MEETING WORLD FOOD NEEDS: FOOD POLICY AND POPULATION GROWTH AMONG THE POOREST OF THE POOR

Wayne A. Schutjer and C. Shannon Stokes

ABSTRACT

The current and future world food problem is centered in low income nations and among low income segments of populations world wide. The thesis of this paper is that increases in income and food production in the poorer nations and among low income segments of rural populations elsewhere are likely to aggravate that problem in the first instance. It is after some minimum level of economic well being has been attained that further increases in income will result in reduced family size.

INTRODUCTION

The food problem of the world is centered in low income nations and among low income segments of populations world wide. The World Development Report 1981 published by the World Bank reports that nations with less than $370 per capita income in 1979 provided 98 percent of national daily per capita calorie requirements.[1] Among that group of nations, those with less than $150 per capita income supplied, on average, less than 90 percent of daily calorie needs. Data regarding the income nutrition relationship within nations is less global but equally dramatic. A study in Colombia in the late 1950's indicated that the rural poor averaged less than 1,600 calories per day while middle class urban citizens averaged 3,000. A similar study in pre-Khomeini Iran found that peasants averaged about 1,800 calories per day while land owners averaged more than 2,600 (Schutjer, 1977).

The poorest nations of the world are also likely to experience more rapid increases in food requirements than higher income countries, as these nations are among those with the most rapid population growth rates. The World Development Report 1981 indicates that the average total fertility rate among the low income nations is 5.7 children per female (China and India are excluded), thus, females in these nations are likely to bear nearly six children during their childbearing years. In nations with less than $150 per capita income the average female can expect to bear more than six children.

In summary, current and future world food deficits are to be found among the poorest of the poor. The theses of this paper is that increases in food production and income in the poorer nations, or among low income segments of rural populations in other nations, are likely to result in initial increases in human fertility—that is in an aggravation of the world food problem. It is only after some minimum level of economic well-being has been attained that increases in food production and income will result in reduced family size.

INCOME AND HUMAN FERTILITY

Theoretically, children can be considered to be the product of decisions regarding the desirability of having an additional child (demand), and the ability of the prospective parents to conceive and bear children (supply). More specifically, following Easterlin a distinction can be made between natural fertility and desired fertility. Natural fertility is the number of children that would result in the absence of any voluntary control of fertility. Desired fertility refers to the number of children parents view as optimum at the time fertility decisions are being made, and reflects estimates of social obligations, resources available, and a range of additional socioeconomic considerations (Robinson and Schutjer).

A number of authors have examined the theoretical determinants of fertility and concluded that both the supply and demand for children are a function of income: supply being positively related to income and demand being negatively related to income (Easterlin, Encarnacion, Schutjer, 1978). See Figure 1.

At lower levels of income, 0-a in Figure 1, the supply curve constrains family size as families are unable to bear the number of children desired. At higher levels of income family size is demand constrained as parents choose to have fewer children than biologically feasible. It is the combination of the constraints posed by a positively sloped supply curve and a negatively sloped demand curve that produces a nonlinear income-family size relationship and a turning point, or threshold level of income, beyond which fertility will be negatively related to income.

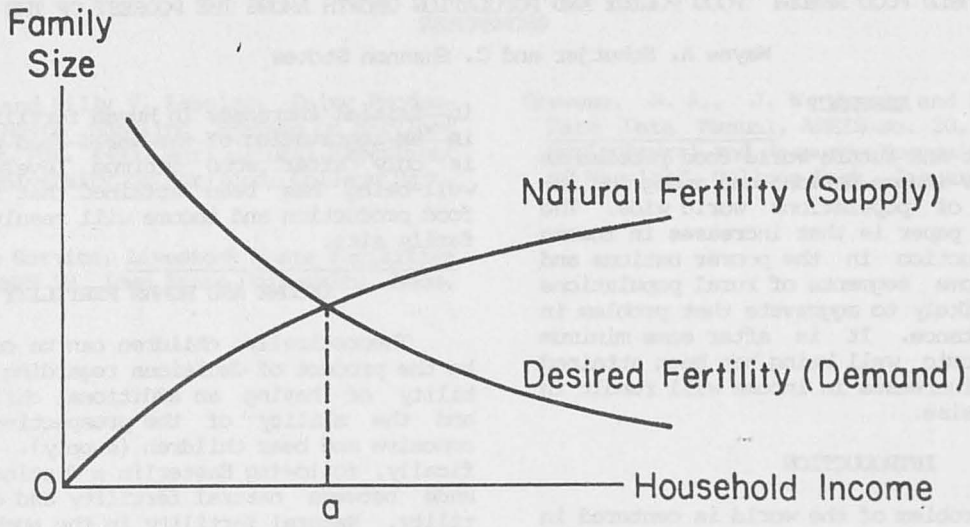
The positive relationship between income and the supply of children requires that female nutrition and health care be positively related to income, and second, that human fecundability be a positive function of nutrition and health care. As noted in the introduction, the evidence for a positive income-nutrition relationship is substantial. The fecundability-nutrition relationship is also well substantiated.

