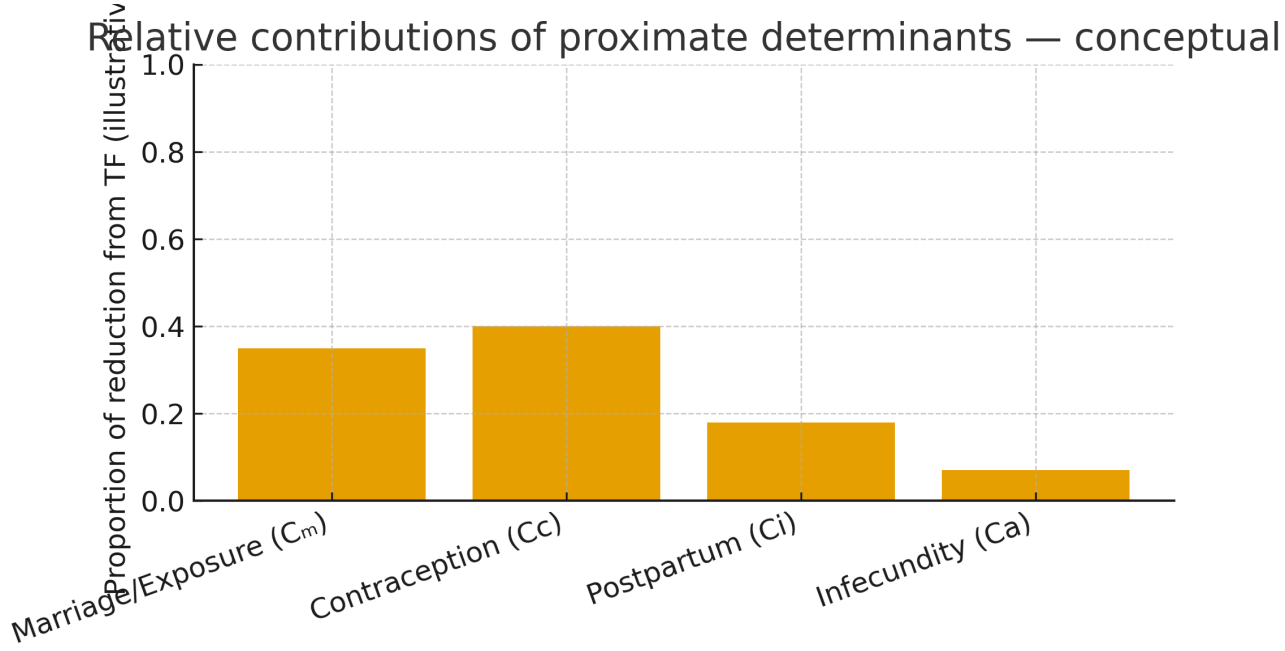

Table 5.1-A. Bongaarts indices — definitions and formulas (plain text)

Index	Formula (plain text)	Notes
C_m (Marriage/Exposure)	C_m = Σ m(a)·g(a) / Σ g(a)	m(a)=proportion married/sexually active; g(a)=ASFR at age a.
Cc (Contraception)	Cc = 1 − 1.08·u·e	u=use rate; e=average method effectiveness (by mix).
Ci (Postpartum)	Ci = 20 / (18.5 + i)	i=average duration of postpartum infecundability (months).
Ca (Pathological infecundity)	Ca = 1 − p_s	p_s=proportion sterile before end of reproductive ages (approx.).
TF (Total fecundity)	Empirical/calibrated (≈15–16 births/woman max)	Reference constant for decomposition.

Table 5.1-B. Ethiopia-specific measurement plan

Component	Measurement plan for Ethiopia
Union/Exposure (C_m)	DHS/EDHS: marital status, sexual debut; compute m(a) by age/region/urban.
Contraception (Cc)	DHS: current use, method mix, effectiveness; continuation/discontinuation.
Postpartum (Ci)	Breastfeeding duration, amenorrhea, abstinence; compute i (months).
Infecundity (Ca)	Secondary sterility proxies, age 40–49 childlessness; caution on bias.
Contextual drivers	Education, wealth, norms, service access, shocks (conflict/climate).

Table 5.1-C. Analytical roadmap

Step	Outputs & purpose
Descriptives	ASFR/TFR by strata; parity progression; ABR; urban–rural/region.
Proximate decomposition	Estimate C_m, Cc, Ci, Ca; implied TFR; compare to observed.
Determinants models	Multilevel logit/Poisson/hazard; design-adjusted SEs.
Decomposition of differentials	Das Gupta/Kitagawa or Oaxaca–Blinder across groups/periods.
Policy translation	Identify binding constraints (method mix, postpartum FP, adolescent exposure).

Table 5.1-D. Data quality checks — essentials for determinants analysis

Risk	Checks & mitigation
Age/marital misreporting	Whipple/Myers; marriage age plausibility; calendar recall.
Heaping/displacement	Spikes at 12/24 months in BLY; reconcile with histories.
Sampling & weights	Use strata/cluster weights; design-adjusted uncertainty.
Small areas & shocks	Flag conflict/inaccessible clusters; cautious borrowing.
Cross-round consistency	Harmonize definitions (in-union, modern methods).

References — Section 5.1

- Bongaarts, J. (1978). A Framework for Analyzing the Proximate Determinants of Fertility. Population and Development Review.

- Bongaarts, J., & Potter, R. G. (1983). Fertility, Biology, and Behavior.

- Rutstein, S. O., & Rojas, G. (2006). Guide to DHS Statistics.

- United Nations (2017). Principles and Recommendations for Population and Housing Censuses.

5.2) Age, Parity & Marital Status Differentials

What this section covers. Age-specific fertility profiles by marital status, how parity progression varies with age, the timing of first marriage and first birth, and how marital composition shapes period fertility in Ethiopia.

Figure . ASFR by marital status

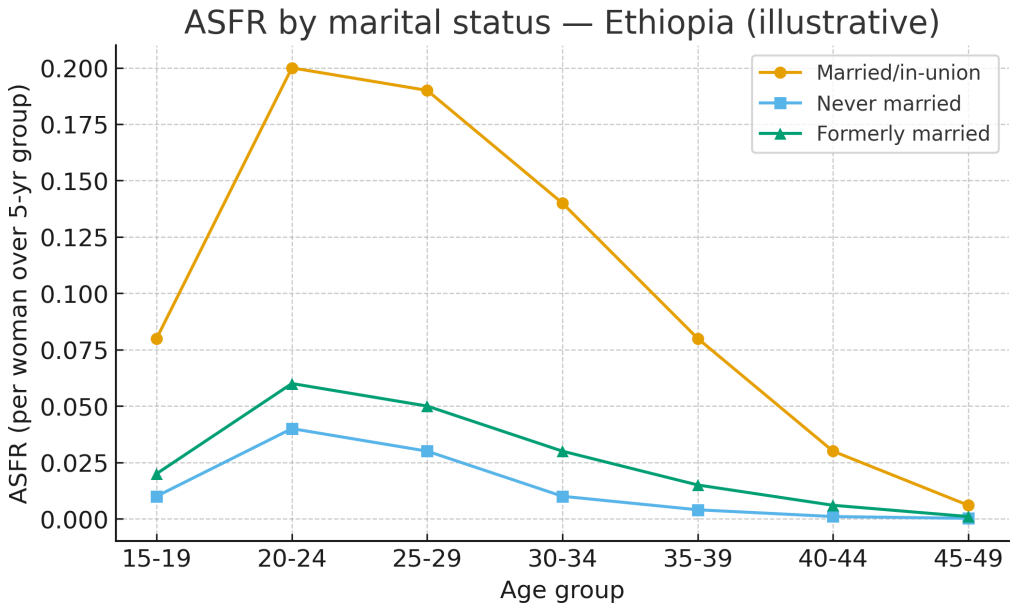

Figure . Marital status composition by age

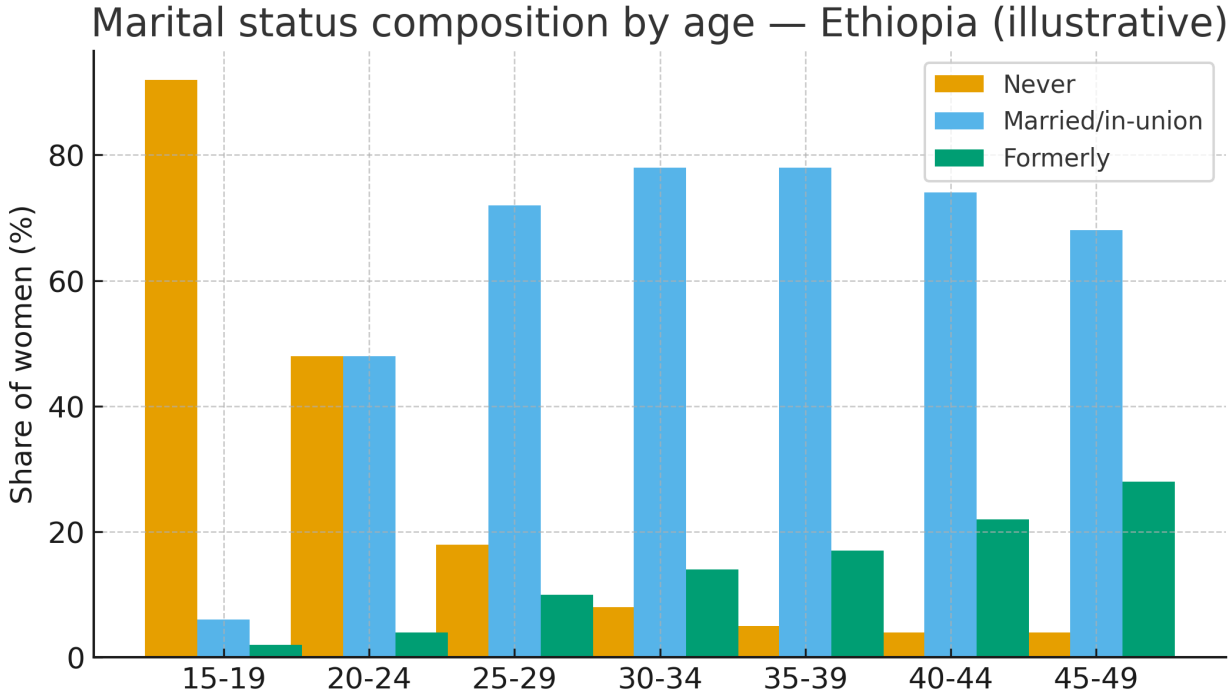

Figure . Parity progression ratios by age band

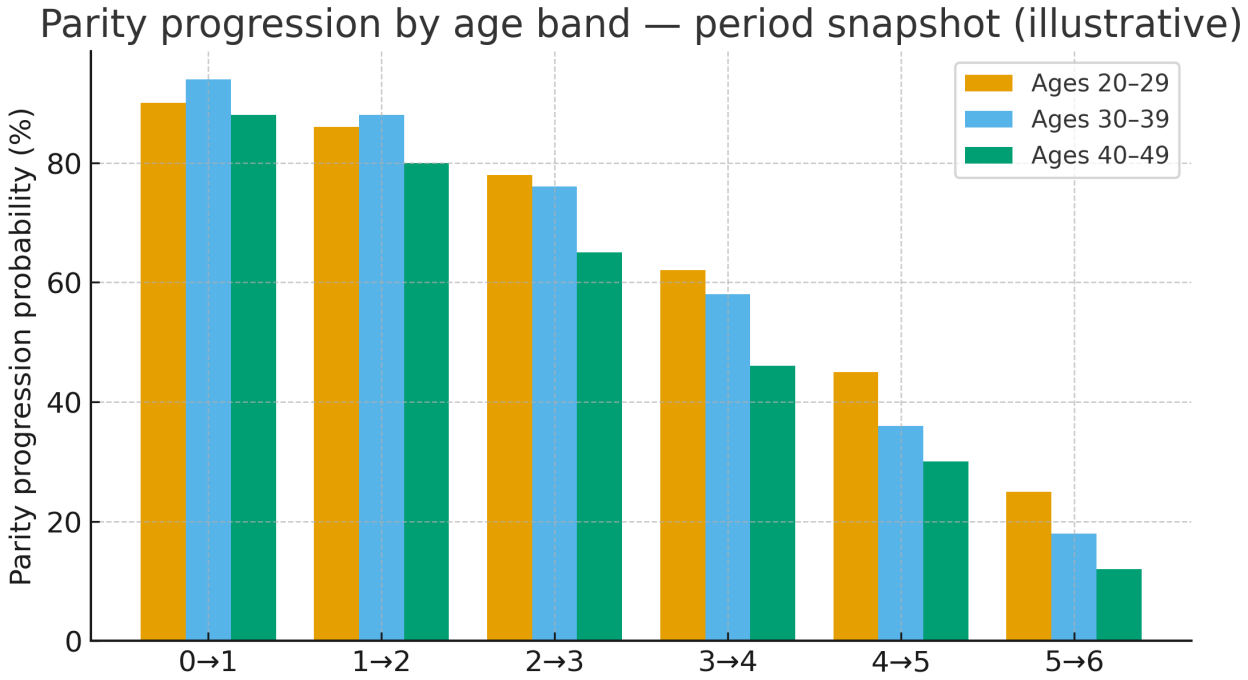

Figure . Age pattern of first births

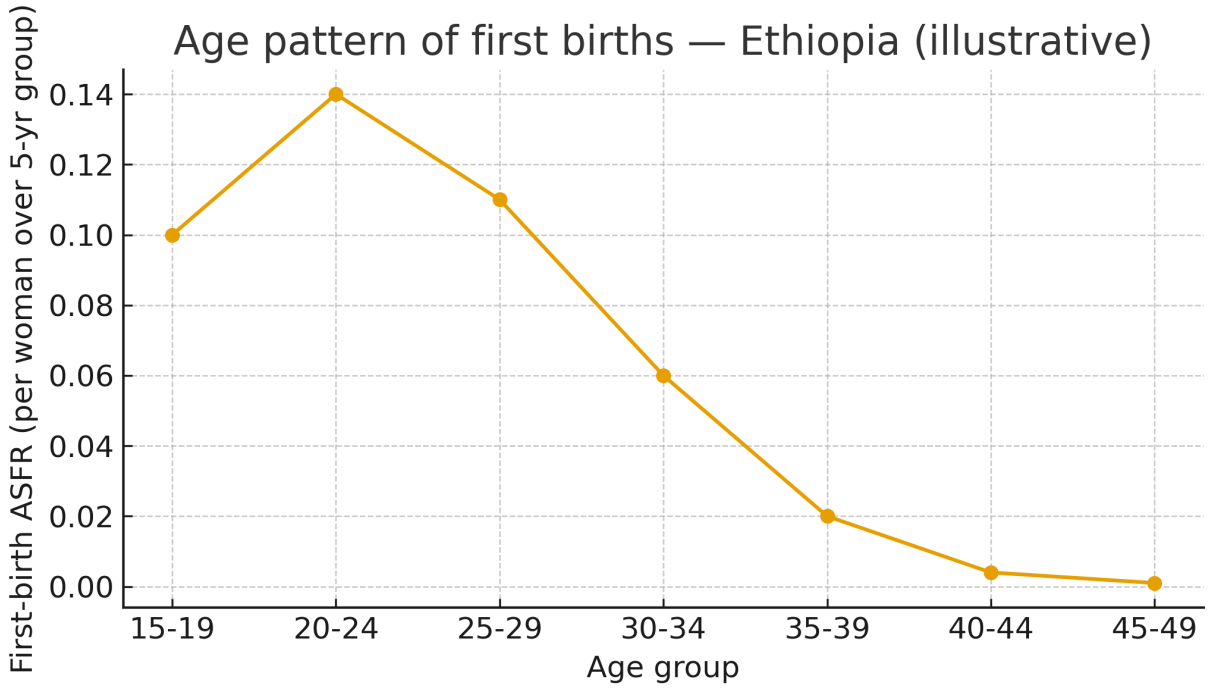

Figure . Age at first marriage distribution — earlier vs later

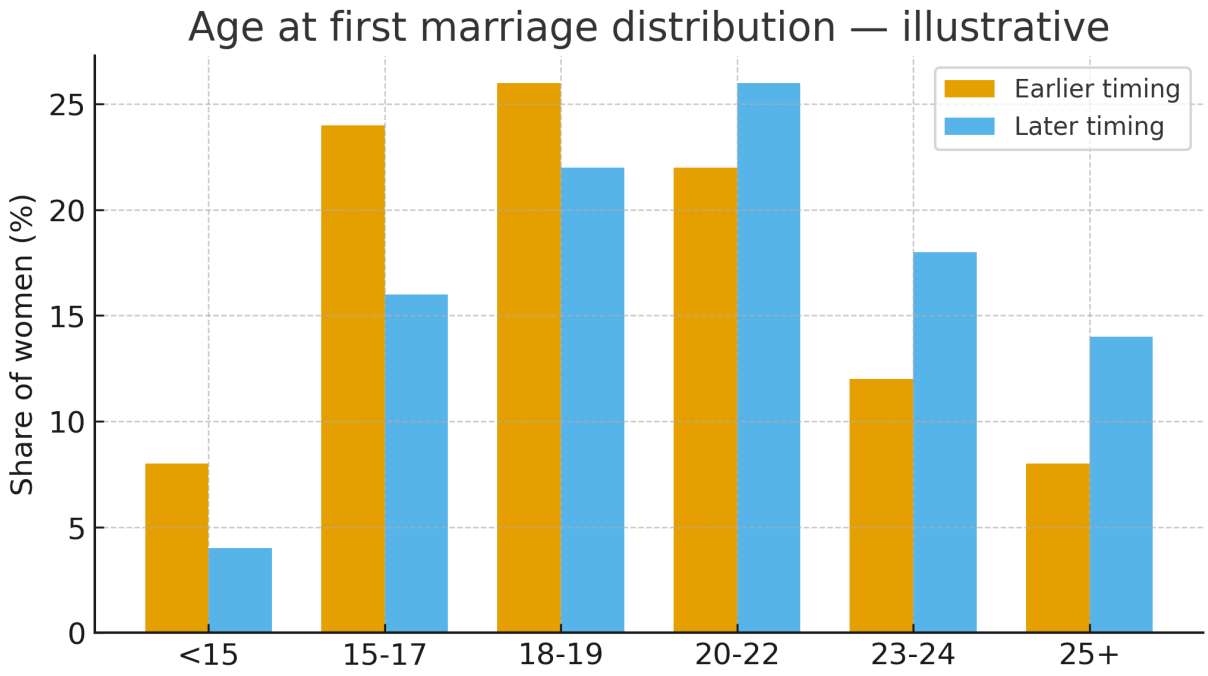

Table 5.2-A. Measures and formulas (plain text)

Measure	Formula (plain text)	Interpretation
ASFR by marital status	b_{a,s} / W_{a,s}	Births to women of age group a and marital status s per woman in that group.
Marital composition by age	W_{a,s} / W_a	Shares of women by status s at age a (never, married/in-union, formerly).
Parity progression ratio (PPR k)	P(k→k+1 | reached k)	Period or cohort; often estimated from birth histories.
First-birth hazard (proxy)	ASFR^1_a	First-birth rates by age a (from full histories).

Table 5.2-B. Worked example — marital-status contributions to period TFR

Status	TFR if all women in status	Share of women (weighted avg)
Never	0.48	25.6%
Married/in-union	3.63	60.6%
Formerly	0.91	13.9%

Table 5.2-C. Diagnostics & cautions

Issue	Why it matters for 5.2
Definition of 'in-union' vs legally married	DHS distinguishes married vs living together; align across rounds.
Age at event heaping & displacement	Check spikes at 12/24 months; verify first-birth timing and marriage dates.
Exposure biases	Sexual activity among never-married; polygyny and differential exposure.
Small cells	Stratify wisely; pool adjacent ages/rounds when needed; report uncertainty.
Ethics & interpretation	Avoid stereotyping; present patterns neutrally; aggregate when privacy risks exist.

Notes & interpretation

• Most births occur within marriage/in-union. Trends in the timing of marriage and first sex shift exposure at young ages.

• Higher-order progression falls more with age, reflecting stopping/spacing; adolescent first-birth risks concentrate among the minority exposed.

• For Ethiopia, regional and urban–rural splits of these patterns are policy-relevant and will be developed in later sections.

References — Section 5.2

- Rutstein, S. O., & Rojas, G. (2006). Guide to DHS Statistics.

- Bongaarts, J., & Potter, R. G. (1983). Fertility, Biology, and Behavior.

- United Nations (2017). Principles and Recommendations for Population and Housing Censuses.

5.3) Education & Schooling

What this section analyzes. Fertility differentials by women's schooling in Ethiopia: gradients in period rates (ASFR/TFR), timing of first birth, parity progression, and how shifts in the education distribution can change overall fertility.

