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Rural Thai Social Setting and Family Planning Activity: Effects on Female Sterilization

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Introduction

Over the last three decades fertility in Thailand has declined from a Total Fertility Rate (TFR) of over 6 in the early 1980s (National Research Council, 1980) to well under 3 by the mid-1980s (Bennett and Chamratrithirong, 1988), while recent evidence suggests that further declines may have taken TFR to below 2 by the end of the 1980s (Hirschman et al. nd).

The fertility decline in Thailand has been almost entirely a result of fertility reductions within marriage with only limited changes due to later marriage, or a smaller proportion of women marrying (Knodel et al. 1987; Limanonda, 1988). During the 1970s acceptance of family planning spread rapidly throughout Thai society. The contraceptive prevalence rate of approximately 15 per cent in 1970 had increased to over 70 per cent by the end of the 1980s. Over the same period a substantial difference in urban and rural levels of contraceptive use was eliminated.

There is quantitative and qualitative evidence to indicate that the Thai Family Planning Program played a major role in the rapid increases in contraceptive levels (Knodel et al. 1987; Bennett et al. 1990). But not established are the factors of the program that were most important in contributing to the success. The effects on contraceptive use of the relationships between family planning program efforts and the social setting where the efforts took place is also not at all clear.

The need to clarify the relationships between program effort and social setting are of particular importance in Thailand as it has been forcefully argued that the rapid diffusion of low fertility norms and the acceptance of family planning have resulted from the favorable social and cultural setting of Thailand (Knodel et al. 1987). A

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previous study undertaken by Chamratrithirong et al. (1989) found that social setting variables were as least as important as program effort variables in explaining variations in contraceptive use but did not examine how program effort might operate differently among social contexts.

In this paper we look more closely at how social setting and family planning program activity effect the acceptance of female sterilization among a sample of Thai women. Family planning activity and social setting variables are measured at the community level while sterilization is measured at the individual level. Individual characteristics that affect the acceptance of sterilization are controlled for the analysis. We focus the analysis on sterilization as in a mature program it is this method that responds most to variations in program effort (Chamratrithirong et al. 1989).

Family Planning Programs and Contraceptive Use

i) Program Effort and Contraceptive Use

Family Planning programs are typically large and expensive undertakings. In most instances they exist because there is a perceived need to reduce levels of fertility. During the period that most countries have initiated family planning programs fertility has declined and contraceptive use has increased. However, there has been considerable variation among countries in the extent of the changes.

There have been claims that family planning programs have contributed relatively little to fertility reduction with the major determinant being social and economic development (Hernandez, 1984). Other researchers claim that the contribution of family planning programs, primarily operating in a synergetic relationship with development, have been instrumental in the fertility declines that have occurred (Bongaarts et al. 1990; Maudlin and Ross, 1991).

As in many other areas of social science much of the debate revolves around methodological issues. Numerous methods have been developed that are designed to assess the impact of family planning programs (see reviews in Population Reports, 1985; and Ross and Lloyd, 1989) but only experimental design and areal regression are capable of providing measures of the effects of family planning programs that are net of the effects of development. Because of logistical and financial constraints there have

been few studies based on experimental design, therefore much of the assessment of the net impact of family planning program effort has employed the regression approach.

A central issue in the areal regression body of literature has been the measurement of family planning effort. In the early 1970s Lapham and Mauldin (1972) constructed an index of family planning effort based on 15 inputs. In 1982 the index was expanded to include 30 items (Lapham and Mauldin, 1985), and in 1989 new scores were generated based on the same 30 items (Mauldin and Ross, 1991). The indexes are constructed by summing the scores, ranging from 0 to 4, of the 30 items. Item scores were assigned by persons working in the field of family planning.

The indexes generated in the studies listed above have been used widely in examining cross-national variation in fertility decline (Mauldin and Berelson, 1978; Bongaarts et al. 1990) and contraceptive use (Lapham and Maudlin, 1985). Findings at the cross-national level have been remarkably consistent; (1) family planning program effort has a significant independent effect on contraceptive use and fertility (2) the effect of social setting is typically greater than that of family planning program effort, and (3) the interaction effect between family planning program effort and development is usually greater than the combined additive effects.

