# Agricultural Shocks and Family Planning*

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VERY PRELIMINARY

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**Abstract**

This paper examines the relationship between household income shocks and fertility decisions. Using panel data from Tanzania we estimate the impact of agricultural shocks on contraception use, pregnancy, and the likelihood of childbirth. To account for potential endogeneity in fertility decisions and shocks, and unobservable household characteristics we use an individual fixed effects model. Households significantly increase their contraception use in response to income shocks from crop loss. Most of this increase comes from an increased use of traditional contraceptive methods (such as abstinence and rhythm method) rather than modern contraceptives (such as condom, diaphragm, pill, IUD, injection, female and male sterilization). Despite most of the increase in contraceptive use coming from traditional methods, pregnancies and childbirth are significantly delayed for households experiencing a crop shock. On average, crops lost over the last 12-14 months have an impact on current contraception use, whereas crop lost 6-12 months ago leads to a reduced likelihood of pregnancy. Finally, we find that the likelihood of childbirth significantly decreases for households following the income shock. For contraceptive use, pregnancies, and childbirths the impact of shocks is significantly larger the poorer the household.

Keywords: Tanzania, family planning, shocks, timing of fertility

JEL codes:

# 1 Introduction

Households coping mechanism to income shocks have been an active area of research in economics for many years. Recent economic literature has found that one of the coping strategy is to change the short term fertility of households in order to deal with the household income shocks (Lindstrom and Berhanu 1999; Pörtner 2008; Rose 1999). However the current literature does not provide show whether the changes in fertility is through intentional planning or through unintentional consequences of other effects that may also have been caused by income shocks.

This paper is the first to examine the direct effect of income shocks on family planning. It shows that an exogenous income shock, measured here through accidental crop loss, leads to a greater use of contraception. We further find that in this case of Tanzania, traditional contraception is primarily responsible for the reduction in short-term fertility in response to shocks. Income shock significantly increases the likelihood of using both traditional and modern contraceptives. We also find that the likelihood of pregnancies and child births decreases in households facing income shocks, resulting from the contraception use.

Although there has been a number of studies depicting decreases in fertility resulting from income shock, it is not obvious whether this decrease is systematically planned by the household. However there are important policy implications, as discussed later on, if farm households respond to agricultural shock through family planning. Potential reasons for unintentional consequences for low fertility may be that adults are depressed or worried about their family, or spending much more time at work, which leads to lesser likelihood of intercourse. Also, severe income shock, for example, agricultural shock can lead to health problems and starvation for household members, which can hamper the ability of intercourse. Another possible unexplored area maybe that severe income shocks can lead to lesser nutrition for mothers, which can then lead to higher number of stillborn births and lesser proportion of infants surviving after birth.

This wide variety of reasons makes it important to find a direct relation between income shock and family planning. One possible way to find whether agricultural shocks affect fertility in a planned way is to find its impact on family planning decisions, i.e. contraception use. In other

words, if an income shock leads to an increase in the use of contraception, it will show us that the family is attempting to control the fertility in a planned method.

The paper makes a number of contributions to the literature. It contributes to the income smoothing literature as households affected by income shock uses family planning as a mechanism of smoothing their consumption. Bearing a child in the short run implies removing scarce resources away from other useful purposes to the birth and wellbeing of the child. Farmers can therefore smoothen their consumption by delaying child birth during times of income shock.

Secondly, this paper also contributes to the family planning and fertility literature. This is the first paper to show that households respond to income shocks through family planning, which then goes on to have an effect on fertility. Earlier studies have shown that fertility rate decreases in response to major economic shocks Pörtner (2008); Lindstrom and Berhanu (1999); Evans, Hu, and Zhao (2010). Our study provides evidence that the reduced fertility occurs through a planned decision process rather than an unplanned consequence.