Figure . ASFR schedules by education

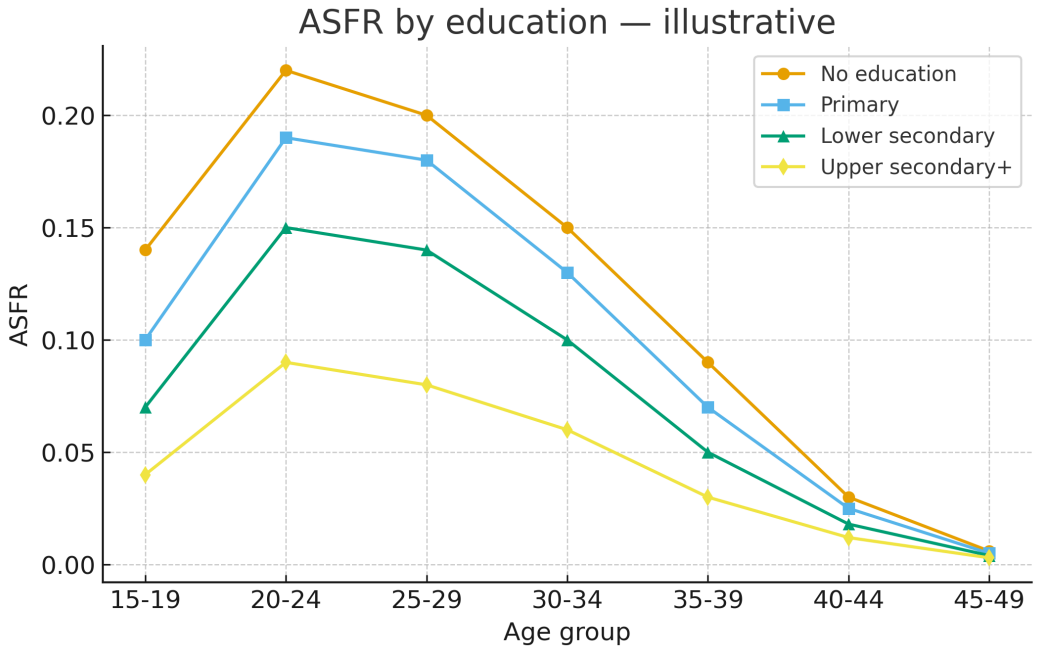

Figure . Female schooling attainment among women 20–24

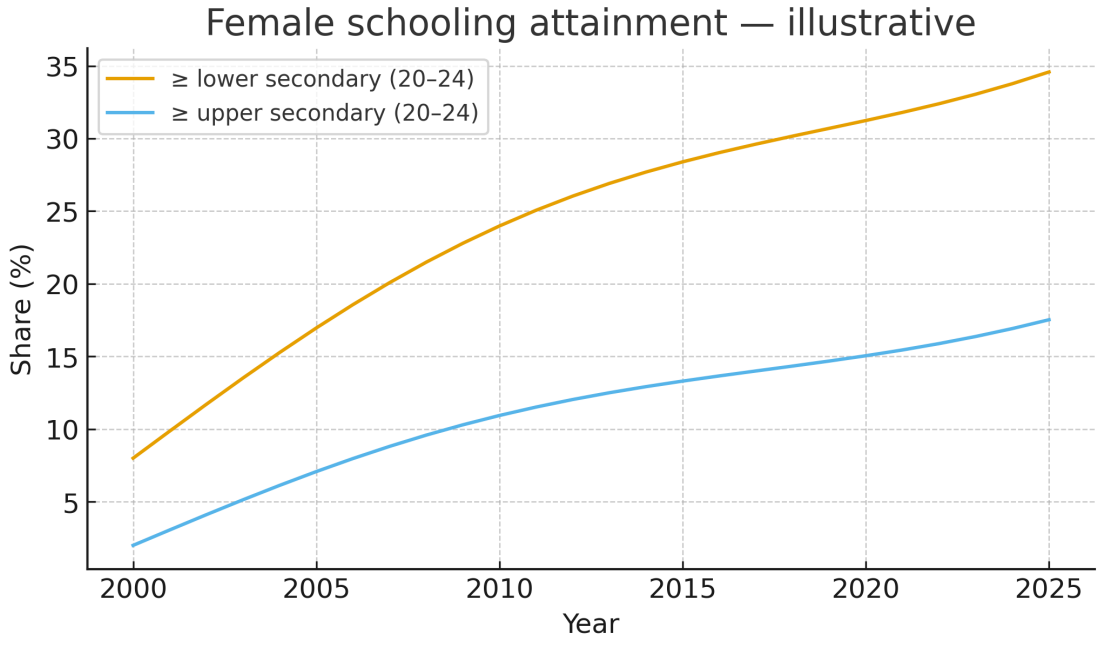

Figure . Age at first birth by education (CDF)

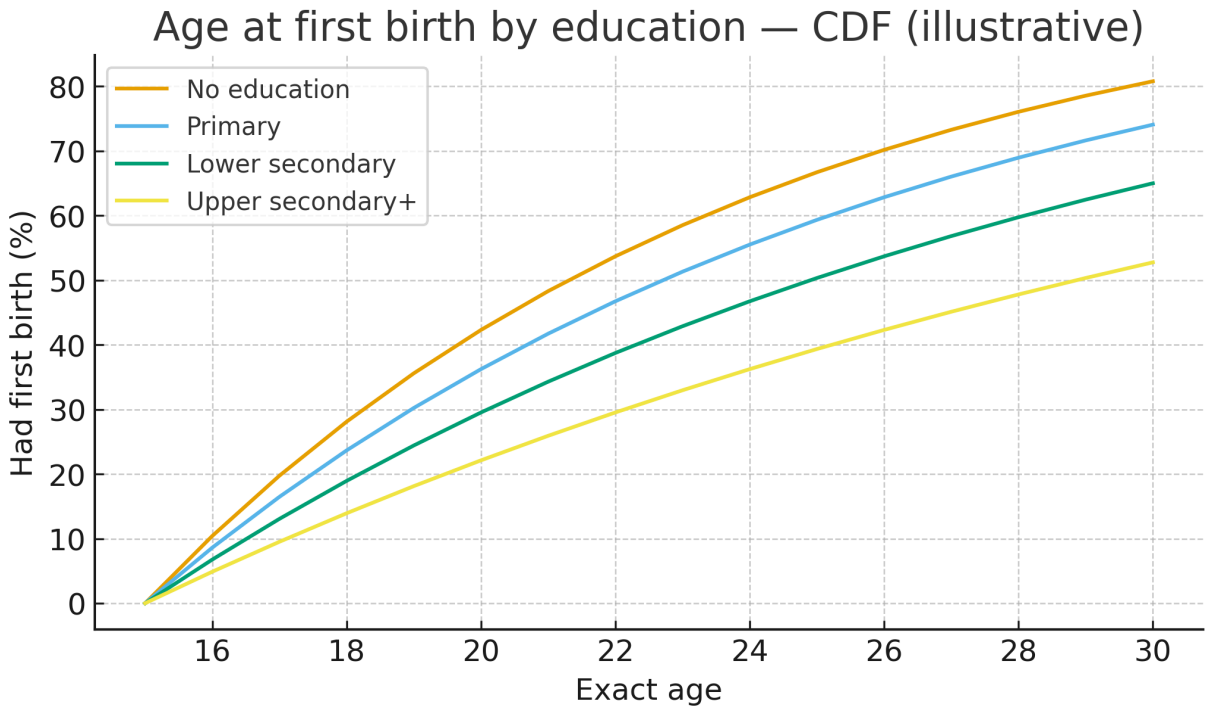

Figure . Parity progression by education (PPR 1→2 and 2→3)

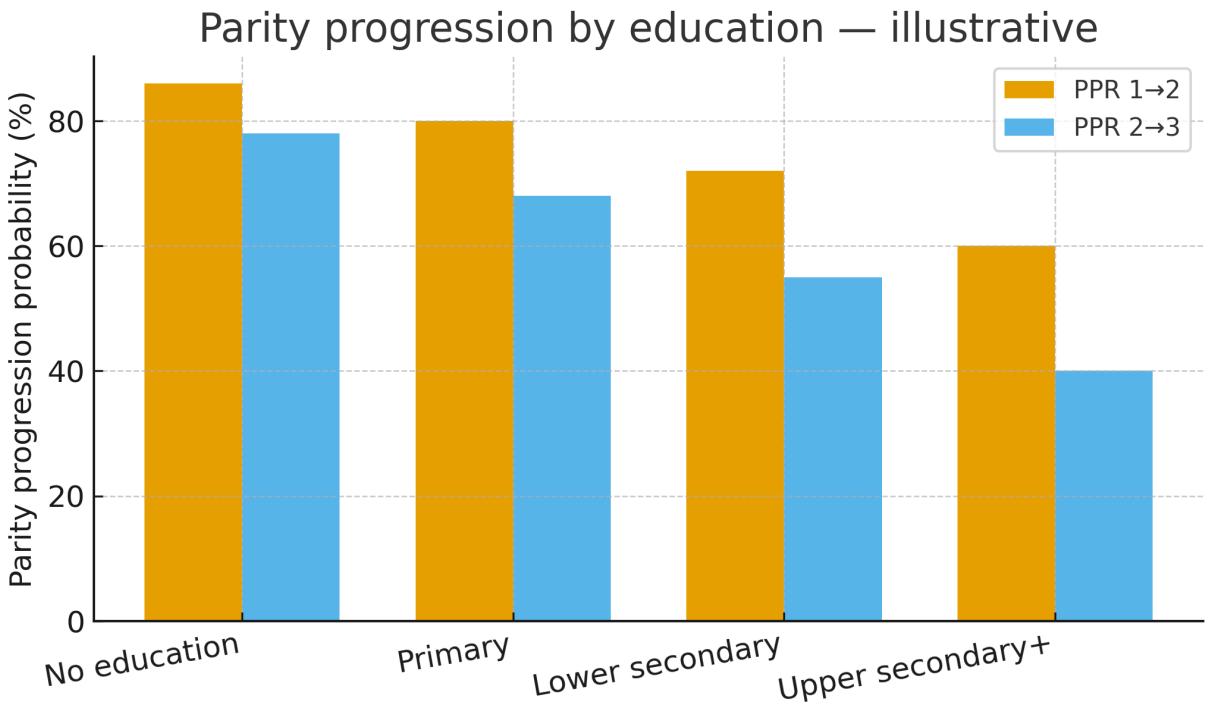

Table 5.3-A. Measures and definitions

Measure	Definition / computation
Education levels	Highest level completed (harmonized).
ASFR by education	b_{a,e} / W_{a,e}.
TFR by education	5 × Σ_a ASFR_{a,e}.
Age at first birth (AFB)	Life-table/KM from full histories.
Parity progression (PPR)	P(k→k+1 | reached k) by e.

Table 5.3-B. Education distribution and TFR — worked example

Education level	TFR_e (period)	Population share (weights)
No education	4.18	46.0%
Primary	3.5	33.0%
Lower secondary	2.66	16.0%
Upper secondary+	1.58	5.0%

Table 5.3-C. Simple composition decomposition of ΔTFR (template)

Quantity	Value	Comment
Current distribution	3.58	—
Counterfactual distribution	3.30	—
Change (ΔTFR)	-0.28	—
Composition effect (weights shift × fixed TFR_e)	-0.28	Main driver in this toy example

Table 5.3-D. Policy levers linked to education

Lever	Rationale for fertility outcomes
Keep girls in school (transition to lower/upper secondary)	Delays marriage/first birth; increases opportunity cost of early childbearing.
Reduce dropout during/after pregnancy	Re-entry policies, childcare support, flexible schooling.
Comprehensive sexuality education (CSE)	Improves knowledge; reduces unintended pregnancy; school-to-clinic linkages.
Youth-friendly services & method choice	Improve continuation; address side-effects; community engagement.
Support to pastoral/remote areas	Alternative delivery to reduce access gaps interacting with schooling.

Notes & cautions

• Associations vs causality: schooling is endogenous; use IV/DiD/natural experiments where possible.

• Harmonize education categories across rounds and consider cohort vs period effects.

• Pair education gradients with access/quality of services to identify binding constraints.

References — Section 5.3

- Rutstein, S. O., & Rojas, G. (2006). Guide to DHS Statistics.

- Bongaarts, J. (2010). The Causes of Educational Differences in Fertility in Sub-Saharan Africa.

- United Nations (2017). Principles and Recommendations for Population and Housing Censuses.

- World Bank & UNESCO Institute for Statistics — education indicators metadata.

5.4) Wealth, Poverty & Economic Opportunity

Focus. How economic status and opportunities shape fertility in Ethiopia. We examine period fertility (TFR/ASFR) by wealth quintile, timing of first birth, parity progression, female employment links, and access barriers (unmet need vs consumption).

Figure . TFR by wealth quintile

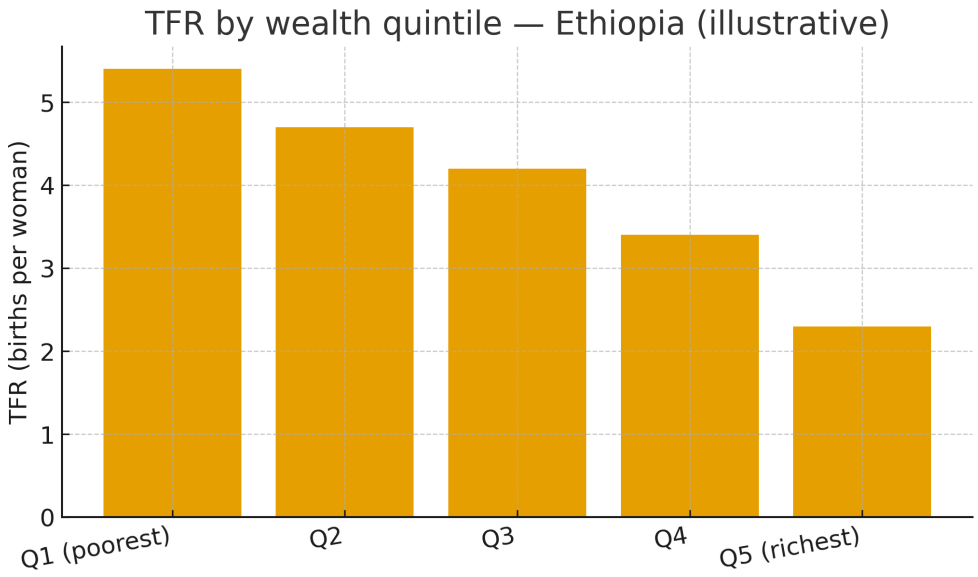

Figure . ASFR schedules — poorest vs richest

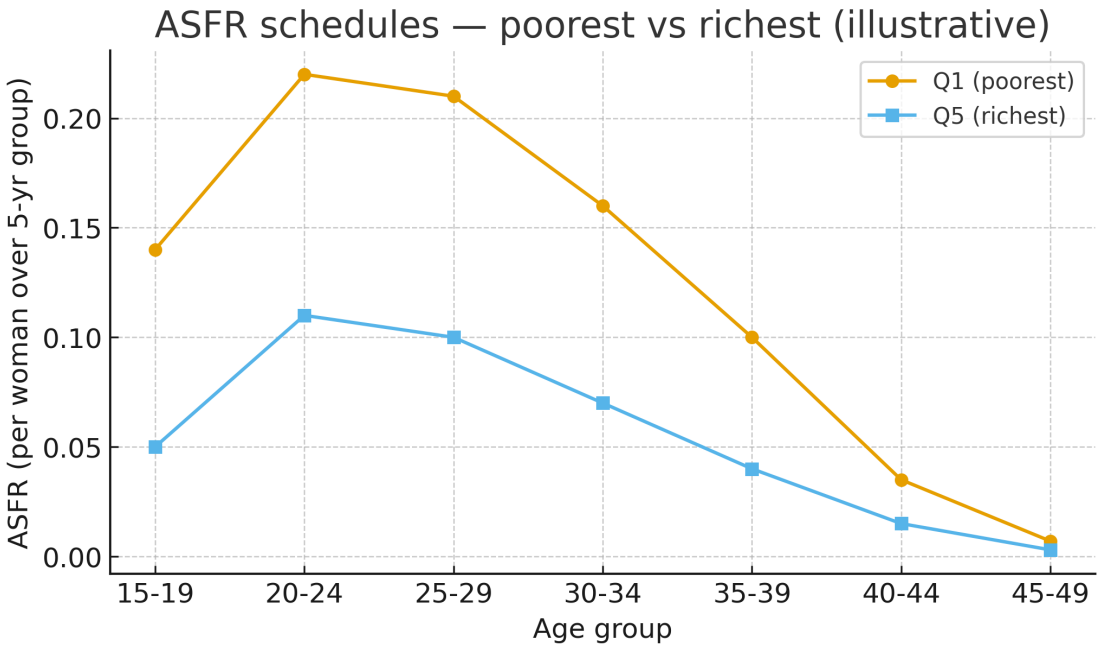

Figure . Age at first birth by wealth — CDF

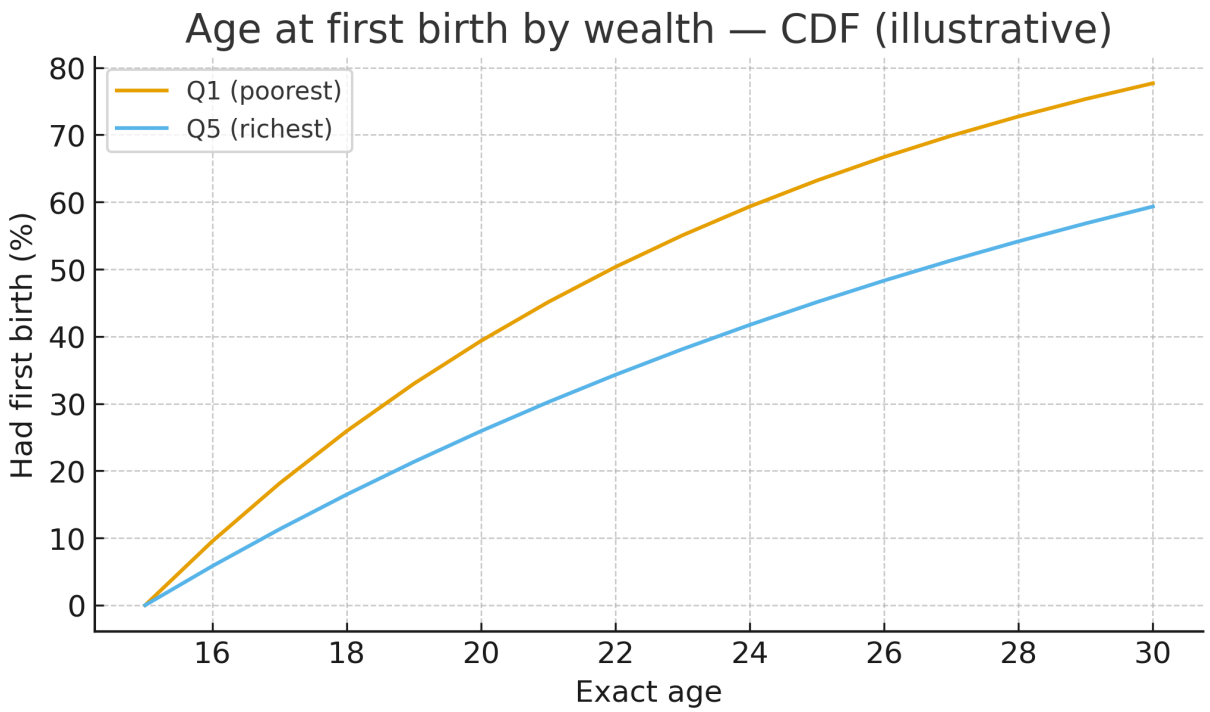

Figure . Parity progression by wealth (PPR 1→2 and 3→4)

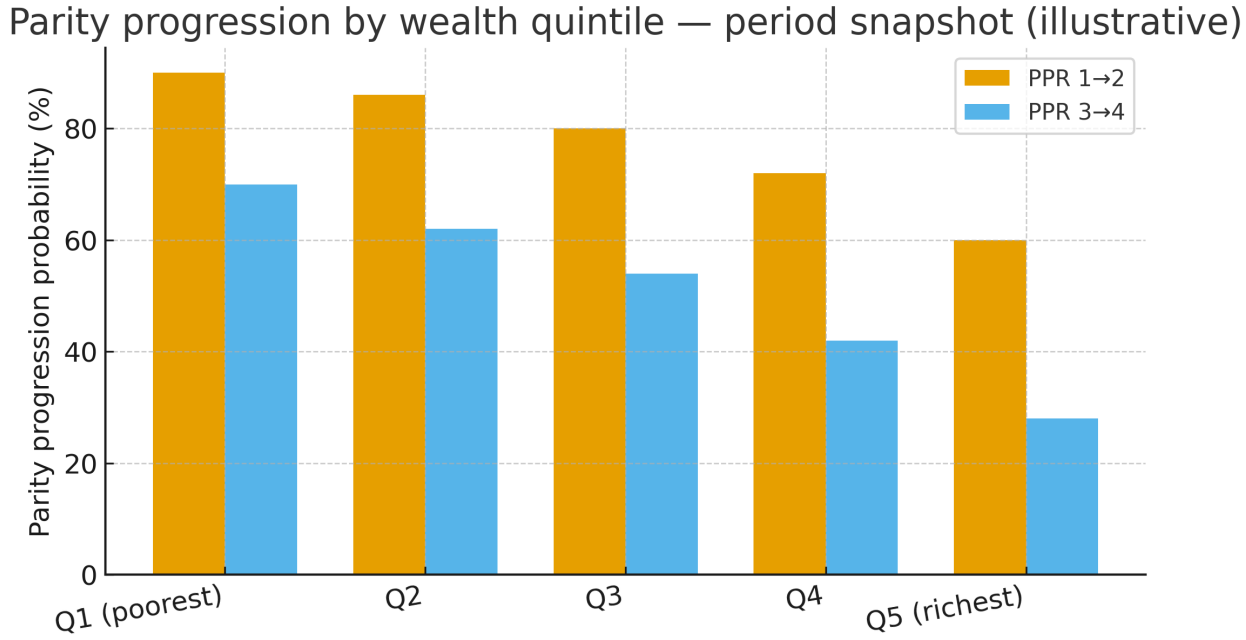

Figure . Female employment vs regional TFR

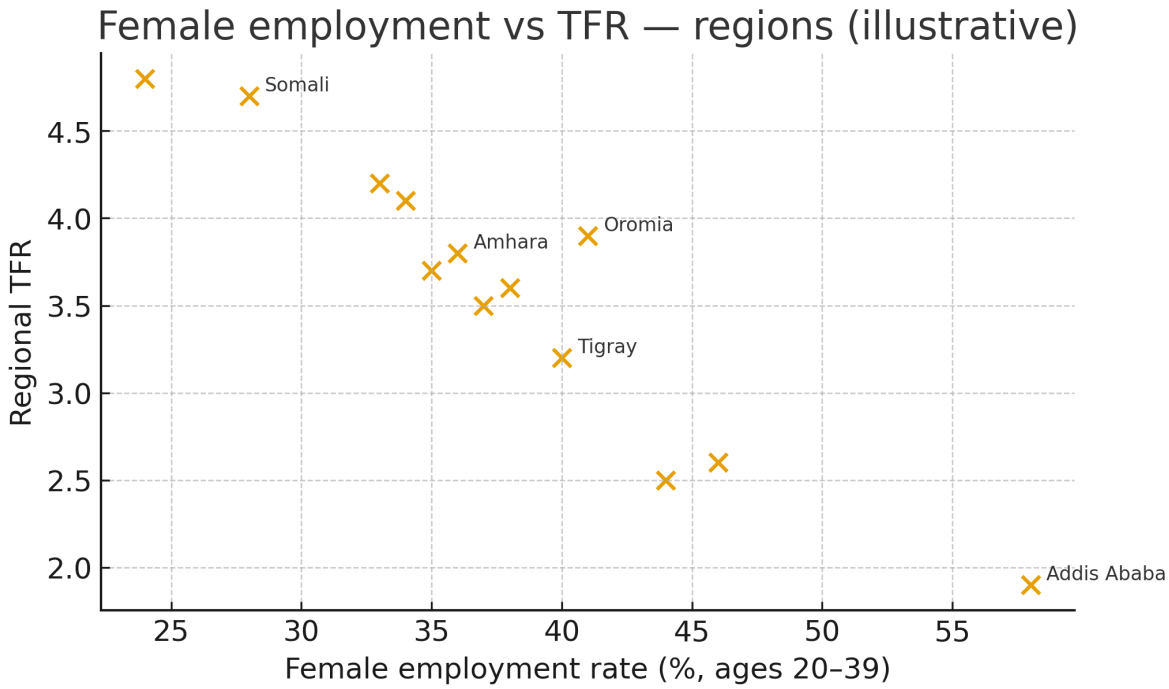

Figure . Unmet need vs consumption/asset index

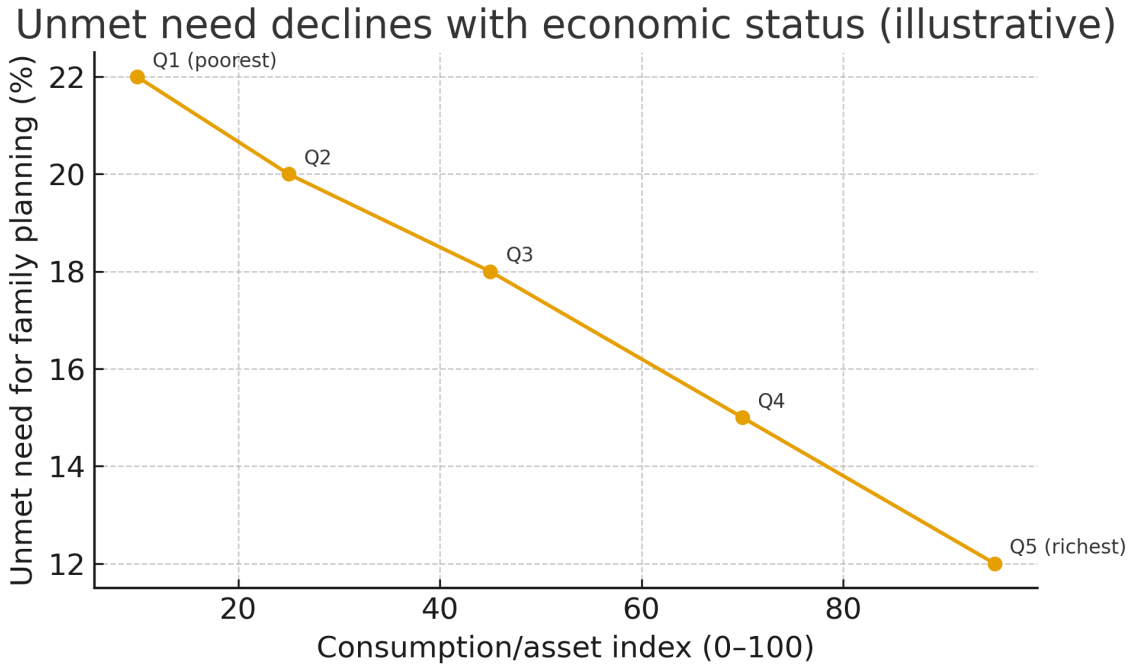

Table 5.4-A. Measures and definitions

Measure	Definition / computation
Wealth index (DHS)	Principal-components index from household assets and amenities; quintiles are survey-weighted.
ASFR_e by wealth	b_{a,q} / W_{a,q} — births per woman to women of age group a in wealth quintile q.
TFR_q	5 × Σ_a ASFR_{a,q} — period TFR for wealth quintile q.
Age at first birth (AFB)	From full birth histories; Kaplan–Meier curves by quintile.
Parity progression (PPR)	P(k→k+1 | reached k) by quintile; consider design weights.
Female employment rate	Share of women (20–39) reporting employment in last 12 months; harmonize definitions.

