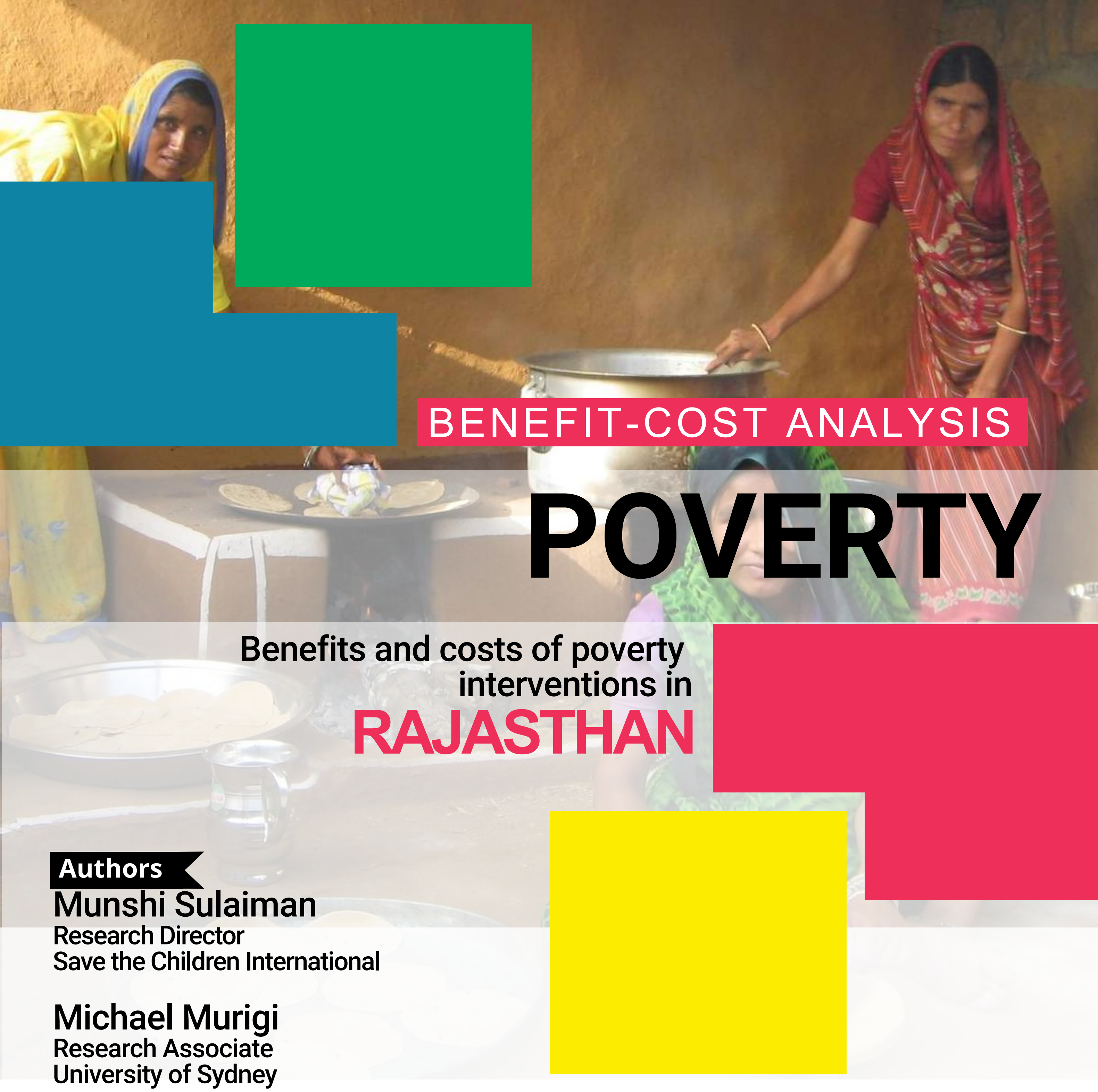

BENEFIT-COST ANALYSIS

# POVERTY

## Benefits and costs of poverty interventions in RAJASTHAN

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RAJASTHAN PRIORITIES AN INDIA CONSENSUS PRIORITIZATION PROJECT

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TATA TRUSTS

# Cost-Benefit Analysis of Crop Insurance and Graduating Ultra-poor

Rajasthan Priorities
An India Consensus Prioritization Project

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# Academic Abstract

Protecting farmers from crop loss related income shocks and eliminating extreme poverty are important development priorities of this century. India has made significant progress in protecting farmers from income loss due to drought and other calamities through various crop insurance schemes. At the same time, poverty rate has also been declining including in Rajasthan. Making further dent on poverty reduction in sustainable manner remains a challenge. In this paper, we look at the evidence on the necessity of subsidies for increasing uptake of crop insurance, and its potential impacts on farmers' risk-taking ability and health benefit. Our estimates show a benefit-cost ratio (BCR) for crop insurance around 1.5 through increased expected income and health benefits. For poverty reduction, graduation model provides a potential avenue of expanding social protection for ultra-poor. There are a number of rigorous impact studies that prove the immediate impacts of this model with strong indication of sustainability. The BCR for graduation model stands around 3.5, which is substantially higher than crop-insurance. One of the major limitations of the BCR estimates is – the comparison does not account for equity such as crop insurance benefitting a wider population than a targeted intervention such as graduation.

# Policy Abstract

## The Problem

Although agriculture is a major source of livelihood for rural population, the marginal farmers have long been vulnerable to the risks of crop losses. Smallholder farmers are particularly vulnerable since they lack the resources for taking preventive measures or for absorb the shocks in case of income loss. Consequently, they modify their livelihoods to mitigate risks by choosing low-risk but low-return crops and technologies and abstaining from other risky investments keeping them in a cycle of poverty. Moreover, in cases of shocks, they often are forced to sell off their limited productive assets and borrow at high interest rates to cope with shocks, leading to further indebtedness and poverty. There is also evidence of more severe consequences whereby crop loss from natural calamities, such as recurrent drought, causes higher mortality among the rural households. While reports of “starvation deaths” attract public attention, the silent health consequence through food insecurity and malnutrition are often more far reaching (Dréze, 2018). There has been major progress in addressing starvation in recent years, but the health consequences remain a challenge for the rural poor.

Although there has been significant progress in reducing poverty in Rajashtan from 38% to 15% in two decades between 1994 and 2012 (World Bank, 2016), rural poverty rate is still higher than that of urban areas with significant differences across districts. Addressing the remaining extreme poverty will require more targeted and sustainable solutions. Under the Strategies for Doubling Farmers’ Income, the Government of Rajsthan has prioritized a number of areas ranging from crop productivity through seed replacement, increasing crop intensity and diversification to post-harvest processing and storage. In this paper, we conduct a cost-benefit comparison of two interventions. The first intervention is a subsidized crop insurance that follows the Pradhan Mantri Fasal Bima Yojana (PMFBY) and the second intervention is a “Graduation Model” for the ultra-poor households that use a package of interventions including food stipend, entrepreneurship building and asset transfer to create a pathway out of extreme poverty within a targeted timeframe.

## Intervention 1: Subsidized Crop Insurance

The subsidized crop insurance offers comprehensive unlimited coverage to farmers. There are a few key features of this insurance schemes, building up on the long history of offering insurance services to the farmers in India. Firstly, the scheme is heavily subsidized with farmers having to pay only 2% of the sum insured for the main *kharif* season. The corresponding rates for *rabi* crops and annual horticulture crops are 1.5% and 5% respectively, or the actuarial rate if this rate is lower than the cut-offs. The remainder of the premium is paid equally by the central and state governments. The government is approximately contributing 5 times that of the premium paid by the farmers, which is much higher rate of subsidy than previous schemes. Secondly, there is no cap on the amount of sum insured per farmer unlike other schemes such as NAIS. Thirdly, the coverage includes wider set of calamities including hail storm, land slide, inundation, prevented sowing due to delayed rain as well as part of the post-harvest losses. Fourthly, the scheme uses technology and smart phones for increasing efficiency. Smart phones are used to collect and upload data of crop cutting that reduces the delays in claim payment to farmers. Moreover, remote sensing reduces the number of crop cutting experiments to reduce losses and make costs of claim processing lower. Finally, this scheme is implemented as public-private partnership whereby insurance companies bid at state level. The early assessments of the scheme indicate a lot of promise to protect farmers (Rathore, 2017).

