Weather Based Crop Insurance Scheme: A Strategy for Adapting to Climate Change

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Abstract

As a concept borrowed largely from the ecological sciences, adaptation has often invoked a sense of immediateness. This immediacy is often and mostly addressed in the policy domain by cherry-picking previously existing strategies which engage with weather to pass as climate change adaptation strategies. The Weather Based Crop Insurance Scheme (WBCIS) has effortlessly transitioned from being a type of agricultural insurance format based on weather index, into a climate change adaptation strategy. Examining the specific example of Rainfall Insurance Scheme for Coffee (RISC) shows that in its form, The WBCIS is not designed to as an adaptation strategy to face the challenges of climate change.

Key Words: Climate change, Adaptation, Weather insurance, Coffee, South India, State Action Plans on Climate Change (SAPCC). .

1. Introduction

In 2009 the Government of India directed all the state governments and union territories to prepare State Action Plans on Climate Change (SAPCC) as a strategy for addressing climate change. These SAPCCs are now available on the website of Ministry of Environment, Forest and Climate Change (MoEFCC).[1] Out of the 32 SAPCCs available online, 23 explicitly mention Weather Based Crop Insurance Scheme (WBCIS) as a strategy to address impacts of climate change on agriculture.

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[1] Link to State Action Plans on Climate Change on MoEFCC website: http://www.moef.nic.in/ccd-sapcc (27/9/2017)

It is argued that this format of agriculture insurance was first introduced in India by J. S. Chakravarti in 1920 (Mishra,1995). Chakravarti proposed a rainfall insurance scheme for Mysore State to protect farmers against drought (Chakravarti, 1920). The defining characteristic of WBCIS is indexing weather. Here the insurance contract responds to an objective parameter (e.g measurement of rainfall or temperature) at a defined weather station during an agreed time period. The parameters are set so as to correlate, as accurately as possible, with the loss of a specific crop suffered by the policyholder. All policyholders within a defined area receive payouts based on the same contract and measurement at the same station, eliminating the need for in-field assessment (Dick &Stoppa, 2011). The main features of this insurance format are:

• A specific meteorological station which is named as the reference station.
• A trigger weather measurement (e.g. cumulative millimeters [mm] of rainfall), at which the contract starts to pay out.
• A lump sum or an incremental payment.
• A limit of the measured parameter is set (e.g. cumulative rainfall), at which a maximum payment is made.
• The period of insurance is stated in the contract and coincides with the crop growth period; it may be divided into phases (typically three), with each phase having its own trigger, increment and limit.

The first insurance scheme based on this format was introduced in 2003. It was a rainfall insurance contract underwritten in 2003 by ICICI-Lombard General Insurance Company for groundnut and castor farmers in the Mahabubnagar district of Andhra Pradesh (Barnett & Mahul, 2007). Given that weather has always been a source of concern for farmers in India and weather insurance format existed as long back as 1920, it is argued that its eventual introduction in 2003 was triggered by factors other than farmers' concern about weather (Rao, 2010).

The first agriculture insurance scheme was introduced in India in 1972. It was based on 'individual approach'. The individual approach required the insurance agency to ascertain crop output of each insured farmer every year. It also required ascertaining for each insured farmer, his crop-output over the past few years as a basis for determining what might be called his 'normal' output (Dandekar, 2011).

This approach was not practical for two reasons: a) it added enormously to the administrative cost b) the chances of moral hazards were extremely high. Moral hazard arises if the insured can, by so acting as to increase the probability of the adverse event thus benefiting at the cost of insurer and the latter cannot monitor the action of the former (Sinha, 2004). There is an adverse selection if the buyers know their own riskiness, but the insurance company does not. The latter will offer a premium rate which may be higher than the fair premium for low risk individuals some of whom might chose not to insure. This process ultimately leads to a market failure (Mishra, 1995). It is difficult to curb moral hazard in 'individual approach' because scheme leaves a lot to the discretion of lower level officials carrying out field visits.

In order to counteract the problems posed by 'Individual approach', a case was made for crop insurance scheme based on 'Homogenous area approach'. From the standpoint of this approach, an area is homogenous if the annual crop output of a majority of the farmers in the area move together above and below their normals. Based on this the Pilot Crop Insurance Scheme was introduced in 1979. The scheme covered food crops and was confined to borrowing farmers on a voluntary basis. This scheme was upscaled and reintroduced in 1985 as Comprehensive Crop Insurance Scheme (CCIS). This scheme was compulsory for borrowing farmers. CCIS was replaced by National Agricultural Insurance Scheme (NAIS) from *rabi* 1999-00 season (RAO 2010).

The NAIS, despite being best suited for Indian conditions, has some shortcomings. The most important one is the 'basis risk', the risk that claim payments do not match with farmer's loss. Yet another challenge is infrastructure and manpower required to conduct millions of crop-cutting experiments across the country to estimate yields of crops. This process contributes to delay in settlement of indemnities as the compilation of yield estimate generally takes three months after the harvest season. Moreover, the yield index-based insurance can be designed only for crops with at least 10 years of historical yield data at insurance-unit level. The combination of the high vulnerability of India's farmer households and low penetration of NAIS provided fertile ground for innovations in the provision of agricultural insurance. One such innovation is the introduction of WBCIS. The WBCIS format is based on "homogenous area approach" and states that weather parameters are being used as "proxy" for crop yields. In statistics, proxy variables are the ones which are not directly relevant but they serve in place of an unobservable or immeasurable variable. Here, the immeasurable or unobservable variable under risk is crop yield. In place of crop yield insurers use a variable which can be indexed and has a proven close co-relation with the yield (Rao, 2010).