The results of the cross-national studies, however, do not shed any light on what aspects of a family planning program is most important in affecting reproductive behavior. The Lapham/Mauldin studies group their 30 items into four areas -- policy and stage setting activities, service and service-related activities, record keeping and evaluation, and availability and accessibility of fertility control methods (Lapham and Mauldin, 1985), but typically apply only the overall index in analysis. The underlying complexity of family planning effort has rarely been analyzed. Entwisle (1989) undertook a confirmatory factor analysis on the 30 items in the Lapham-Maudlin scale measured for 100 countries and identified eight separate dimensions. Entwisle argues that there is a need to use each of these items separately in analysis, although she does note that the limited number of units available for analysis makes this difficult. A related, but as yet unexplored, question, is whether the number of dimensions of family planning effort vary at different stages of the development of a family planning program.

Compared to cross-national studies efforts to apply an index of family planning effort in examining variation in contraceptive use or fertility among units within a country have been less successful in either explaining variation in the dependent variable or of isolating significant effects of family planning program efforts (see Population Reports, 1985). There are several difficulties in applying the Lapham-Mauldin framework to within country studies; (1) variation in program inputs are usually smaller within countries than among countries (Population Reports, 1985), (2) the placement of program inputs may be conditioned on the levels of fertility with, for example, more inputs being allocated to areas of high fertility (Ross and Lloyd, 1989), a problem that is particularly acute as a program matures, (3) the underlying dimensions of family planning inputs at the national level may bear little relation to dimensions at the local level, and (4) data is often much more difficult to obtain at the local level than it is at the national level, resulting in some instances in researchers substituting family planning output measures, such as CPR, for input measures.

Ross and Lloyd (1989) have provided a detailed review of the problems that have faced researchers who have attempted to measure the effects of family planning programs by examining variation in fertility behavior among areal units within countries. However, they also note that this approach is receiving renewed attention because of the availability of data sets that integrate community and individual level data. Models that combine both individual and aggregate level data are usually referred to as multilevel.

ii) Multilevel Models of Reproductive Behavior

Multilevel studies of fertility, while having been carried out with countries as the units of analysis (Entwisle et al. 1986), have most often been applied to data collected for one country. These studies provide the opportunity to isolate particular aspects of social settings or family planning programs that affect individual reproductive behavior. For example, in a study of contraceptive use in Egypt, Entwisle et al (1989) found that the type of contraceptive service facilities and numbers of village family planning workers affected individuals contraceptive use. Furthermore, they found that the effects of these variables differed among persons with different characteristics.

There have been several attempts to formulate multilevel models for explaining fertility behavior in Thailand. The key areal measure in several of these

studies has been the availability of contraceptives (Entwisle et al. 1984; Chamratrithirong and Kamnuansilpa, 1984), while other studies have concentrated on indicators of development (Hogan and Frenzen, 1981; Chayovan, 1982; Chamratrithirong et al. 1992; Guest and Chamratrithirong, 1992; Hirschman et al. 1993). Results of these studies have shown that the impact of community variables, including both contraceptive availability and development variables, have been statistically significant although fairly modest.

Several criticisms of the previous multilevel studies conducted in Thailand can be made. Several studies have used levels of aggregation that may be too large to adequately index social settings that influence fertility decisions (Chamratrithirong et al. 1992; Guest and Chamratrithirong, 1992; Hirschman et al. 1993); measures of family planning inputs, where they are available, are usually quite limited (Chayovan, 1982; Entwisle et al. 1984); and there has been few efforts to simultaneously investigate the effects of social setting and family planning inputs on contraceptive use or fertility.

A recent study based on the collection of a large number of indicators of family planning inputs and indicators of social setting at various levels of aggregation has also found limited effects of family planning inputs on contraceptive use (Chamratrithirong et al. 1989). The authors note that at the time that the analysis was carried out the Thai family planning program had been in operation for a long period and contraceptive use was already high. Where a program has been successful, and has motivated the bulk of the population to accept a small family size norm, it is likely that family planning inputs will be of more limited relevance to variation in levels of contraceptive use compared to contexts where motivation to contracept remains low. The study also found, however, that family planning input variables were relatively more important at explaining initiation of female sterilization than an overall measure of contraceptive use.

iii) Female Sterilization as a Contraceptive Choice

The suitability of sterilization as a `pure' measure of demand for family planning services in Thailand has been discussed by Bennett and Chamratrithirong (1988). They note that the Thai National Family Planning Program (NFPP) is the main supplier of this method, and hence the method is sensitive to changes in levels of

inputs (Chamratrithirong et al. 1989). They also argue that because of the nature of the method, in particular its permanency, motivation for use has to be extremely high.