### Costs and Benefits

#### Costs

The cost of this intervention is the subsidy that the state and central government split equally. The amount of subsidy is the balance of actuarial premium from the 1.5% to 5% that the farmers pay. The premium subsidy paid in 2016-17 was Rs. 2,885 per hectare for 74.6 lakh hectare that were covered in Rajasthan. The insurance coverage was 28.6% of the gross cropped area. We project increase in the premium subsidy per hectare and increase in insurance coverage of cultivated land to estimate a total cost of Rs. 511 billion at 5% discount rate for a scheme that continues till 2032.

#### Benefits

The benefits from the crop insurance are two-fold – income from crop production and health benefits. The increase in income from crop production takes place because farmers can cultivate higher-risk crops that also give higher return on average, invest more in improved technologies and increase the amount of land cultivated for both seasons (i.e. increase gross cropped area). Farmers who suffer crop loss also benefit from the claims paid by the insurance companies. On the health front – we use the evidence of climate induced crop loss resulting in higher deaths and increased child malnutrition. Taking these benefits, our estimated BCR is 1.53 for the investment in crop insurance intervention. Although the BCR estimates are not extremely high, the projected benefits are reasonable estimates.

## Intervention 2: Graduating ultra-poor

The goal of graduation model is to create a pathway out of extreme poverty through an intensive set of interventions that combine asset transfer to promote self-employment, food subsidy for supporting the shift to an alternative livelihoods, social support and handholding for protecting assets and increasing profitability of their business. This model follows a strict set of targeting criteria to reach the ultra-poor and provide a time-bound support that usually last between 18 to 24 months. A number of evaluations of this model has demonstrated that the intervention creates immediate impact on food consumption, income, savings and assets of the beneficiary households. More importantly, these impacts sustain and even continue to increase after a year to five years from the end of all programmatic supports. This model is being implemented, although at small scales, by various NGOs in West Bengal, Andrha Pradesh and Jharkhand.

### Costs and Benefits

#### Costs

Because of the comprehensive nature, the cost of the intervention is relatively high at over Rs 25,000 per beneficiary household. Half of this amount is spent in direct supports including the asset transfer (usually livestock) and food stipend. The other half includes provision of other services (such as health) or intensive coaching for ensuring their micro-enterprises are profitable. Assuming the intervention will reach 30% of the poor households, the total investment required for this intervention is Rs. 11.33 billion.

#### Benefits

The main components of the benefits are increase in annual household consumption, amount of savings and assets. For this paper, we use the impact study results from West Bengal that measure impact up to seven years from the start of the interventions. Although there are indications of these impacts to be continuing for longer, we use the existing evidence to find a BCR of 3.54 for the investments.

## BCR Table

Table 1. Summary of Benefit-Cost Estimates

| Interventions | Benefit (Billion Rs.) | Cost (Billion Rs.) | BCR | Quality of Evidence |
|---|---|---|---|---|
| Crop insurance | 782.9 | 511.4 | 1.53 | Medium |
| Graduation | 40.1 | 11.3 | 3.54 | Strong |

Notes: All figures assume a 5% discount rate

# 1. Introduction

Rajasthan, the largest state in terms of geography and seventh largest in population, has achieved commendable success in reducing poverty and ensuring social development. While the poverty rate in India has declined from 45% in early 1990s to 22% in 2011-12, the corresponding rates in Rajasthan are 38% and 15% (World Bank, 2016). Similar to the national trend, rural poverty in Rajasthan is higher (16%) than urban areas (11%). Although there has also been increasing urbanization, over 75% of the poor population of the state lives in rural areas. Majority of the rural households rely on agriculture as their primary livelihoods, the extent of marginal farming has been on the rise due to land fragmentation. For example, average landholding per household has consistently declined from 2.7 hectare in 1991 to 2.1 and 1.5 by 2003 and 2013 respectively (NSSO, 2015). According to 70$^{th}$ National Sample Survey, the proportion of landless households in the state has declined from 5.7% to 3.9% between 2003 and 2013 while the rate has declined from 11% to 7% in the county. Average landholding of those who own land has declined from 2.2 hectare to 1.5 hectare between 2003 and 2013. Despite the prominence of agriculture in rural livelihoods, the declining farm size poses important challenge in further reduction in rural poverty to achieve the goal of eliminating extreme poverty by 2030.

Agriculture sector in India has made remarkable progress with food grain production increasing four times since independence and at a higher pace than population growth (Rao, 2008). The marginal farmers are extremely vulnerable to crop losses due to rain failure and other calamities. According to 70$^{th}$ NSS data, less than 30% of the land cultivated by the marginal farmers (who have less than half a hectare land) in Rajasthan were irrigated, which is much lower than the state average of 57%. There have been a number of initiatives to expand irrigation facilities to reduce reliance on rainfed agriculture and protection schemes over the years, but many of the farmers remain vulnerable to weather shocks. While the effects of such shocks are more severe for the marginal farmers, all farmers are vulnerable to weather shocks especially with climate change. This has both micro and macro consequences for both farmers and non-farmer households of the state.

With uncertainty of rainfall, farmers may plant low-risk but low-return crop, such as bajra, instead of a higher-risk but high-return crop, such as barley or moong. Furthermore, farmers concerned about the unpredictable weather may decide not to make other investments in their farms, such as increasing fertilizer use or use seeds of higher yielding varieties. As a result, the threat of extreme weather or uncertainty of rainfall can trap farmers in a cycle of low productivity. Continuous drought is the one the major problems to address the productivity issues in agricultural in Rajasthan. The state has the highest dependency on rainfed agriculture and faced drought in 20 of the last 50 years.

There are many studies that have established the links between rainfall variability causing crop failure as a major driver of rural poverty. In extreme cases, this may lead to farmers committing suicide after crop failure as the ultimate coping strategy. Carleton (2017a) used about 50 years of trend data since 1967 to establish a causal linkage between climate change and suicide rate in India. In the study, she finds that although there is an association of temperature and precipitation with suicide rates during cropping season, there is no correlation during non-cropping season. This establishes crop failure as the mediating factor in the causal link between rainfall and suicide rate. Although farmers' suicide in Rajasthan is not as major an issue as it is some other states, there are often reports of "starvation deaths", especially during droughts (Dréze, 2018). Burgess et al (2017) find effects of drought on all-age mortality rate (with the magnitude of 3 to 6 additional deaths in rural areas). The study also establishes that the mechanism is through crop damage and reduced wage for day laborers, and access to financial services can reduce the risks.

Besides weather shocks, the marginal farmers relying primarily on agriculture are also vulnerable to post-harvest losses. Although studies on effects of weather shocks primarily focus on drought, there is ample evidence of their effects on per capita GDP in the developing world compared to the developed world (Raddatz, 2009). Moreover, such threats are likely to increase in the future through increased frequency and severity of weather shocks due to climate change. Global estimates indicate that climatic changes will reduce the world's agricultural output by 16% by 2020 with a large impact on some major staple food crops like rice, wheat and maize (Nelson et al, 2010). Because of the covariate nature of these shocks, informal insurance mechanism fails to meet the need of the affected population. Consequently, government social protection schemes remain critical.

The effects of crop failure and low income on child wellbeing (especially on health and cognitive abilities) creates an inter-generational poverty trap. By using 2002 drought in Andhra Pradesh as a natural experiment, Ahmed (2015) finds that a one standard deviation decrease in rainfall reduce child weight-for-age z-score by 0.63. Similar to mortality trend, this effect of poor rainfall on child nutrition is mitigated if the households have access to social safety net services. A more thorough study covering all the states of India, Kumar et al (2016) find that drought leads to a 1.8 percentage point increase in underweight and 1.5 percentage point increase in severe underweight. This study also shows a negative effect on child anemia and households' asset ownership.