Table 5.4-B. TFR by wealth and population shares

Wealth quintile	TFR_q (period)	Population share
Q1 (poorest)	5.4	22.0%
Q2	4.7	22.0%
Q3	4.2	21.0%
Q4	3.4	19.0%
Q5 (richest)	2.3	16.0%

Table 5.4-C. Composition vs rate effects — decomposition template

Quantity	Value	Comment
Observed TFR (weighted)	4.12	—
Counterfactual TFR (new weights, same rates)	3.89	—
ΔTFR	-0.23	—
Composition effect	-0.23	Shift in wealth distribution
Rate effect	0.00	Using template; fill with real Δ in TFR_q

Table 5.4-D. Determinants modeling menu

Outcome	Modeling notes
ASFR (count rates)	Poisson/negative binomial with offsets; random effects by cluster/region.
First birth timing	Discrete-time hazard model by single-year age; covariates: education, wealth, urban, region, cohort.
Contraceptive use	Logit/probit; quality-of-care proxies; service readiness; distance/travel time.
Parity progression	Multi-state or sequential logit with duration since prior birth.
Endogeneity checks	Instrument schooling with policy reforms; control for selection into employment.

Table 5.4-E. Policy levers linked to economic opportunity

Lever	Rationale for fertility outcomes
Cash/in-kind transfers (conditional/unconditional)	Reduce poverty-related high parity progression; support girls' schooling.
Livelihoods & jobs for young women	Raise opportunity cost of early childbearing; enable method continuation.
Reduce access costs	Lower travel time, stock-outs, and informal fees that bind poorest quintiles.
Community engagement	Norms around early marriage and desired family size in low-resource settings.
Service quality	Method choice, counseling, side-effect management; continuity in remote areas.

Notes & cautions

• DHS wealth is a relative index; trends over time reflect both assets and scaling changes. Compare within round and harmonize across rounds cautiously.

• Employment measures vary (any work vs formal employment); ensure consistent definitions across surveys.

• Causality is non-trivial: use designs that address selection (instrumental variables, policy shocks, DiD).

References — Section 5.4

- Rutstein, S. O., & Rojas, G. (2006). Guide to DHS Statistics.

- Filmer, D., & Pritchett, L. (2001). Estimating Wealth Effects Without Expenditure Data.

- Bongaarts, J. (2010). The Causes of Educational Differences in Fertility in Sub-Saharan Africa.

- World Bank. World Development Indicators — labor and poverty metadata.

5.5) Urban–Rural, Regional & Livelihood Systems

Scope. How fertility differs across Ethiopia's urban–rural divide, regions, and livelihood systems (pastoral, agrarian, urban). We pair fertility levels with access (travel time), modern contraceptive coverage, and schooling to show program-relevant gradients.

Figure . Urban vs rural TFR by region

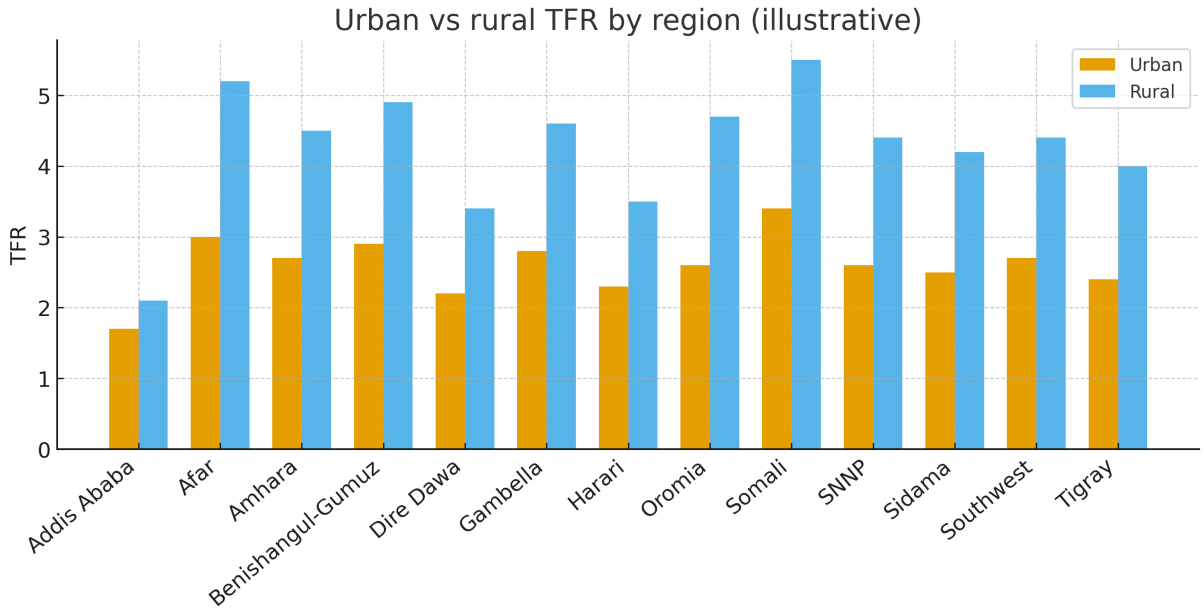

Figure . Access and coverage: travel time vs mCPR

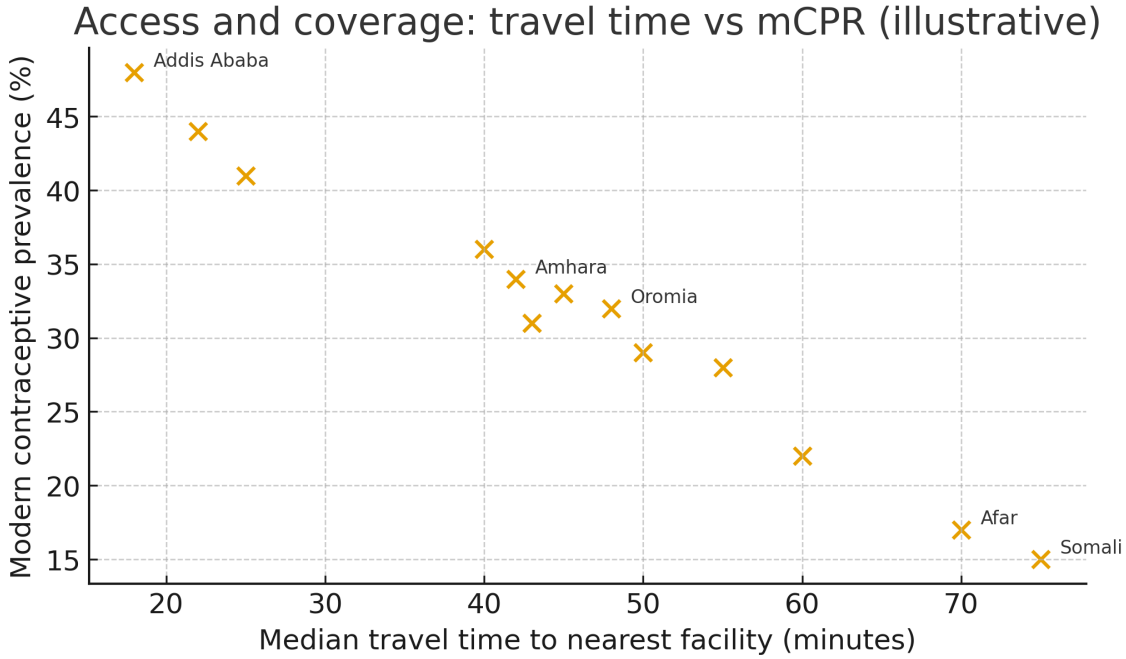

Figure. Human capital gradient: schooling vs TFR

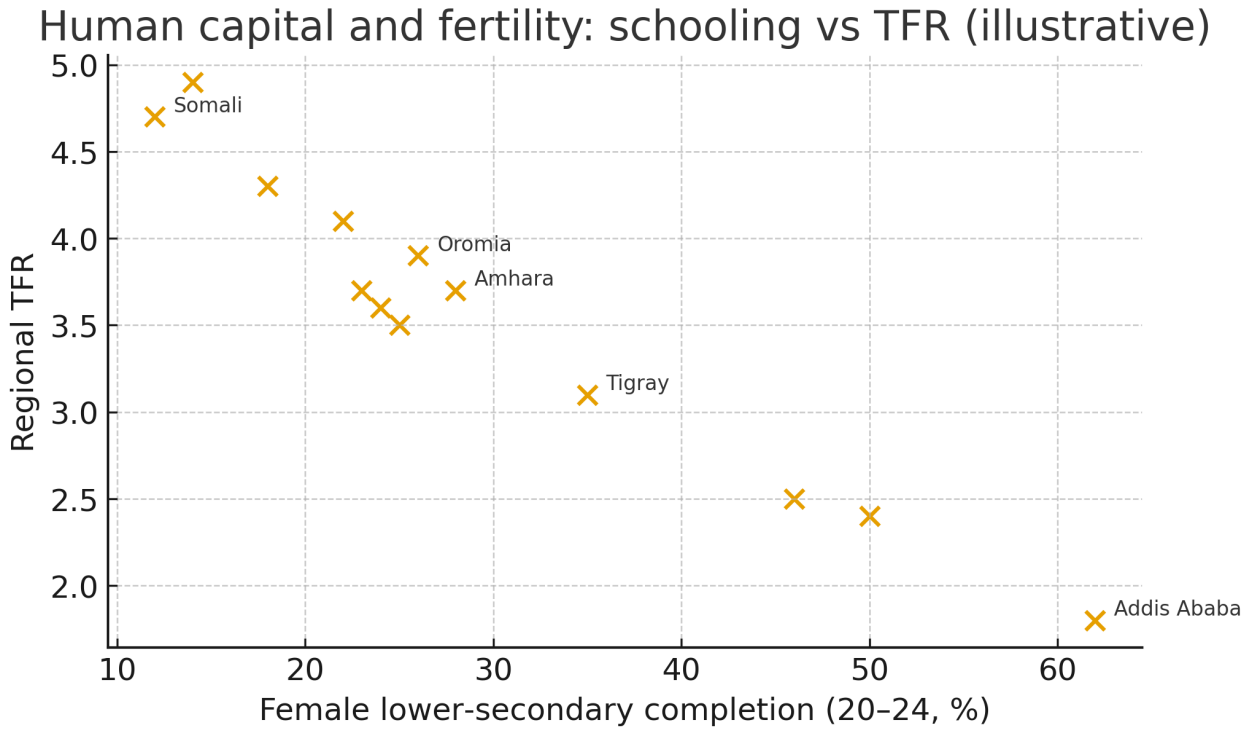

Figure . Livelihood systems comparison (scaled indices)

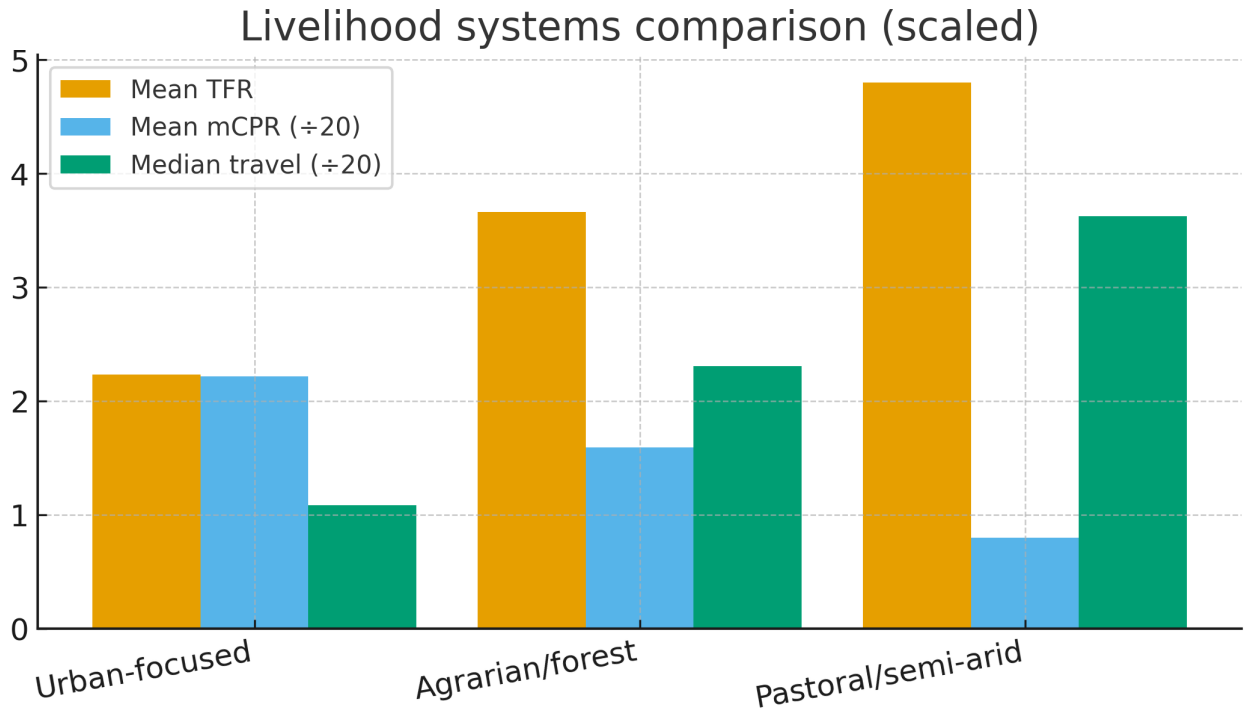

Table 5.5-A. Regional summary — fertility, access & human capital

Region	TFR	Urban TFR	Rural TFR	mCPR (%)	Travel time (min)	Female lower-sec complete (20–24, %)	Livelihood system
Addis Ababa	1.8	1.7	2.1	48	18	62	Urban/Industrial
Afar	4.9	3.0	5.2	17	70	14	Pastoral/Semi-arid
Amhara	3.7	2.7	4.5	34	42	28	Agrarian/Mixed
Benishangul-Gumuz	4.1	2.9	4.9	28	55	22	Agrarian/Mixed
Dire Dawa	2.5	2.2	3.4	44	22	46	Urban
Gambella	4.3	2.8	4.6	22	60	18	Lowland/Riverine
Harari	2.4	2.3	3.5	41	25	50	Urban
Oromia	3.9	2.6	4.7	32	48	26	Agrarian/Mixed
Somali	4.7	3.4	5.5	15	75	12	Pastoral/Semi-arid
SNNP	3.6	2.6	4.4	33	45	24	Agrarian/Mixed
Sidama	3.5	2.5	4.2	31	43	25	Agrarian/Mixed
Southwest	3.7	2.7	4.4	29	50	23	Agrarian/Forest
Tigray	3.1	2.4	4.0	36	40	35	Conflict-affected/Agrarian

Table 5.5-B. Livelihood typology — program-relevant features

System	Program-relevant features
Urban/Industrial	Metropolitan/secondary city settings; diversified services; higher schooling; shorter travel times; lower TFR.
Agrarian/Mixed	Crop-based livelihoods; seasonal access constraints; mid-level schooling; moderate TFR.

Pastoral/Semi-arid	Mobile/remote settlements; longer travel times; low schooling; higher TFR; service outreach needed.
Lowland/Riverine	Sparsely populated, access by river/seasonal roads; program delivery by outreach/mobile teams.
Conflict-affected	Disruptions to services and schooling; temporary spikes in unmet need and early marriage risks.

Notes & cautions

• Urban–rural gaps partly reflect exposure (marriage, sexual debut) and access; definitions must be consistent across rounds.

• Pastoral areas face distance and mobility barriers; outreach/mobile services and multi-month dispensing may be critical.

• Conflict and shocks can reverse gains; interpret recent estimates with context on accessibility and displacement.

References — Section 5.5

- Rutstein, S. O., & Rojas, G. (2006). Guide to DHS Statistics.

- United Nations (2017). Principles and Recommendations for Population and Housing Censuses.

- World Bank. World Development Indicators — access and education metadata.

- Ethiopia MOH/CSA reports (various years) on service readiness and coverage.

5.6) Religion, Ethnicity & Social Norms

Scope & principles. Describe how religious affiliation, ethnicity, and social norms correlate with fertility in Ethiopia, with rigorous caveats on interpretation and ethics. Focus on period differentials (TFR/ASFR), ideal family size, contraceptive use, and selected norm indicators.