Trends in levels of female sterilization in Thailand have differed among regions. It is notable that initial high levels of sterilization of women in Bangkok, vis-a-vis women in other regions have not been maintained over time. On the other hand women from the poorest regions of the country, particularly the North and Northeast are increasingly turning to sterilization as a contraceptive method as the motivation to limit fertility becomes more widespread in the region (see Bennett and Chamratrithirong, 1988).

The choice of female sterilization as a contraceptive method would appear to be the most suitable output indicator of the effects of family planning inputs in situations of a mature and successful family planning program. It must also be noted, however, that sterilization may be related in different ways to family planning inputs than are other methods. For example, medical inputs are more likely to be important for sterilization than they are for temporary methods. It is therefore important to separately examine different aspects of program activities.

Data and Methods

i) Data Sources

Several sources of data are used in the analysis. Individual level data come from a national sample of 7,085 ever-married women aged 15-49. This survey, known as the Contraceptive Use Pattern Survey (CUPS), interviewed respondents during the period April to June 1987 in a sample drawn from 27 provinces. Special samples of Muslims were drawn from the Southern provinces of Yala and Satun. As the interest in this analysis is to investigate relationships among variables, rather than providing nationally representative estimates of levels, the unweighted data, including the Muslim sample, is used in the analysis. The survey collected detailed information of socio-economic characteristics of respondents, patterns of contraceptive use and fertility. For more details of the survey see Leoprapai and Thongthai (1989).

In each province include in the survey two rural districts were randomly selected (three districts in two provinces). From within each of the sampled districts two

sub-districts were sampled. The social setting variables used in the analysis are measured at the district level. Most of this information was collected from government statistical sources or local government officials (see IPSR, 1987;1988). As the data on family planning program effort was the focus of an intensive data collection effort (IPSR, 1988) a wide range of information on family planning inputs and personnel is available for analysis. In each district included in the CUPS sample interviews were conducted with the District Health Officer (DHO) and District Hospital Director (DHD) or their assistants. These are the officials primarily responsible for the delivery of contraceptive services under the National Family Planning program.

There were several criteria for inclusion in the sample employed for the analysis. Only women living outside of municipal areas were selected. Municipal areas, primarily Bangkok and provincial capital, were excluded from the analysis because of the difficulties in identifying the relevant social setting for their contraceptive choices. A woman in Bangkok, for example, is influenced by a multitude of settings and can obtain contraceptive services from many different locations. Only women who could make a choice about sterilization were used in the analysis. As most of the social setting and program variables relate to the period near or at the time of the survey it was decided to exclude women who were sterilized before 1985. This resulted in all but 291 of the 1218 rural women who had been sterilized being excluded. Women over the age of 44 were not included as many of these women would not consider themselves fecund. Finally, a small number of women whose husbands had been sterilized were excluded from the analysis. The final sample contains 4401 rural women aged between 15 and 44. Of these women 291 had been sterilized in the period from January 1985 to June 1987. The sampled women lived in 54 districts in 26 provinces.

ii) Family Planning Effort and Social Setting Variables

Two main approaches to dealing with the large number of potential indicators of family planning effort can be identified in the literature. The first approach, exemplified in the many studies undertaken by Parker Maudlin, Robert Lapham, Bernard Berelson and John Ross, is based on combining indicators of family planning effort into one overall index. In most of these applications each item in the index contributes equally to the index. The second approach is to explore which of the indicators available is most strongly related to contraceptive use and only use these indicators in

further analysis. An example of the second approach as applied to Thai data can be seen in the study by Chamratrithirong et al (1988).

A third approach, that makes greater use of the information available in the data than either of the other two approaches described above, is to create separate indexes for each of the dimensions of family planning effort identified. Entwisle (1989), after identifying the complexity of the dimensions involved in family planning program effort, advocates this strategy. In the present study an exploratory principal components analysis of 28 indicators of family planning program effort at the district level was undertaken (see IPSR, 1988 for a description of the variables). The results of the analysis confirm the complex multi-dimensional nature of family planning program effort. Ten factors with eigen values exceeding one were identified. Most of these factors explained vary little of the common variance and were hard to interpret. A three factor solution was decided upon as each factor was clearly interpretable and explained similar amounts of variance (8 to 10 per cent).