For the landless or marginal farmers who also rely on causal work, the weather effects also create income shocks through reduced wage labor. While India has been in the forefront for taking various anti-poverty initiatives, such as Rajasthan Agriculture Competitiveness Project (RACP) or Rajasthan Rural Livelihood Project (RRLP), elimination of extreme poverty needs continued efforts by scaling successful approaches. Graduating ultra-poor is one such model that are being implemented, albeit in smaller scales, and show the promise of being incorporated into national social protection schemes. Started with fairly small-scale pilot in West Bengal and Andhra Pradesh by NGOs, there have been discussions of taking it at state and national level. For example, there Jharkhand State Livelihood Promotion Society established by the State Government is implementing it in two districts.

In this paper, we review the existing evidence of crop insurance schemes and graduation model to conduct a benefit-cost analysis in Rajasthan. We find that benefit cost ratios (BCR) of crop insurance is 1.53 while the BCR of graduation model is 3.54 at 5% discount rate. The total investment needed for scaling up the two interventions (at 2017 price) are Rs. 511 billion and Rs. 11.3 billion respectively. Although the crop insurance requires a much higher investment, the costs are incurred annually whereas the investment in graduation model can be completed over shorter period.

# 2. Crop Insurance

## 2.1 Description of intervention

India has been a pioneer in designing interventions for making agriculture less risky for the farmers. Crop insurance models that involve both individual and area approach have been tried since independence (Rathore, 2017). Among the more recent schemes, Pradhan Mantri Fasal Bima Yojana (PMFBY) was launched in January 2016. This scheme replaced the existing two crop insurance schemes viz. National Agricultural Insurance Scheme (NAIS) and Modified NAIS and is being implemented since *kharif* season (June) of 2016. This is the most comprehensive national schemes till date that provides coverage for natural calamities, pests and diseases with the objective of protecting farmers from income loss and promoting adoption of innovative and modern agriculture technologies (PMFBY, 2016). The target of this scheme is to double insurance coverage to 50%.

For this cost-benefit analysis, we take the costs of PMFBY and make estimates of benefits assuming a similar design. Therefore, the intervention can be considered as the "PMFBY like" crop insurance scheme. Unlike many of the other insurance shames, PMFBY targets farmers beyond making it a scheme for borrowers. However, a report by CAG (2017) noted that at the early stage of the PMFBY, it was mainly taken up by loanee farmers as it has been stipulated as mandatory for them and for non-loanee farmers the uptake is low. At the launch, the number of farmers taking up the scheme was 39 million in *kharif* season of 2016.

The scheme is implemented as "area-based approach" where by it is assumed all the insured farmers, in a Unit of Insurance, which are defined as 'Notified Area' for particular crops, face similar risk exposures, incur to a large extent, identical cost of production, and more importantly experience similar extent of crop loss due to the particular peril. In practicality, this unit of insurance is typically at village or village *panchayat* level. This area-based approach has the obvious advantage of reducing monitoring costs for claims.

There are a few key features of this insurance schemes, building up on the long history of offering insurance services to the farmers. Firstly, the scheme is heavily subsidized with farmers having to pay only 2% of the sum insured for the main *kharif* season. The corresponding rates for *rabi* crops and annual horticulture crops are 1.5% and 5% respectively, or the actuarial rate if that is lower than the cut-offs. The remainder of the premium is paid equally by the central and state governments. The government is approximately contributing 5 times that of the premium paid by the farmers, which is much higher rate of subsidy than previous schemes. Secondly, there is no cap on the amount of sum insured per farmer unlike other schemes such as NAIS. Thirdly, the coverage includes wider set of calamities including hail storm, land slide, inundation, prevented sowing due to delayed rain as well as part of the post-harvest losses. Fourthly, the scheme uses technology and smart phones for increasing efficiency. Smart phones are used to collect and upload data of crop cutting that reduces the delays in claim payment to farmers. Moreover, remote sensing reduces the number of crop cutting experiments to reduce losses and make costs of claim processing lower. Finally, this scheme is implemented as public-private partnership whereby insurance companies bid at state level. The early assessments of the scheme indicates a lot of promise to protect farmers (Rathore, 2017).

## 2.2 Data

The analysis in this report used secondary information and no primary data was collected for this purpose. We have collated information from various sources including - impact studies on crop insurance schemes, studies on impact of rainfall failure on crop production and farmer households, cost of production and profitability data from season wise estimates by Commission for Agriculture Costs and Prices (CACP, 2017a and CACP, 2017b), statistics on farm size from National Sample Survey reports (NSSO, 2015), information on insurance coverage from national agriculture statistics (DES, 2017), and state-wise crops production, sum insured and number of farmers from online government data portal (GOI, 2018). Specific pieces of information that has been used in the benefit-cost calculations are specified along with their respective sources in the section on "calculation of costs and benefits".

## 2.3 Literature Review

This literature review touches on three main points that are relevant for the benefit-cost estimates – a) uptake of crop insurance through various schemes, b) impact of crop insurance on farmers decisions for risk taking and production, and c) other health benefits that crop insurance may create by mitigating the risks and income smoothing.

There is ample evidence that crop insurance uptake is extremely low unless it is heavily subsidized. For example, from a review of 10 randomized control trials (RCTs) on indexed based insurance, JPAL (2016) concludes – "weather index insurance protects farmers against losses from extreme weather and facilitates investment in their farms, but randomized evaluations in South Asia and sub-Saharan Africa have shown low demand for these products at market prices…". Five of their reviewed studies were conducted in the states of Andhra Pradesh, Tamil Nadu, Uttar Pradesh and Gujarat of India with various insurance companies as partners to test their products. Based on these studies, the review estimates that the take-up of insurance schemes at 100% market price (i.e. actuarial rates) is expected to be between 10% - 20%. Different methods of increasing the take-up rate have been tested in a number of studies. Although training and awareness initiatives increase the uptake by about 6 percentage points in Gujarat, this approach is not cost-effective for the insurers to pay for the training (Cole et al, 2014). While interlinking credit and insurance has long been used as an approach for increasing insurance coverage, a study in Malawi shows that this can lead to smaller farmers deciding not to take loans and further prohibits profitable investments (Gine and Yang, 2009). A series of experiments by Gine et al (2010) in Andhra Pradesh demonstrate that to achieve an insurance coverage of at least 50%, the premium needs to be subsidized at least by 30%. Subsidy requirements in Tamil Nadu and Uttar Pradesh were also similar.

While protecting farmers from income shocks is an important outcome on its own, the benefit of insurance coverage on farmers risk taking behavior, investment decisions and impact on productivity are the major economic justification for subsidizing crop insurance. Cole et al (2017) conducts experiment to measure these impacts. The study finds that insurance coverage influences farmers to move from crops with low-expected return to high-return crops that are more sensitive to rainfall variability. In the season that the treatment farmers are covered with insurance, they are 6 percentage points more likely to produce cash crops which is equivalent to 12 percent increase. At the same time, the farmers are also likely to increase the total cultivation area. The point estimates of the effect size converts to a 27% increase in cultivated land for a farmer who would have cultivated 2 acres in the absence of the insurance. This is a substantial increase given that many farmers in Rajasthan operate at a scale of less than one-hectare land. Finally, the study also finds significant effects on farmer's investment for crop production (in terms of money spent for buying inputs). However, the study does not measure the effects on household income due to these investments.

There are a few studies that assessed the impact of drought on health effects (such as mortality, suicide and child health) in India (e.g. Burgess et al, 2017; Carleton, 2017a; and Kumar et al, 2017). However, in our literature review, we did not find any robust evidence of insurance coverage preventing such health consequence of these climatic shocks. Therefore, the benefit assessment makes assumptions of mitigation effects by using the health impact of weather shocks. However, given the strength of evidence around agriculture production, food price increase and wage decrease being the main mechanisms behind the health impacts, it is a reasonable assumption that income protection from crop insurance would prevent deterioration of some of these health outcomes for farmers facing crop loss.