Thirdly, the paper contributes to the buffer stock literature (Deaton 1992) and finds the role of asset holdings as a coping mechanism to shocks. We find that households with greater assets are able to offset the shock, and hence their contraception use does not increase in response to the shock. Hence, greater assets act as a buffer for households and does not necessitate change in family planning for those households.

Lastly, there are potentially important policy implications resulting from the results of this paper. If farm households increase their contraception use because of a negative income shock, but decreases its use during agricultural income boom, it may mean that farmers can be potentially incentivized during their boom. If policymakers are interested in increasing contraception use to reduce fertility rate in developing countries, they can now possibly intervene through policies related to agricultural output.

Although there are many studies that show the impact on contraception use, such as, contraception use increases in response to schooling (Ainsworth et al., 1996; Chen and Guilkey, 2003; Feyisetan and Ainsworth, 1996), focused information campaigns (Chen and Guilkey, 2003),

participation in savings or credit group (Steele et al., 2001), etc., there has only been one study (Hernandez-Correa, 2010) that attempts to show the impact of shocks on contraception use. He uses a cross-sectional data to find that households suffering from adverse events are more likely to use contraception compared to ones not suffering from that event.[1] However, the paper does not claims or provide evidence that the adverse events are exogenous or transitory in nature. The effect of the adverse event is not clearly identified and there is potential endogeneity bias as the paper only compares these two groups without any household or individual level fixed effects, and therefore the difference in contraception use can result from some other endogenous characteristics present within the group. The cross-sectional data, rather than a panel also limits his study as they cannot find the before and after effects of shocks on contraception use.

# 2 Prior Literature

Several papers, mostly using historic data on developed countries, have studied the impact of various economic shocks on fertility. For example, Galloway (1987) employs data from 1681-1787 to find that wheat price increase led to a dramatic fertility decline for the urban poor in Rouen, France, while the fertility of urban wealthy is unaffected in response to those shocks. Bailey and Chambers (1998) employ annual English historic data from 1542 to 1800 to find that mortality shocks lead to short term fertility declines with the largest decline typically the year following the shock. They also find that an increase in real wage leads to an increase in short-term fertility for households. However, Eckstein, Mira and Wolpin (1999) find that increases in wage rate and decline in child mortality explains a significant part of the long term fertility decline in Sweden during the period 1736 to 1946.

In another study on Sweden, Schultz (1985) uses aggregate county level data to show that an

[1] Adverse events include economic and environmental aspect, such as: rise in input cost, rise in cost of goods, difficulty finding buyers, difficulty finding inputs, floods, late rains, early rains, droughts, pest problems, etc. Households may be able to anticipate many of these problems and therefore they can adjust their behavior accordingly which can lead to endogeneity. However, the author does not claim that these adverse events are actually exogenous or transitory in nature, so the author may possibly recognize this as an endogenous variable.

increase in the value of womens time relative to mens time led to a decrease in fertility in Sweden during the period 1860-1910. He finds that an increase in prices of butter increased womens relative wage compared to men, thus leading to a decline in fertility. Eckstein, Schultz and Wolpin (1985) also uses Swedish data to find that a positive crop shock, positive weather shock and positive wage shock increases fertility through higher population growth for the following five to ten years period. However, the increase in birth rate is found to be only a change in the timing of birth and has no cumulative effect on long term fertility rate. They also find that an increase infant death rate is followed by a short term increase in birth rate. They also find that an increase in non-infant death rate first reduces fertility (child bearing population in marriage are reduced), but is followed by a rise in fertility with the peak occurring in about five years. In a developing country setting, Lindstrom and Berhanu (1999) also provides evidence that famine and domestic/regional military attacks in Ethiopia leads to a short-term decrease in the likelihood of conception.