Weather is a variable which is closely related to yield and can be indexed using the historical data records. This observation is indicative of the fact that while the format of the scheme is designed to insure weather the triggers for introducing this format in agriculture sector were not farmers' weather concerns, but the ability of weather data to act as a proxy variable for crop yield. While the scheme is not informed by farmers' situated weather concerns, it nonetheless has to corroborate with these concerns for farmers to subscribe to the scheme. Thus, it can be argued that while the scheme is formulated based on scientific and statistical data its success depends on how well it captures farmers' situated experience of the weather event.

Scale Discordance

This gap between scientifically calibrated comprehension of a weather event and its situated experience is of immense importance in thinking through adaptation strategies for climate change. Climate change literature identifies this gap as an issue of scale discordance. Scale discordance is defined in terms of a mismatch occurring when available scientific information does not reflect the unique context of the environmental conditions and/or the geographic scale for decision making (Gordon et.al, 2015). Simply put, scale discordance argues that difference between scientific comprehension of weather event and its situated experience is one of degree.

I engage with these two comprehensions of weather (scientific and situated), using Tim Ingold's work in which he argues that the scientific and situated comprehension of a weather event are not just different in degrees but in kind. Situated experience is not just a limited or narrowly focused apprehension scientific and statistical comprehension. Rather it is based on an altogether different mode of apprehension, a practical perceptual engagement with components of a world that is inhabited or dwelt-in, rather than a detached disinterested observation of a world calibrated by scientific instruments (Ingold, 2011).

To engage with growers' situated experience, I use the concept of situated knowledge proposed by feminist geographer Donna Haraway. According to this concept, knowledge and understanding are contextually generated and simultaneously embody both natural and social worlds. Situated knowledge is different from traditional/ local/ indigenous knowledge. These knowledge systems are driven by secondary set of non-factual expertise whose defining characteristic is being unexposed or untainted by the scientific knowledge. Situated knowledge, on the other hand, is not a passive or secondary body of non-factual expertise. It is a conceptual framework to engage with knowledge that accounts for both the agency of knowledge producer and object of study. The key aspect of this concept most relevant for this study is that it focuses on interlinkages.

Recognizing that scientific and situated comprehensions of weather are different in kind and not just degrees has important implications for thinking through WBCIS as an adaptation strategy. The most significant implication being that improving scientific information will not automatically make scheme more attractive and relevant for farmers. This paper looks at a specific WBCIS, which is the Rainfall Insurance Scheme for Coffee (RISC). The paper compares RISC's scientific and statistical comprehension of rainfall with coffee growers' situated experience of it. This comparison opens up the larger question: what are the challenges that an adaptation strategy is expected to address?

2. Field work and methodology

The RISC was introduced in 2007-08 by Agriculture Insurance Company of India (AICI or AIC) in consultation with Coffee Board of India for coffee growers in three traditional coffee growing states of South India: Karnataka, Kerala and Tamil Nadu. In India, coffee estates are located in the Western Ghats belt. Western Ghats is a mountain range that runs parallel to the western coast of Indian peninsula along the Arabian Sea. The mountains intercept rain-bearing westerly monsoon winds, and are consequently an area of high rainfall particularly on the western side. The range starts from Southern part of Gujarat and goes through Maharashtra, Goa, Karnataka and Kerala before it ends at Kanyakumari in Tamil Nadu. The Western Ghats are a major source of water for peninsular India. It is one of the world's eight biodiversity hotspots and a world heritage site (UNESCO, 2017).

The 4X4 Climate Assessment Report (4X4 Report for short) was brought out in 2010 by Indian Network for Climate Change Assessment (INCCA), MoEFCC. The report argues that precipitation in this region will be more intense with less number of rainy days and temperatures will see a gradual increase (INCCA, 2010). Moreover, coffee is extremely sensitive to weather conditions and is therefore correctly considered to be a highly unpredictable crop (Wintgens, 2009; Wrigley,1988).

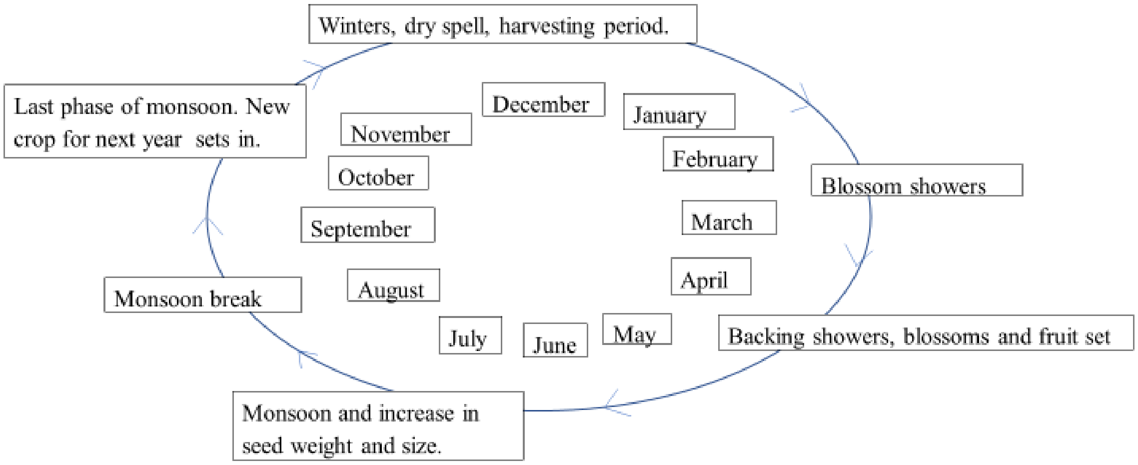
Weather is so crucial a factor that coffee traders minutely monitor the weather conditions within the major coffee producing countries before making investment decisions. Given, that coffee plant is inherently sensitive to local climatic and weather conditions and Western Ghats face a serious threat of climate change, research works have been carried out to study if the existing rate of change in the local climate would be able to support coffee ecosystems in this region in future (Kushalappa et.al, 2011; Centre for Social Markets, 2012; Chengappa & Devika, 2016).