As noted earlier, farmers committing suicide after crop loss often catch media attention and these stories influence the moral side of human protection. While a lot of policy discussion and decisions are influenced by these events through public pressure, quantitative evidence has largely been missing. The seminal study by Carleton (2017a) makes a significant contribution in this policy discussion. The study finds that one celsius "degree day" variability during cropping season increase the likelihood of suicide by 0.003 to 0.008 for every one lakh population. Since there is no correlation between weather change and suicide rates during non-cropping season, the study concludes crop loss as the main channel for this effect. The study also finds that the four states that are often at the center of India's public debates regarding agricultural influences on suicide (viz. Maharashtra, Karnataka, Tamil Nadu and Andhra Pradesh) not only have severe suicide responses to temperature but also have the highest negative effects on agriculture income. This corroborates the argument that crop loss is the driver behind the loss of lives. This paper has attracted a good amount of policy and academic attention because of the sensitivity of the issue. Das (2018), Murari et al (2017), Plewis (2018) and Carleton (2017b) contain rich discussion on the limitations of the findings and rebuttals. Although suicide is not as major an issue in Rajasthan as it is in other states, there are strong health implication of income loss from crop failure due to drought (Dréze, 2018).

Mortality rates through increased food insecurity due to climate shocks is more difficult to measure. The study by Burgess et al (2017) match district level panel all-age mortality data from 1957 to 2000 with temperature data to measure the effects of hot days on mortality. They study finds that hot days increases mortality by 0.002 to 0.005 per 1,000 population in rural areas and no effect in urban areas. However, there are many possible channels through which this effect may take place. The study rules out particular disease outbreak as the mechanism of this impact. On the other hand, the association of hot days with agriculture productivity and wage rates suggest that the "hunger season" is an important mechanism. However, other potential sources of this effect (e.g. farmers needing to work being exposed to hot ambient temperature causing bad health) could not be fully ruled out. Interestingly, the study finds that access to credit can act as a mediating factor to reduce the hazards of mortality due to high temperature. For our study, the channel of influence through reduction in farm output and wage rates show that there are potential health benefits (in terms of reduced mortality) due to crop insurance.

Finally, the study by Kumar et al (2015) show that exposure to drought by rural households increase likelihood of children being under-nourished. In this study, the estimate the effects of being exposed to drought condition in the year of birth on weight-for-age z-score (WAZ). According to their estimate, drought exposure in early life reduces WAZ by 0.1 standard deviation, and consequently the likelihood of being (severely) underweight increase by 2 percentage points. This study tries to establish crop loss and income shock as the main channel and find significant negative effect on asset ownership. Although the study suggests some long-term effects on subsequent health and cognitive developments, the results are less robust. Several other studies in different contexts show long-term effects on children's cognitive ability if they were born in year of good rainfall (e.g. Shah and Steinberg, 2014; Maccini and Yang, 2009). Similar to other studies on this topic, Shah and Steinberg (2014) also argue that the mechanism of the long-term effect is through reduced agriculture production causing low income and malnutrition although the mechanism could not be directly tested.

Although none of these evidence on health impacts directly test the mitigating role of crop insurance, the substantial evidence on crop failure and income loss being the underlying mechanism is adequate to consider such benefits in our cost-benefit estimates.

## 2.4 Calculation of Costs and Benefits

The agricultural crop year in India is from July to June. The Indian cropping season is classified into two main seasons - *kharif* and *rabi* based on the monsoon. The *kharif* cropping season is from July–October during the south-west monsoon and the *rabi* cropping season is from October-March (winter). The *kharif* crops include rice, maize, sorghum, pearl millet/bajra, finger millet/ragi (cereals), arhar (pulses), soyabean, groundnut (oilseeds), cotton etc. The *rabi* crops include wheat, barley, oats (cereals), chickpea/gram (pulses), linseed, mustard (oilseeds) etc. Kharif crops require hot and wet climate whereas cold and dry climate is best suited for Rabi crops. Rainfall plays a significant role in the yield of the two types of crops, in the sense that rain is good for *kharif* crops while the same may spoil the yield of *rabi* crops. While the rain variability is relevant for both crops, insurance coverage in *rabi* season is consistently lower than kharif season. For our cost and benefit estimates, we estimate annual production and coverage instead of season specific estimates due to unavailability seasonal disaggregation of all required data. In this section, we explain the cost estimates followed by benefit. For benefit calculation, we explain the production benefit resulting in higher income for the insured farmers, and the health benefits.

### 2.4.1 Cost

The cost estimates of the crop insurance intervention are done from the actual estimates available for the seasons in 2016-17 crop calendar. A response to a parliamentary question on the PMFBY insurance coverage, the Ministry of Agriculture and Farmers Welfare provided state-wise aggregates of premiums paid by the central and state governments (GOI, 2017). According to this data, the total amount of premium paid by the central and state government of Rajasthan were Rs. 179,800 lakh in *kharif* season and Rs. 35,440 lakh in *rabi* season of 2016-17. In order to convert this into premium subsidy per hectare of insured land, we used the estimates of gross cropped area (261 lakh hectare) in 2016-17 and share of cultivated land covered by insurance in the state (28.6%). These estimates of area insured and gross area sown are taken from Tabel 14.15(a) and 14.16(a) respectively in DES (2017). This gives us an estimated cost of Rs. 2,885 per hectare of insured land, which is about 18% of the total sum insured (Rs. 12,207 crores in total in Rajasthan and Rs. 16,359 per hectare covered). The sum insured figures obtained from the online data portal (GOI, 2018) and DES (2017) are consistent.

In order to predict the costs of insurance coverage for the future years, we estimate that the insurance coverage will increase gradually to 50% by year 2024 and reach a steady state for the subsequent 8 more years. Therefore, the cost projections are counted for 16 years starting in 2017. This assumption of 16 years is somewhat arbitrary. Therefore, in our sensitivity analysis we show that the BCR does not change by different assumptions for length of intervention although the net present value of the total cost (in 2017) obviously is function of the duration of intervention.

Besides duration of intervention, the other important parameters in cost estimate are the change in the value of sum insured per hectare and subsidy rate (as percentage of sum insured).

### 2.4.2 Benefit to farmers' production and income

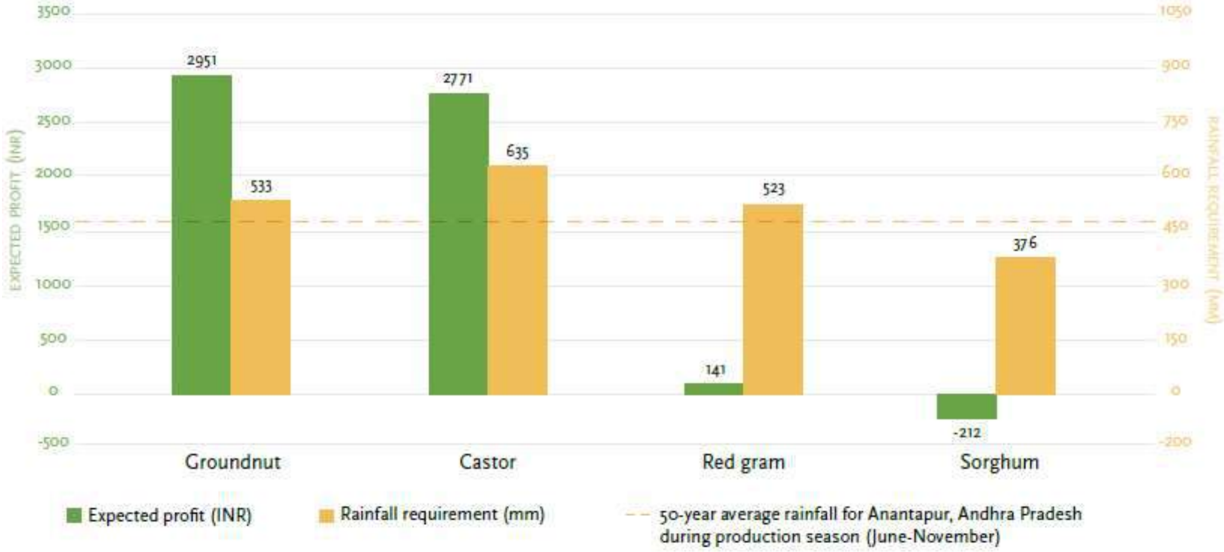
As discussed in literature review, there is evidence of crop insurance impacting farmers' risk taking and choice of crops to produce. Figure 1 shows a stylized facts of low-risk low-return and high-risk high-return crop. This particular case shows that groundnut and castor (high-risk high-return crops) has much higher expected income than red gram or sorghum (low-risk low-return crops). Although rainfall requirement for the high-risk high-return crops are only marginally above the average rainfall of the location, farmers often choose to plant sorghum, which has less than average rainfall requirement and in fact gives a negative net profit. Therefore, income protection from insurance will result in benefit due to the shift in crops cultivated with higher return on average.