# 3 Data description

We employ the Kagera Health and Development Survey (KHDS) conducted by the World Bank and the University of Dar es Salaam in the Kagera region in Tanzania. This survey was conducted in four rounds from 1991 through 1994 and surveyed over 800 households, drawn from 51 communities (49 villages) in the six districts of Kagera.[2] The average interval between each of the survey rounds were between six to seven months. The sample selection was based on a variable probability sampling procedure (a two-stage, randomized stratified procedure) based on expected mortality.[3] The data contains detailed information on individual and household level characteris-

[2]From Beegle et. al. (2006): The Kagera region of Tanzania is located on the western shore of Lake Victoria, bordering Uganda to the north and Rwanda and Burundi to the west. The population (1.3 million in 1988, about 2 million in 2004) is overwhelmingly rural and primarily engaged in producing bananas and coffee in the north and rain-fed annual crops (maize, sorghum, cotton) in the south. Tree-crops and cassava, a commonly grown crop, have fairly continuous cultivation over the year.

[3]In the first stage, based on the 1988 Tanzanian census, the census clusters were randomly selected after stratifying them based on mortality rates and agro-climatic zones. Then the households were stratified into high-risk and low-risk groups in the second stage, which was based on illness and death of households in the 12 months before the enumeration process, and then the households were randomly sampled from the groups. For further details on the sample selection, please refer to World Bank (2004).

tics on demographic and socioeconomic variables, which makes it suitable for this study. Among other variables, the survey asks detailed questions to all women 14 years and above, and to married women under 14 years about information regarding their fertility and birth control. Specific questions include total number of prior births; whether she is currently using any contraception; if she is currently using contraception, the type of contraception used; whether the woman is currently pregnant; whether the woman gave birth to a child since the last survey round. The survey also asks the households about any accidental crop loss that they have faced since the last survey. The survey specifically asks whether the households lost any crop due to insects, rodents, fire, rotting, or other calamities. We use this accidental crop loss variable as an income shock to find its impact on contraceptive use, pregnancy and fertility. In order to avoid confusion, we define below the terminology that we use for our study: Current period - the interval between the round of survey being discussed and the previous survey round. For example, if we are discussing crop lost in the period 4 survey, then the current period crop loss will be the loss between period 3 and period 4 rounds of survey. 1-period lag - measurement done 1 period before the current survey round being discussed, or in other words - i.e. if we are discussing crop lost in period 4, and interested in 1-period lag in crop lost, then it means we are interested in the crop loss between the periods 2 and 3.

Picture depicting timing here

# 4 Results and Discussion

We employ individual fixed effects estimation technique to find the impact of accidental crop loss, which allows us to control all time-invariant mother characteristics. The KHDS is a rich survey that allows us to control for many time varying individual and household characteristics including womens age, education, number of prior births, education of the household head, and time fixed effects. The survey also allows us to have a detailed measure of household assets holdings: value of business equipment, durable goods, land, livestock and personal savings. We control for all

these above variables. Unless otherwise state, we employ individual dummy variables for crop lost, contraception use, pregnancy and child birth in all the following estimations.

First, we find the impact of crop loss since the last survey round (i.e. in the previous 6-7 months) on the likelihood of being currently pregnant which is represented by a dummy variable. We also control for assets before the shock occurs and an interaction term of assets owned and the shock to find whether higher asset ownership helps the household to reduce the effect of shock on fertility. As shown in Table 1, column 1, crop lost has a significant impact on pregnancy. However, crop lost in the period before can also have an influence on the likelihood of pregnancy, and therefore we include that variable in our estimation. As shown in column 2, we find that crop loss in the previous period (appx. 7-14 months before) reduces the likelihood of presently being pregnant. However, the coefficient of the current period crop becomes insignificant. We believe it is insignificant as some of the crop loss in the current period (previous 6-7 months) may have occurred after the event of pregnancy, in which case an effect of shock on pregnancy would be difficult to observe. However, it is important to note, that higher asset holdings before the current period shock has a positive impact on the likelihood of pregnancy. Therefore, households with higher asset holdings may be better able to deal with shocks, and thus households with higher assets do not need to adjust their fertility in response to a shock as compared to households with low levels of assets.