For this study, field work was carried out in a specific part of the Western Ghats range known as Malnad. Malnad, covers portions of six districts in South Indian state of Karnataka which accounts for 71% of total coffee production in India (Coffee Board of India, 2016). Coffee estates are located in three of these six districts: Kodagu, Chikmaglur and Hassan.

A total period of seven months from 2011-2015 were spent on the field. Detail interviews were carried out with 80 coffee growers and 62 others responded to a written set of questionnaire. Along with these three districts the study also looked at one more district located in the eastward extension of Western Ghats in Tamil Nadu. This is the Palini hills region in the Dindigul district. Unlike the Malnad belt, this region receives North- East monsoon.

Additionally, I traced the institutional landscape of scientific and administrative organizations informing the RISC. This included carrying out 80 interviews with scientists at Central Coffee Research Institute (CCRI); Coffee Board officials; insurance officials; coffee traders & roasters; meteorologists at Indian Meteorological Department (IMD) Delhi, Bengaluru and Pune; and climate scientists at Centre for Mathematical Modeling and Computer Simulation (C-MACCS). Given the nature of my enquiries the field work was largely ethnographic in orientation. The ethnographic study was carried through focused interviews after a small period was spent as participant observer to get sensitized with the social and ecological settings. To document every day experiences and observations on the ground semi-structured interviews, structured interviews, surveys and focus groups discussions were carried out.

Figure 1: Coffee Crop Cycle in India



RISC for Coffee Growers

In a coffee estate, each climatic component (such as: temperature, length of dry season, pattern of rainfall, etc) feeds into other one. But, visibly, rainfall is the trigger that initiates blossoming, which decides the entire year's crop cycle therefore rainfall is very closely monitored by coffee growers. Blossom shower is the first rainfall of the season expected in the month of March and April for Robusta and Arabica respectively.[2] In every interview growers emphasized upon the timely arrival of blossom showers. Dr. Pradeep, ex-president Karnataka Growers Federation (KGF), reflected on this:

> Like all fruit crops, coffee is a gamble on the weather. The rubber planter gets his crop in any case, tea may be held up by drought but has chance of making up later in the season, but anything happens to coffee planter's blossom he is done for until another year comes around (Personal interview, 2015)

[2] Arabica and Robusta are two varieties of coffee grown in India. Arabica grows in relatively higher altitudes and cooler climate and fetches higher price than Robusta.

Blossom shower have to be then followed in quick succession with backing showers. Monsoon and Post-Monsoon showers are expected between June and October. Figure 1 shows coffee crop cycle along with the corresponding rainfalls.

The RISC was devised in such a way that it was intended to cause a positive impact by providing an assured compensation amount in the event that the grower experienced a proven shortfall/excess in rainfall. Claim payments to farmers are an explicit function of rainfall. The important components of RISC are the claim triggers. Claim triggers are the threshold values decided by the insurer which activate the payouts. These are divided into four categories based on the type of rainfall.

Table 1: Insurance cover period under different rainfalls

Cover	Cover Period	
	Arabica	*Robusta*
Blossom Showers	1st March to 30th April	1st March to 15th April
Backing Showers	18th day of starting of Blossom showers till 40th day failing which it shall be from 1st May till 19th May	
Monsoon Showers	1st June to 30th September	
Post Monsoon Showers	1st November to 31st January	1st December to 28th February

[The insurance period operates from 31March to 28 February
Source: Agriculture Insurance Company of India Ltd. (18/2/2013). *Rainfall Insurance Scheme for Coffee*. Circular No: AIC/RISC 2013.]

Table 2: Rainfall definitions or "claim triggers" in the RISC document

Rainfall	Definition as mentioned in RISC Document
Blossom Showers	shall mean the rainfall received between 1st March to 15th April (Robusta) and 1st March to 30th April (Arabica)for the bud to flower (bud enlargement and anthesis). The normal requirement of rainfall is 25 mm in seven consecutive days for Arabica and 20mm in seven consecutive days for Robusta.
Backing Showers	shall mean the rainfall received from 18th day of the starting of blossom shower till 40th day to achieve full fruit development & retention. The normal requirement of rainfall is 12mm in two consecutive days.
Monsoon Showers	shall mean the rainfall received from 1st June to 30th September for the fruit to grow in size. The aggregate rainfall of beyond a specified limit in any seven consecutive days during the period is likely to adversely affect the coffee yield.

Post Monsoon Showers	shall mean the cumulative rainfall of at least 100mm received continuously over a period of 5 days in case of *Arabica* during 1st November to 31st January. The cumulative rainfall of at least 125mm received continuously over a period of 7 days in case of *Robusta* coffee during 1st December to 28th February

[Source: Agriculture Insurance Company, 2016]

The reason for having indexed "normal" blossom showers at 25 mm and 20mm for Arabica and Robusta respectively was made clear in an interview given by Dr. Chandra Gupt Anand, Divisional Head, Plant Physiology, Central Coffee Research Institute (CCRI):

> Coffee is a perennial plant with an annual bearing habit. The flower buds having been initiated by about August- September grow rather slowly and attain a size of 7 -8 mm by February and stop growing further. Rain or overhead irrigation at this stage induces anthesis[3] of buds which open usually within 8-10 days. Successful blossom will be obtained with about 13mm for Robusta and 25.4 mm for Arabica, depending upon overhead shade. Prolonged drought and inadequate showers provoke retardation of growth and production of star and snake mouthed flowers (personal interviews, 2015).

The amount of rainfall is further divided into slabs which decide the amount of payoff to be given. These slabs, moreover, are based on the geographic location of the place where the estate is located. For example, the following is a trigger[4] and the payout slab table for the blossom rainfall cover for Arabica in the Karnataka State, Chikmaglur district, Aldur zone for the year 2015.