For the benefit calculation, we first identified the main food and cash crops that are common in Rajasthan. Although a more localized estimates (e.g. by district and by season) is possible, state level estimates are reasonable reflection of the benefits although the real benefits to the farmers may vary by district. It is important to highlight that the profit differential between low-risk low-return and high-risk high-return crops is the benefit while the exact composition of the crops may differ.

There are three components of crop production and income benefits to the farmers. The first is the claims made by the farmers, which is assumed to be 98% of the premium subsidized by the government based on 2016 estimates. Based on per ha premium cost estimates, it is Rs.

2,827 in 2017 and increase in subsequent years proportionately to the increase in premium costs.

Figure 1. Risk and return of crops




Source: JPAL (2016)

The second component is the increase in crop income due to shift from low-risk low-return crops to high-risk high-return crop. According to the impact study, in the first year of insurance coverage it is estimated that the shift happens for 8% of the insurance covered land, and the shift increases over the years as farmers get accustomed to the new income smoothing mechanism. The rate reaches a steady state of 30% shift by year 2023 and stays the same for the next years of cost-benefit calculations. For the expected income calculation, we use the cost of production and net benefit estimates from CACP (2017a and 2017b). These estimates are for crops and does not account for crop variety. For example, the cost and profitability vary substantially among the different varieties of paddy cultivated. However, a shift in variety within crop types is not considered in the benefit calculation. We identify five crops that are low-risk low-return (e.g. bajra, maize, jowar, gram and urad) and three crops as high-risk high-return (barley, moong and groundnut). The average net profit of the first set of crops is Rs. 2,607 and the second set of crops yield average profit of Rs. 7,174. It is important to clarify here that we used the net profit estimates from CACP. However, the absolute values of the net profit for crop types is not relevant for the benefit estimates. The difference in profitability between the two sets of crops is relevant for the exercise.

The third benefit comes from farmers increasing gross cropped area due to their greater risk-taking ability being covered by the insurance. This increase in gross cropped area is assumed to be 2% annually, which can happen either by covering uncultivated area or by more intensive seasonal use of cultivated land. We assume that the net profit from this increased cropped area is equal to the low-risk low-return crops' average.

### 2.4.3 Health benefits

There are two elements of health benefits considered in this cost-benefit analysis. Given the impact results of all-age mortality rate in Burgess (2017) and suicide rates in Carleton (2017a), we estimate that the number of lives saved per 100,000 insured farmer households is 5 annually. To convert the total number of lives saved by the crop-insurance, we estimate that 20% of the insured farmers would receive the income protection from severe weather events for whom the health effects are relevant. According to GOI (2018), there were 53.1 lakh farmers who were covered by the insurance schemes. Therefore, the total number of lives saved in 2017 is 53.05, and the same principles are used for calculating benefits of later years. Assuming these lives are saved at 35 years of age, the average remaining years of life is 41.3 years in the state. These years life lost (YLL) is discounted to the year of when the lives are saved. For example, at 5% discount rate, the discounted YLL is 17.33 for 41.3 years for undiscounted life lost. This is converted to monetary benefits by using the assumption of value of DALY, which is three times of annual GSDP of Rajasthan.

The second health benefit is reduced malnutrition for children. Given average household size of 5.1 and 10.7% of the household members are below under-five, we have 0.546 under-five children per household. The impact assumed for crop insurance on malnutrition reduction is 1.5 percentage points for a year. A year spent with malnutrition is considered as 5.3% as "bad" as a year of life lost due to premature death. This gives a benefit of 2301 YLD avoided in 2017 by reaching 53.1 lakh farmers through crop insurance. Subsequent years use the same approach of estimation.

## 2.5 Assessment of Quality of Evidence

The benefit estimates use different three sets of evidence in terms of impact of crop insurance on the outcomes. While each of the individual studies are of very strong quality, the assumptions needed to be made for taking the evidence into benefit calculation make the overall quality of evidence ranking as "medium to strong". The impact study of crop insurance on farmers' risk-taking behavior was conducted following randomized control trial method in Andhra Pradesh since no comparable study in Rajasthan could be obtained. The evidence of health effects show that crop or income loss are the causal factors of lives lost or malnutrition, which is used as adequate evidence to assume income protection from insurance coverage will yield the benefits of avoiding these losses.

## 2.6 Sensitivity Analysis

In this section, we present the BCR estimates by changing the parameters of a few assumptions. The 'base estimates' in Table 2 shows the BCR for the assumptions outlined in the section on method of cost and benefit calculations. It shows that the BCR ratio is between 1.55 and 1.51 at discount rates of 3% and 8% respectively. The reason the BCR estimates not changing substantially across discount rates is – both the cost and benefits are materialized annually and hence gets discounted at the same rates. Consequently, the change in the assumption of number of years for the project does not change the BCR by much margin. The next two columns show the BCR if the health benefits are taken away and no change in gross cropped area is assumed. Overall, the BCR seems to be stable at 1.5 mark although it seems to be relatively low compared to other interventions.

Table 2. Sensitivity analysis of crop insurance

| Discount rate | Base estimate | Changes from base estimate | | |
|---|---|---|---|---|
| | | Project for 10 years | No health benefit | No change in gross cropped area |
| 3% | 1.548 | 1.477 | 1.510 | 1.514 |
| 5% | 1.531 | 1.463 | 1.500 | 1.497 |
| 8% | 1.509 | 1.447 | 1.485 | 1.476 |

# 3. Graduation Program for the Ultra-poor

Eliminating extreme poverty, which is a global ambition, depends critically on creating sustainable livelihoods for the economically active ultra-poor. These are households who are landless and marginal farmers, and also rely on casual work for their livelihoods. Consequently, they suffer from income shocks due to lean seasons and often are not able to access financial services including loans and micro-insurance. The success of a "Graduation Model" in a number of countries have made it as a formidable contender as one of the critical tools in social protection schemes. Over forty countries are implementing different versions of graduation model at different scales.

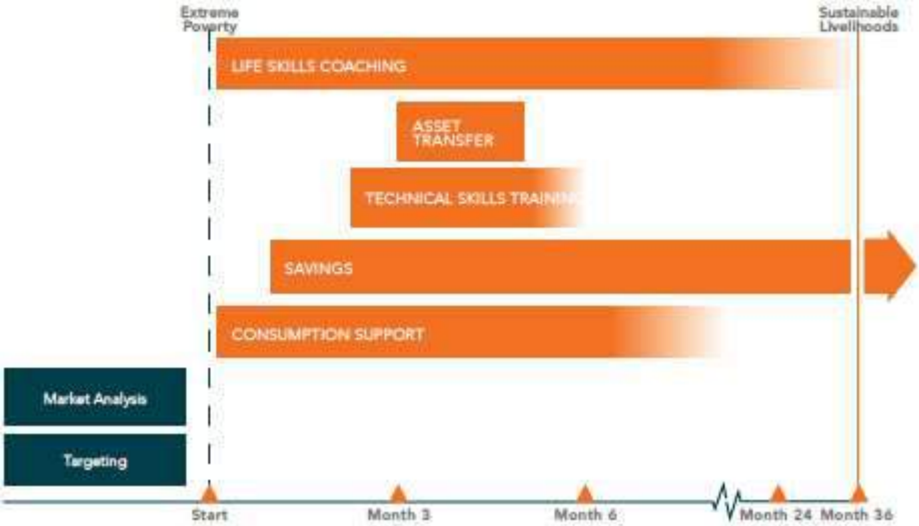
## 3.1 Description of intervention

The main features of Graduation approach are – rigorous targeting, a carefully sequenced and comprehensive set of interventions, and creating a time-bound exit path out of ultra-poverty. The overarching objective of this approach is to create a sustainable livelihood for the ultra-poor so that they are able to continue on a growth path by breaking free from poverty trap within a time-bound (usually 18-24 months) support system and are able to cope with (at least minor) shocks without further support after graduation.