We confirm our estimation result of the impact of crop loss on pregnancy by examining the impact on the likelihood of child birth (Table 2). We estimate the impact of crop loss last period (7-14 months ago) on the likelihood of having a child birth in the current period (last 6-7 months), which is represented by a dummy variable. As shown in column 1, 1-period lagged crop loss leads to a lower likelihood of child birth. However, it is well within the realm of possibility that a mother was already pregnant before the crop loss. Therefore, we include one further lag of crop loss, i.e. 2-period lagged crop loss. However, this limits our estimation to only the last two periods of the survey, periods 3 and 4, which leads to very few number of child birth (97 cases) in our estimation equation. We believe that this small sample size was the reason behind the statistical insignificance

of the variables, albeit the expected signs.

The above empirical estimations provide evidence that agricultural shock indeed has an impact on fertility. However, it is important for policy implications to find whether the impact on fertility occurs through family planning or it occurs through other means such as sickness, too low body weight to bear child, mental depression, migration of spouse for better work opportunities, etc. To show that households indeed plan their fertility in the face of income shock, we find the impact of agricultural shock on their contraception use. If households facing income shock increase their contraception use compared to households not facing a shock, it provides evidence that households are planning their fertility in response to a shock.

The survey questionnaire asks the women: What contraceptive method are you and your partner using at the present? We estimate the effect of crop loss on the contraception use when survey round was completed. Using the same control variables as before, we estimate the impact of crop lost in this period on current contraception use. We categorize the type of contraception used into traditional and modern contraceptives. Traditional contraceptives include abstinence and rhythm method. Modern contraception include: condom, diaphragm, pill, IUD, injection, female and male sterilization. As female and male sterilizations are typically permanent procedures stopping pregnancy, once an individual is sterilized we remove them from our sample because their fertility decision can no longer be a choice variable. We employ the same control variables as before including the individual and time fixed effects. We present our estimation of the impact of crop loss in current period on present contraception use in Table 3. In column 1, we find that crop loss in current period and previous period both significantly increases the use of modern contraceptives, and the interaction term of assets and current crop lost is also significant with a negative sign. It shows that higher assets holdings help households to cope with the income shock better than households with lower asset holdings and therefore higher asset holdings can help them to reduce their contraception use. We estimate the impact of crop lost on traditional contraception and do not find a significant effect. However, as it is possible that only a substantial shock has an impact on traditional contraception. Therefore we only consider crop loss which is above 2500 Tanzanian

shillings in value. It means that we convert about a third of the crop loss to zero. Once we estimate the impact of this adjusted crop loss on traditional contraceptives, we find that crop loss has a significant impact on traditional contraceptive use. It indicates that only a substantial crop loss has an impact on the use of traditional contraceptives.

Table 1: The Effects of Crop Loss on Current Pregnancy

| | Pregnant Now | |
|---|---|---|
| | I | II |
| Crop lost in current period | $-0.070^{*}$ | $-0.058$ |
| | (0.036) | (0.061) |
| number of child birth in total | $-0.885^{***}$ | $-1.044^{***}$ |
| | (0.034) | (0.055) |
| 1 period lag assets owned | $-0.000$ | $-0.000^{*}$ |
| | (0.000) | (0.000) |
| crop lost x assets owned | 0.000 | $0.000^{*}$ |
| | (0.000) | (0.000) |
| 1 period lag crop lost | | $-0.099^{**}$ |
| | | (0.042) |
| 2 period lag assets owned | | $0.000^{*}$ |
| | | (0.000) |
| 1 pd lag crop lost x Assets | | $-0.000$ |
| | | (0.000) |
| Constant | $3.830^{***}$ | $4.218^{***}$ |
| | (0.196) | (0.338) |
| $R^2$ | 0.423 | 0.446 |

**Note.** Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

# 5 Robustness Checks

Although we find the impact of agricultural shock on fertility occurs through family planning, it is possible that a different time-varying factor affects fertility in response to crop loss. Potential factors include: delay in marriages in response to crop loss; male partners migrating away in response to shock, famine induced amenorrhea which is usually accompanied by lower weight and