Figure . TFR by religion

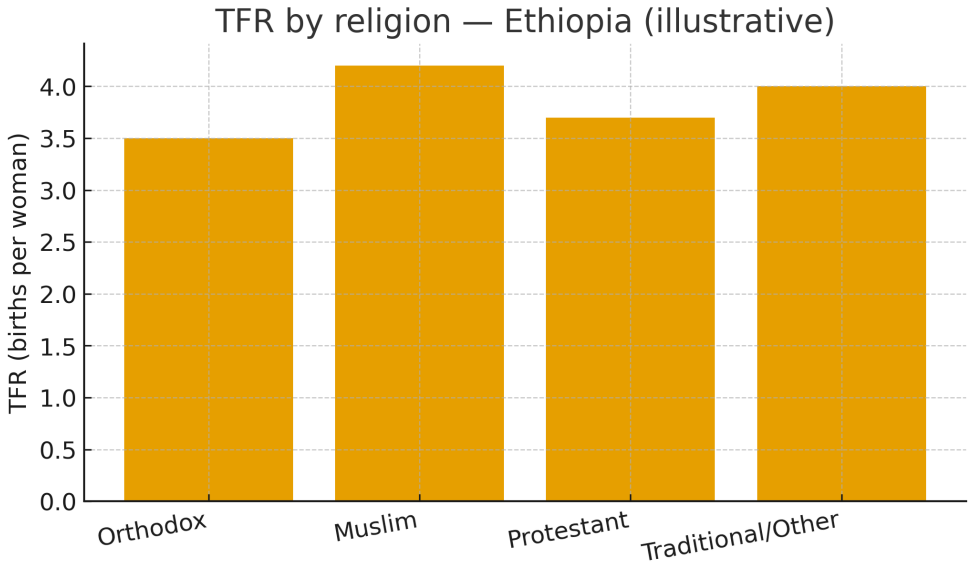

Figure . Ideal family size by religion

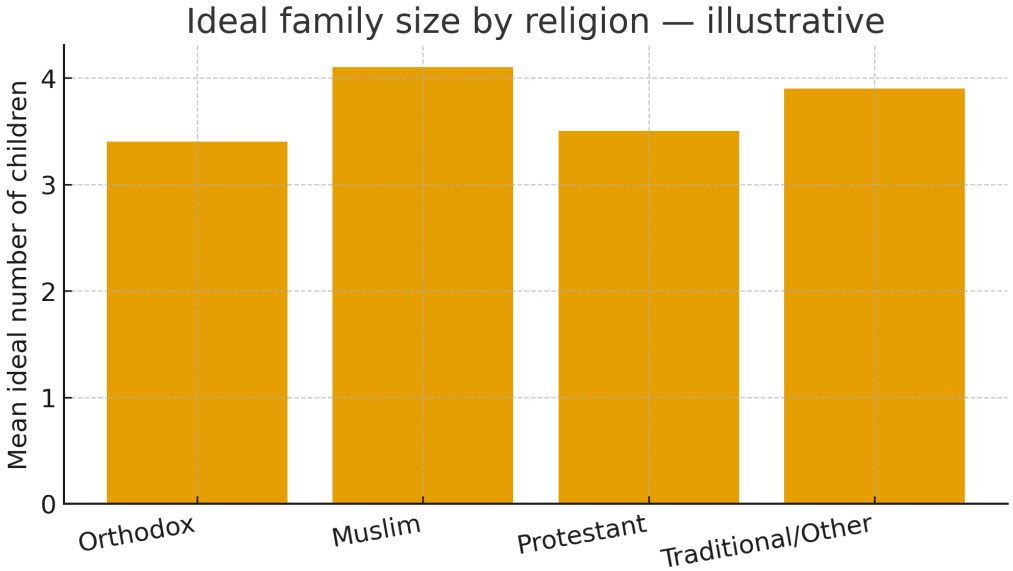

Figure . Modern contraceptive prevalence by religion

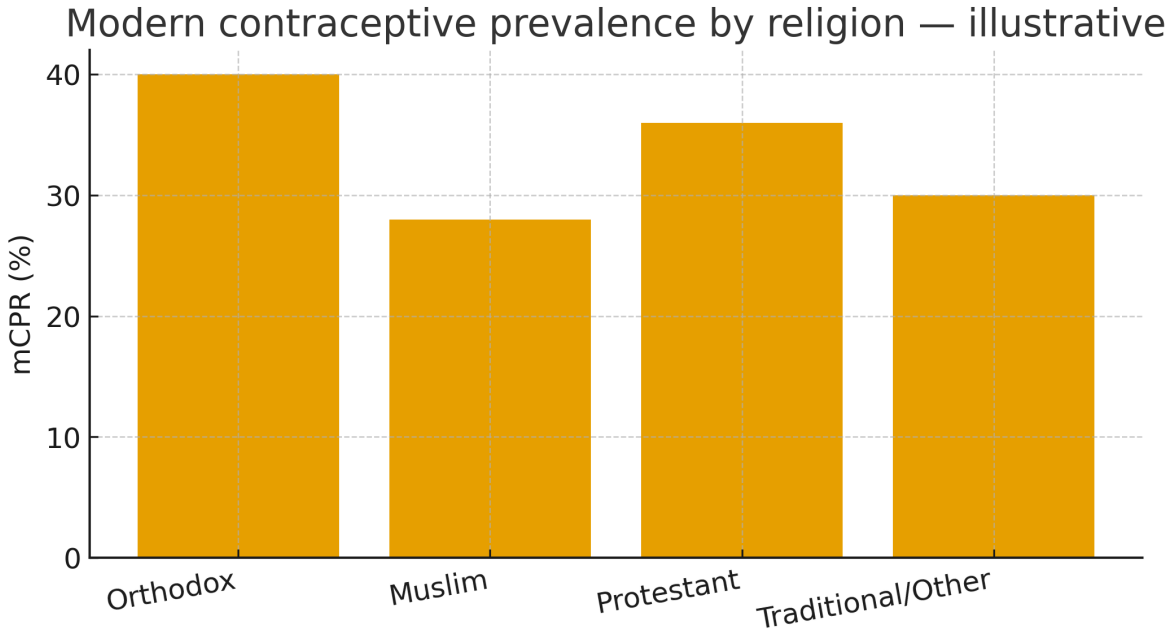

Figure . TFR by ethnicity — ranked

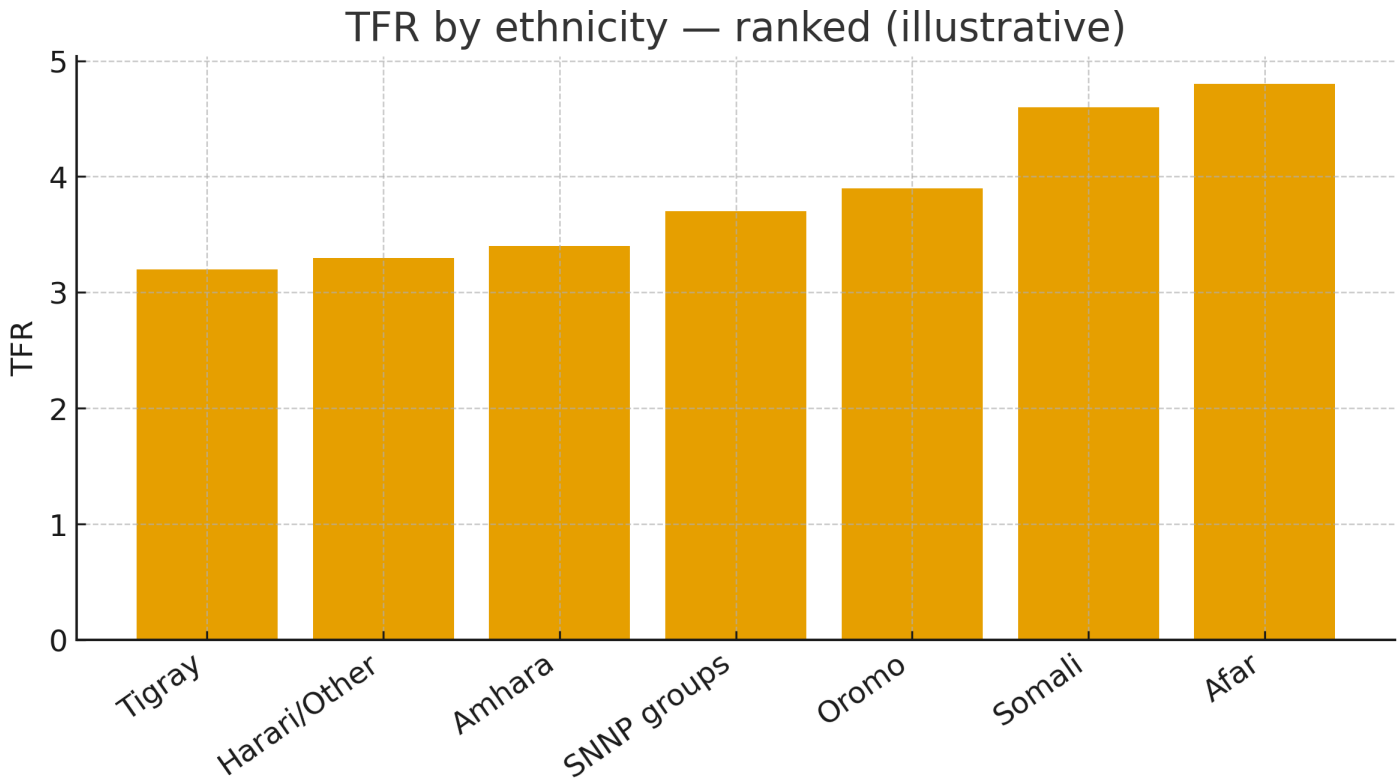

Figure . Selected norm indicators by religion

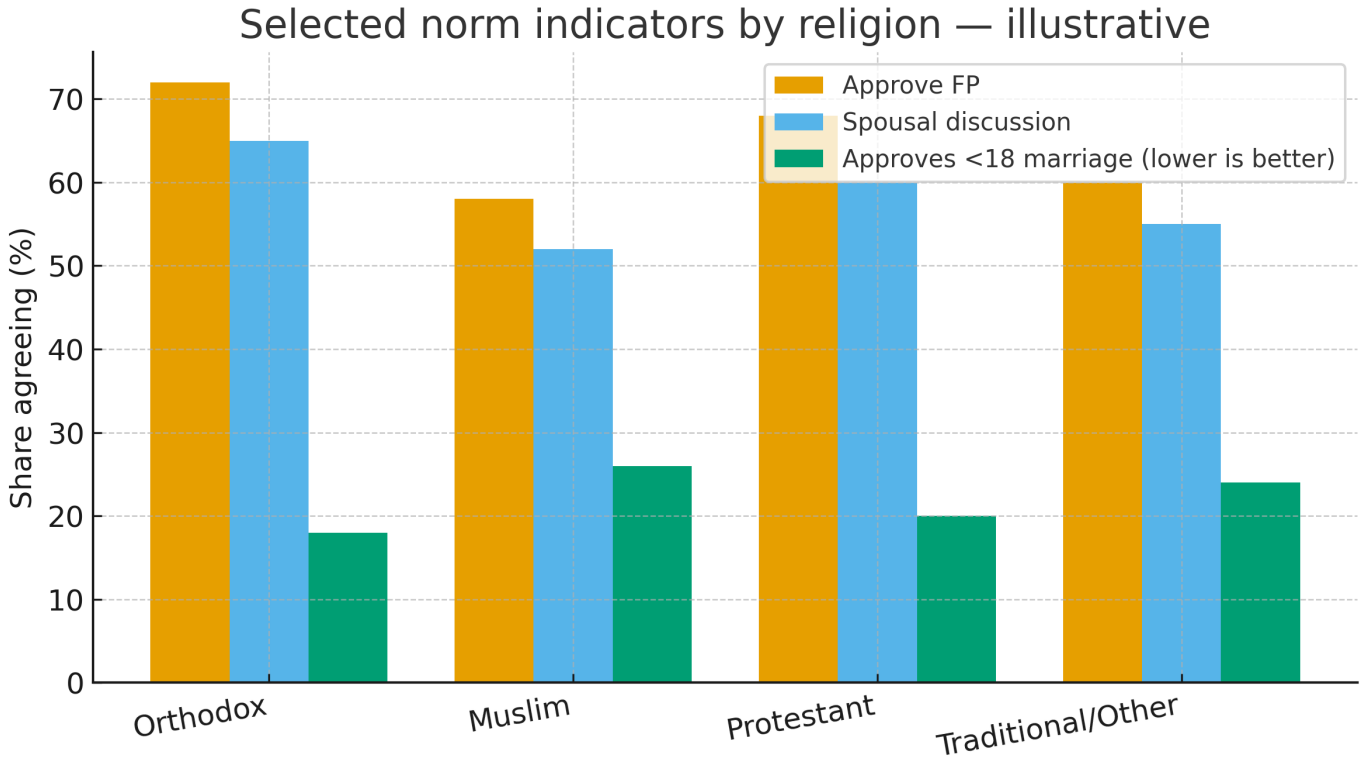

Figure . Son preference proxy by religion

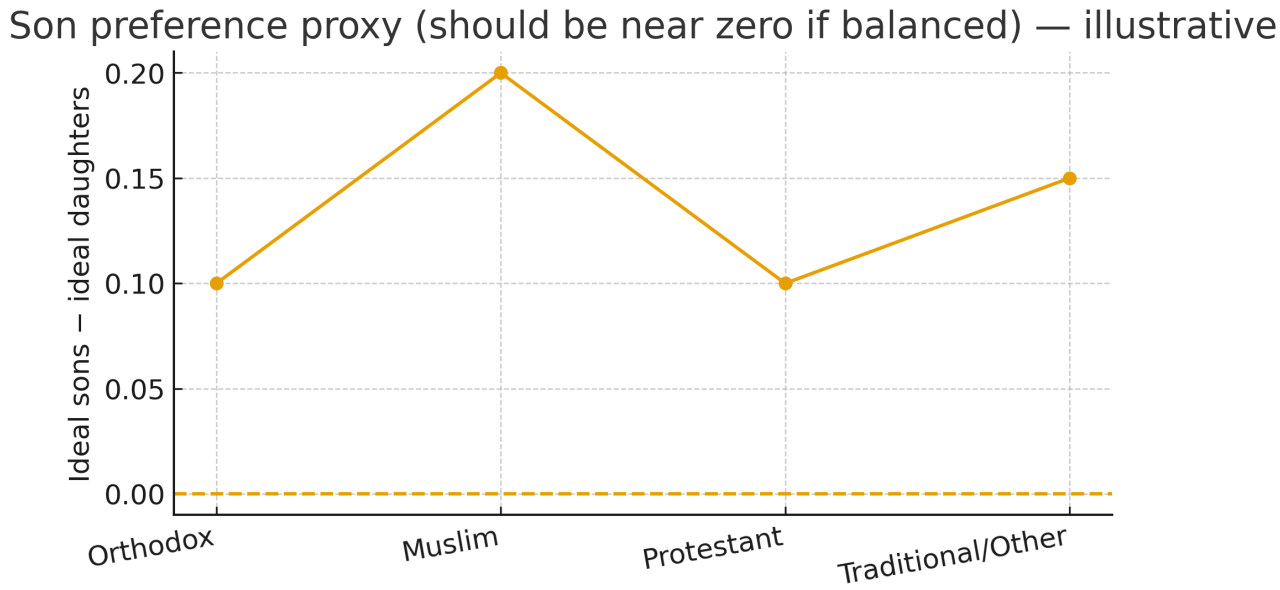

Table 5.6-A. Measures and definitions

Measure	Definition / computation
Religion/denomination	Self-reported affiliation (Orthodox, Muslim, Protestant, Traditional/Other).
Ethnicity	Self-identified group (harmonize across rounds).
TFR by group	5 × Σ ASFR_{a,g} using group-specific denominators/weights.
Ideal family size (IFS)	Mean of numeric responses; top-code extreme values; analyze wanted vs ideal.
mCPR	Modern method use among married women (or all sexually active) — align denominators.
Norm items	Approve FP; spousal communication; attitudes to early marriage; GBV/IPV; decision-making.

Table 5.6-B. Modeling notes

Topic	Notes
Group differentials	Multilevel Poisson/logit with region/religion/ethnicity random effects; design-weighted.
Norms & behaviors	Structural paths: norms → use/continuation → spacing/stopping; beware simultaneity.
Endogeneity	Religiosity and ethnicity correlate with residence, schooling, wealth; include controls and fixed effects where possible.
Measurement	Social desirability bias in norm questions; use vignettes/anchoring if available.
Ethics	Avoid stigmatization; aggregate small groups; protect privacy in small areas.

Table 5.6-C. Diagnostics & harmonization

Issue	Action
Small cells	Pool across adjacent rounds or aggregate categories; show uncertainty bands.
Denominator alignment	Married vs all sexually active; consistent across groups.
Outliers in IFS	Winsorize/top-code; report distribution, not just mean.
Secular trends	Cohort vs period: separate compositional change in affiliation from behavioral change.
Geography confounding	Control for urban–rural and region when comparing groups.

Interpretation notes

• Differences across religion/ethnicity often reflect geography, schooling, and livelihoods; adjust comparisons accordingly.

• Norm questions can be sensitive; present aggregates and avoid identifiers for small groups/areas.

• In Ethiopia, pronounced son preference at birth is not consistently observed in surveys; monitor for local pockets and cohort shifts.

References — Section 5.6

- Rutstein, S. O., & Rojas, G. (2006). Guide to DHS Statistics.

- Bongaarts, J., & Watkins, S. C. (1996). Social Interactions and Contemporary Fertility Transitions.

- United Nations (2017). Principles and Recommendations for Population and Housing Censuses.

- Ethiopia DHS/EDHS reports (various years) — chapters on fertility and FP differentials.

5.7) Union Formation & Sexual Debut

Focus. Timing of first sex and first marriage/union in Ethiopia, premarital exposure windows, and union forms (polygyny, divorce/separation) that shape exposure to the risk of childbearing and observed fertility patterns.

Figure . Age at first sex vs first marriage — CDFs

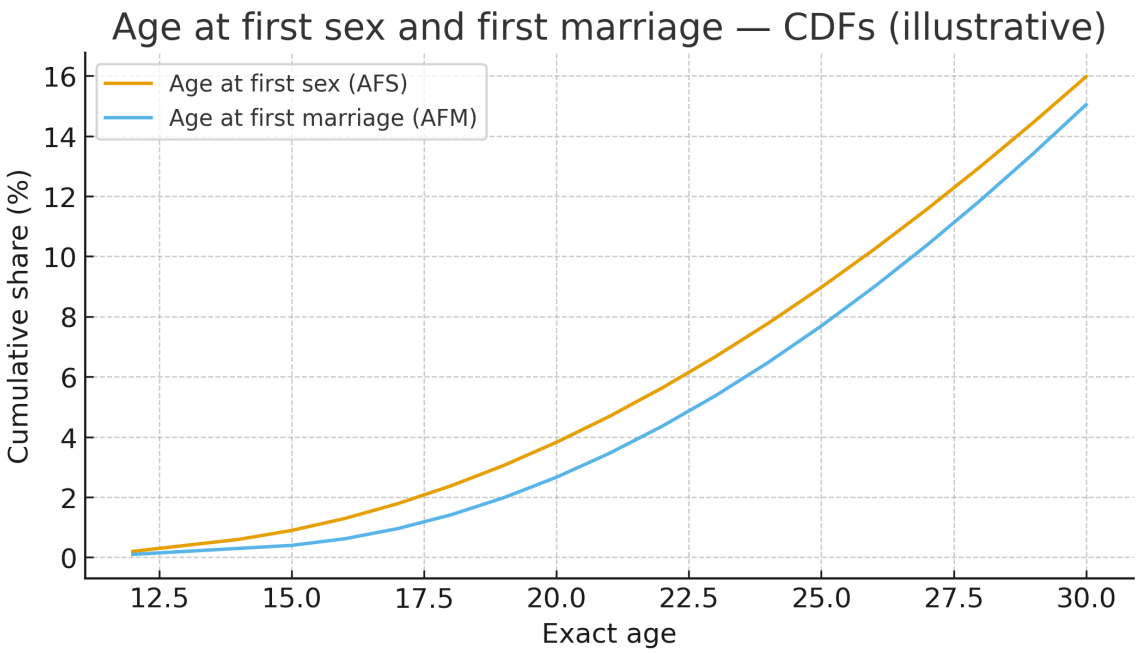

Figure . Premarital exposure by age

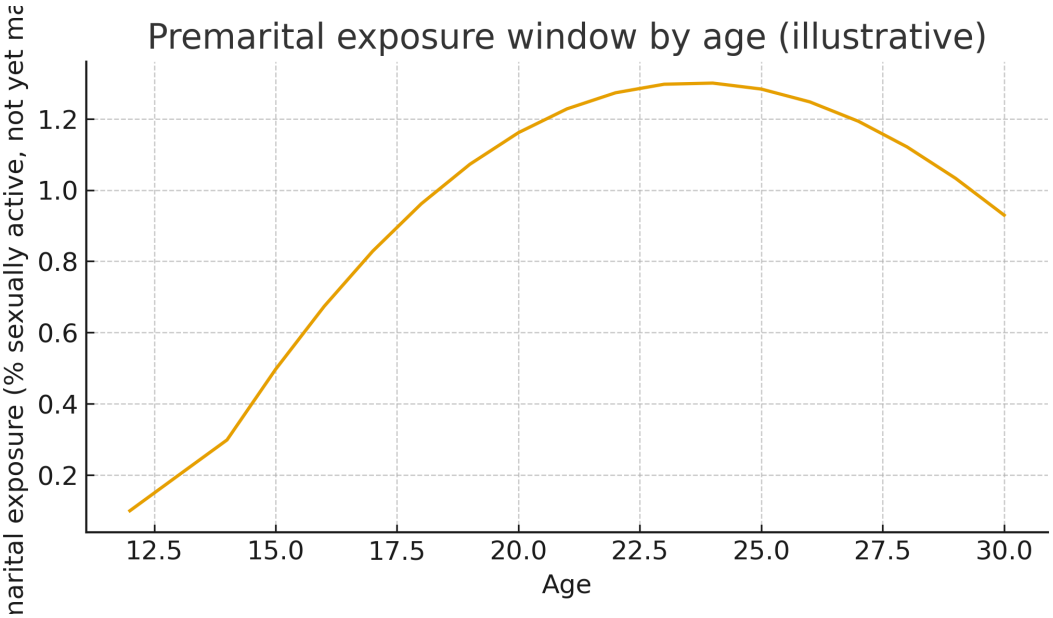

Figure . Union forms among ever-married — polygyny and divorce/separation by age

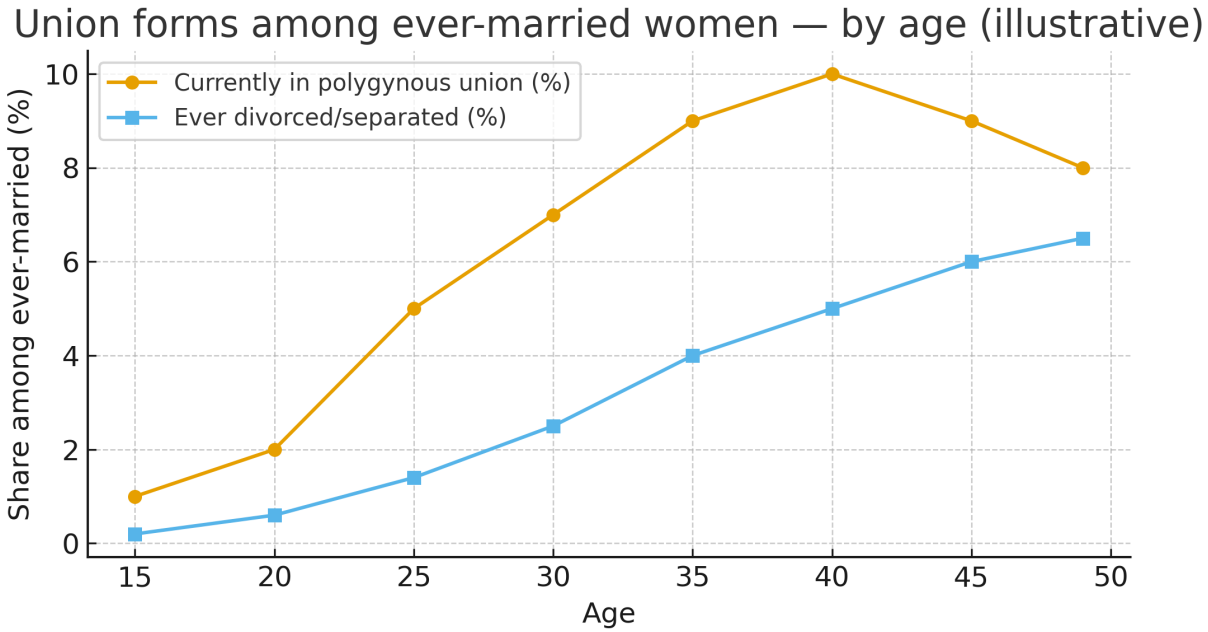

Figure . First-birth hazard by marital status

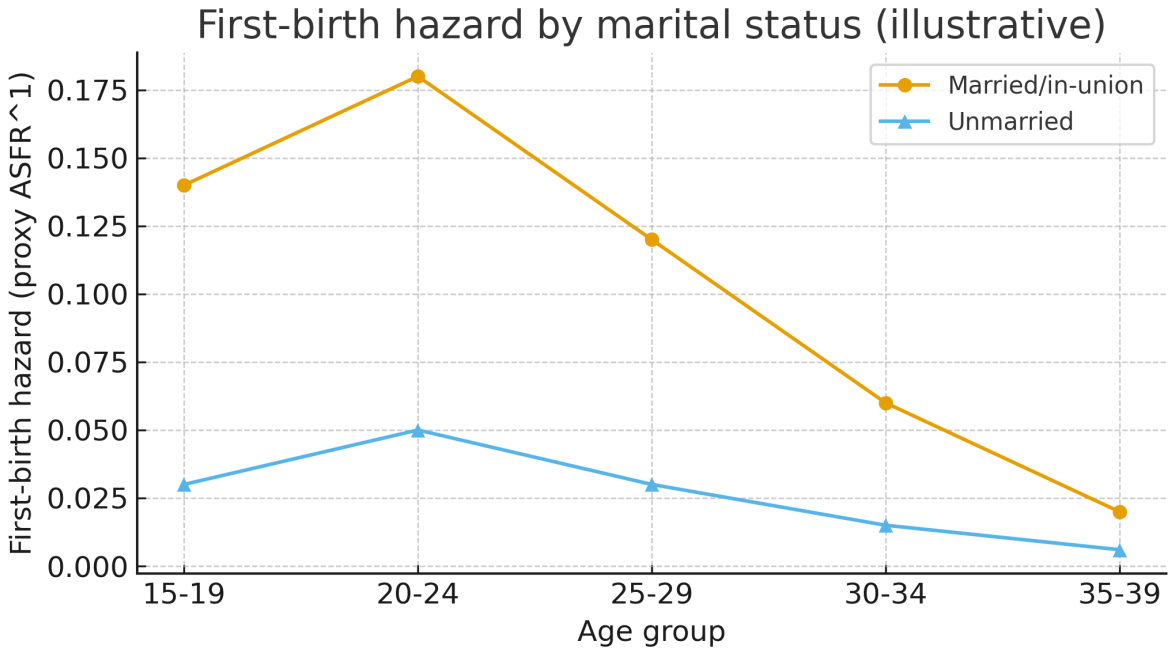

Table 5.7-A. Measures and definitions

Measure	Definition / computation
Age at first sex (AFS)	From DHS calendar or direct questions; compute Kaplan–Meier/Life-table curves.
Age at first marriage/union (AFM)	From marital history; align 'in-union' vs legal marriage; handle cohabitation.
Premarital exposure	Share sexually active but not yet married by age; relevant to adolescent fertility risk.
Polygyny prevalence	Share of married women in polygynous unions; examine by age/region.
Divorce/separation (ever)	Ever-divorced/separated among women; indicates union instability and exposure changes.
First-birth hazard by status	Rate of first births by age and marital status (from full birth histories).

Table 5.7-B. Diagnostics & harmonization

Issue	Action
Heaping and displacement	Spikes at ages 15/18; month imputation may shift AFS/AFM — document rules.
Denominators	Married vs in-union vs all sexually active; define consistently across rounds.
Premarital births	Identify with birth order & marital timing; adjust if marriage and birth in same month.
Censoring	Right-censoring for younger cohorts; use survival methods rather than means.
Privacy & ethics	Sensitive topics — aggregate reporting; ensure anonymity.

Table 5.7-C. Modeling menu

Topic	Notes
AFS/AFM timing	Discrete-time hazard models by single-year age; cohort & region random effects.
Premarital first birth risk	Competing risks: premarital vs marital first birth; exposure as time-varying.
Union stability	Multi-state models: married ↔ separated ↔ remarried; fertility consequences.
Selection & causality	Schooling and norms co-determine AFS/AFM; consider IV or natural experiments.
Program relevance	Youth-friendly SRH, child marriage prevention, and social protection linkages.

Interpretation notes

• Rising AFM typically widens the AFS–AFM gap, increasing premarital exposure; implications for adolescent birth risks and FP programming.

• Polygyny and union instability can alter exposure and parity progression; analyze with caution and appropriate denominators.

• Regional and urban–rural heterogeneity is substantial; pair with service access and schooling gradients (see 5.5).

References — Section 5.7

- Rutstein, S. O., & Rojas, G. (2006). Guide to DHS Statistics.

- Clark, S. (2004). Early Marriage and Schooling in Sub-Saharan Africa.

- Bongaarts, J., & Potter, R. G. (1983). Fertility, Biology, and Behavior.

- United Nations (2017). Principles and Recommendations for Population and Housing Censuses.

5.8) Fertility Preferences & Intentions

Purpose. Document how desired family size and intentions shape realized fertility in Ethiopia, distinguishing wanted and unwanted components, mapping the intentions–behavior gap, and quantifying demand satisfied by modern methods (mDFPS).