Improved nutrition has been shown to increase female fecundability directly through earlier menarche and increased ovulation (Kleinman, 1981). Indirectly, improved nutrition improves fecundability through reductions in disease-based infertility. Empirically, it has been difficult to separate the direct nutititonal impact from that associated with disease, since there is a close correlation between poor nutrition and susceptibility to disease--particularly infectious disease. Also, it is likely that the indirect impact of poor nutrition, operating

---

The authors are Professor of Agricultural Economics and Professor of Rural Sociology, respectively, at The Pennsylvania State University.

[1] The actual per capita calorie requirements are based upon 1977 estimates; however, it is not likely that climate, body weight and other determinants of calorie needs changed noticeably between 1977 and 1979.



Household Income and the Supply and Demand for Children

Figure 1

through disease susceptibility, is greater than the direct effect. Evidence regarding the relationship between disease and infertility is provided by a 1975 review conducted by the World Health Organization that found chronic gonorrhea, pelvic tuberculosis, and pelvic schistosomiasis all to be associated with infertility, while malaria, syphilis, and a number of viral bacterial rickettsial, and protozoan diseases increased stillborn rates and fetal loss.

Child and infant mortality are also greatly influenced by malnutrition which also contributes to the positive income-nutrition-family size relationship. Morley reported that approximately 25 percent of child and infant deaths in developing nations are directly due to malnutrition. Puffer and Serrano found that in more than 50 percent of child and infant deaths, malnutrition is a contributing factor. Infants born with a low birth weight for gestational age have likely suffered *in utero* malnutrition. Following birth, infants born to low income families often do not have enough food, and suffer the effects of recurrent acute infections. As a result, improved nutrition is likely to increase the survival rate among low income populations.[2]

The negative income fertility relationship expressed by the demand curve in Figure 1 reflects changing parental cost-benefit calculations regarding the value of children. Specifically, as family income rises the range of child-based contributions to the family utility function narrows and net benefits of children stemming from individual child-based contributions falls. Leibenstein has argued children can provide families three alternative utilities: income utility (additions to family income), security utility (financial and emotional security in parents' later years), and consumption or consumer good utility. Parents seeking to define a desired family size must compare the benefit associated with each of the utilities with the cost of obtaining the benefit. The negative slope of the demand curve results from the fact that both the overall weight assigned to each utility and the net value of individual utilities vary with income.

In a traditional agricultural setting all three potential child-generated utilities are important. Child labor in agricultural production and household maintenance activities, such as water and fuel procurement, are an important source of of family economic well-being. Children are also an important source of future income security for parents in traditional societies. In fact, in many societies, rearing children is the only way the poor can save. At the same time, in higher income nations, children

[2] It is also true, however, that reductions in infant and child mortality may have a longer-term positive effect on fertility. The strong positive biological effect of child and infant mortality on subsequent fertility, operating through shortening postpartum lactational amenorrhea, has been well documented (Knodel, Cantrelle *et al.*). A behavioral response which would relate infant deaths to a parental desire to replace lost children is less certain and more likely to be observed among higher income populations.

probably on balance are a net drain on family income, and institutional mechanizations exist to provide a degree of financial security to elderly people in the absence of support from children. Thus, at higher levels of income it is largely the consumption utility that pertains.

Research results tend to support a positive relationship between both current and anticipated economic contributions of children and motivations for larger family size. Banskota and Evanson found a very strong positive relationship between fertility, the earning ability of children, and child contribution to family income in rural Philippine households. Rosenzweig and Evanson (1977) found similar evidence in India. A major empirical study of child contributions to family income in Thailand (Buripakdi) found that most Thai respondents answered a question regarding the advantages of having children as being: (1) companionship and avoidance of loneliness, (2) economic and general help, especially in old age, and (3) continuity of the family name. As agricultural modernization occurs, however, it is likely tha mechanization will substitute for labor--particularly labor of the unskilled type that children can provide. Merrill noted, for example, that in the early stages of the mechanization of grain production, labor requirements may be reduced as much as 30 to 40 percent. The declining value of children as a source of farm labor reduces their contribution to current family income, and hence, contributes to a decline in the value of children to the family.