Table 3: Blossom cover in RISC for Arabica coffee in Aldur zone Chikmaglur district, 2015.

AIC OF INDIA Ltd.			
RAINFALL INSURANCE SCHEME FOR COFFEE (RISC) 2015			
State: Karnataka	**District: Chikmaglur**	**Zone: Aldur**	**Sub Zone Aldur**
Variety: Arabica			**Unit: Hectare**

[3] Anthesis refers to flowering period of a plant, from the opening of the flower bud.
[4] Trigger refers to the amount of rainfall which if recorded at the respective RRG will initiate the payouts.

Cover: 1. Blossom Rainfall

Period: 01 March to 30 April

Condition: The payout will start if the cumulative rainfall is less then 25mm in 5 consecutive days during the specified period in case of multiple events and all are of less than 25mm (over 5 consecutive days), the event with maximum rainfall will be considered.

Trigger and payout slab:

RF < (in mm)	Payout (in Rs)
25	2500
20	3500
15	5500
10	7500
5	10,000

Source: RISC document 2015, AIC office Bengaluru, Karnataka

A network of various meteorological organizations involved in measuring rainfall help in identifying the triggers for RISC. The Agriculture Insurance Company (AIC), for example, uses past rainfall records and yield data to statistically arrive at a proposed set of trigger levels. These proposed triggers are then shared with the Coffee Board. The Coffee Board in turn consults Karnataka State Disaster Management Cell (KSNDMC) to confirm the rainfall data and check the probability of the occurrence of the proposed trigger levels. Simultaneously, Coffee Board consults Central Coffee Research Institute (CCRI) to assess different water stress levels for coffee plants under the proposed triggers. To confirm the probability of the proposed triggers, the KSNDMC consults the Centre for Mathematical Modeling and Computer Simulation (C-MAACS). For operational purposes AIC gathers rainfall data from KSNDMC and National Collateral Management Services Limited (NCMSL).

Unpacking the indexing process of rainfall for RISC highlights that insurers identify normal rainfall based on the correlation between previous rainfall and the coffee crop yield output data (observation from primary field work). Indexing blossom shower along with other rainfalls to decide when to give payoffs have two characteristics which do not sit comfortably with coffee growers a) deciding for a grower what is “normal” rainfall b) the act of isolating rainfall as an event whose performance is judged independent of any other changes that might be observed in local weather preceding or succeeding these “rainfall events”.

Defining Normal Rainfall for Coffee Growers

During the field work carried out for this study coffee growers were asked what they considered as the ideal conditions for growing coffee. Mr. Prasanna M a coffee grower from Hassan District, Karnataka, mentioned that even though there are a set of ideal conditions prescribed by Central Coffee Research Institute (CCRI, research wing of Coffee Board) for growing coffee but growers work towards sustaining “band manageable conditions” (Personal interview, 2011) .

The concept of “band of manageable conditions” was best explained by Mr. M. Majunath, a progressive Arabica grower in Ballupet near Sakleshpura, Karnataka. Manjunath has not been deterred by the fact that his estate is mostly located at lower elevations, which are not necessarily ideal for growing Arabica coffee. Oddly enough, his estate has often been felicitated by the Coffee Board for its record production of coffee output per acre. The secret of this success, according to him, lies in how he conceptualizes and sustains “band of manageable conditions”, which involves nurturing mutually supporting elements: a pond & a well (a natural source of water), a herd of cows, thick canopy of forest cover and a second layer of shade provided by dadap trees. The cows, according to him, are important not because they provide milk for consumption but, more importantly, for the organic manure (cow dung) which is crucial for fertilizing the coffee crop. In other words, for the grower a series of elements need to be sustained as interlinked and interdependent variables for coffee growing (Personal interview, 2011).

Working under the larger rubric of “manageable conditions”, growers find it difficult to define normal rainfall for their estates in terms of absolute numbers. Shiv Shankar Belagola, a coffee grower near Badra forest in Chickmaglur district in Karnataka came closest to defining a successful blossom shower in terms of numbers. According to him,

> *Revathi* (blossom shower) should not be less than 20 mm. but if the downpour was heavy it might result in the dropping of flowers before pollination.

> Significantly as well, if the grower followed a misleading prediction about the timing of the *Revathi* (blossom shower) by irrigating his crop as a mitigation strategy, then a late backing shower could also result in the flower dropping (Personal interview, 2011).

Though, again, he was quick to further qualify, that even delayed backing showers would not cause any harm if *Revathi* (blossom shower) brings up to 75-85 mm of rain. On the other hand 40 -60 mm of rain during *Revathi* (blossom shower) is not bad but it needs to be immediately followed by backing showers. Also, the coffee flowers do not open properly in case there is an average rainfall (40-60 mm) during *Revathi* (blossom shower) which is then followed by delayed backing showers. In another interview, T.Krishnamurthy, a coffee grower in Palini hills Tamil Nadu, explained how he identifies failure of rainfall at his estate.

> Upon squeezing the fruit if there is a gap or air between the pulp and the outer skin of the fruit that means either the fruit has not developed properly or shriveled due to insufficient water availability (Personal interview, 2014).

He called it the bubble effect. For him it was not the amount of rainfall received but the bubble effect which if observed in the coffee fruit indicated drought at his estate. Palini hill estates are located at a higher altitude and climatically better suited for Arabica. They mainly receive North-East Monsoon and record maximum rainfall in the month of October.