Figure . Distribution of ideal family size (IFS)

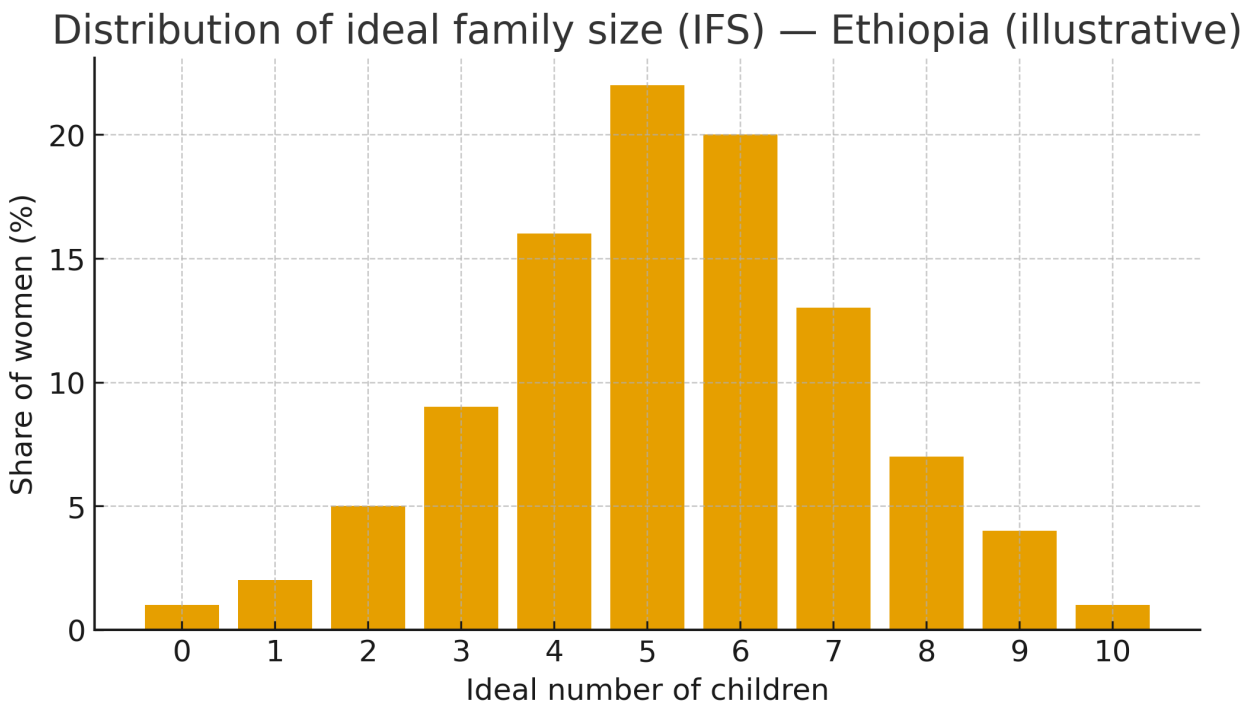

Figure 5.8-2. Trends in wanted vs unwanted fertility (WTFR vs TFR − WTFR)

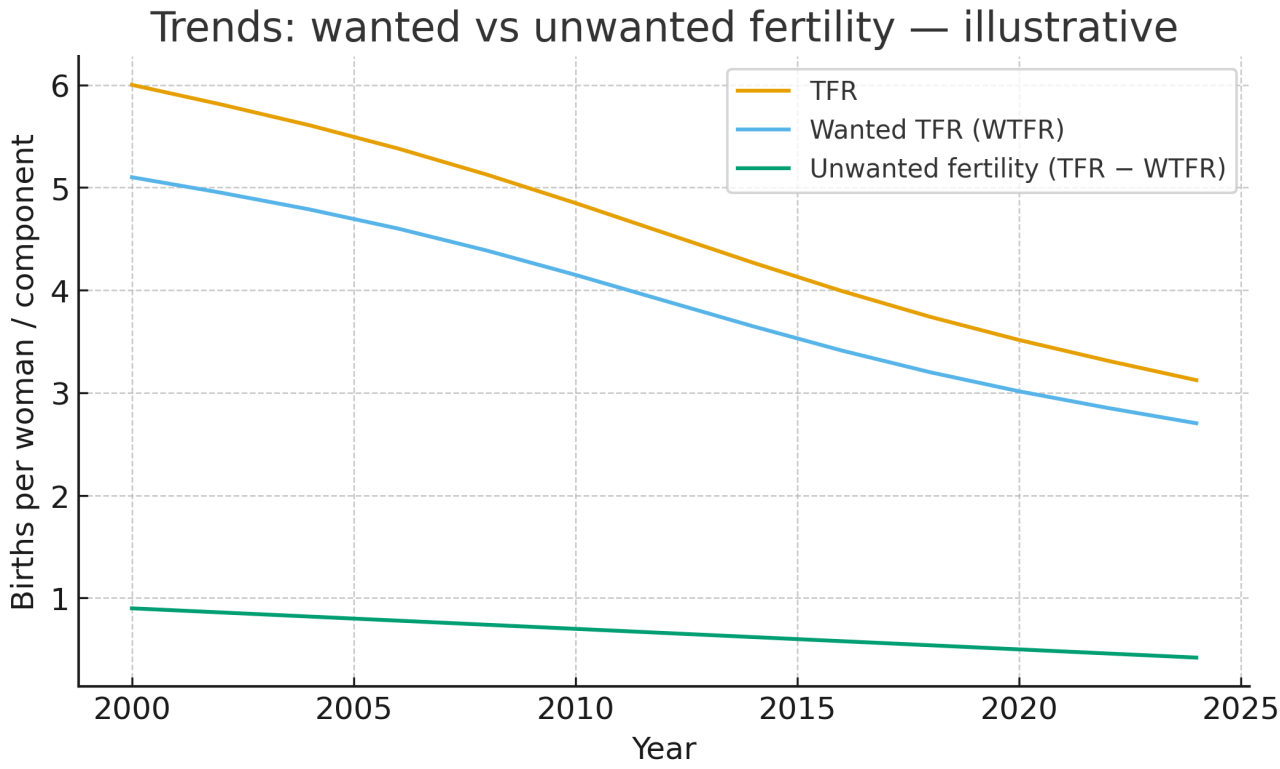

Figure . Intentions vs adoption within 12 months — by parity

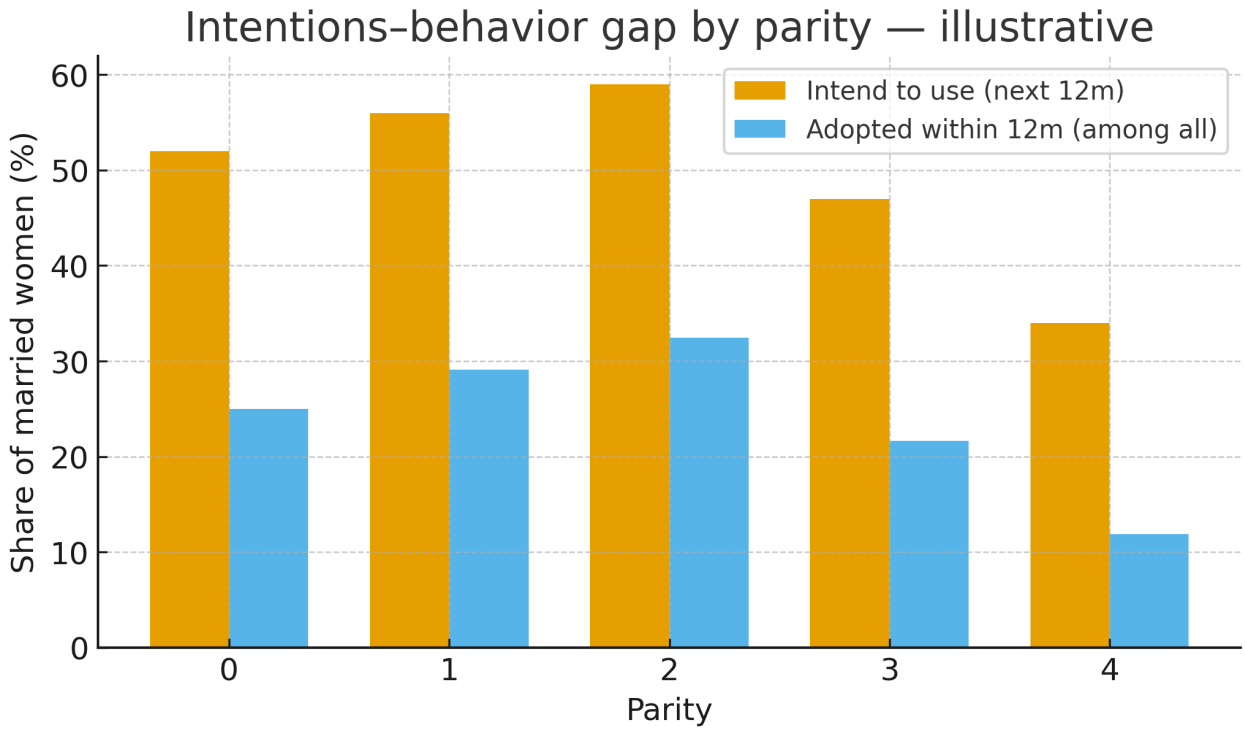

Figure . Spacing vs stopping preferences by age

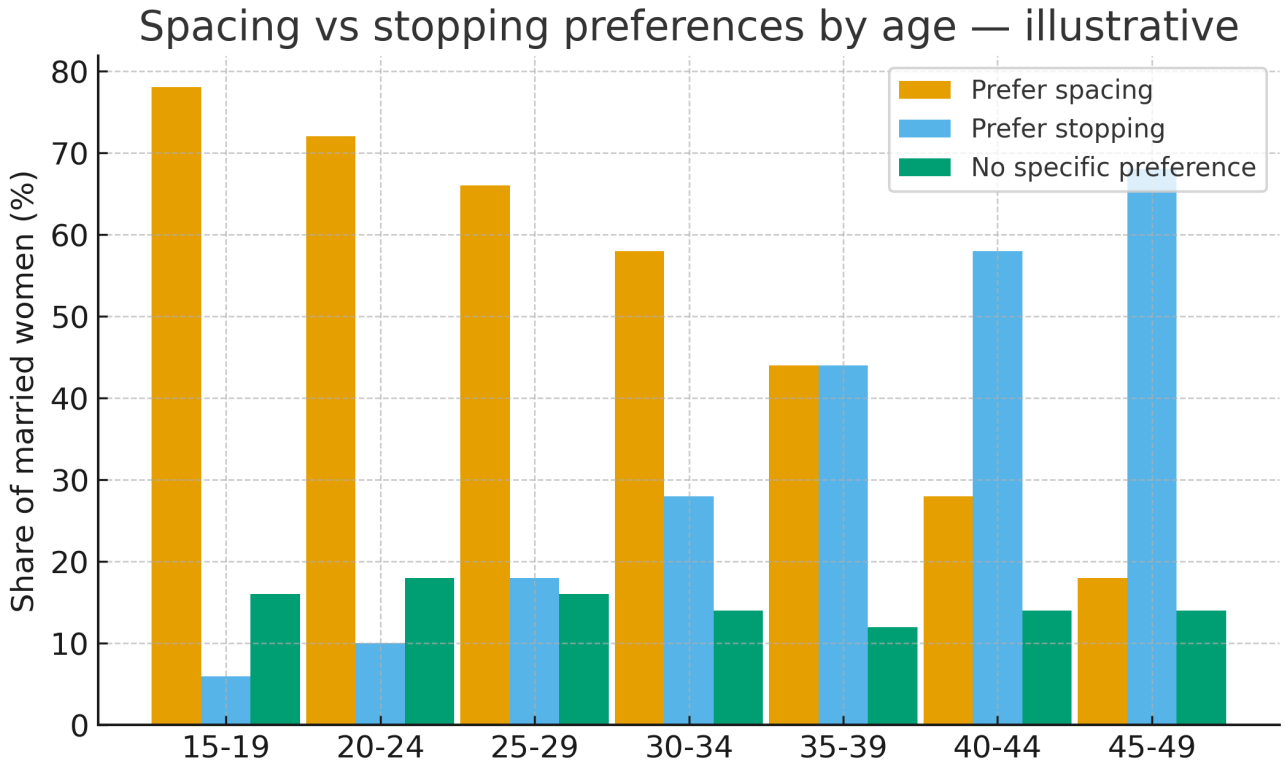

Figure . Demand satisfied by modern methods (mDFPS) by wealth quintile

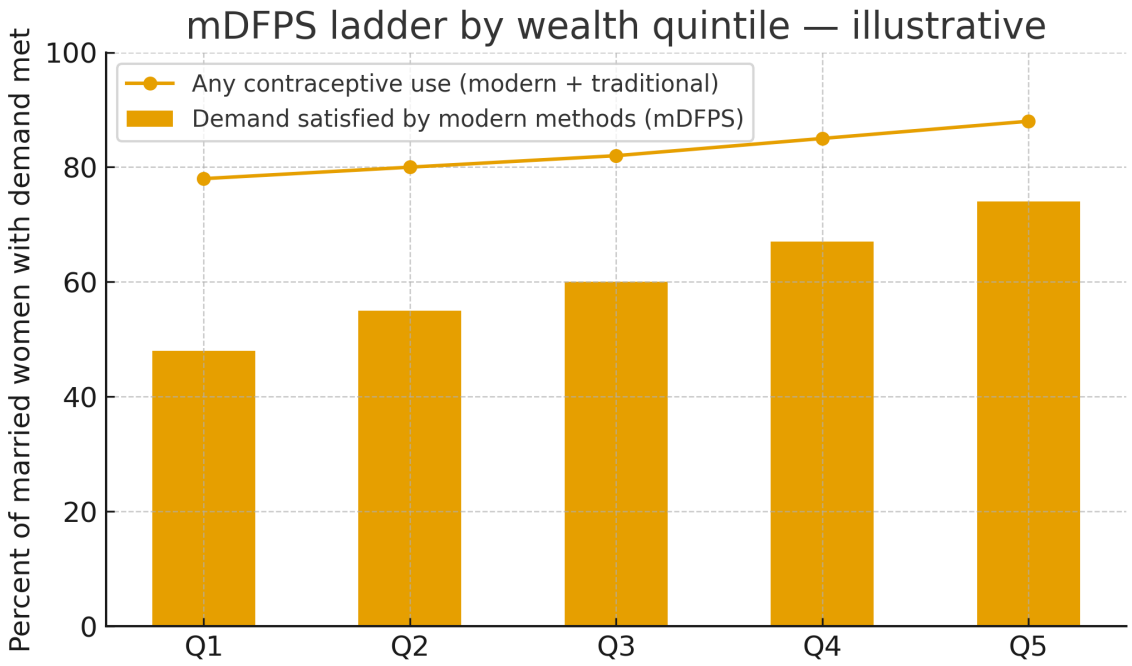

Table 5.8-A. Measures and definitions

Measure	Definition / computation
Ideal family size (IFS)	Numeric ideal number of children; analyze distribution (mean/median/mode).
Wanted Total Fertility Rate (WTFR)	TFR computed using wanted births only (from wantedness of recent births/pregnancies).
Unwanted fertility	TFR − WTFR; includes mistimed and unwanted births per period method.
Intention to use	Stated intention to use contraception within a defined horizon (e.g., 12 months).
Demand satisfied by modern methods (mDFPS)	Modern users among those with demand (current users + unmet).
Unmet need (period)	Non-users wanting to delay/limit births and at risk of pregnancy.
Spacing vs stopping preference	Stated preference to delay next birth vs desire no more children.

Table 5.8-B. Decomposition of TFR into wanted and unwanted components

Year	TFR	WTFR	Unwanted (TFR−WTFR)
2000.0	6.0	5.1	0.9
2002.0	5.81	4.95	0.86
2004.0	5.61	4.79	0.82
2006.0	5.38	4.6	0.78
2008.0	5.13	4.39	0.74
2010.0	4.85	4.15	0.7
2012.0	4.56	3.9	0.66
2014.0	4.27	3.65	0.62

2016.0	3.99	3.41	0.58
2018.0	3.74	3.2	0.54
2020.0	3.51	3.01	0.5
2022.0	3.31	2.85	0.46
2024.0	3.12	2.7	0.42

Table 5.8-C. Intentions–behavior gap (12-month)

Parity	Intend to use (12m) %	Adopt within 12m %	Gap (pp)
0.0	52.0	25.0	27.0
1.0	56.0	29.1	26.9
2.0	59.0	32.4	26.6
3.0	47.0	21.6	25.4
4.0	34.0	11.9	22.1

Table 5.8-D. Couple concordance (percent of couples)

Wife preference	Husband wants more	Husband wants same/no more
Wife wants more	36	18
Wife wants same/no more	22	24

Table 5.8-E. Modeling menu

Topic	Notes
Wantedness model	Logit/probit for unwanted last birth; covariates: age, parity, spacing intention, FP use, access.
Intention→adoption	Event history or 12-month transition model; control for service quality and partner agreement.
Couple agreement	Bivariate probit or concordance models; measure discordance and effects on use.

Demand satisfied (mDFPS)	Hierarchical model for coverage with district-level supply covariates.
Decomposition	Kitagawa/Das Gupta of TFR into wantedness vs rate components over time/groups.

Notes & cautions

• WTFR depends on reported wantedness and may misclassify mistimed births; triangulate with prospective intentions where available.

• Explicitly define denominators for mDFPS (married vs all sexually active).

• Couple disagreement is common and predicts non-use/discontinuation; incorporate in counseling and modeling.

References — Section 5.8

- Rutstein, S. O., & Rojas, G. (2006). Guide to DHS Statistics.

- Bradley, S. E. K., Croft, T. N., Fishel, J. D., & Westoff, C. F. (2012). Revising Unmet Need for Family Planning.

- Casterline, J. B., & El-Zanaty, F. (2015). The Estimation of Unintended Fertility.

- United Nations (2017). Principles and Recommendations for Population and Housing Censuses.

5.10) Postpartum Insusceptibility & Birth Intervals

Purpose. Quantify how breastfeeding, amenorrhea, and abstinence shape exposure to pregnancy after a birth in Ethiopia; summarize birth-interval patterns; and translate into the Bongaarts Ci index with program implications for healthy spacing.

Figures (illustrative — replace with official estimates)