The first factor was interpreted as a demand creation factor (**DEMAND**). All demand indicators were positively and highly related to the factor. Other variables with high positive loadings included indicators of efforts by the District Health Office to motivate health centre workers. On the other hand, high and negative loadings were observed for measures of the per capita presence of health centers and village health volunteers. High scores on the factor appear to identify those contexts that lack family planning facilities and have been targeted by the government in an attempt to increase levels of demand. The second factor was clearly associated with facilities, including private inputs into family planning (**FACILITIES**). High positive loadings were observed for the density of hospital beds, doctors, private hospital beds and private clinics. There were low loadings on indicators of help from government ministries in the family planning program. In contrast, for the third factor (**GOVERNMENT**), variables indexing government ministry involvement in family planning at the district level and variables indicating a high density of village level government facilities and/or personnel were positively related to the factor.

Exploratory factor analysis was also undertaken in order to determine dimensions of social setting. Fifteen variables district-level variables, described in detail in **IPSR** (1987), were included in the analysis. At the first stage of the analysis four factors were extracted. The fourth factor explained only a small proportion of

variance and was discarded. The three factor solution explained 54 per cent of the common variance, with the first of these factors explaining 33 per cent of the variance.

The first factor could be clearly identified as a dimension indexing development (**DEVELOP**). Very high positive loadings were observed for district levels of population density, per capita tax, per capita consumption of electricity, the per cent of households with electricity, banks per capita, and the proportion of workforce in non-agricultural occupations. In contrast, the third factor identifies a dimension that is closely related to underdeveloped agricultural areas (**ISOLATED**). A high proportion of the persons of labour force age were economically active, primarily in agriculture, there was a high negative loading on the proportion of school-age population attending school and a high positive loading on distance from the province capital. The second factor (**SOCIAL**) indexes contexts where there are relatively high levels of social development (education of women of reproductive ages and of children is high) relatively close to Bangkok, but with only moderate levels of economic development.

Indexes were calculated for the three social setting variables and the three family planning effort variables using the factor loadings. The indexes, each of which has a mean of zero and a standard deviation of one, are used in the multilevel analysis described below.

iii) Methods of Analysis

The literature on statistical applications of multi-level analysis has become increasing complex (see Bilsborrow and Guilkey, 1987 for a review). Earlier studies focused discussion on the interpretation of aggregate effects in individual-level models (Firebaugh, 1979; Blalock, 1983). The point that was stressed in what was a relatively new area of analysis for social scientists was that social setting variables used in the analysis were not meant as proxies for individual characteristics.

More recent work has stressed the methodological problems of estimating models based on more than one unit of analysis with statistical techniques that combine error terms from each level of analysis (see Mason et al. 1983). While methods have been developed to undertake appropriate statistical analysis for multilevel models these methods are mainly confined to models where the dependent variable is measured at an interval level. Wong and Mason (1985) have proposed a method of analysis for models

with limited dependent variables but this procedure is difficult to implement and the properties of the estimation have not yet been fully explored (Bilsborrow and Guilkey, 1987). Hence the approach that has been typically undertaken is to estimate models using standard limited dependent variable models (see for example Entwisle et al. 1989) while recognizing that this will lead to inefficient estimation of parameters. In the present analysis logistic regression is employed as the analysis technique.

Results and Discussion

i) Characteristics of Sterilized Women

The 291 women sterilized in the two and a half year period before the survey differ from other women on a number of characteristics. While 7.7 per cent of Buddhist women were sterilized, less than one per cent of women of other religious denominations, who were overwhelmingly Muslim, underwent sterilization during the same period (see Table 1). This is also reflected in the rates of prevalence by region, with over 7 per cent of women in all regions except the South having been sterilized. In the South, that has a large Muslim population, the per cent sterilized was only 4.3. Kamnuansilpa and Chamratrithirong (1985), in analysis of contraceptive differentials from the 1984 Contraceptive Prevalence Survey (CPS3), note that Muslims, especially in the South, are much less likely to use permanent methods of contraception and much more likely than other women to cite religious reasons for not using contraception.

Socio-economic differentials in the rate of recent sterilization can also be observed. The women most likely to have been sterilized were those with a primary school level of education. However, there is little difference among different occupational groups, with women working in agriculture, those working in non-agriculture and those not in the labour force having similar rates of sterilization. The differentials in recent sterilization rates among educational categories may be partly due to demographic factors. For example there is an inverse U shape relationship between age and recent sterilization, with the mean age of sterilization of 30.3 being only slightly higher than that for women not sterilized. The small proportion of women with no education are, on average much older than other women in the sample, while those with secondary education are on average younger than other women.