Central to this approach of "band of manageable conditions" is the fact that it recognizes that each estate is in several ways topographically and ecologically unique. In effect, rainfall impacts variably on a range of factors within the estate such as elevation, proximity to the Western Ghats, forest covers and even soil health. The geographical spread of the estates moreover often times defies the simple measurement of rainfall data in broad regional terms. For instance when Dundiga Estate, at Mudigere in Chikmaglure district, receives on an average 90 inches of annual rainfall, Bavalimoole Estate, at Sakleshpura, receives on an average 150 inches of annual rainfall (primary rainfall data gathered from estates).[5]

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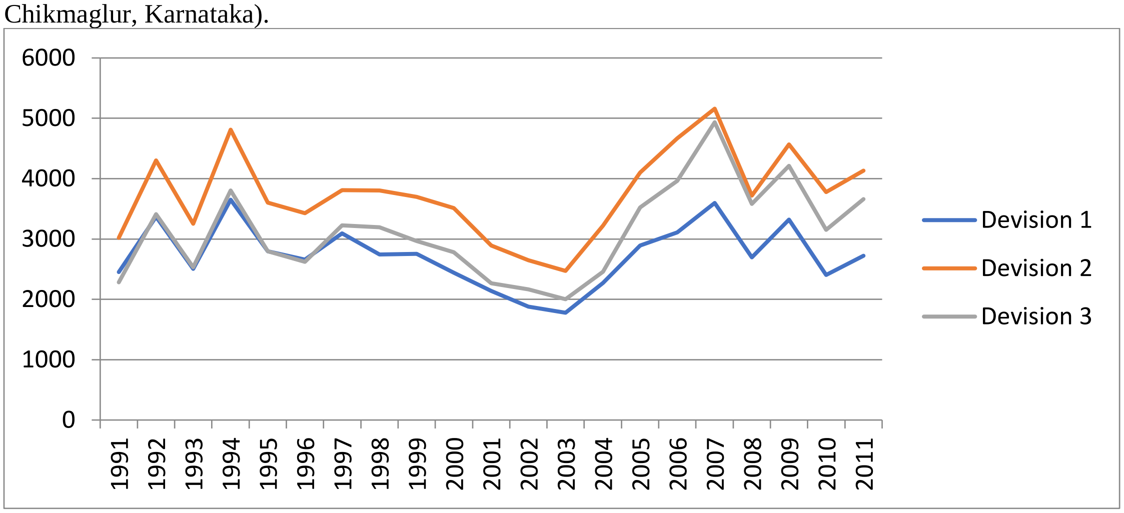
[5] Coffee growers in South India, as I discovered, probably because of the plants sensitivity to precipitation have a habit of maintaining rainfall records in their estate. Rainfall is usually recorded through a calibrated rain gauge that is kept in an open area, generally the drying yard. Measurements are taken every day, almost like a religious ritual.

Thus, while some growers will notice a disturbance others may not find it significant or may not even consider it a deviation on their estate. In effect, trying to arrive at efforts that indicate patterns of weather change through rainfall can be deeply problematic and one has to be cautious when comparing data between estates. Following graph based on the rainfall data gathered from three different points at the same estate (Kelagur estate, Chikmaglur, Karnataka) highlights the variation in quantity of rainfall received.

Figure 2: Graph showing rainfall data collected from three different points in the same estate (Kelagur estate, Chikmaglur, Karnataka).



[Source: Primary data collected from the estate during the field visit in 2011.]

This idea of "band of manageable conditions" finds its reflection in the biographies of European planters who worked towards achieving a "happy mean" by continuously using one variable against the other. For instance H.C.P. Hull mentioned how locating the right slope was essential in order to neutralize the effect of excessive rainfall (Hull, 1887: 42); Elliot emphasized on the importance of shade in counteracting the force and nature of winds beating upon the ground (Elliot, 1871); Arnold discussed how locating an estate at a right height above the sea level could neutralize the effect of heat and dryness (Arnold, 1881).

This gap between happy mean/ band of manageable condition and ideal/normal rainfall is not to be confused with basis risk. Basis risk in WBCIS arises when the index measurements do not match an individual insured's actual losses. Basis risk is a factor of the distance between the index measurement location and the production field. This is a known drawback of all WBCISs . A general response to basis risk is having wider network of rain gauges. The concern here, however, is not about the difference between rainfall measurements at two different locations rather the difference between experienced rainfall and indexed rainfall. One is emerging from lived everyday negotiations with weather and by extension local climate. Other is emerging from statistical calculations of past rainfall data. The next section compares these two comprehensions of rainfall received in the Western Ghats belt. Indexed rainfall refers to rainfalls as defined in the RISC document. Experienced rainfall refers to growers' comprehension of success or failure of a rainfall event.

Experienced rainfall vs indexed rainfall

In the Western Ghats belt the South-West monsoon sets in during the month of July, and lasts till the later part of August and early September. In October, one witnesses the play of the North-East monsoon. However, several growers whom I spoke with argue that in recent year they have increasingly begun to perceive a kind of 'lateral shift in the behavior of the South –West Monsoon'. In the words of Anand Periera, a coffee grower in Sakleshpur, Karnataka:

> the beauty of the monsoon pattern in the shade growing coffee regions is its distribution. In coffee, the quantum of rainfall is not important rather the distribution pattern over the period of five months is crucial. Instead of being distributed over five months, the major chunk of monsoonal rainfall in now concentrated within two months. This kind of downpour leads to soil erosion, making coffee plants more fragile and thus introducing new kinds of pests and diseases (Personal interview, 2011).

The accumulation of the monsoonal rainfall into a two month period has created new problems on the ground. Instead of being uniformly distributed, the monsoon now arrives as a downpour and soil do not get time to absorb and retain moisture. There are, in fact, increased chances of soil erosion and the spread of black rot disease increases — a fungal infection that affects leaves, developing berries and tender shoots. Favorable conditions for this disease include continuous and heavy monsoon without a break or dry period.

This change in the pattern of rainfall distribution is not reflected in the calibrated monitoring of monsoon by RISC which focuses on cumulative amount of precipitation received in seven consecutive days. While the lateral shift in the monsoon has had visible impacts on the ground, cumulatively speaking, however, the monsoons do not show a sharp behavioral change. Indexing the monsoon would arguably thus report a normal monsoon or an approximate thereof. However its uneven distribution leaves the grower unsatisfied both during early phase of the monsoon and during the later one.