Land Availability, Labor Demand, and Fertility

What is generally lacking in the literature, however, are studies which directly relate the demand for child labor to subsequent fertility. The set of literature which comes closest to dealing with the complete relationship is that relating land availability in rural areas to family size. Thus, land availability provides an indirect measure of the relative demand for labor and, by inference, of the potential income contribution of child labor. Rosenzweig and Evanson found that land size, which they assumed to be complementary with child labor, had a positive and significant effect on fertility within a sample of 189 districts in India. This finding was supported by family data collected by Driver in Central India. Similarly, Kleinman (1973) used an index of cultivated acreage per farming household as a measure of landholdings for 315 districts of India in 1961. He found that cultivated acreage per household was significantly and positively related to fertility in a 15-variable regression model.

Recent work by Chalamwong et al. also provides strong direct empirical support for the importance of child labor as a determinant of fertility. Thus, the importance of child labor, as measured by the proportion of family labor provided by children, was positively and significantly related to family size among Thai farm families when income, ownership status, cultivated acreage, and a number of demographic variables were included. In a later study, Chalamwong reports similar results, using the proportion of available child labor that was actually used as a measure of the importance of child labor to the farm enterprise.

A reduction in the importance of child help to assure old age security can also be anticipated with modernization of national welfare systems. Caldwell argues that a reduction in fertility will occur when the net wealth flow between generations turns from the situation in which parents are net recipients, to one in which parents basically support children, and children become a financial liability. The pronatalist impact of depending on children for future income and security was demonstrated earlier by Heer and Smith whose simulation analysis indicated that even at moderate levels of mortality, parents need to beget at least five children to be 95 percent certain that they will have one son who will survive to their old age.

As with the demand for child labor, the family relationship to land perhaps provides the best indirect measure of the importance of children to parents' old age security. Within the rural sector, land is the principal store of wealth. Land ownership can provide income beyond the period during which the operator receives a management or labor return. Thus, conceptually, land ownership should reduce desired family size by altering the weight assigned to future parental security to be obtained from children. The available literature regarding variation in family size among land owners, tenants, and landless laborers, in general supports that conclusion.

Three studies in the Philippines (Hawley; Schutjer et al., 1978; and Hiday) have investigated the influence of land tenure on fertility. Hawley found that farm tenants tended to have higher fertility. Schutjer et al. found that the direct effect of land ownership on fertility was positive among a village-level sample in Luzon. More important, however, the indirect effects, operating through female education and village level traditionalism, were negative. Moreover, the indirect effects were stronger than the direct effects, resulting in an overall negative relationship between land ownership and fertility. Similar results were found by Hiday who reported a negative relationship between land tenure and fertility among farm families in two Mindanao communities. Owners and part-owners had the lowest fertility.

Recent analyses of fertility behavior among rural families in Thailand (Ron) and Egypt (Schutjer, et al. 1981) more nearly capture the relationship between land ownership and fertility operating through security utility. Both analyses employ multiple regression techniques in an analysis of family size variation among farm families with varying degrees of land ownership. In both cases, with cultivated area, income, and a set of demographic control variables included, land ownership was negatively and significantly related to fertility. In fact, other than demographic control variables, land ownership was the most important variable in explaining variation in total fertility among the sample families in both Egypt and Thailand.

The declining utility of children as an income source, both in the present and the future, provides an initial impetus for the negative slope to the demand curve for children. At high-

er levels of income, the negative slope likely results from a higher price for children. Theoretically, income increases will result in increased demand for normal goods--provided the price remains constant. In the case of children, however, it seems clear that the price is not independent of income, and in fact, is a positive function of income. Thus, as income increases, the negative price effect on the demand for children outweighs the positive direct income effect; fewer higher-priced children are traded-off for more, less-expensive children.

The costs of children that increase with income include both direct costs, e.g., expenditures on health, clothing, and education, and the indirect costs associated with the value of female time. Thus, children are notoriously intensive of female time and at higher levels of income the opportunity cost of that time is likely to be higher--primarily because of female education and off-farm employment opportunities.