Figure . Duration of any breastfeeding — CDF

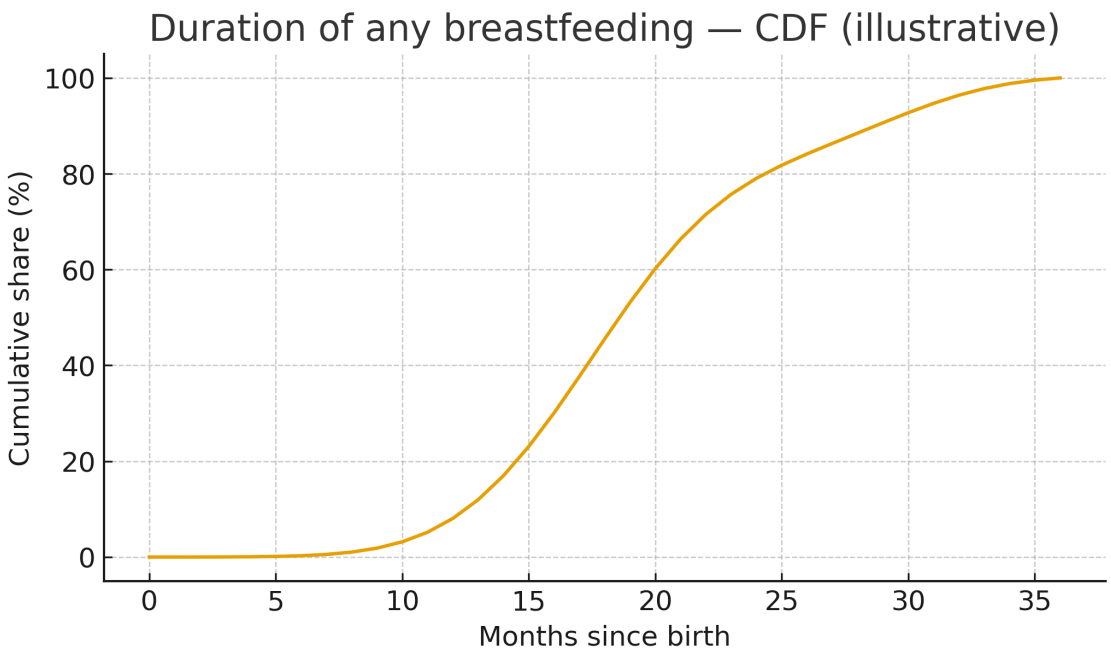

Figure . Postpartum amenorrhea duration — CDF

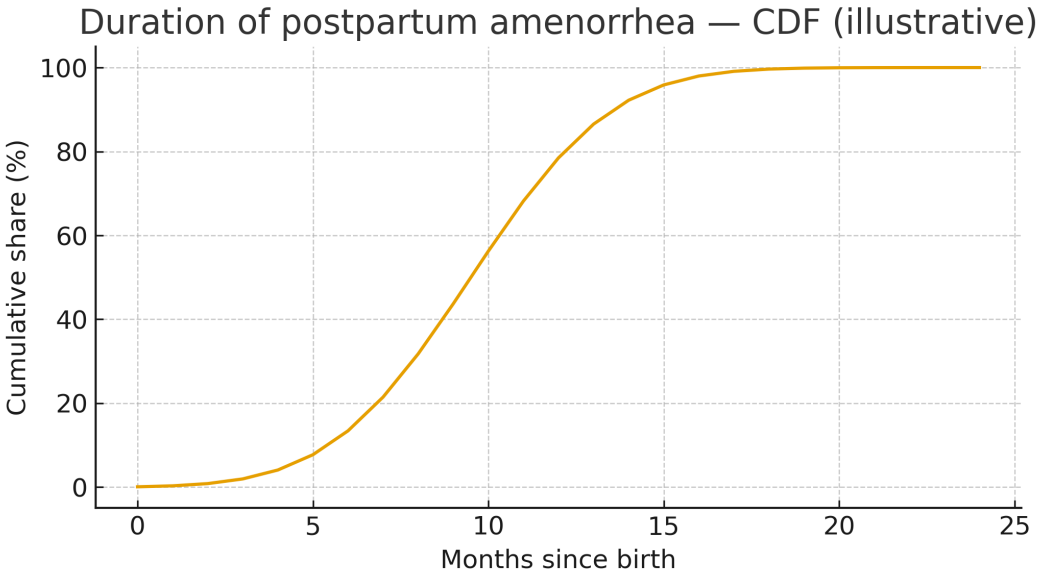

Figure. Postpartum abstinence duration — CDF

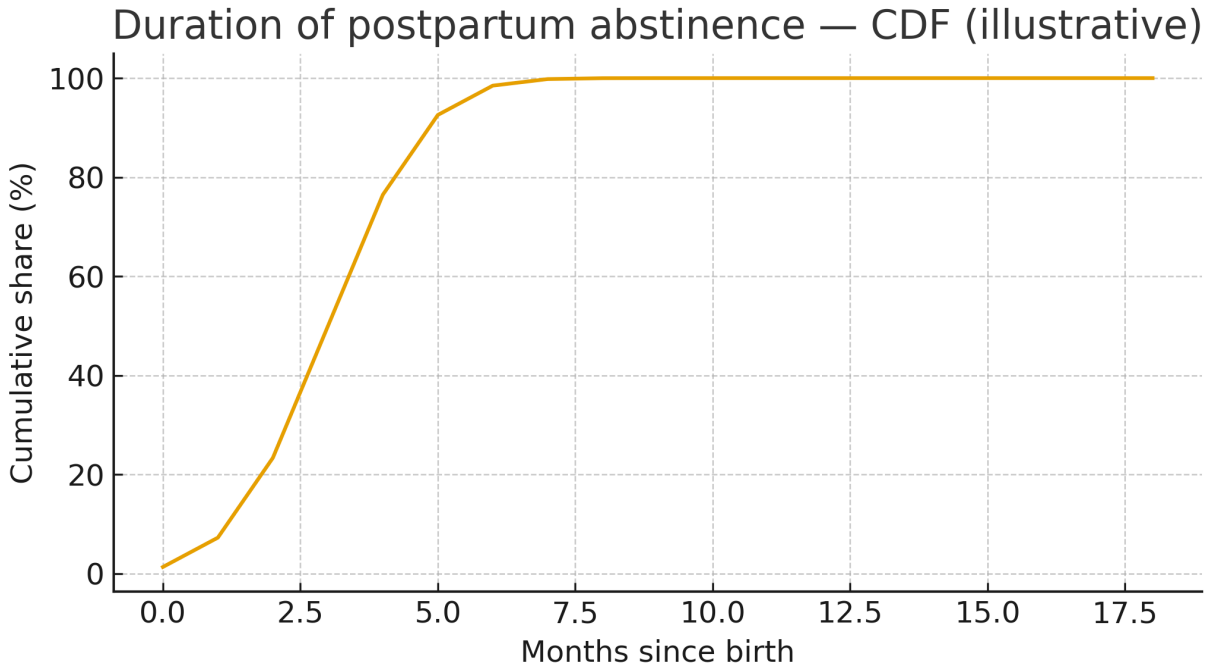

Figure . Distribution of preceding birth intervals

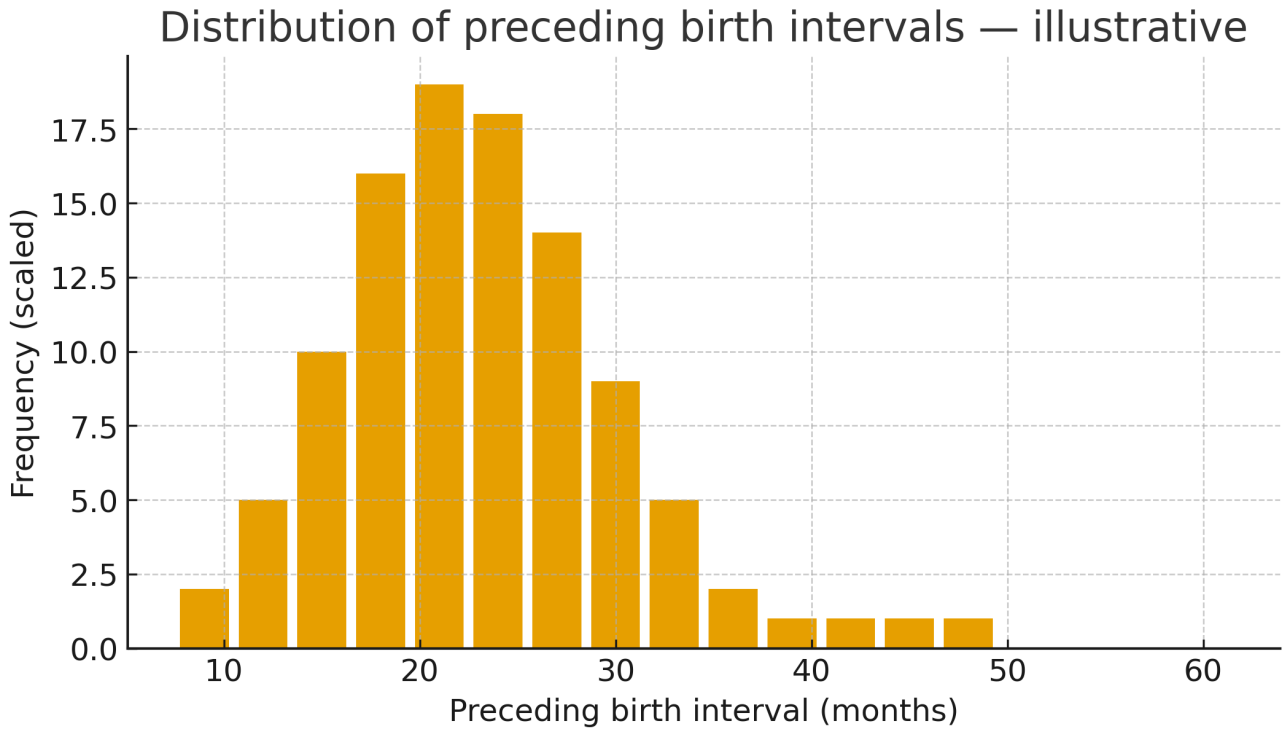

Figure . Hazard of next birth by months since last birth

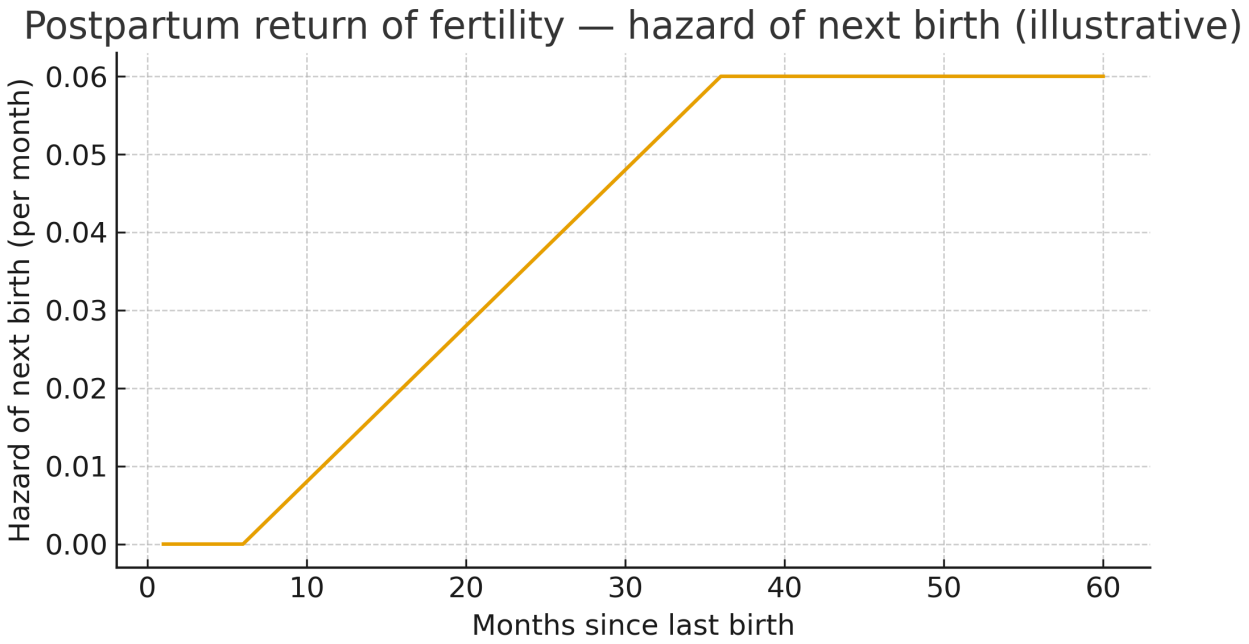

Figure . PPFP method mix over postpartum months

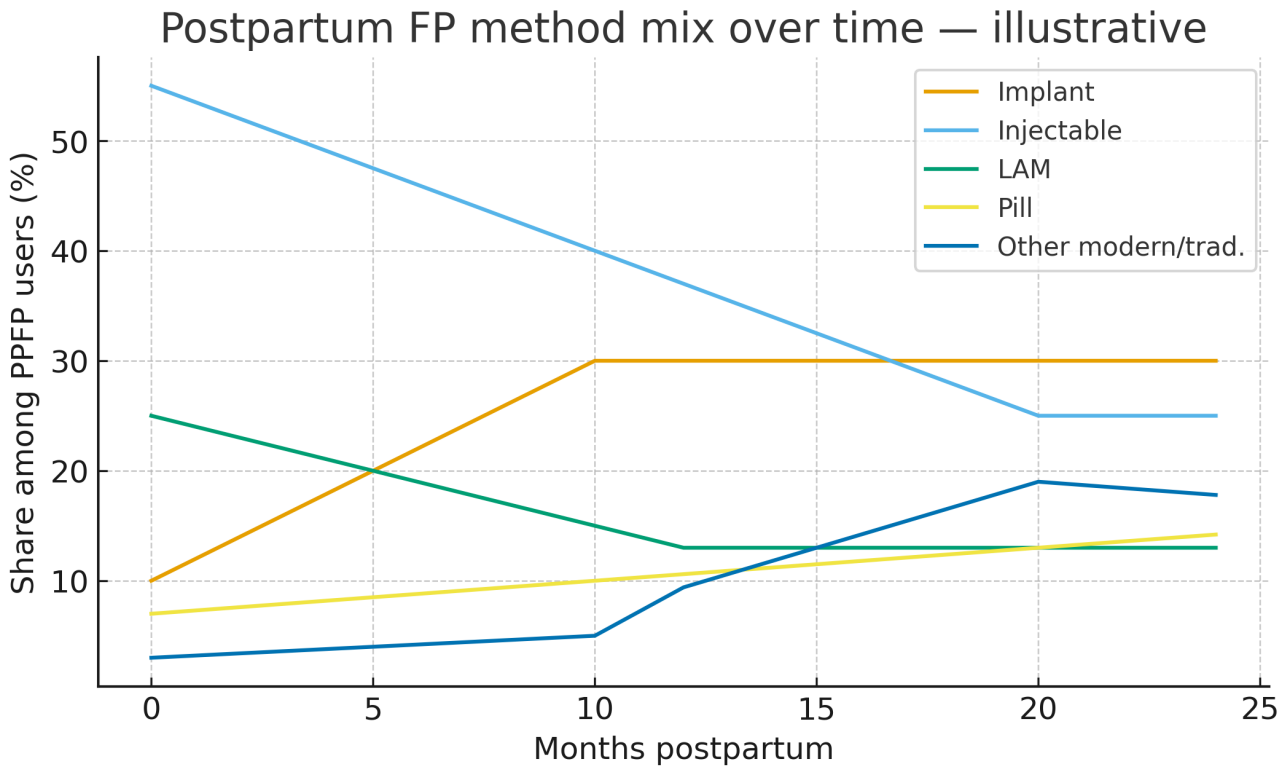

Table 5.10-A. Measures and definitions

Measure	Definition / computation
Postpartum insusceptibility (i)	Average months not at risk due to amenorrhea and/or abstinence (avoid double-count).
Bongaarts index (Ci)	Ci = 20 / (18.5 + i); higher i lowers exposure and reduces TF.
Closed birth interval	Months between a birth and the next birth.
Open interval hazard	Risk of next birth given months since last birth.
LAM	Effective first 6 months with full/near-full breastfeeding and amenorrhea; transition thereafter.

Table 5.10-B. Ci values by average months of insusceptibility

Average i (months)	Ci = 20/(18.5+i)
3.0	0.93
6.0	0.816
9.0	0.727
12.0	0.656
15.0	0.597
18.0	0.548

Table 5.10-C. Key medians (illustrative)

Indicator	Value
Median breastfeeding (months)	18.6
Median amenorrhea (months)	9.5
Median postpartum abstinence (months)	3.0

Table 5.10-D. Program levers for healthy spacing

Lever	Rationale
Immediate PPFP (facility)	Offer implants/IUD (where appropriate), injectables, counseling before discharge.
Community PPFP	CHW follow-up; multi-month refills; outreach to remote/pastoral areas.
Breastfeeding & LAM support	Strengthen EBF and clear LAM criteria; plan transition by 6 months.
Post-discontinuation support	Manage side-effects; enable switching without gaps.
EPI integration	Offer FP at child immunization contacts to reduce missed opportunities.

Table 5.10-E. Diagnostics & cautions

Issue	Action
Calendar recall/Imputation	Affects interval measures and LAM classification; document QA rules.
Interval censoring	Use survival methods for open intervals.
Denominators	Specify married vs all sexually active and postpartum subgroups.
Overlap of amenorrhea & abstinence	Avoid double-counting when estimating i.
Privacy	Aggregate reporting; avoid small-cell disclosure.

Notes & interpretation

• Illustrative medians: breastfeeding ≈ 18.6 months; amenorrhea ≈ 9.5 months; postpartum abstinence ≈ 3.0 months.

• For Bongaarts decomposition, compute i from observed durations (avoid double-counting), then apply $C_i = 20/(18.5+i)$.

• Healthy spacing (≥24 months between births) reduces maternal and child risks; monitor interval distributions and integrate PPFP at delivery/immunization.

References — Section 5.10

- Rutstein, S. O., & Rojas, G. (2006). Guide to DHS Statistics.

- DaVanzo, J., Hale, L., Razzaque, A., & Rahman, M. (2007). Effects of Interpregnancy Intervals on Infant and Child Mortality.

- Bongaarts, J., & Potter, R. G. (1983). Fertility, Biology, and Behavior.

- WHO (2005 & later). Birth spacing recommendations and PPFP guidelines.

5.11) Maternal, Newborn & Child Health Intersections

Purpose. Show the two-way links between fertility dynamics and MNCH in Ethiopia—coverage cascades, spacing and survival, adolescent births, and contact points for integrated postpartum family planning (PPFP).

Figure . MNCH coverage cascade by region

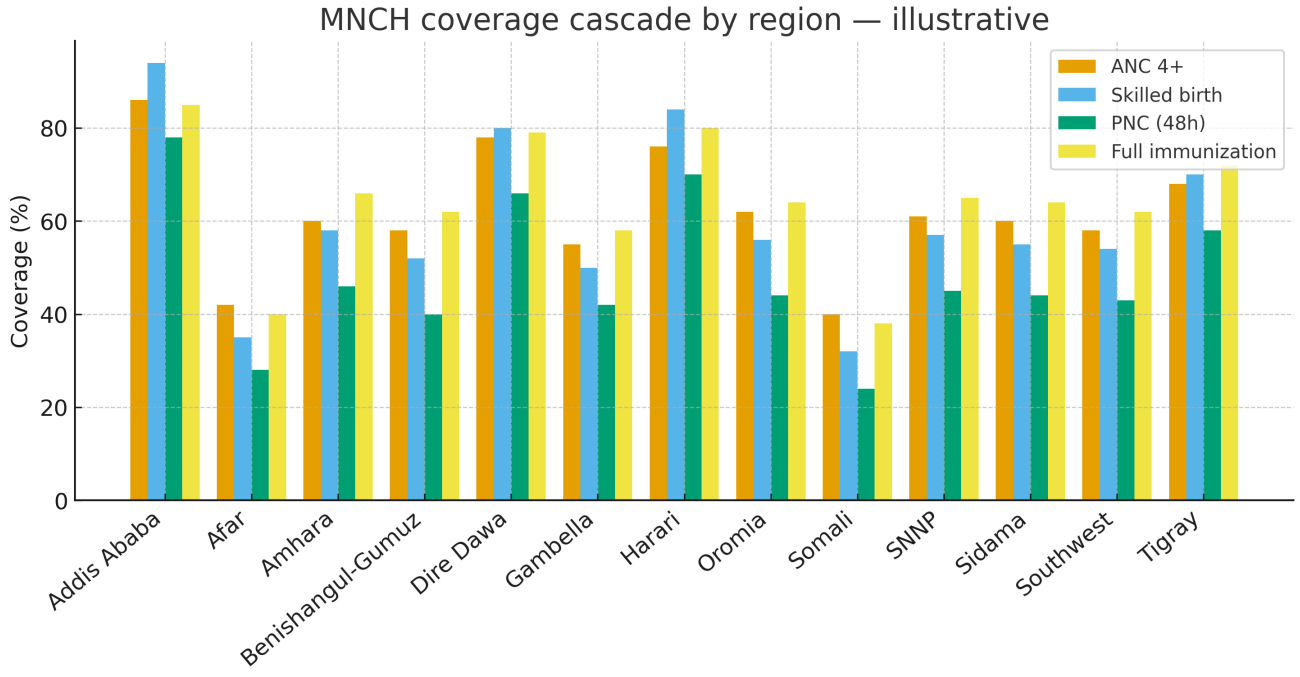

Figure . Stunting vs median birth interval (regional)

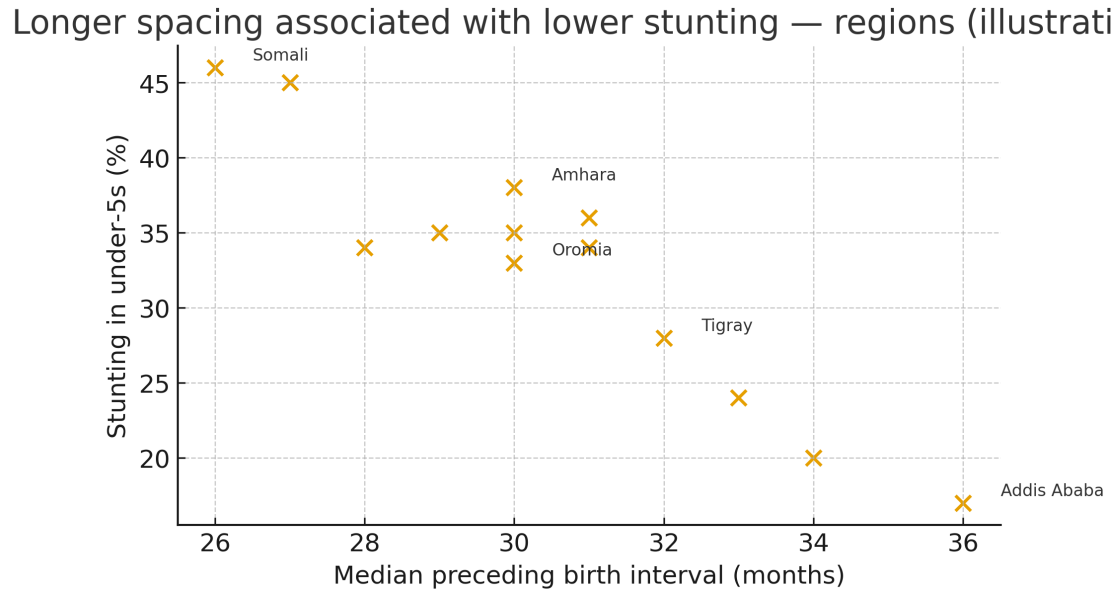

Figure . Under-5 mortality vs TFR (regional)

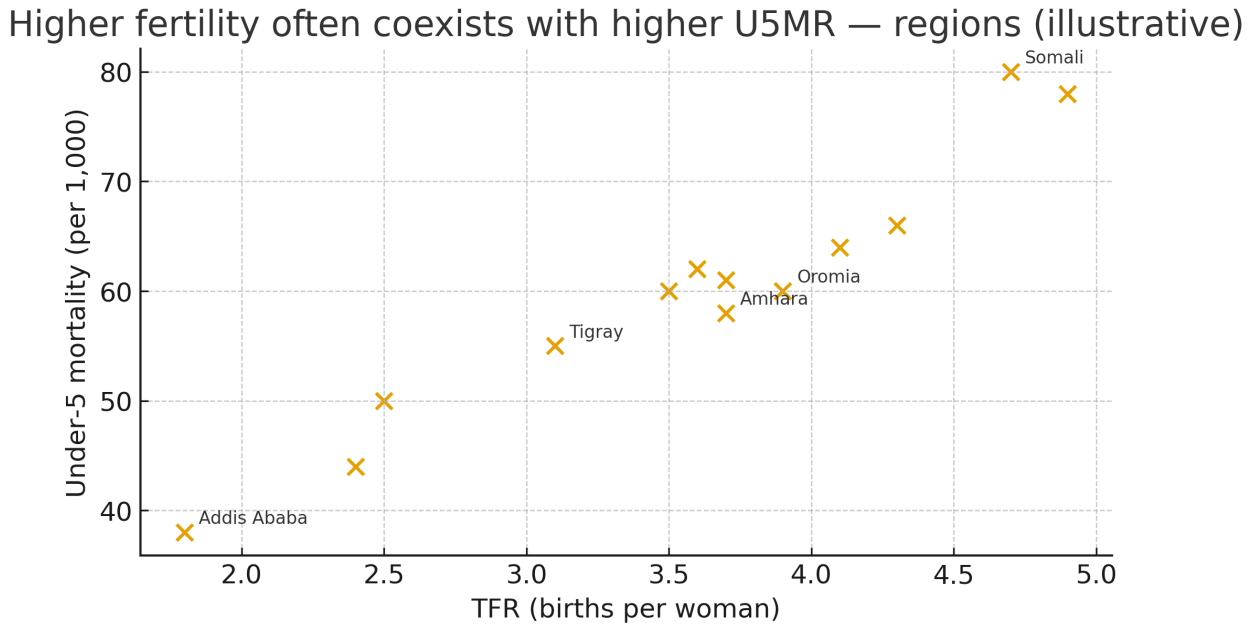

Figure . Distribution of births by maternal age

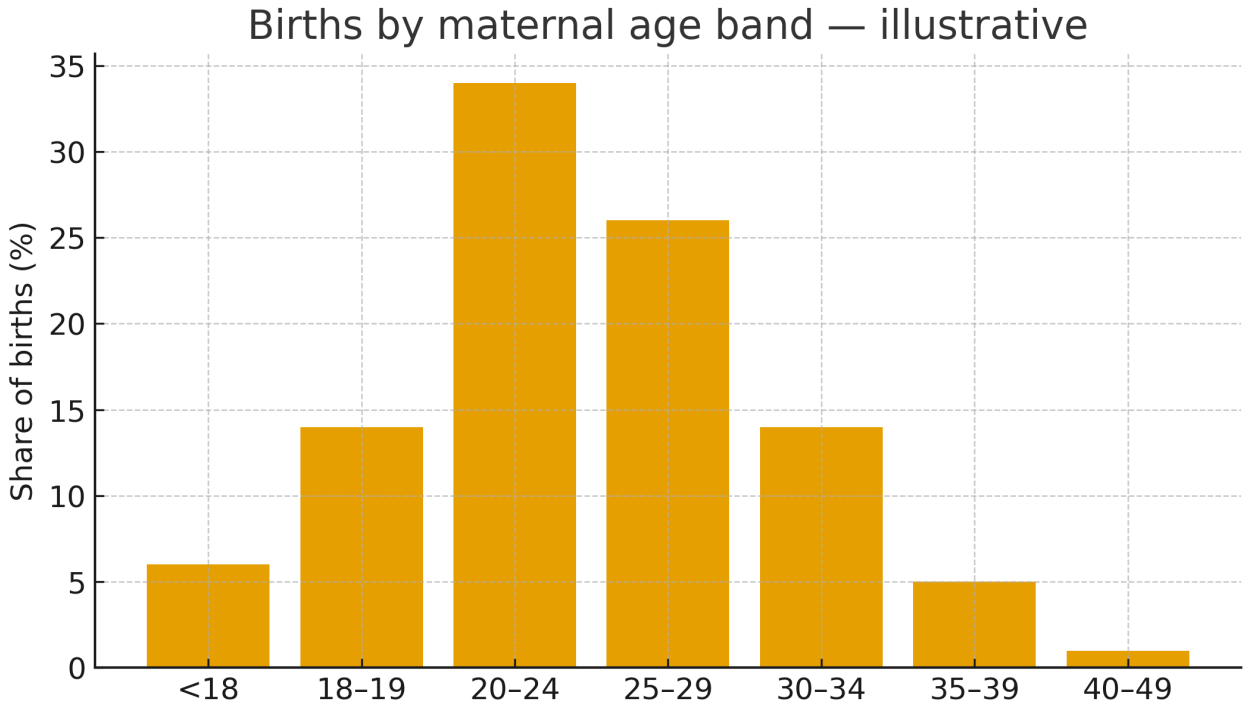

Figure . Adolescent birth rate trend

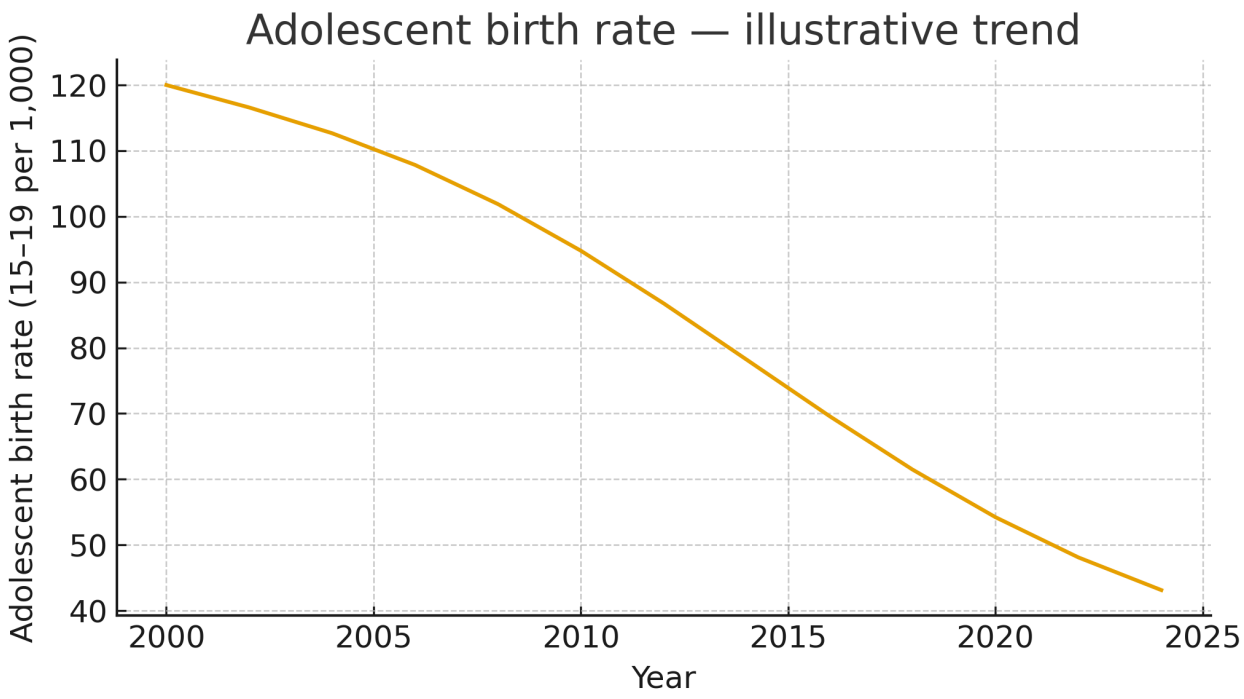

Figure . Low birth weight vs ANC 4+ coverage

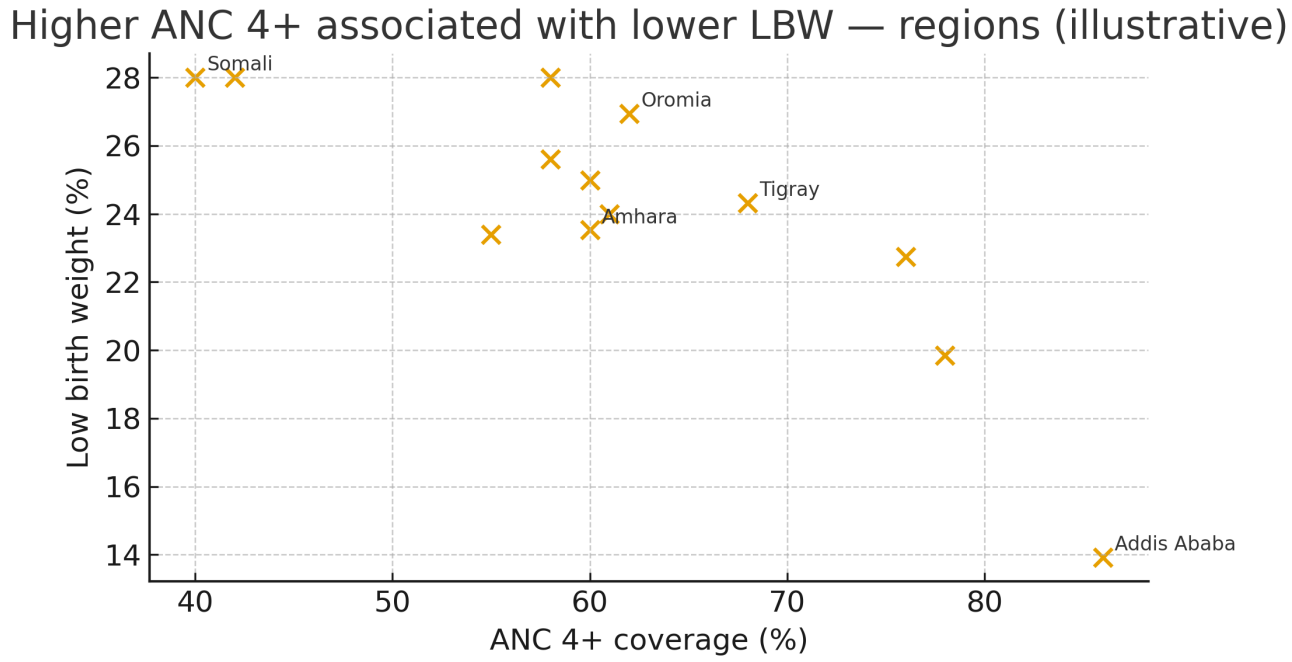

Table 5.11-A. Indicators and definitions

Indicator	Definition / computation
ANC 4+	% of recent births with ≥4 antenatal care visits
Skilled birth attendance / facility delivery	% of recent births with skilled attendant or in facility
Postnatal check (PNC) within 48h	% mothers/newborns checked within 2 days
Full immunization (12–23m)	% children receiving age-appropriate vaccines (per schedule)
Stunting (HAZ<-2)	% under-5 children with height-for-age z-score below −2
Under-5 mortality (U5MR)	Deaths under age 5 per 1,000 live births (modelled from full histories)
Median preceding birth interval	Months between a birth and the immediately preceding birth
Adolescent birth rate (ABR)	Births per 1,000 women 15–19
Low birth weight (LBW)	% of live births <2,500 g (or proxy from size at birth)