Monsoon breaks

One of the most discussed aspects of the accumulation of monsoonal rainfall in a two month period by the growers is often the absence of the monsoon break. Traditionally after onset of the monsoon there are one or two breaks in between which can last from a couple of days to over a week. These breaks are important because growers believe that it gives a) the coffee plant respite from the continuous showers, b) a chance for the soil to absorb the water and c) preparation time to the plant for the next round of monsoonal rainfalls.

However, with the concentration of monsoons in the two month period, the growers now feel that the monsoonal breaks can no longer be observed. So while the amount of rainfall received has not increased or drastically decreased, the absence of monsoonal break renders the plant incapable of processing the rainfall water efficiently. RISC in the monsoonal cover provides caps for cumulative rainfall received over any 7 consecutive days during the monsoon months. In the changing scenario what this index rainfall risk is unable to factor in, according to the growers is the role and importance of the monsoonal breaks.

Dry Spell

Dry spell is a period of 90 days observed from the end of monsoons till the commencement of blossom shower next year. Mr. Girish, a coffee grower whose estate is located near Sakleshpur is Hassan district, Karnataka, mentioned the importance of this dry period. According to him

> this causes water stress in plants which results in uniform blossoming upon being exposed to first rainfall (blossom showers) in the months of March and April (Personal interview, 2011).

The dry period according to him was important in order to generate maximum impact of blossom showers. Ms.Geetha Suresh, another coffee grower from the same region, while mentioning about the importance of the dry period in determining the success of following blossom showers, pointed towards untimely blossoms at her estate. She mentioned:

> Early December is the period when the soil had been recently manured and this is half way into the period of the dry spell. Thus even a sprinkle would initiate blossoming. But this untimely blossoming will wither away. This untimely blossom in turn dilutes the impact of the *Revathi* (blossom shower, first rainfall of the season that initiates blossoming). And by the time the full force of the *Revathi* comes these buds would already be lost and hence there would be a net loss even if *Revathi* delivers as per expectation (Personal interview, 2011).

In such cases even if blossom showers perform as per expectation the grower would already have lost part of the crop. The indexed rainfall is not designed to address the factors, such as dry spell, preceding the rainfall. Thus there is an emerging possibility for growers to suffer net loss in the crop even if the blossom showers have performed according to the RISC rainfall index.

Temperature trends

The ideal temperature for growing Arabica is between15^0- 26^0C. The plant overall, however, prefers a relatively cool climate. Robusta, on the other hand, does reasonably well even at relatively higher temperatures. The ideal temperature for Robusta is 20^0- 30^0C and prefers humid conditions as well. In South India, the sometimes high summer temperatures combined with poor sub-soil moisture can become severe limiting factors for the total coffee crop output. Dr. Anand Periera, a grower from Sakleshpur region, known for his extensive investments in artificial irrigation systems, in his estimate felt that there was a visible rise in overall temperature through the years. According to him, if 20 years ago the temperature touched 32^0C it meant that they would have a downpour. But in 2010, even if the temperature touched sometimes as high 33^0C the rains did not necessarily follow. Commenting on these temperature trends, Mr. Bassana, a senior coffee grower in Anemahal, Sakleshpur, shared an anecdotal observation:

> In summers, during my childhood, if we were to sweat while sitting inside our house it was sure sign of approaching rains. Now there is no correlation. Summers are definitely much hotter now (personal interview, 2011).

Another senior coffee grower Mr. Gangehegde further supported this observation:

Growers regret not maintaining temperature records. While we can feel it, it is difficult to provide data.

In a coffee estate, temperature trends are directly related to vegetative growth and more specifically with the growth of leaves. Leaf growth shows periodicity with maximum number of leaves initiated in August/September. The leaves that grow during this period tend to be larger and are found to be associated with the maximum temperature range of 23^0 C -27^0 C and minimum temperature range of 11^0 C - 12^0C (Coffee Guide, 2014).

However, a high temperature inhibits leaf expansion and causes formation of smaller leaves. Smaller leaves pose limit to the ability of the plant to grow and manufacture food for itself. Irrespective of the performance of rainfall, the higher temperatures in fact limits the net crop output. While such observations are reflected in the growers' situated experience of weather on the coffee estates it is not always captured in the indexed understanding of rainfall which informs RISC.

Temperature, Rainfall and White Stem Borer

In a coffee estate the impact of rainfall is dependent on the temperatures being experienced. The most intricate relation of the two is observed in fighting pests like White Stem Borer (WSB). Exposure to high temperatures for a prolonged period results in high pest incidences like WSB (Pereira & Pereira, 2009). Estates in South –West monsoon belt especially the once located in Hassan district in Karnataka State have been witnessing serious infiltration by White Stem Borer (WSB) in Arabica plants.

Coffee White Stem Borer, *Xylotrechus quadripes*, is a serious pest of Arabica coffee causing a yield loss up to 40 per cent in all coffee growing areas of India (Jayaraj and Muthukrishnan, 2013).The worst infestation of White Stem Borer in South- West Monsoon belt was experienced during the drought of 2002-2005. It is known local fact that during drought conditions, due lack of rainfall, infestation incidences increase. But unlike previous drought incidences, Arabica has not been able to recover in this region since then. According to Mr. H.R. Bassana

temperatures are relatively higher. WSB stays dormant during the rainy season but appear again once the rainfall stops (personal interview, 2011).

To curb the WSB menace Coffee Board introduced monetary incentives for growers to trace White Stem Borer in all its forms (pupae, larvae and adult beetle) (Pereira & Pereira, 2009). In order to break this cycle of infestation growers are increasingly switching to Robusta. For instance Mr.