The relationship between female education, off-farm employment opportunities and fertility is well known. Less well established is the positive relationship between income and direct child costs, and the fertility impact of rising child costs. A recent study of the quantity-price trade-off among rural families in a developing nation is that of Dyck. Drawing upon a sample of 436 farm households in the Central Plain region of Thailand, Dyck related income, educational expectations (judged to be the major discretionary cost factor) for individual children, and fertility, using a two-stage regression technique. Using a number of individual household and village-level variables, he explains 38 percent of the variation in the expected school level of individual children. Among the significant variables is family income which is positively related to educational expectations for children. In the second stage of the analysis, the average educational expectation for children is combined with age of the female, marriage duration, and educational attainment of the female to predict total expected family size.

The resulting fertility equation explained 25 percent of the variation in total expected family size among the sample women. Other than female education, each variable was significant at the one percent level with the expected sign. Significantly, the negative standardized Beta associated with educational expectations was second only to that associated with marriage duration.

An extension of this work is represented by Ron who estimated a more formal household-economic model, using the same data that Dyck used in a less formal model. Ron's findings strongly support the existence of an income-induced, education-family size trade-off among Thai rice farmers. Thus, both Dyck and Ron were able to demonstrate that among farm families in the Central Plain Region of Thailand, income is positively associated with greater educational expectations for children (i.e., higher priced children), and that higher educational expectations for children were significantly and negatively related to fertility.

In short, there appears to be empirical evidence that is consistent with the theoretical model that predicts that the relationship between income and fertility will turn from positive to negative at a threshold level of income. Research aimed at direct estimates of the resulting income-fertility relationship within that theoretical framework are more limited.

Romaniuk demonstrated that among low income populations natural fertility is likely to rise with modernization. His work in Zaire (Romaniuk, 1980) and among Canadian Indians (Romaniuk, 1981), indicates that fertility increases largely due to lessening of biological and behavioral reproductive checks, although the relationship to income is not examined.

Ron and Schutjer (1982) attempted to estimate the income-fertility threshold among a sample of rural Thai rice farm families using a proxy for permanent income. The results indicate that the threshold exists among Thai farm families who felt their economic position had not noticeably improved over the five years preceding the study. For these Thai families, the threshold occurred at a household income level of about $450, or approximately 40 percent of the mean household income of the sample families.

POLICY IMPLICATIONS

The positive relationships between income, food supply, and human fertility at low levels of income has led some scientists to argue that food aid and agricultural technology should be withheld from nations whose population growth is "not under control." Paddock and Paddock suggested that a "triage" policy be followed with no foreign assistance being provided to nations where aid would increase income, and hence increase population. A second proposal went further, and suggested that not only should foreign aid be withheld from nations with high population growth rates, but that the technology needed to help these nations meet growing food requirements should also be withheld (Aycock). In short, it is argued that a Malthusian solution be forced upon nations with high fertility to prevent an even more tragic outcome at higher population levels.

The implication of our analysis is to the contrary; that is, development efforts and food aid to the poorer nations will pay large dividends if the fertility bulge associated with initial increases in income can be accomplished while the population base is relatively small. Similarly, internal income distribution schemes designed to improve the income and nutritional status of low income populations are likely to have important long-term fertility reducing effects.

The data regarding specific turning points under varying cultural and agro-climatic circumstances will not permit hard estimates of the population growth that would be prevented by a focus of development policy on low income groups. It is true, however, that the majority of the world's population (53%) is located in nations with per capita incomes below $370. By the year 2000, these nations will contain 3.3 billion people which will represent 55 percent of the total world population. If that growth in population

can be accompanied by rising income and nutritional standards, much of the underlying pressure for populaion growth beyond 2000 will be dissipated. If not, populations are likely to continue to grow in low income nations and the development task further complicated.

REFERENCES

Aycock, Robert. "Paddock-Niederhauser Proposals." Phytopathology News, 10(1976):3-4.

Banskota, K. and Robert Evanson. "Fertility, Schooling and Home Technology in Rural Philippines Households." Unpublished paper, 1978.

Buripakdi, C. The Value of Children: A Cross National Study, Thailand. Honolulu: East-West Population Institute, 1974.

Caldwell, J. C. "Toward a Restatement of Demographic Transition Theory." Population and Development Review 3, 4(September-December 1976): 321-366.

Cantrelle, P., B. Ferry, and J. Mondot. "Relationships Between Fertility and Mortality in Tropical Africa." In Samuel H. Preston (ed.), The Effects of Infant and Child Mortality on Fertility. New York: Academic Press, 1978.