Table 2: The Effects of Crop Loss on Births

| | Gave birth since last survey | |
|---|---|---|
| | I | II |
| 1 pd lag crop lost | −0.108* | |
| | (0.063) | |
| Age | 0.022 | 0.015 |
| | (0.114) | (0.116) |
| 2 period lag assets owned | −0.000 | −0.000 |
| | (0.000) | (0.000) |
| 1 pd lag crop lost x assets | 0.000 | |
| | (0.000) | |
| 1 pd lag crop lost above 2500 shill. | | −0.114 |
| | | (0.105) |
| 2 pd lag crop lost above 2500 shill. | | 0.011 |
| | | (0.072) |
| 1 pd. lag crop lost x assets | | 0.000 |
| | | (0.000) |
| 2 pd. lag crop lost x assets | | −0.000 |
| | | (0.000) |
| Constant | 0.196 | 0.180 |
| | (0.412) | (0.421) |
| $R^2$ | 0.034 | 0.032 |

**Note.** Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

BMI in response to shocks; or increases in fertility reducing diseases. To show that fertility is indeed affected in a planned way instead of an unplanned consequence, we find the effect of crop loss on the above mentioned factors. As shown in Table **??**, accidental crop loss does not lead to a significant increase in migration (column 1), sickness of women (column 2), and reduction of BMI of women (column 3). Crop loss may also possibly affect fertility rate through delayed marriages, and we address this issue by considering the likelihood fertility, pregnancy, and contraception use of married women in our initial estimations.

Table 3: The Effects of Crop Loss on Contraceptive Use

| | Type of Contraceptive | |
|---|---|---|
| | Modern | Traditional |
| Crop lost in current period | 0.056** | |
| | (0.024) | |
| 1 period lag crop lost | 0.054** | |
| | (0.027) | |
| number of child birth in total | −0.386 | 0.045 |
| | (0.269) | (0.034) |
| Age | 0.003 | −0.033 |
| | (0.032) | (0.027) |
| 1 period lag assets owned | 0.000 | −0.000 |
| | (0.000) | (0.000) |
| 2 period lag assets owned | 0.000 | −0.000 |
| | (0.000) | (0.000) |
| crop lost x assets owned | −0.000*** | |
| | (0.000) | |
| Assets owned before crop lost x crop lost in previous period | −0.000 | |
| | (0.000) | |
| Crop lost above 2500 shillings | | 0.078* |
| | | (0.040) |
| 1 pd lag crop lost above 2500 shillings | | 0.088 |
| | | (0.071) |
| crop lost above 2500 shill. x assets owned | | −0.000*** |
| | | (0.000) |
| 1 pd. lag crop lost above 2500 shill. x assets owned | | 0.000 |
| | | (0.000) |
| Constant | 1.636 | −0.036 |
| | (1.101) | (0.199) |
| $R^2$ | 0.141 | 0.060 |
| Observations | | |

**Note.** Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

# 6 Conclusion

To be added.

Table 4: Robustness Checks

| | Partner lives in HH? | Number of days ill | BMI |
|---|---|---|---|
| Crop lost in current period | −0.028 | −0.059 | −0.000 |
| | (0.029) | (0.115) | (0.000) |
| 1 period lag crop lost | −0.006 | −0.034 | −0.000 |
| | (0.011) | (0.082) | (0.000) |
| crop lost x assets owned | 0.000 | 0.000 | 0.000 |
| | (0.000) | (0.000) | (0.000) |
| 1 pd lag crop lost x assets | 0.000 | −0.000 | 0.000 |
| | (0.000) | (0.000) | (0.000) |
| Constant | 0.084*** | 1.168** | 0.002*** |
| | (0.019) | (0.573) | (0.000) |
| $R^2$ | 0.014 | 0.023 | 0.056 |

**Note.** Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

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# A Appendix