B.M.Jaganath, a coffee grower, having approximately 70 acres of land in Ballupet near Sakleshpura, was largely an Arabica grower prior to 2002 but he incurred heavy loss during 2002-2005 droughts. Moreover WSB which infested his estate then has not still entirely gone. More than twice he was forced to uproot new Arabica saplings within 2 years of planting them. While talking about Robusta which have almost entirely replaced Arabica in his estate, he said

> Robusta is the only plausible way of dealing with White Stem Borer menace especially for a grower like me whose neighbor is completely ignorant towards his estate as a result his plants are a constant source of infestation for my estate. Although Robusta is not entirely resistant to the pest but it prevents pest cycle from kicking in which if instigated would push us in debt for five years straight (personal interview, 2011).

In the time of changing climate drought is associated not just with failure of one or two crop cycle but with loss of plant due to infestation. More importantly, as is evident now, risk assessment of drought for a grower also includes the investments in redesigning the estate from Arabica to Robusta. Indexed rainfall will identify the rainfall failure but in the changing conditions the extent of experienced damage accentuated because of increased temperatures are not taken in account. Robusta which is planted because of its higher resistance to WSB faces another set of problems. Honey bee is crucial for the pollination in Robusta plants. Robusta growers recalled in an interview: ‘till few years back, during flowering season one could hear the hum of honey bee for miles (personal interview,2014).

Now, honey bees are scarce. Though no scientific proof is available for their diminishing number but Mr. Kanan, a coffee grower and a bee keeper attributes their absence to high temperature. Absence of honey bees result in reduced degree of pollination. As a result even if rainfall delivers as per expectations the fruit setting will be affected and there would be reduction in net crop produced (personal interview, 2014). Switching from Arabica to Robusta in the background of these unprecedented variation in weather events reduces relevance of RISC for two reasons. First, in the times of unprecedented variation in weather failure of rainfall or drought requires growers to take in account the cost incurred in replanting the estate while RISC is designed to compensate only one failed crop cycle. Second, for a grower rainfall is one of the factors which affect fruit set. Other equally important and interdependent factors include temperature and honey bees for pollination. While for the grower fluctuation in any of these factors affect the total crop output for

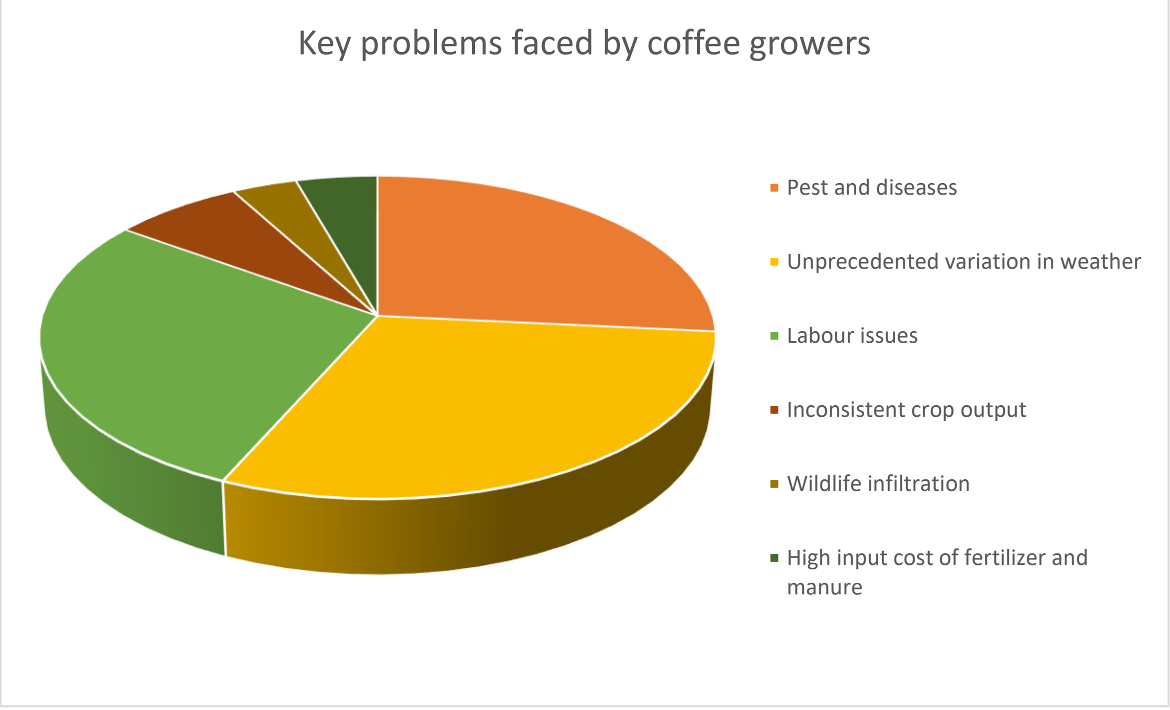
RISC rainfall is the only component monitored. Therefore, there is a likelihood that crops can suffer even though there is no drastic change in the total amount of rainfall received.

Analysis and discussion

The comparison I have made between the two different comprehensions of rainfall received in the Western Ghats belt - RISC's scientific and statistical comprehension of rainfall and coffee growers' comprehension informed by their situated experience - highlights that growers are experiencing unprecedented variation in weather pattern which is not captured by scientifically and statistically informed RISC. Thus it can be argued that growers' situated experience of rainfall is more in tune with unprecedented changes being observed on the ground than the scientific and statistical assessment of the weather event.