One of the strongest correlates of sterilization is parity. Women who have undergone a recent sterilization had an average of 2.9 living children compared to the average of 2.0 living children of non-sterilized women in the sample. In the multilevel analysis conducted by Chamratrithirong et al (1989), parity remained one of the most powerful predictors of sterilization after controlling for family planning effort and social setting variables.

TABLE 1

Per cent Recently Sterilized by Socio-economic Characteristics

Characteristic	Sterilized	Not Sterilized	Total	Number
Religion				
Buddhist	7.7	92.3	100.0	3712
Other	0.9	99.1	100.0	689
Region				
North	7.1	92.9	100.0	1025
Northeast	7.8	92.2	100.0	1012
Central	7.9	92.1	100.0	1021
South	4.3	95.7	100.0	1343
Education				
No Education	4.0	96.0	100.0	297
Primary	7.4	92.6	100.0	3127
Secondary or above	4.9	95.1	100.0	977
Occupational Sector				
Agriculture	6.9	93.1	100.0	2516
Non-agriculture	6.1	93.9	100.0	1178
Not in the Labour Force	6.4	93.6	100.0	707
TOTAL	6.6	93.4	100.0	4401

Source: CUPS, 1987

The substantial variation in the incidence of recent sterilization suggests the importance of controlling for individual-level characteristics in examining the effects of community level variables on sterilization. In Thailand there is substantial variation among communities in the demographic and socio-economic composition of residents. In part this reflects regional differences in levels of development but the variation can also be substantial within regions, resulting from differential access to resources and facilities and different levels of migration.

ii) Social Setting and Family Planning Effort

Correlation coefficients for relationships among the indexes of family planning activity and district social setting are shown in Table 2. As the indexes within each of these two areas were derived from principal components analysis the correlations between indexes within each group are all less than 0.10. However, there are moderately strong (0.35 to 0.48) correlations involving pairs of family planning activity and social setting indexes. As none of the correlations exceed 0.50 the measures of family planning activity and social setting are clearly not acting as proxies for each other.

TABLE 2

Correlation Matrix of Indexes of Social Setting and Family Planning Activity

	DEVELOP	SOCIAL	ISOLATED	DEMAND	FACILITIES	GOVERNMENT
Social Setting						
DEVELOP	1.00	0.06*	-0.02	0.02	0.48*	-0.02
SOCIAL		1.00	0.03	-0.10*	0.10*	0.35*
ISOLATED			1.00	0.43*	-0.10*	0.06*
Family Planning Program						
DEMAND				1.00	0.08*	-0.08*
FACILITIES					1.00	0.02
GOVERNMENT						1.00

Source: CUPS, 1987 and District Data Base

Note: * - Significant at 0.01 level

The strongest relationship is between the indexes of **DEVELOP** and **FACILITIES**. Those districts with a high score on economic development are the districts with high levels of private sector involvement in health activities and a relative abundance of medical resources. The positive correlation between **SOCIAL** and **GOVERNMENT** indicates that those areas with moderate levels of economic development, but that score highly on social development, are more likely to rely on local-level government resources for their family planning facilities. The third pairing of correlations involve **ISOLATED** and **DEMAND**. In those districts that have limited development and which are remote from the major local urban area there are considerable family planning motivation efforts designed to increase demand.

Previous research on reproduction in Thailand has documented large regional differences in fertility and contraceptive behavior (Knodel et al. 1987; Leoprapai and Thongthai, 1989; Chamratrithirong et al. 1992). In part this can be attributed to regional variation in regional social and economic development. Partly in response to these differences family planning program activities have also differed among regions. These differences are reflected in Table 3 where the mean values of index scores for family planning activities and social setting are shown.