Table 5.11-B. Regional MNCH & fertility summary

Region	ANC 4+ (%)	Skilled birth (%)	PNC 48h (%)	Full imm. (%)	Stunting (%)	U5MR (per 1,000)	TFR	Median interval (months)
Addis Ababa	86	94	78	85	17	38	1.8	36
Afar	42	35	28	40	45	78	4.9	27
Amhara	60	58	46	66	38	58	3.7	30
Benishangul-Gumuz	58	52	40	62	35	64	4.1	29
Dire Dawa	78	80	66	79	24	50	2.5	33
Gambella	55	50	42	58	34	66	4.3	28

Harari	76	84	70	80	20	44	2.4	34
Oromia	62	56	44	64	33	60	3.9	30
Somali	40	32	24	38	46	80	4.7	26
SNNP	61	57	45	65	36	62	3.6	31
Sidama	60	55	44	64	34	60	3.5	31
Southwest	58	54	43	62	35	61	3.7	30
Tigray	68	70	58	72	28	55	3.1	32

Table 5.11-C. Pathways linking fertility and MNCH

Pathway	Implication
Healthy spacing → child survival	Longer intervals reduce low birth weight, preterm, and sibling competition.
MNCH access → postpartum FP	Facility delivery/PNC contacts enable PPFP counseling and uptake.
Lower U5MR → lower desired fertility (long-run)	Child survival improvements reduce insurance-motive for high fertility.
Adolescent births → higher risks	Elevated obstetric and neonatal risks; schooling disruption; higher lifetime fertility.
Immunization platform → FP touchpoints	Co-delivery of services reduces missed opportunities for counseling/supplies.

Table 5.11-D. Program levers for integration

Lever	Action focus
Immediate postpartum FP (before discharge)	Offer a choice incl. LARC; ensure counseling and informed consent.
Integrated contacts	Bundle FP with ANC (3rd visit), PNC, and EPI sessions; appointment reminders.
Adolescent-friendly MNCH	Privacy/confidentiality; flexible hours; link to CSE and school retention.
Community outreach	Health extension workers/mobile teams for remote/pastoral settings.
Quality improvement	Stock management, respectful maternity care, and client-centered counseling (MII metrics).

Table 5.11-E. Diagnostics & cautions

Issue	Action
Denominators / definitions	Align married vs all sexually active; indicator definitions across rounds.
Confounding & causality	Ecological plots are descriptive; use multi-level models to test mechanisms.
Recall / measurement	Birth histories, birth weight heaping, and size-at-birth proxies can bias estimates.
Small cells	Aggregate across years/regions where necessary; present uncertainty.
Ethics & equity	Protect privacy; avoid stigmatizing high-risk groups; focus on service solutions.

Notes & interpretation

• Integrated MNCH–FP contacts (delivery, PNC, EPI) are critical opportunities for PPFP and spacing.

• Regional heterogeneity is large; pair coverage plots with access (travel time) and quality metrics (MII, stock-outs).

• Adolescent births carry elevated risks; combining CSE, school retention, and youth-friendly services is essential.

References — Section 5.11

- Rutstein, S. O., & Rojas, G. (2006). Guide to DHS Statistics.

- WHO recommendations on ANC, intrapartum, and postnatal care; child immunization schedules.

- DaVanzo, J., Hale, L., Razzaque, A., & Rahman, M. (2007). Interpregnancy intervals and mortality.

- Ethiopia MOH/CSA reports on MNCH and FP (various years).

5.12) Shocks, Conflict & Resilience

Purpose. Summarize how shocks (conflict, drought, displacement) interact with fertility and FP/MNCH services in Ethiopia, and outline analytic strategies and resilience levers. Figures/tables are templates — replace with official estimates.

Figure . Shocks and facility functionality over time

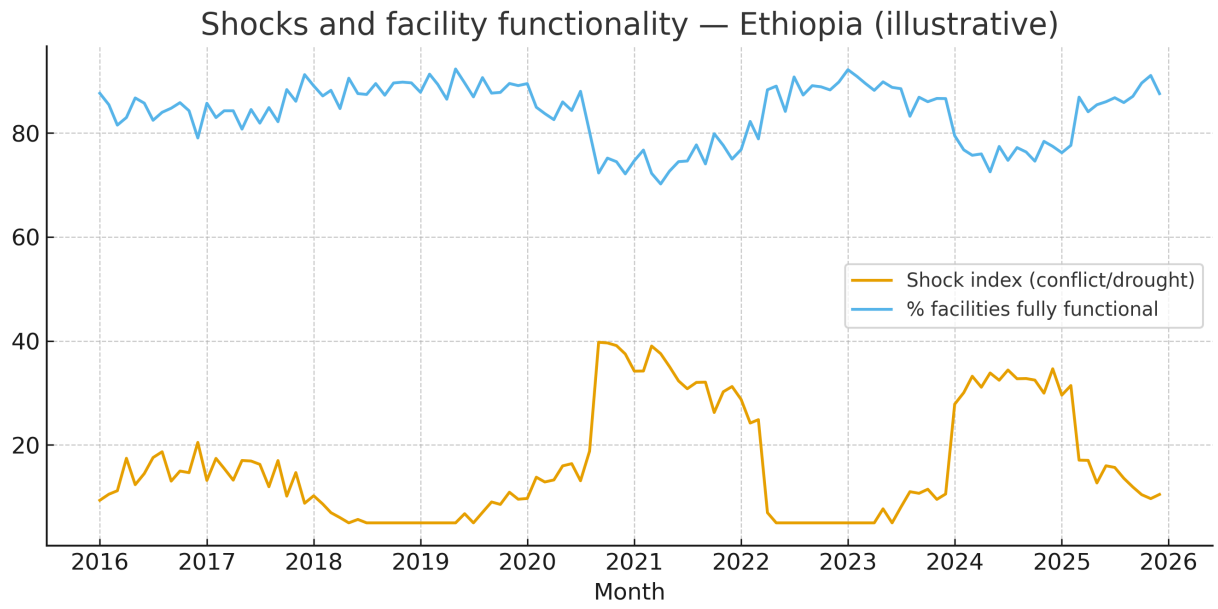

Figure . Coverage indicators (mCPR & ANC4) under shocks

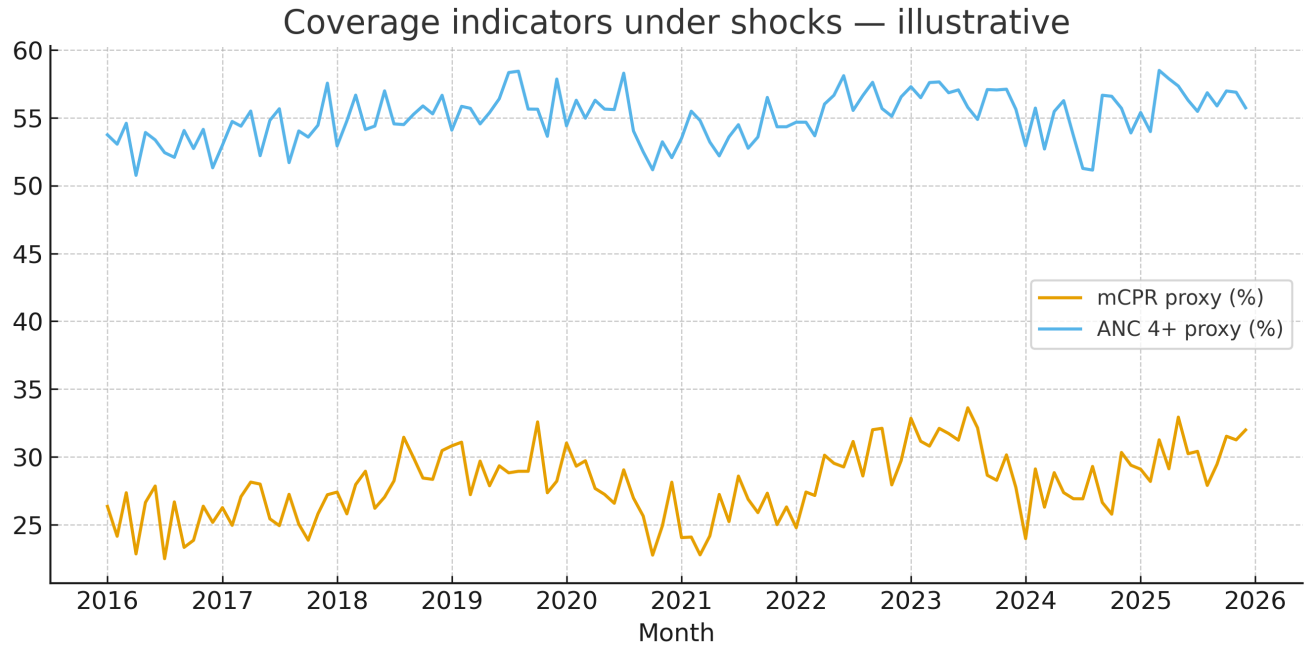

Figure . Birth seasonality and disruption

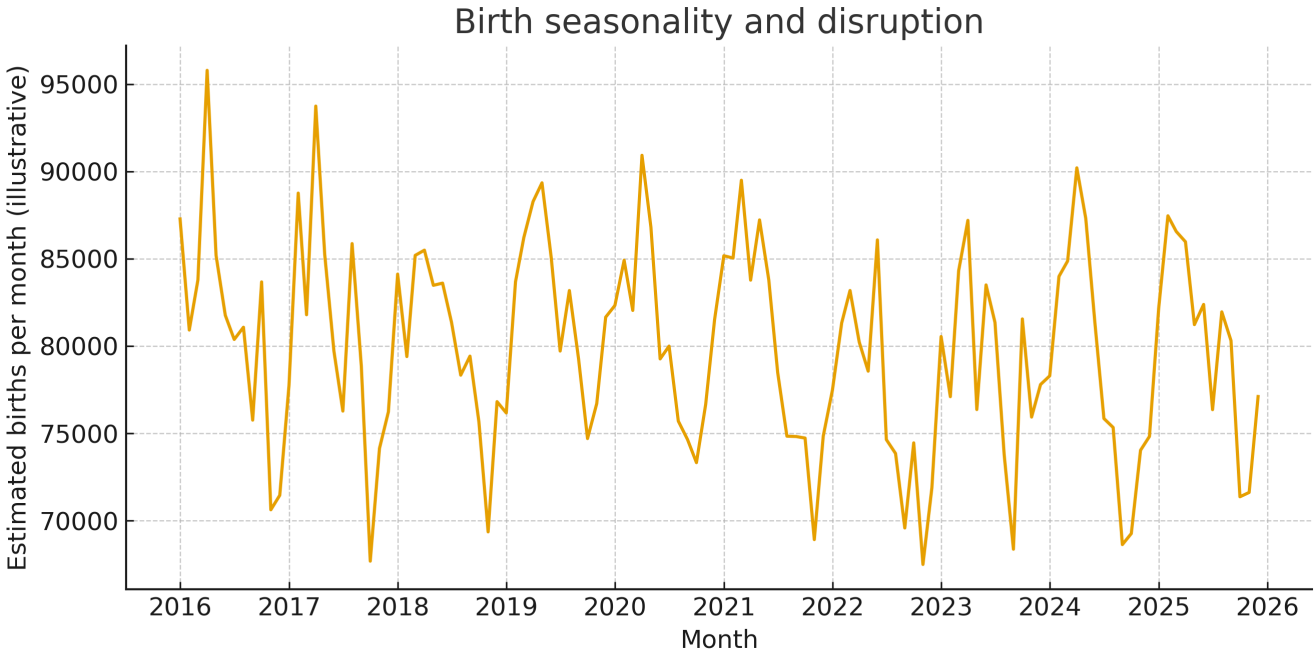

Figure . Displacement vs FP coverage — 2024 snapshot

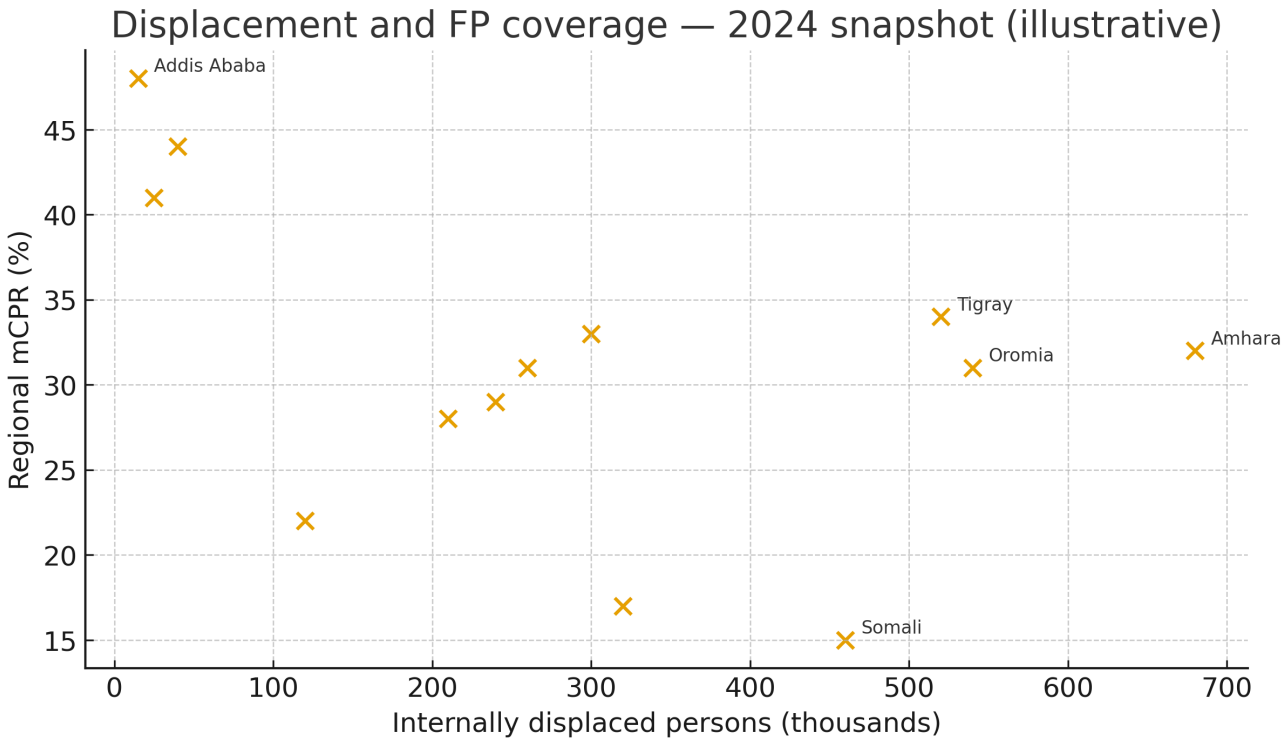

Figure . FP stock-outs during shocks

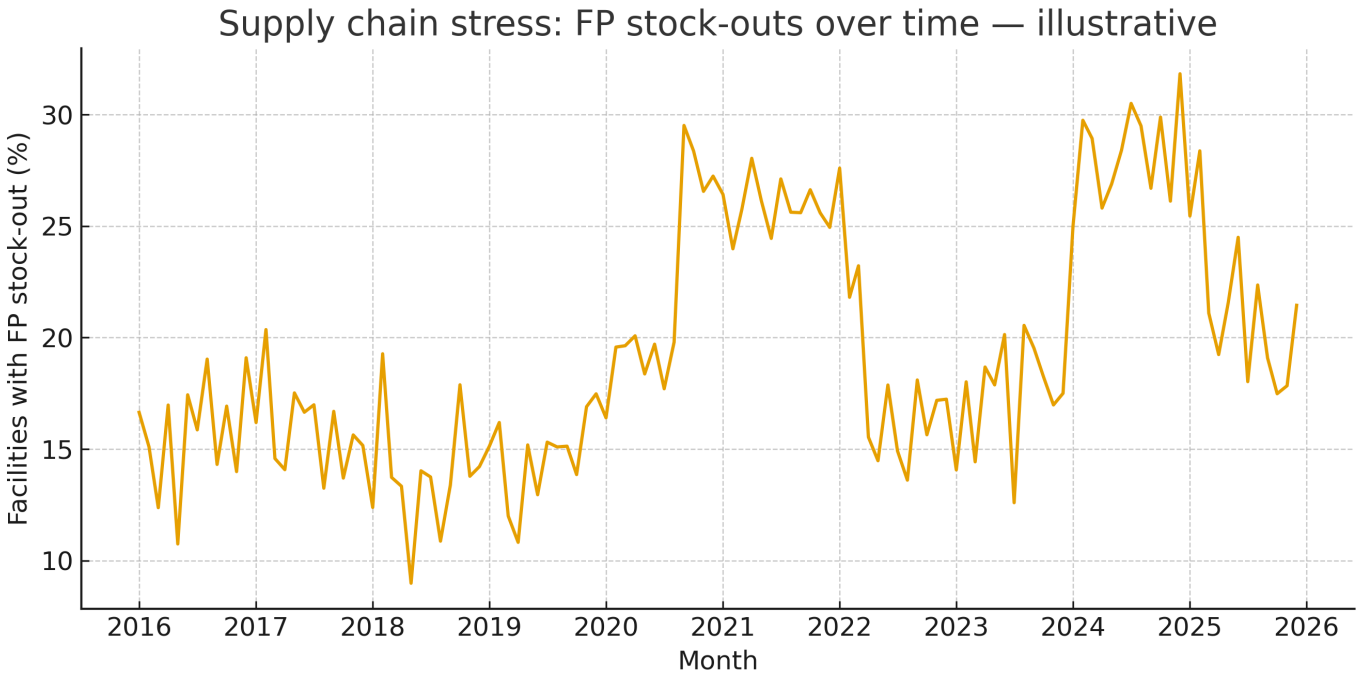

Figure . Early marriage prevalence with shock-related spikes

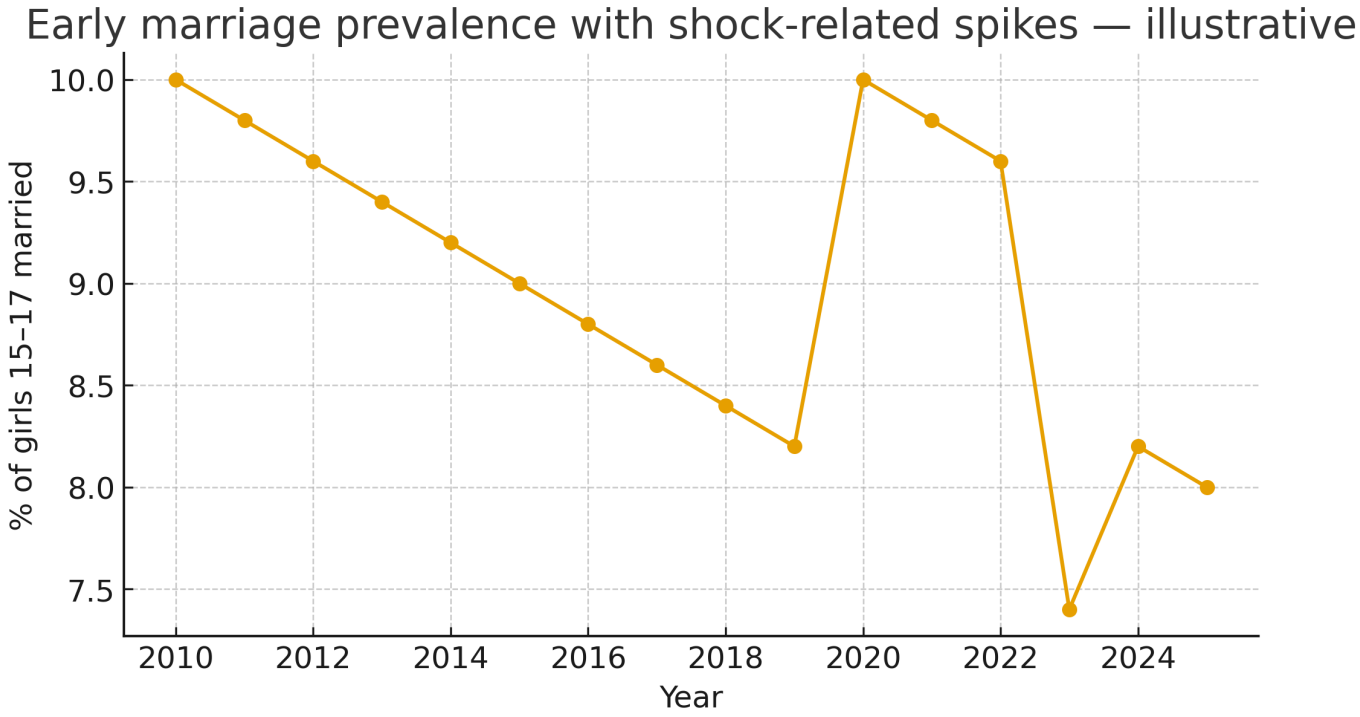

Figure . Resilience inputs vs recovery time (bubble)

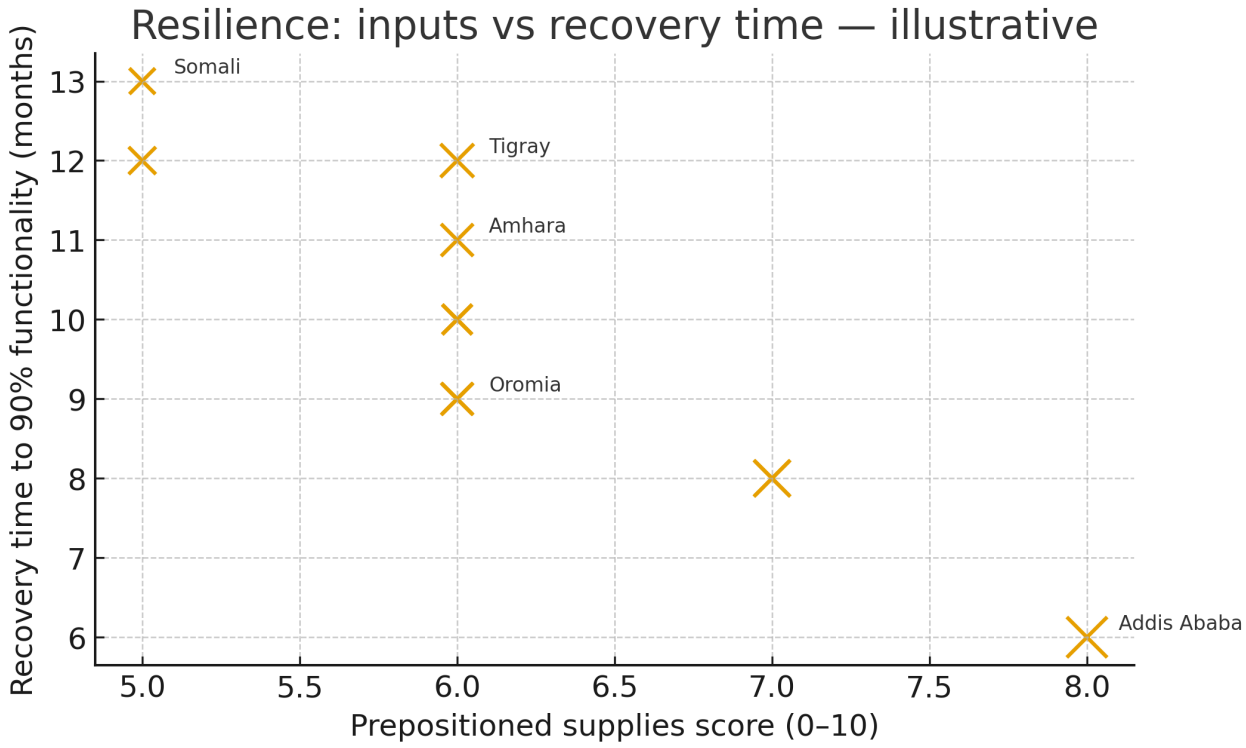

Table 5.12-A. Indicators and definitions

Indicator	Definition / computation
Shock index	Composite of conflict events, displacement, and drought severity (normalized).
Facility functionality	Share of health facilities reporting fully functional services.
mCPR / ANC4	Coverage proxies subject to service disruptions and access barriers.
Stock-out rate	% facilities with ≥1 contraceptive stock-out in last 3 months.
Displacement (IDPs)	Population displaced within country; regionally disaggregated.
Resilience / recovery time	Months to restore ≥90% of pre-shock functionality.