Rigorous targeting that combines different targeting tools – spatial targeting, community based participatory wealth ranking, and proxy-means tests – has been the general approach for all the graduation initiatives at pilot and scale. The importance of targeting comes from mainly two facts. Firstly, because of the comprehensive nature of the interventions, it is relatively costly and hence has relatively higher costs of inclusion error. Secondly, effective targeting has been found to have strong association with community buy-in, which is one of the key success factors for this approach. Figure 2 gives a generic description of the approach. Some large-scale expansion of the model, e.g. a scheme in Pakistan, use other proxy means approach such as poverty scorecard.

Consumption support: Soon after participants are selected into the program, they start receiving consumption support in the form of a small cash stipend or foodstuffs. This support gives them "breathing space" by easing the stress of daily survival. It can be offered through a pre-existing government or other safety net program, in contexts where this is available. This component reflects the important lessons derived from the field of social protection.

Figure 2. Component of graduation model




Source: de Montesquiou et al (2014)

Savings: Once people's food consumption stabilizes, they are encouraged to start saving, either semi-formally through self-help groups (SHGs) or more formally through an account with a formal financial services provider. In addition to building assets, regular savings instils financial discipline and familiarizes participants with formal financial services. Most graduation programs have seen the need to offer financial literacy training, teaching participants about cash and financial management, and familiarizing them with savings and credit. This feature draws on emerging lessons about the importance of savings from the field of financial inclusion.

Market analysis and asset transfer: A few months after the program starts, each participant receives an asset (e.g., livestock if the livelihood involves animal husbandry; inventory if the livelihood is retailing) to help jump-start one or more economic activities. Prior to that transfer, the program staff have thoroughly analyzed the local market's infrastructure and support services to identify sustainable livelihood options in value chains that can absorb new entrants. Once the staff has identified several viable options, the participant chooses from a menu of assets, based on livelihood preferences and past experience.

Technical skills training: Participants receive skills training on caring for an asset and running a business. While rudimentary, such training is essential in managing successful small businesses. The training also provides information on where to go for assistance and services (e.g., a veterinarian, for the many program participants whose livelihood selection involves animal husbandry). The asset transfer and skills training incorporate lessons derived from the livelihood development field.

Life skills coaching: Extreme-poor people generally lack self-confidence and social capital. Weekly household visits by staff allow for monitoring and "coaching" over the 18 to 24 months of the program. During these meetings, staff members help participants with business planning and money management, along with social support and health and disease prevention services. In several instances, it has proven valuable to organize social support groups (such as "village assistance committees") or link up with a health care service provider, whether government clinics or nongovernmental options.

Health support: Provision for health support for all the household members to avoid distress sales of assets is also made part of the package in a few pilots. While the programs in Bangladesh has a direct provision for these supports (including hospitalization and other tertiary care), there has been innovations in other pilots where the ultra-poor households are linked with existing micro-health initiatives.

## 3.2 Data

There have been a number of RCT studies measuring the impacts of the model in a variety of contexts. For this cost-benefit analysis, we use the impact study results from West Bengal that measured the impacts at three different times of post-interventions – 18 months after the intervention started (i.e. at the end of intervention), 30 months from start or a year after intervention completed, and 7 years from start or 5 years in post-intervention (Banerjee et al, 2016). In addition, other estimates are drawn from Banerjee et al (2015) where the same pilot was included as one of the six-country studies. This study had a sample of about 1,000 households and about 50% uptake rate. Despite the impartial uptake, the estimates are done as intention to treat (ITT) effects. Therefore, the impact estimates of West Bengal are conservative since the average treatment effects are higher than ITT.

The pilot in West Bengal was implemented by an NGO (*Bandhan*) in rural setting of Murshidabad distrtict. The design of the project activities followed the overall graduation scheme outlined above. With support from World Bank's Graduation programme, the beneficiariaries received an asset worth $100 per household. The beneficiaries met at least three of the following five selection criteria – primary income source is begging or casual day labour, owns less than 20 decimal land (including homestead), do not own any productive assets, no able bodied male member in the household, and children of school going aged work for income instead of going to school.

## 3.3 Literature Review

The graduation model is one the most rigorously tested anti-poverty intervention model. It originated with BRAC, an NGO from Bangladesh that later expanded in a few countries in Asia and Africa, as a pilot in 2002. Several papers using the quasi-experimental data showed significant effects of the model in Bangladesh on a range of outcome indicators such as income, food security and assets (e.g. Rabbani et al, 2006; Emran et al, 2014). Asadullah and Ara (2016) use panel data and the same proxy comparison group of BRAC's pilot phase to measure long-term impact – nine years from the baseline study. Although the effect sizes were smaller in a few cases, they find significant long-term effects on food security, savings, assets and engagement in self-employment as livelihood.

The model gained more prominence with the six country RCT studies that showed the replicability of the model's impact in various context – India (West Bengal), Pakistan, Ethiopia, Ghana and Peru. The study did not find similar effects in Honduras, where the project suffered an important implementation failure due to selection of livestock that were not suited for the climate where the beneficiaries lived. This study by Banerjee (2015) not only found significant effects at the end of the intervention but also the impacts sustained a year after all the project interventions were phased out. A large scale RCT in Bangladesh also found similar trend four years after the interventions started (Bandiera et al, 2017). This study also found that the impacts continue to increase seventh year from intervention start. However, this long-term impact is somewhat speculative since the control group also received intervention after four year.

However, Banerjee et al (2016) look at the 7 years results (i.e. 5 years after the end of intervention) of the pilot in West Bengal with a control group who did not receive any intervention. The study shows that the impact on productive assets sustain at around 0.9 standard deviation whereas impact on household assets index increase from 0.45 to 1.1 standard deviation between one year and five years from the end of interventions. Similar increasing trend is observed for food security index with the effect size being 0.18 SD, 0.25 SD and 0.43 at end of intervention, one-year post intervention and five-year post intervention respectively. The study also found positive impact on financial stability, time spent working, and physical and mental health. Some of the positive effects include outcomes where they did not originally find any effect in the short or medium run. The authors conclude that – the promise of the program to have unlocked a "poverty trap" seem realized, at least in this context.

In addition to these studies, there was another RCT conducted in Andhra Pradesh (Bauchet et al, 2015). This study, however, was contaminated due to "displacement effects" for the treatment households benefitting less than the control households from other social protection scheme – mainly the employment guarantee scheme. This study provides important insight on possible displacement effects, which is also a concern of scaling up this intervention alongside other social protection programming, the measures are not reflective of the graduation model.

## 3.4 Calculation of Costs and Benefits

The estimates in Banerjee et al (2016) were in 2014 purchasing power parity (ppp) values similar to the study in Banerjee (2015) making the monetary conversions comparable. The cost of the intervention is calculated as per beneficiary household cost, which is calculated by dividing the total project budget (excluding the impact evaluation costs) with the number of beneficiary households. It comes to 1,455 dollars (in 2014 ppp) inflated by 5% to year 3. We convert this into dollar in exchange rate by using the conversion factor of 3.52 ppp dollars per USD deflated to 2-year intervention cost. This gives us per beneficiary cost of USD 394 (in exchange rate), which we convert to 2017 using exchange rate 64.1 for every dollar. About half of the cost is for direct supports to the beneficiaries in terms of assets and food stipend. It is important to note here that per beneficiary cost in Andhra Pradesh pilot was also similar (at

USD ~400). For calculating the total cost for the state, we estimate the number of ultra-poor households by taking the average household size of 5.1 and assume 30% of the poor can be classified as "ultra-poor". This gives 495,235 households as the total number of ultra-poor households to be reached in Rajasthan.