This observation is further supported by the survey response given by growers. In response to a written survey questionnaire growers shared the key concerns they face on the estate. Unprecedented variation in weather figured as one of their top three concerns. Following pie-chart is based on growers' survey response:

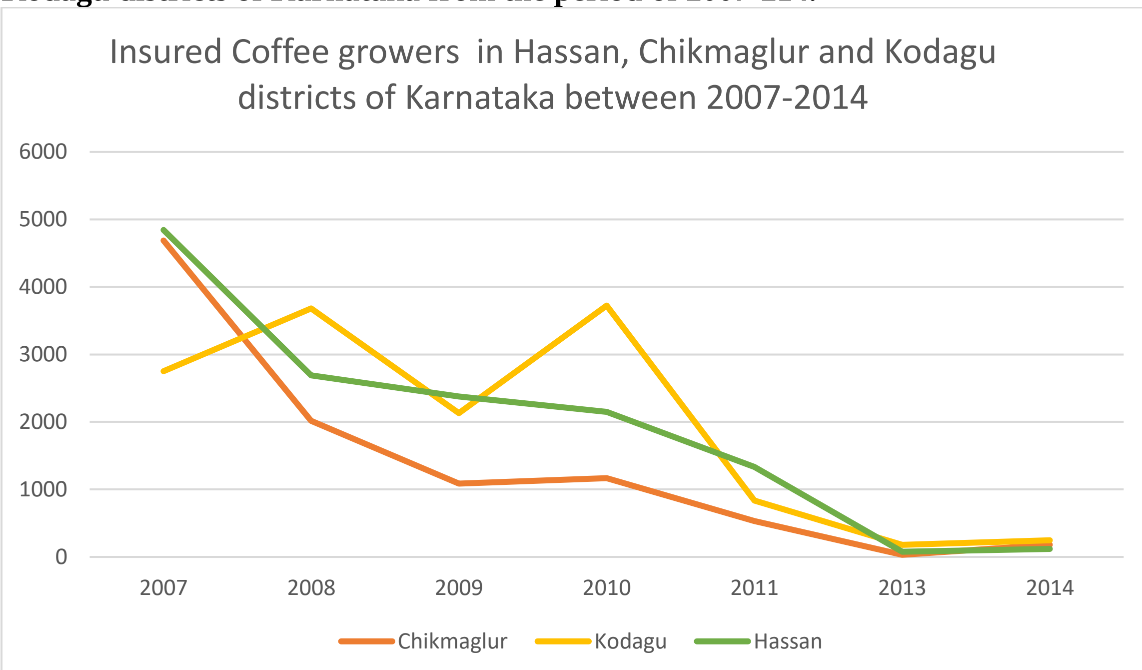
Figure 3: key problems faced by coffee growers at their estates.



[Source: Based on primary data. The Survey was conducted on 18th January, 2015 at University of Agriculutre and Horticulture Sciences, Shimoga University, Mudigere, Chikmaglure, Karnataka.]

However, this concern is not reflected in their interest to buy RISC cover. Following graph shows the number of insured growers in the three coffee growing districts of Karnataka between 2007-2014. There is clear downward trend in all the three districts.

Figure 4: Number of grower Insured with RISC scheme in Hassan, Chikmaglur and Kodagu districts of Karnataka from the period of 2007-214.



[Source: Based on primary data collected from by Agriculture Insurance Company (AIC) office Bangalore.

This inverse relation between growers' increased concern for unprecedented variation in weather and their lack of interest in RISC arguably arises from the gap between indexed rainfall and experienced rainfall. It can thus be argued that as incidences of unprecedented weather variation increase growers are more likely to move away from RISC. This inverse relationship is indicative of the fact that insuring weather by indexing it cannot be unproblematically categorized as adaption strategy for climate change. As an adaptation strategy WBCIS has to reconcile two different comprehensions of weather which are growing increasingly out of sync with each other.

Concluding Remarks

This paper argues that in the current format WBCIS is not an adaptation strategy. The paper begins by highlighting that while WBCIS is designed to insure weather, the triggers for introducing this format in agriculture sector were not farmers' weather concerns per se. The primary reasons for introducing WBCIS were:

a) The homogenous area approach on which it based is administratively easier to manage than the previously existing 'individual approach'.
b) A correlation can be established between weather data and crop yield data. As a result, weather data can successfully act as proxy variable for crop yield.

Most interestingly, while weather insurance for agriculture did not organically emerge from farmers' concerns about weather, it nonetheless has to corroborate with farmers' situated experience in order for them to subscribe to it. The paper looks at the specific case of RISC. RISC focuses on a specific weather event in a defined geographic location: rainfall in the coffee growing district of Western Ghats in South India. It provides cover for four rainfalls (blossom, backing, monsoon and post-monsoon showers) which are crucial in a coffee crop cycle. There are defined trigger levels which identify excess or deficient rainfall based on statistical and scientific assessment. The RISC's scientific comprehension of rainfall exists alongside growers' situated experience of it. Building on Tim Ingold's work, this paper argues that the situated/local comprehension is not just a limited or narrowly focused apprehension of the larger scientific and statistical comprehension. Rather, it is based on an altogether different mode of apprehension, a practical perceptual engagement with components of a world that is inhabited or dwelt-in, rather than a detached disinterested observation of a world calibrated by scientific instruments. The paper further uses Donna Haraway's concept of situated knowledge to capture growers' experience of weather variation on the ground. This concept focuses on interlinkags between the weather event and other natural and social processes in the given context.

The findings from the field work highlights that the growers' situated experience is able to identify unprecedented changes in weather pattern better than the scientific and statistical calculations of RISC scheme and that here is an inverse relation between growers' increased concern for unprecedented variation in weather and their lack of interest in RISC.

Thus, it can be argued that with increase in unprecedented changes in the weather pattern the scientific and situated comprehension of the weather is increasingly growing out of sync with growers' situated experience of these weather events. Clearly, a weather insurance scheme which is losing subscription with increased incidences of unprecedented changes in weather pattern cannot be considered as an adaptation strategy. The challenge for an adaptation strategy, therefore, is to identify these different comprehensions of weather event and meaningfully converge them. Rethinking WBCIS as an adaptation strategy would require gathering situated experience of variation in weather event to actively inform the scientific and statistical comprehension of it.

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