TABLE 3

Mean Scores of Social Setting and Family Planning Activity Indexes by Region

Index	North	Northeast	Central	South	N
Social Setting					
DEVELOP	-0.31	-0.26	0.79	-0.05	4047
SOCIAL	0.42	0.41	0.70	-1.01	4047
ISOLATED	-0.65	0.87	-0.57	0.20	4047
Family Planning Program					
DEMAND	-0.21	0.53	-0.70	0.19	4081
FACILITIES	-0.39	0.01	0.78	-0.26	4081
GOVERNMENT	0.48	0.20	-0.11	-0.40	4081

Source: CUPS, 1987 and District Data Base

As expected, districts in the North and Northeast regions have the lowest mean scores on the index of economic development. In terms of social development it is districts in the Southern region, strongly influenced by distance from Bangkok, that have the lowest scores. Sample districts in the Northeast are more likely to score highly on the **ISOLATED** index than do districts in the other three regions.

Demand creation activities are strongest in the districts of the Northeast and South, the two regions that have been targeted by the government as priority areas to increase contraceptive use. Districts in the Central region score most highly on the **FACILITIES** index while districts in the North and Northeast have the highest mean scores for the **GOVERNMENT** index. The sample districts in the South have low scores for both the **FACILITIES** and **GOVERNMENT** indexes, indicating a lack of district facilities and village-level personnel, although efforts are being made to create a demand for contraceptive services.

In an attempt to gauge the relationship between the district level indexes and the probability of women having undergone a recent sterilization scores on the indexes were divided roughly into quartiles and the proportion of women recently sterilized was calculated within each quartile. The results of this exercise are shown in Table 4.

TABLE 4

Proportion of Women Sterilized Within Quartiles of Social Setting and Family Planning Activity Index Scores

Index	First Quartile	Second Quartile	Third Quartile	Fourth Quartile
Social Setting				
DEVELOP	0.069	0.065	0.062	0.075
SOCIAL	0.064	0.069	0.079	0.055
ISOLATED	0.075	0.072	0.069	0.053
Family Planning Program				
DEMAND	0.063	0.065	0.059	0.073
FACILITIES	0.056	0.064	0.059	0.079
GOVERNMENT	0.069	0.053	0.064	0.071

Source: CUPS, 1987 and District Data Base

For the three social setting variables only the **ISOLATED** index displays a consistent relationship with recent female sterilization. As scores on the index increase the probability of a recent sterilization decreases. This relationship is consistent with a diffusion process of the spread of motivation to limit family size. Couples geographically and economically remote from the main areas of development are the last to be motivated to use permanent methods of contraception such as female sterilization. For the other two indexes of social setting the relationships are not linear. For the **DEVELOP** index the relationship is U shaped while for the **SOCIAL** index the relationship is in the form of an inverted U. An examination of the levels of sterilization among contexts within each quartile displays large amounts of variation.

Women living in contexts with the highest scores on the family planning activity indexes are the most likely to have undergone a recent sterilization. The greatest contrast can be observed for the **FACILITIES** index, where almost 8 per cent of women in the fourth quartile had undergone a recent sterilization compared to 5.6 to 6.4 per cent of women in the other three quartiles. The importance of district level medical facilities for undertaking female sterilization (Chamratrithirong et al. 1989) has been previously noted, however the lack of a clear relationship at lower levels of the **FACILITIES** indicates that other factors apart from facilities are also operating. There is also no clear relationship between female sterilization and the other two family planning activity indexes across the lowest three quartiles of the indexes.

iii) Additive Model of Determinants of Female Sterilization

The results of additive models of acceptance of female sterilization are shown in Table 5. Results for three models are presented. In the first model individual level characteristics are entered. The second model adds the three social setting indexes while the final model includes the three family planning activity variables. In the final column the odds ratio for variables that demonstrate a significant effect in model 3 are displayed. Individual variables are entered first as we argue that there are individual preferences for sterilization that are not related to social setting or family planning activity. As the main interest of the study is to examine the effects of the aggregate variables on initiation of sterilization the individual variables are first controlled. Social setting variables are entered before the family planning activity variables on the assumption that family planning activities adjust to the setting where they are placed rather than vice versa.

The effects of the individual variables are mostly significant and in the expected direction. The probability of sterilization increases until approximately age 29 when it begins to decrease. Increases in numbers of children borne increases the probability of female sterilization as does being Buddhist relative to other religious denominations. Even after controlling for religion, women living in the North, Northeast and Central regions are significantly more likely than women living in the South to have been recently sterilized. Women working in agricultural occupations are the least likely to be sterilized while the effects of education also show that those women with no education are significantly less likely than women with a secondary level of education to have been sterilized.