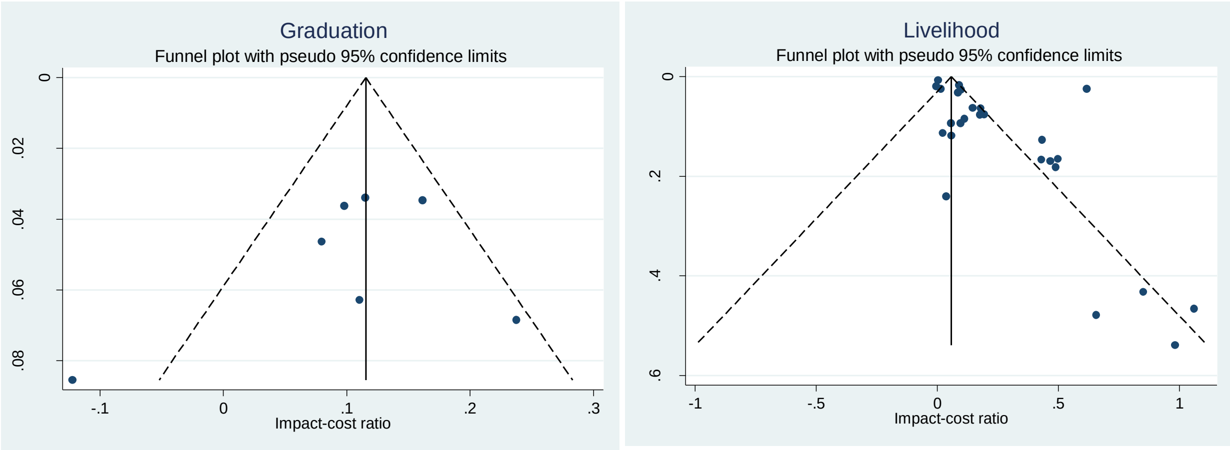
For benefits, we take the estimates from impact studies measuring impact on household consumption at the end of intervention, one-year post-intervention and five-year post intervention. For the third and fourth year, we interpolate using the impact estimates of first and fifth year of post-intervention. In addition to annual household consumption gain, we include savings and assets at the seven-year study. The impact on savings 18.644 ppp dollars, which translates to Rs 340. Finally, for assets we take an estimate of Rs. 14,000 which is reported in a similar pilot in West Bengal by Trickle Up (Siahpush et al, 2015) since the impact estimates on assets in Banerjee et al (2015 and 2016) are reported as standardized outcome instead of monetary values. Although a one standard deviation impact is considered "large" in almost any setting, we use different values for asset impact in sensitivity analysis.

## 3.5 Assessment of Quality of Evidence

As noted earlier, this intervention has quite robust evidence of impact. However, there are a couple of potential concerns that need to be discussed. Firstly, the evidence come from various contexts, including other states of India, but not the state for which we are estimating the benefits. Therefore, the assumption is the impacts observed in West Bengal can be replicated in Rajasthan. In fact, the results in West Bengal among the six countries was the highest. On the other hand, the poverty impacts are also expected to result in nutritional impact on children although the West Bengal study did not measure this outcome. BRAC's RCT in Bangladesh found positive impact on children's weight-for-height (Raza, 2017).

The second concern is related to potential publication bias in graduation results. If there is a bias in publishing results that show better outcomes of the model than the less desirable outcomes, there could be over-estimation of benefits. One of the ways to test for potential publication (which can be a part of small study bias) is to look at the funnel plot whereby the studies with lower precision (or higher standard errors) are more represented in the positive end than negative. Sulaiman (2016) did this test for the seven RCT studies for graduation model against a variety of livelihood programs. Figure 3 shows the results where we see possible publication bias in livelihood program but not for the graduation model.

**Figure 3. Testing possible publication bias**




Source: Sulaiman (2016)

## 3.6 Sensitivity Analysis

For sensitivity analysis, we take the existing evidence as the base estimate, and then change assumptions for the duration of the consumption gains in future. Banerjee et al (2015) used perpetuity for their CBA, but the results are still commendable if 10 years of benefit continuation is assumed. Finally, changing the asset gain does not reduce the BCR substantially.

**Table 3. Sensitivity analysis of graduation for ultra-poor**

| Discount rate | Existing Evidence | Changes from base estimate | | |
|---|---|---|---|---|
| | | Consumption gain for 10 years | Consumption gain for 15 years | Asset gain is Rs 7000 |
| 3% | 3.763 | 5.512 | 7.021 | 3.502 |
| 5% | 3.542 | 4.987 | 6.120 | 3.290 |
| 8% | 3.253 | 4.347 | 5.092 | 3.015 |

While the impacts of the model are found to be consistently positive in various contexts that this model is tested, a couple of important considerations are to be made in taking the estimate for a state-wide poverty reduction effort through graduation model. Firstly, there has not been many scaleup of this model. The largest implementation of the model happened in Bangladesh that reached about 300,000 households. Although there are no strong general equilibrium effects on livestock or commodity prices is not observed, the same may not happen in

Rajasthan. However, the fact that livestock is already a major activity in the state suggest possible use of this livelihood strategy for scale up. Secondly, the costs are estimated based on West Bengal and the specific components of the costs is expected to differ between states. However, various pilots of the model have worked under different budget constraint that range between USD 200 to USD 1,500. So long as the impact results can be replicated, the components of the model can be adjusted (e.g. changing the frequency of supervision visits or the size of food subsidy) to yield the same BCR.

## 4. Conclusion

Eliminating extreme poverty and protecting farmers from income shocks are important development challenges of this century. While the world has set a target of eliminating extreme poverty by 2030, the increasing climatic shocks is making increasing number of households, especially the marginal farmers, vulnerable to crop and income losses. Stories of extreme consequences, such as farmers committing suicide after crop loss, hit the news and draws public and political attention almost every year. Systematic analysis of suicide and mortality data also prove that the climatic shocks lead to additional deaths, mainly through higher food insecurity induced by crop or income loss and increased food price.

**Summary Table**

| Interventions | Discount | Benefit (Billion Rs.) | Cost (Billion Rs.) | BCR | Quality of Evidence |
|---|---|---|---|---|---|
| Crop insurance | 3% | 929.3 | 600.3 | 1.55 | Medium |
| | 5% | 782.8 | 511.4 | 1.53 | |
| | 8% | 618.2 | 409.6 | 1.51 | |
| Graduation for ultra-poor | 3% | 44.3 | 11.8 | 3.76 | Strong |
| | 5% | 40.1 | 11.3 | 3.54 | |
| | 8% | 34.8 | 10.7 | 3.25 | |

While crop insurance has been used to protect farmers from risks of crop losses, studies have shown that increasing insurance uptake for the marginal farmers require heavy subsidization. In this study we use impact assessment results to estimate the benefit that can be attained through a change in farmers risk taking that allow them to cultivate crops with higher expected return, which are often riskier. The other benefits considered in the BCR calculation for crop insurance are increase in gross cropped area and health benefits from avoided death and reduced malnutrition. Due to the high cost of the intervention, the BCR value hovers around 1.5 mark.

Graduation model, on the other hand, targets landless or marginal farmer households, and enable them to have a sustainable source of income through micro-enterprises. There are many studies that have proven the success of this model in various contexts. We use a long-term impact study that follow the beneficiaries for seven years in West Bengal to measure BCR. We find graduation model to have a BCR of 3 at the most conservative estimate.

# 5. References


Ahmed, H. (2015) “Rainfall shocks and children’s well-being in India”, University of Kent.

Asadullah, M. N. and Ara, J. (2016) “Evaluating the long-term impact of an innovative anti-poverty programme: Evidence using household panel data”, *Applied Economics*, vol. 48(2): 107-120

Bandiera, O., Burgess, R., Das, N., Gulesci, S., Rasul, I. and Sulaiman, M. (2017) “Labour market and poverty in village economy”, *Quarterly Journal of Economics*, vol. 132(2): 811-870

Banerjee, A., Duflo, E., Chattopadhyay, R. and Shapiro, J. (2016) “The long term impacts of a graduation program: Evidence from West Bengal”, mimeo, MIT.

Banerjee, A., Duflo, E., Goldberg, N., Karlan, D., Osei, R., Pariente, W., Shapiro, J., Thuysbaert, B. and Udry, C. (2015) “A multifaceted program causes lasting progress for the very poor: Evidence from six countries”, *Science*, Vol. 348 (6236): 1-16

Bauchet, J., Morduch, J. and Ravi, S. (2015) “Failure vs. displacement: Why an innovative anti-poverty program showed no net impact in South India”, *Journal of Development Economics*, vol. 116: 1-16

Burgess, R., Deschenes, O., Donaldson, D. and Greenstone, M. (2017) “Weather, climate change and death in India”, University of Chicago.