Chalamwong, Yongyuth. Land, Income, Wealth, and Human Fertility Among Rural Farm Families in the Central Plain of Thailand. Ph.D. dissertation, The Pennsylvania State University, 1979.

Chalamwong, Yongyuth, Merwyn R. Nelson, and Wayne A. Schutjer. "Variation in Land Availability and Human Fertility Among Thai Rice Farmers." Paper presented at Population Association of America Meetings, Philadelphia, 1979.

Driver, Edwin. Differential Fertility in Central India. Princeton: Princeton University Press, 1963.

Dyck, John H. Expected Schooling for Children in Rural Thailand and Its Relationship to Fertility. M.S. Thesis, The Pennsylvania State University, 1979.

Easterlin, Richard A. "An Economic Framework for Fertility Analysis." Studies in Family Planning 6(March 1975):54-63.

Encarnacion, Jr., Jose. Population and Development in Southeast Asia: A Fertility Model. Discussion paper No. 77-6, University of the Philippines, November 1977.

Hawley, Amos H. "Rural Fertility in Central Luzon." American Sociological Review, 20(1955): 21-27.

Hiday, Virginia A. "Agricultural Organization and Fertility: A Comparison of Two Philippine Frontier Communities." Social Biology, 25 (1978):69-75.

Kleinman, David S. "Fertility Variation and Resources in Rural India." Economic Development and Cultural Change, 21(1973):679-696.

Kleinman, David S. Human Adaptation and Population Growth: A Non-Malthusian Perspective. Montclair, New Jersey: Allanheld, Osmun and Co., 1981.

Knodel, John. "European Populations in the Past: Family-level Relations." In Samuel H. Preston (ed), The Effects of Infant and Child Mortality on Fertility. New York: Academic Press, 1978.

Leibenstein, Harvey. "An Interpretation of the Economic Theory of Fertility." Journal of Economic Literature, 12(June 1974):457-479.

Merrill, William. Agricultural Mechanization. Occasional Paper No. 1, Economics and Sector Planning Division, Office of Agriculture, Technical Assistance Bureau, U.S. Agency for International Development, Washington, DC, 1975.

Morley, D. Pediatric Priorities in the Developing World. London: Butterworths,972.

Paddock, William and Paul Paddock. Famine - 1975. Boston: Little, Brown, 1967.

Puffer, R. R. and C. C. Serrano. Patterns of Mortality in Children. Scientific Publication No. 262. Pan American Health Organization, 1973.

Robinson, Warren C. and Wayne A. Schutjer. "Economic Evaluation Procedures for Use With Population Related Projects." Prepared for the Latin American Bureau, Agency for International Development, U.S. State Department, January 1980.

Romaniuk, A. "Increase in Natural Fertility During the Early Stages of Modernization: Evidence from an African Case Study, Zaire." Population Studies 34(July 1980):293-310.

Romaniuk, A. "Increase in Natural Fertility During the Early Stages of Modernization: Canadian Indians Case Study." Demography 18(May 1981): 157-172.

Ron, Zvi. Agricultural Variation, and Household Variation, and Household Behavior: A Micro-Economic Analysis of Human Fertility Among Thai Rice Farm Families. Unpublished Ph.D. Dissertation, The Pennsylvania State University, 1980.

Ron, Zvi and Wayne Schutjer. An Econometric Analysis of Fertility, Schooling, and Time Allocation Among Thai Agricultural Households. Research Bulletin 840. The Pennsylvania State University (Forthcoming).

Rosenzweig, Mark R. and Robert Evanson. "Fertility, Schooling, and the Economic Contribution of Childern in Rural India: An Econometric Analysis." Econometrica, 45(1977):1065-1079.

Schutjer, Wayne A. "The World Food Problem: A Policy Perspective." Farm Economics. The Pennsylvania State University, March 1977.

Schutjer, Wayne A. "Agricultural Development Policy and the Demographic Transition." The Journal of Developing Areas. 12(1978):269-280.

Schutjer, Wayne A., C. Shannon Stokes and Gretchen Cornwell. "Relationships of Land Tenancy and Fertility." Journal of Developing Areas, 14(October1980):83-96.

Schutjer, Wayne A., C. Shannon Stokes and John R. Poindexter. Land Distribution and Human Fertility in Rural Egypt. Mimeo. The Pennsylvania State University, 1981.

World Health Organization. The Epidemiology of Infertility. WHO Technical Report Series 582, Geneva, 1975.