Model 1 represents a significant improvement in explanation relative to the null model. The log-likelihood is reduced by 255, or an average of 23 per degree of freedom. The introduction of the social setting indexes in model 2 significantly improves model fit, with the log-likelihood decreasing by 43 for the extra 3 degrees of freedom used by the model. Of the three social setting variables two have significant effects on the probability of sterilization. Increases in district level scores on the **SOCIAL** index and on the **ISOLATED** index are both related to lower probabilities of female sterilization. While the latter effect is as expected the former is difficult to explain.

The female sterilization rates by region provide an indication of the difficulties in using cross-sectional data in explaining geographical variations in sterilization. The two regions with by far the highest rates of female sterilization in 1978, Bangkok and the Central Region, both had lower rates than the North and Northeast regions by 1987. Bennett and Chamratrithirong (1988) speculate that the failure of sterilization levels to increase in Bangkok over the period may have been due to the increase in availability of facilities to undertake sterilizations in other regions. This would reduce the need for women from other regions to come to Bangkok to have a sterilization. However, the results of the model estimated above shows that even for areas outside of Bangkok some forms of development, especially on social dimensions, can have significant negative impacts on the probability of sterilization. There appears to be a reduction in demand for sterilization as social, and to a lesser extent, economic development increase. This might be related to increased awareness of, and confidence in, other methods.

TABLE 5
Additive Multilevel Logistic Regression Models of Initiation of Female Sterilization

Variables	Model 1	Model 2	Model 3	Odds Ratio Model 3
Individual				
Age	0.81**	0.83**	0.83**	2.29
Age Squared	-0.01**	-0.01**	-0.01**	0.99
Parity	0.59**	0.65**	0.66**	1.94
Buddhist[1]	2.96**	3.43**	3.50**	33.19
North[2]	0.74**	1.26**	1.19**	3.28
Northeast[2]	0.46**	1.19**	1.09**	2.97
Central[2]	0.63**	1.30**	1.13**	3.08
None[3]	-0.80*	-0.66	-0.66	----
Primary[3]	-0.22	-0.17	-0.17	----
Agricultural[4]	-0.58**	-0.59**	-0.60**	0.55
Non Agriculture[4]	-0.43	-0.43	-0.40	----
Social Setting				
Develop		-0.12	-0.17	----
Social		-0.52**	-0.52**	0.60
Isolated		-0.28**	-0.25**	0.78
Family Planning Program				
Demand			-0.04	----
Facilities			0.12	----
Government			0.05	----
Constant	-17.92	-19.15	-19.11	
Log Likelihood	1584.77	1541.99	1538.09	
Change in Log Likelihood	254.96**	42.78**	3.91	
Change in DF	11	3	3	
N	3770	3770	3770	

Source: CUPS, 1987 and District Data Base

Notes: Reference categories for dummy variables are: [1] Other, [2] South, [3] Secondary, [4] Not in Labour Force.

The inclusion of the social setting variables had large effects on the regional contrasts. The district level social setting variables reduced the contrasts between the North, Northeast and Central regions while increasing the differences between these three regions and the South. Thus, while differences in levels of female sterilization among regions, especially between the Northeast and the other two non-South regions can be largely explained by regional differences in social setting, the social setting of the South is conducive to higher levels of sterilization than actually exist.

The family planning activity variables entered in model 3 did not significantly improve model fit. None of the three indexes were significantly related to the probability of having undergone a recent sterilization. If the family planning index variables are entered before the social setting variables there is a significant improvement in model fit and **FACILITIES** exhibits a significant positive relationship with female sterilization. However, in the context of an additive model the effects of family planning activity of female sterilization are limited.

iv) Interaction of Family Planning Activity and Social Setting

In cross-national research examining the effects of family planning program effort on contraceptive use the absence of significant additive effects of family planning effort are not unusual (see for example, Bongaarts et al. 1990). However, interaction effects between social setting and family planning effort are usually found to be large. In the present analysis all two-way interactions between social setting and family planning activities were added to the variables included in model 3. The overall effect of including these 9 interaction terms was to decrease the log likelihood by only 3.4. None of the individual interaction terms were significantly different from zero and the inclusion of the interaction terms had little effect on the magnitude of the other coefficients estimated. Region can also be thought of as a social setting variable. The finding that some regional differences increase after controlling for district social settings suggest that regional effects are important in their own right. Regional variations could be indicating differences in cultural settings as they affect sterilization or they could index contexts of access to resources that are not captured by variation at the district level. To investigate whether family planning program activities had different effects on the probabilities of sterilization in different regions a model including interactions between region and the three family planning indexes was estimated. The interactions resulted in a significant improvement in fit when compared