CACP (2017a) “Price policy for kharif crops: The marketing season 2017-18”, Ministry of Agriculture and Farmers Welfare, GOI, New Delhi.

CACP (2017b) “Price policy for rabi crops: The marketing season 2018-19”, Ministry of Agriculture and Farmers Welfare, GOI, New Delhi.

Carleton, T. A. (2017a) “Crop-damaging temperatures increase suicide rates in India”, *PNAS*, vol. 114(33): 8746-51

Carleton, T A. (2017b) “Crop-Damaging Temperatures Increase Suicide Rates in India.” *Proceedings of the National Academy of Sciences* 114 (33). National Acad Sciences: 8746–8751.

CAG (2017) “Performance audit of agriculture crop insurance schemes”, Comptroller and Auditor General (CAG) of India, Report number 7.

Cole, S., Giné, X., Vickery, J. (2017) “How does risk management influence production decisions? Evidence from a field experiment”, *The Review of Financial Studies*, vol. 30(6): 1935–1970

Cole, S., Stein, D. and Tobacman, J. (2014) “Dynamics of demand for index insurance: Evidence from a long-run field experiment.” *American Economic Review: Papers and Proceedings*, vol. 104(5):284–290.

Das, S. (2018) “Unfounded Assumptions in Linking Crop-Damaging Temperature and Suicide in

India." *Proceedings of the National Academy of Sciences* 115 (2). National Acad Sciences: E116–E116.

De Montesquiou, A., Sheldon, T., DeGeovanni, F. and Hashemi, S. M. (2014) "From extreme poverty to sustainable livelihoods: A technical guide to graduation approach", CGAP and Ford Foundation.

DES (2017) "Agricultural statistics: At a glance 2016", Directorate of Economics and Statistics (DES), Ministry of Agriculture and Farmers Welfare, GOI, New Delhi.

Dréze, J. (2018) Sense and Solidarity: Jholawala Economics for Everyone, Permanent Black.

Emran, S., Robano, V. and Smith, S. C. (2014) "Assessing the Frontiers of Ultra-poverty Reduction: Evidence from Challenging the Frontiers of Poverty Reduction/Targeting the Ultra-poor, an Innovative Program in Bangladesh", *Economic Development and Cultural Change*, vol. 62(2): 339-380

Giné, X., Menand, L. Townsend, R. and Vickery, J (2010) "Microinsurance: A case study of the Indian rainfall index insurance market." World Bank Policy Research Working Paper No. 5459.

Giné, X. and Yang, D. (2009) "Insurance, credit and technology adoption: Field experimental evidence from Malawi." *Journal of Development Economics*, vol. (89):1–11.

GOI (2017) Compensation under Pradhan Mantri Fasal Bima Yojana, Answer to Lok Sabha question number 549, online document downloaded on March 18, 2018 from http://www.indiaenvironmentportal.org.in/files/file/COMPENSATION%20UNDER%20PRADHAN%20MANTRI%20FASAL%20BIMA%20YOJANA.pdf

GOI (2018) online portal of government data from https://community.data.gov.in/ accessed between 10th March and 8th April, 2018

JPAL (2016) "Make it rain", Policy Bulletin, Abdul Latif Jameel Poverty Action Lab (JPAL), Centre for Effective Global Action (CEGA) and Agriculture Technology Adoption (ATAI).

Kumar, S., Molitor, R. and Vollmer, S. (2016) "Drought and early child health in rural India", *Population and Development Review*, vol. 42(1): 53–68

Maccini, S. and Yang, D. 2009. "Under the weather: Health, schooling, and economic consequences of early-life rainfall," *The American Economic Review*, vol. 99(3): 1006–1026.

Malik, S. M., Awan, H. and Khan, N. (2012) "Mapping vulnerability to climate change and its repercussions on human health in Pakistan", Globalization and Health, vol. 8: 31.

Murari, K. K., Jayaraman, T. and Swaminathan, M. (2017) "Climate Change and Agricultural Suicides in India." *Proceedings of the National Academy of Sciences*. National Acad Sciences.

Nelson G. C., Rosegrant, M. W., Palazzo, A., Gray, I., Ingersoll, C., Robertson, R., Tokgoz, S., Zhu, T., Sulser, T. B., Ringler, C., Msangi, S. and You, L. (2010) “Food Security, Farming and Climate Change to 2050: Scenarios, Results, Policy Options” International Food Policy Research Institute (IFPRI)

NSSO (2015) “Household ownership and operational holdings in India: NSS 70th round”, National Sample Survey Office (NSSO), Government of India.

Plewis, I. (2018) “Analyzing Indian Farmer Suicide Rates.” *Proceedings of the National Academy of Sciences* 115 (2). National Acad Sciences: E117–E117.

PMFBY (2016) “Operational guideline: Pradhan mantra fasal bima Yojana”, Ministry of Agriculture and Farmers Welfare, New Delhi. Link http://agri-insurance.gov.in/pmfby.aspx, downloaded on March 18, 2018.

Rabbani, M., Prakash, V. A. and Sulaiman, M. (2006) “Impact assessment of CFPR/TUP: a descriptive analysis based on 2002-205 panel data” CFPR/TUP working paper no. 12. RED – BRAC, Dhaka and AKFC, Canada.

Raddatz, C. E. (2009) “The Wrath of God: Macroeconomic Costs of Natural Disasters” World Bank Policy Research Working Paper Series 5039, Washington D. C.

Rathore, V. (2017) “The performance of PMFBY and other crop insurance models in India”, *International Journal of Advanced Research and Development*, Vol. 2(5): 602-607

Rao, C. A. R., Kareemulla, K., Dixit, S., Ramakrishna, Y. S. and Shankar, K. R. (2008) “Performance of agriculture in Andhra Pradesh – A spatial and temporal analysis”, Policy Paper no. 1/2008, Central Research Insitutue for Dryland Agriculture (CRIDA), Hyderabad.

Raza, W. A., “(Accidentally) harvesting higher hanging fruits: Addressing under-5 malnutrition using Graduation Approach”, Policy in Focus, Vol. 14(2): 43-46.

Shah, M. and Steinberg, B. M. (2014) “Drought of opportunities: Contemporaneous and long term impacts of rainfall shocks on human capital.” mimeo, Harvard University.

Siahpush, A., Sonson, J. and Bombyk, M. (2015) “Evaluation note: Evaluating Trickle Up’s Graduation program in India”, Tricke Up, New York

Sulaiman (2016) “Making sustainable reduction in extreme poverty: A comparative meta-analysis of livelihood, cash transfer and Graduation approaches”, Microfinance Gateway.

World Bank (2016) “Rajasthan: Poverty, growth and inequality”, online document downloaded from http://documents.worldbank.org/curated/en/423761467995629413/pdf/105877-BRI-P157572-ADD-SERIES-India-state-briefs-PUBLIC-Rajasthan-Proverty.pdf on April 15, 2018

Rajasthan is the largest Indian state. It has a diversified economy, with mining, agriculture and tourism. Rajasthan has shown significant progress in improving governance and tackling corruption. However, it continues to face acute social and economic development challenges, and poverty remains widespread. What should local, state and national policymakers, donors, NGOs and businesses focus on first, to improve development and overcome the state's remaining issues? With limited resources and time, it is crucial that priorities are informed by what can be achieved by each rupee spent. To fulfil the state vision of "a healthy, educated, gender sensitive, prosperous and smiling Rajasthan with a well-developed economic infrastructure", Rajasthan needs to focus on the areas where the most can be achieved. It needs to leverage its core competencies to accelerate growth and ensure people achieve higher living standards. Rajasthan Priorities, as part of the larger India Consensus – a partnership between Tata Trusts and the Copenhagen Consensus Center, will work with stakeholders across the state to identify, analyze, and prioritize the best solutions to state challenges. It will commission some of the best economists in India, Rajasthan, and the world to calculate the social, environmental and economic costs and benefits of proposals.

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