Table 5.12-B. Regional displacement & service snapshot (2024)

Region	IDPs (thousands)	mCPR (%)	Functional facilities (%)
Addis Ababa	15	48	90
Afar	320	17	62
Amhara	680	32	58
Benishangul-Gumuz	210	28	60
Dire Dawa	40	44	78
Gambella	120	22	64
Harari	25	41	75
Oromia	540	31	66
Somali	460	15	55
SNNP	300	33	61
Sidama	260	31	60
Southwest	240	29	59
Tigray	520	34	63

Table 5.12-C. Approaches to quantify shock impacts

Approach	Notes
Interrupted time series (ITS)	Model level and slope changes at shock onset; include seasonality and autocorrelation.
Difference-in-differences	Compare more/less affected regions/districts pre/post shock; check parallel trends.
Event study	Dynamic treatment effects across leads/lags to inspect anticipation and recovery paths.
Synthetic control	Construct counterfactual for highly affected region using donor pool of others.

Small-area estimation	Fuse surveys, admin and satellite data to map impacts on coverage/outcomes.
Survivorship correction	Adjust for population displacement and sample frame disruptions.

Table 5.12-D. Resilience levers

Lever	Action focus
Prepositioning & last-mile logistics	Buffer stocks; multi-month dispensing; mobile depots in pastoral/remote areas.
Flexible service delivery	Mobile/outreach teams; community distribution; tele-referrals.
Continuity of care	Defaulter tracking; interoperable health IDs; SMS reminders.
Provider surge & safety	Rapid rosters; PPE; mental-health support; hazard allowances.
Data systems	Rapid monitoring via DHIS2/pulse surveys; satellite proxies (night lights, roads).

Table 5.12-E. Diagnostics & ethics

Issue	Action
Measurement under conflict	Missingness, biased reporting, and area inaccessibility; use multiple sources.
Attribution caveats	Multiple concurrent shocks (drought, conflict, epidemics); avoid over-attribution.
Protection & do-no-harm	Suppress small-area outputs that could stigmatize/target communities.
Equity lens	Track recovery gaps for adolescents, IDPs, and remote/pastoral populations.
Open data & privacy	Anonymize, aggregate, and comply with data sharing rules.

Notes & interpretation

• Service coverage drops and stock-outs tend to co-move with shocks; quantify rebound speed and equity gaps.

• Displacement complicates denominators and sampling; triangulate admin, survey, and satellite data.

• Protect communities: anonymize and aggregate outputs; prioritize do-no-harm in dissemination.

References — Section 5.12

- Rutstein, S. O., & Rojas, G. (2006). Guide to DHS Statistics.

- WHO Health Emergency & Disaster Risk Management (H-EDRM) guidance.

- UNOCHA & IOM DTM technical notes on displacement metrics.

- FP2030/PMI & MOH Ethiopia: service continuity and supply chain guidance in emergencies.

5.13) Data Gaps, Uncertainty & Research Priorities

Purpose. Provide an uncertainty-first view of Ethiopia's fertility evidence base: what is missing, how uncertain we are, how to triangulate, and priority studies to close gaps. Figures are templates to be replaced by official estimates.

Figure . TFR with uncertainty bands

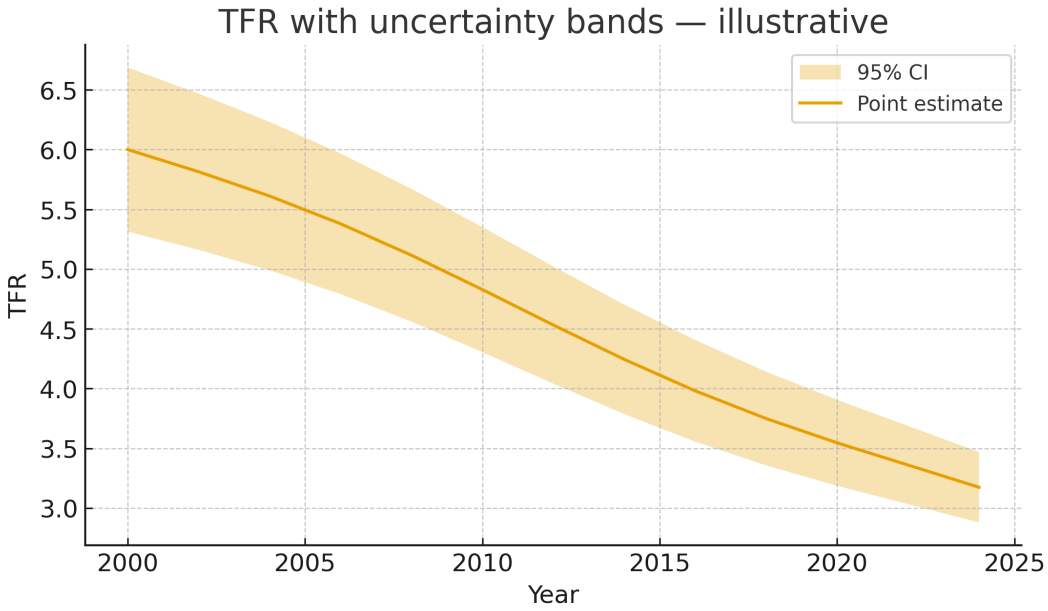

Figure . Sensitivity of TFR to ASFR errors by age group

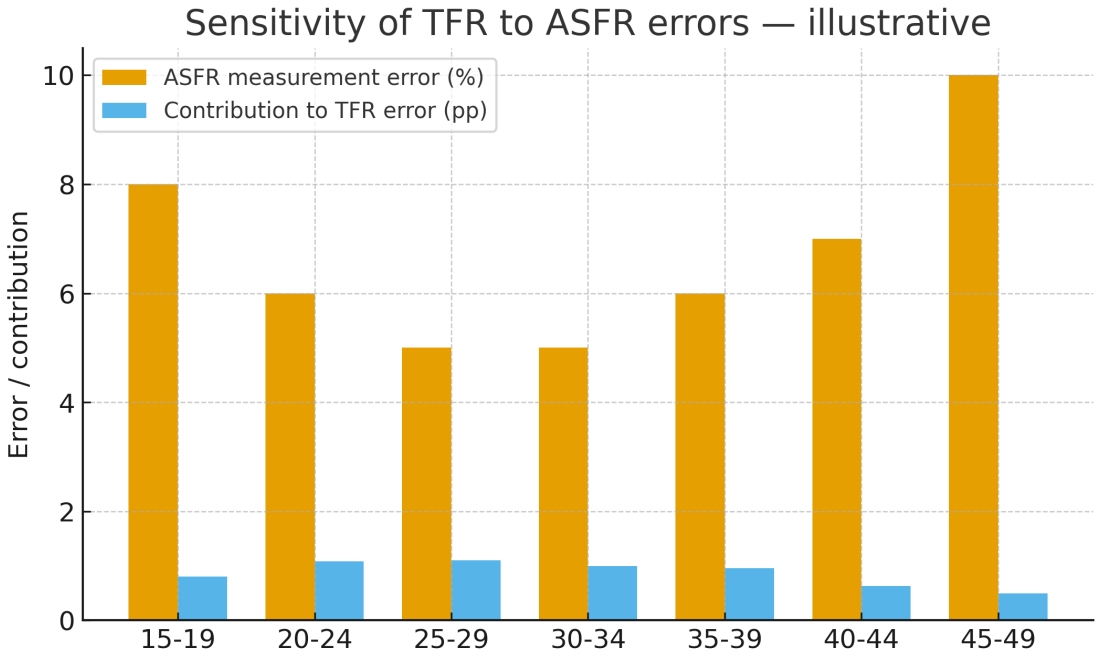

Figure . Small-area estimation uncertainty by region

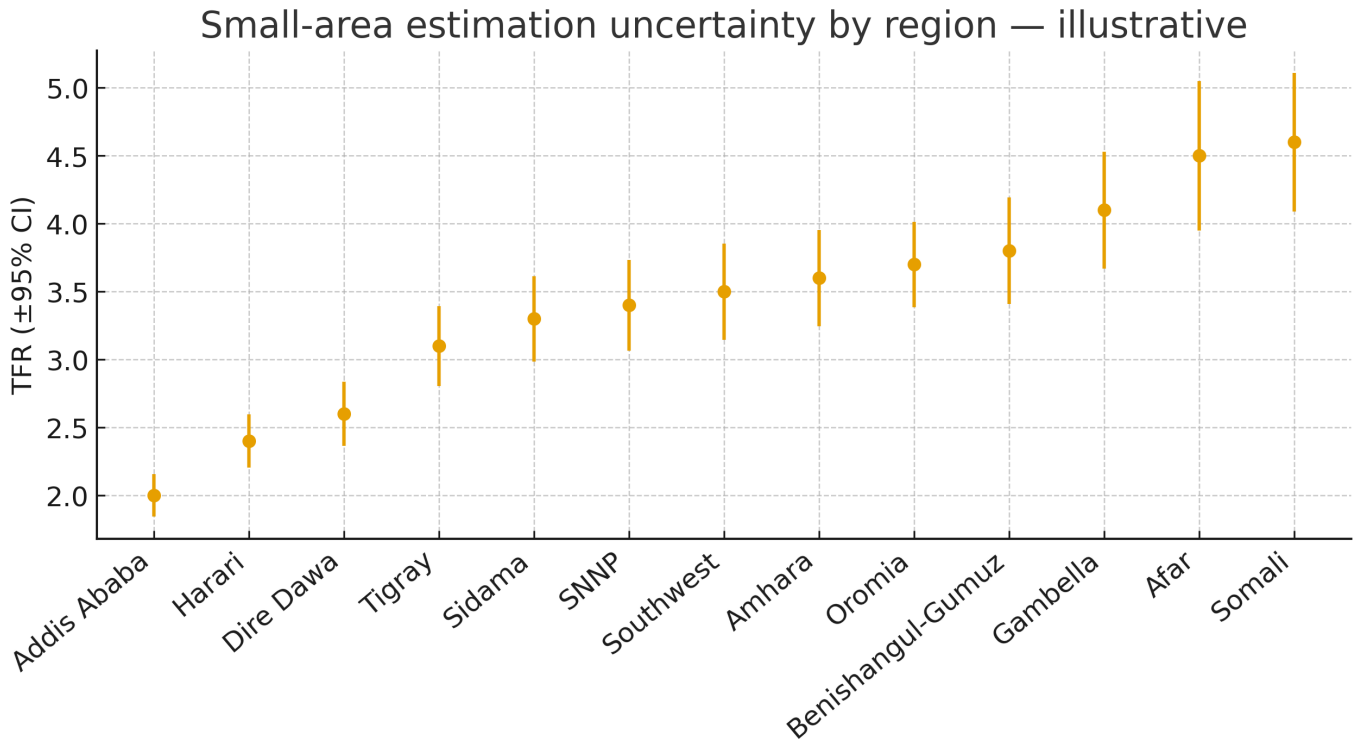

Figure . Research pipeline timeline

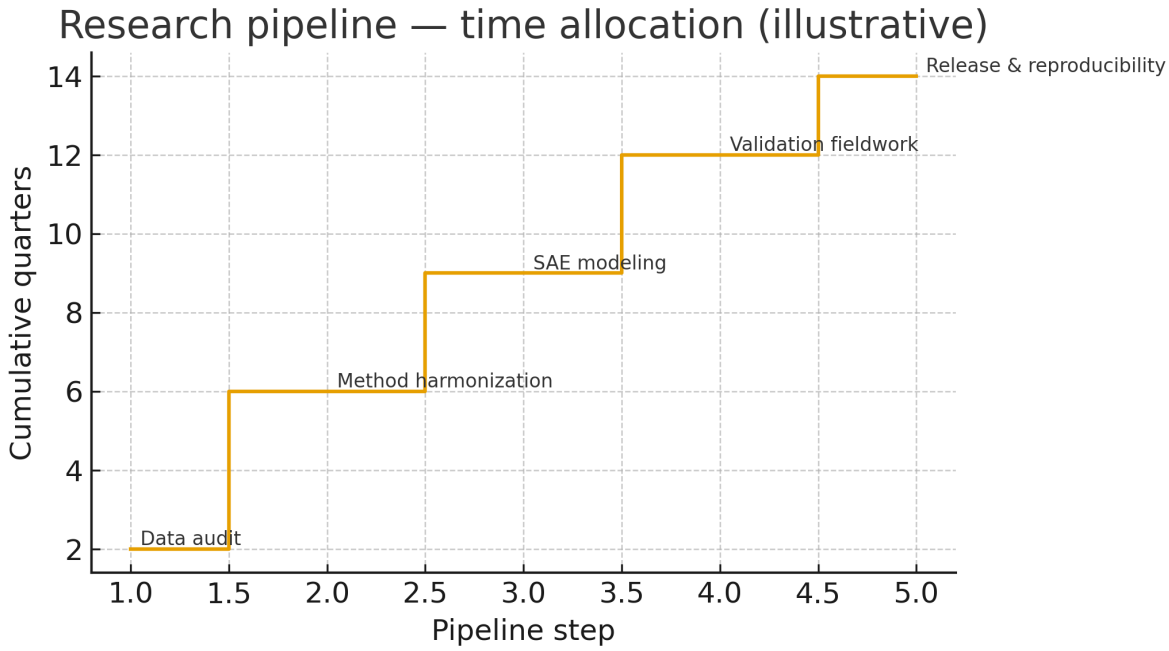

Table 5.13-A. Uncertainty sources and mitigation

Uncertainty source	Mitigation strategy
Sampling variance	Use design weights and replicate weights; present 95% CIs.
Non-sampling error (recall/heaping)	Imputation diagnostics; heaping correction; sensitivity tests.
Coverage gaps (insecurity/remote)	Small-area estimation with spatial priors; satellite covariates; uncertainty maps.
Frame error (displacement)	Adjust denominators; triangulate with admin/DTM and night-lights.
Measurement inconsistency	Harmonize definitions (married vs sexually active); crosswalks across rounds.
Model misspecification	Out-of-sample validation; k-fold cross-validation; posterior predictive checks.
Bias from missing not at random	Selection models; bounded estimates; tipping-point analyses.

Table 5.13-B. Validation & triangulation plan

Triangulation axis	Checks & actions
Household↔Facility linkage	Compare use with method availability/stock-outs; travel time gradients.
Admin vs survey coverage	Reconcile trends (DHIS2 vs DHS/PMA); adjust for reporting delays and scale.
Modelled gridded vs survey density	Check population denominators against WorldPop/GHS-POP; reweight if needed.
Births & deaths vital signals	Use CRVS completeness, HMIS deliveries, and satellite night-lights as proxies.
Geospatial plausibility	Edge checks at borders, lakes, and uninhabitable areas; ensure masks are applied.

Table 5.13-C. Priority data gaps for Ethiopia

Gap	Why it matters / what to improve
Pastoral/remote enumeration	Under-count of mobile populations; expand listing, satellite-assisted frames.
Vital events completeness	CRVS and facility reporting incomplete; phased completeness audits.
Men/adolescents modules	Limited male/adolescent SRH modules; enhance consent/privacy protocols.
Service quality and continuity	Facility readiness and MII not routinely tracked sub-regionally.
Migration & displacement	Incomplete person-time denominators for IDPs/returnees; need integrated registers.
Longitudinal follow-up	Panel data for intentions→adoption and postpartum trajectories are scarce.

Table 5.13-D. Research priorities & study designs

Question	Suggested design & outcomes
PPFP effectiveness in routine systems	Stepped-wedge or phased rollout; outcomes: spacing, continuation, healthy intervals.
Education shocks & fertility	Natural experiments (school closures/conflict); outcomes: AFM/AFS, parity progression.
Resilience interventions	Cluster RCTs of prepositioning/mobile teams; outcomes: coverage continuity, stock-outs.
Small-area fertility mapping	Bayesian SAE fusing DHS/PMA/admin/satellite; district-level FP need estimates.
Digital data quality tools	Field-ready heaping diagnostics and adaptive sampling apps; measure impact on bias.

Table 5.13-E. Reporting templates & reproducibility

Practice	Notes
Code & data versioning	Public repos (as permitted); containerized environments; metadata.
Open methods appendix	Share model specs, priors, diagnostics, and sensitivity results.
Uncertainty-first graphs	Always pair point estimates with CIs or posterior intervals.
Ethical review	IRB or ethics clearance; anonymization & aggregation for small areas.
Documentation	Read-me, data dictionaries, and reproducible notebooks.

Notes & cautions

• Always report uncertainty: confidence/posterior intervals and sensitivity to key assumptions.

• Use multiple data sources and document reconciliation rules; publish code and metadata for reproducibility.

• Ethics first: anonymize microdata, suppress small cells, and avoid harm in fragile settings.

References — Section 5.13

- Rutstein, S. O., & Rojas, G. (2006). Guide to DHS Statistics.

- United Nations (2017). Principles and Recommendations for Population and Housing Censuses.

- WorldPop / GHS-POP documentation; PMA/DHS methodological reports.

Glossary & Reference URLs for Chapters 4–5

Glossary of Terms (Chapters 4–5)

Term	Definition / Notes
Age-Specific Fertility Rate (ASFR)	Births to women in age group x per 1,000 women in that age group in a period (usually 1 year).
General Fertility Rate (GFR)	Births per 1,000 women of reproductive age (15–49) in a year.
Total Fertility Rate (TFR)	Sum of ASFRs across ages × (age-interval width), approximating the average number of births a woman would have if exposed to current age-specific rates throughout her childbearing years.
Gross Reproduction Rate (GRR)	Average number of daughters a woman would bear if she experienced current ASFRs and the current sex ratio at birth, ignoring mortality.
Net Reproduction Rate (NRR)	Average number of daughters a cohort of newborn girls would bear over their lifetimes if subject to current ASFRs and female survival rates; NRR≈1 implies replacement.
Cohort Fertility (Completed Fertility)	Total number of births to a real cohort of women by the end of their reproductive years (often at age 45–49).
Median Age at First Birth (AFB)	Age by which 50% of women have had a first live birth.
Median Age at First Marriage/Union (AFM)	Age by which 50% of women (or men) are first married/in union; specify definition of union.
Marital Fertility Rate	Births per 1,000 married/in-union women (15–49).

Wanted TFR (WTFR)	TFR computed counting only births reported as wanted at the time of conception.
Unwanted Fertility	Portion of fertility above the WTFR; births reported as unwanted at conception (mistimed vs unwanted distinguished when possible).
Unmet Need for Family Planning	Women who wish to delay or limit childbearing but are not using contraception, per DHS revised definition (2012).
Modern Contraceptive Prevalence Rate (mCPR)	Share (%) of women using a modern contraceptive method; denominator must be explicit (married vs all sexually active).
Method Mix	Distribution (%) of contraceptive methods among current users.
Method Information Index (MII)	Quality-of-counseling proxy: % of users told about side-effects, what to do, and other methods.
Postpartum Insusceptibility (i)	Average months postpartum not at risk of conception due to amenorrhea and/or abstinence (avoid double-counting overlaps).
Bongaarts Index of Postpartum Infecundability (Ci)	Reduction factor for fertility due to postpartum insusceptibility: Ci = 20 / (18.5 + i).
Lactational Amenorrhea Method (LAM)	A method effective in the first 6 months postpartum when breastfeeding is exclusive or near-exclusive and menses have not returned.
Birth (Preceding) Interval	Months between a birth and the next birth; healthy spacing is typically ≥24 months.
Adolescent Birth Rate (ABR)	Births per 1,000 women aged 15–19 in a year.

Under-5 Mortality Rate (U5MR)	Deaths under age 5 per 1,000 live births.
Low Birth Weight (LBW)	Live births weighing <2,500 g (or proxy from size-at-birth where measured).
Postpartum Family Planning (PPFP)	Family planning provided during the first 12 months after childbirth (immediate, early, and extended postpartum).
Continuation / Discontinuation (12-month)	Share of contraceptive users who continue (or discontinue) a method within 12 months; reasons include side-effects, access, failure, desire for pregnancy, etc.
Typical-Use Failure Rate	Pregnancies per 100 woman-years under typical use (includes incorrect and inconsistent use).
Service Availability & Readiness	Facility capacity to deliver services, measured via tracer indicators (guidelines, trained staff, equipment, medicines, commodities).
Stock-out Rate	Share of facilities with ≥1 stock-out of a given commodity in a defined period (e.g., last 3 months).
Internally Displaced Persons (IDPs) / Returnees	People displaced within a country due to conflict or disaster; returnees are those returning to places of origin.
Health Emergency & Disaster Risk Management (Health-EDRM)	WHO framework for managing health risks across prevention, preparedness, response, and recovery.

Core Formulas (quick reference)

Quantity	Formula
ASFR_x	ASFR_x = (Births to women aged x to x+n in year) / (Women aged x to x+n) × 1,000
GFR	GFR = (Total births in year) / (Women aged 15–49) × 1,000
TFR	TFR = Σ_x (ASFR_x) × (age-interval width, e.g., 5 years) / 1,000
GRR	GRR = TFR × (Proportion female at birth)
NRR	NRR = Σ_x (ASFR_x × l_x × proportion female at birth) / 1,000 (l_x = female survival to age group x)
Bongaarts Ci	Ci = 20 / (18.5 + i), where i is average months of postpartum insusceptibility