to model 3 in Table 5 (reduction in log likelihood of 20.19 with 9 df), with the interaction between **FACILITIES** and region contributing significantly to the explanation of the model (Wald statistic 13.47, with each of the three interaction terms negative and significant at the 0.01 level. None of the coefficients of the interactions between **DEMAND** and region and **GOVERNMENT** and region were significant. The main effects coefficients for region was not significant after including the interactions, although all three social setting variables were significant and negative, while the main effect for **FACILITIES** was significant and positive. To illustrate the effects of the interactions in Table 6 the predicted probabilities of sterilization for women in the different regions are shown at various levels of values of the **FACILITIES** index.

TABLE 6

Predicted Proportions of Women Undergoing Recent Sterilization by Levels of Family Planning Facilities Index and Region

Index Score	North	Northeast	Central	South
Mean - 2 standard deviations	0.185	0.130	0.056	0.000
Mean - 1 standard deviation	0.110	0.099	0.065	0.011
Mean	0.066	0.075	0.076	0.047
Mean + 1 standard deviation	0.039	0.057	0.088	0.210
Mean + 2 standard deviations	0.023	0.043	0.103	0.928

Source: CUPS, 1987 and District Data Base

Notes: Probabilities are predicted from a model consisting of all variables in Model 3 (see Table 5) plus interactions between REGION and each of the three Family Planning Index variables. In calculating the predicted probabilities the interval level variables (age, age squared, parity, the three social setting variables and the other two family planning activity variables) were set at their means while the categorical variables (education, work and religion) were set at their sample proportions.

The predicted values clearly indicate that the extent of medical facilities and private support of family planning operate differently among the regions. Higher scores

on the **FACILITIES** index is related to lower levels of recent sterilization in the North and Northeast but higher levels of sterilization among women in the Central and Southern regions. While the actual predicted values for the South must be treated with caution because of the limited variation on the facilities index, the strength of the relationship is very clear. It is also notable that after adding the effects of facilities within the different regions to the full model the South does not have significantly lower levels of female sterilization compared to the other three regions.

The regional effects of the **FACILITIES** index can be understood in terms of the demand for sterilization services. The **CUPS** survey found that 29 per cent of married women aged 15-44 in the North, 27 in the Northeast, 25 in the Central region and 15 per cent in the South had been sterilized. Thus the pool of women who were available to undergo sterilization was much higher in the South compared to the other regions. In the Northeast, and particularly in the North, there was limited opportunity to increase levels of sterilization. It is not that increased levels of facilities causes a decrease in the incidence of female sterilizations in these two regions, rather the presence of a high level of facilities is correlated with past success in increasing levels of sterilization and hence reduces the number of women who are now available for sterilization. On the other hand, in the Central region and especially in the South, improved facilities can still results in higher levels of sterilization.

Conclusion

The analysis undertaken above illustrates the difficulties of establishing a linkage between family planning program activities and contraceptive use within a context where contraceptive use exceeds 70 per cent and the family planning programs has been existence for a number of years. In such a context motivation for using contraception can be assumed to be high and it is unlikely that variations in program activities will have significant effects on use patterns.

Female sterilization is the contraceptive method that arguably requires the highest level of motivation. Therefore, whether a woman had undergone a sterilization since the start of 1985, roughly two and on-half years before the survey, was taken as the dependent variable. However, even this form of contraceptive use was not significantly related to variation in three indexes in family planning activities. The one exception was for the level of medical facilities available within a district. However,

even for this relationship the effects for the North and Northeast are probably confounded with past successes in catering for a demand for female sterilization. Only in the South, with its relatively low levels of use, does family planning effort, in particular the provision of medical facilities, have a pronounced effect of raising the probability of female sterilization. Although not the major focus of the paper, the analysis demonstrates that social setting variables and individual characteristics both contribute to explaining variations in levels of recent female sterilization. As areas become more integrated economically, geographically and socially into the development process the demand for sterilization can be expected to grow. Increases in local family planning personnel and greater efforts aimed at increasing the demand for family planning will probably have little or no effect on levels of sterilization at moderate to high levels of contraceptive use. Improvements in medical facilities may have a positive effect in those areas where the demand for sterilization has not been met.

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