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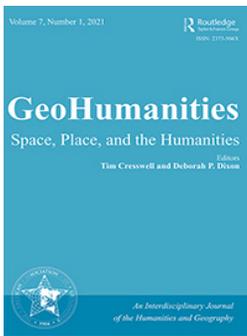
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MONSOON ASSEMBLAGES FORUM

Gambling on the Monsoon in the Indian Desert

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In the desert area of Rajasthan, people have been betting money on when and how much it will rain during the monsoon for centuries. Despite state investment in forecasting technologies in India, rain bettors do not believe official weather data can predict the precise timing, volume, or location of rain. They instead observe the sky and share real-time information via social networks. Ethnographic research on weather prediction has focused on farmers' expertise and information relevant for agriculture. Rain betting highlights other monsoon patterns in northwest India, especially sudden shifts in cloud direction and speed. It also foregrounds a creativity around weather uncertainties that, like weather derivatives trading, is about pursuit of profit through active ongoing engagement with weather risks. Rain betting, I argue, is a form of vernacular speculation in futures in an area where people are increasingly giving up farming for more profitable work. **Key Words: forecasting, gambling, India, rain, speculation.**

The monsoon in India is a celebrated yearly weather phenomenon loaded with symbolic significance. From June to September, it travels from the coasts of South India toward the foothills of the Himalayas before it finally reaches the semidesert of Rajasthan in the north. On its way, it irrigates farmland, fills water reservoirs, and cools down the overheated land. In Rajasthan, the monsoon rain, intensely anticipated by farmers and a sweating city population, gives rise to an energetic market for betting. During the monsoon season, anyone can bet anything from 100 to 100,000 rupees on whether or not it will rain during a particular timeslot on a particular day (the mean monthly income is around 10,000 rupees). This brings people from a radius of 100 kilometers to the town of Kishpur,[1] a center for rain betting located in the Shekhawati region. On the margins of the town's shopping area, at the end of a street mostly occupied by sweet shops, people gather in an open space around the downpipe of an old building. When rainwater comes through the downpipe, those who have betted on rain can collect their profit from the bookmakers who can always be found in this space.

The weather in India is becoming increasingly volatile as a result of climate change (Mahdi 2018). In response, the Indian government has been making significant investments in improving forecasting technologies, both to prevent the escalation of natural disasters and to develop new methods for the management of farming, which accounts for more than 60% of the country's gross domestic product (GDP). Despite these new technologies and extended access to them via weather apps and online weather information, farmers and traders in and around Kishpur do not believe that national forecasting experts are able to predict the local weather. Both the inhabitants of the town and the farmers living around it agree that only rain bettors are able to accurately forecast when and where it will rain.

This article unpacks the practice of rain betting in order to shed light on the risks and possibilities for play and profits presented by weather uncertainties during the monsoon season in the drought-prone state of Rajasthan. In doing so, it contributes to the human geography and anthropology of the weather, with a localized perspective on the monsoon. It is based on six months' fieldwork around the town of Kishpur between 2015–2017, where I took part in the everyday life of bettors, farmers, and traders and interviewed them about their perceptions of and engagements with the uncertainty of the weather. It also draws on interviews with a number of employees from state and private institutions dealing with forecasting and agriculture, including the national meteorological institute (IMD).

Anthropologists have stressed the value of local expertise in weather forecasting as a possible addition to the data created by meteorologists (Peterson and Broad 2016). However, this has typically been investigated from the viewpoint of farmers, who are also considered to be the potential users of improved weather forecasting. In contrast, this paper takes the perspective of town-dwellers from varied backgrounds many of which are involved in small-scale businesses, for whom the uncertainty of the weather presents a possibility for play and profit. Farmers engage actively with the weather as it provides the foundation for their work and existence, but their weather forecasting is particularly attuned to weather-crop interactions (Lazrus 2015; Roncoli, Ingram, and Kirshen 2002). Their knowledge therefore works around a particular temporality that has to do with the rhythms of the crops. It may not be that relevant to a farmer whether, for example, it rains after fifteen minutes or five hours or even five days. But this can make a big difference to a rain gambler, since a betting period might only last five hours. Rain bettors have therefore developed local expertise in short term forecasting based on ground observations. This makes them a particularly interesting source of expertise on local weather conditions as they take a more proactive approach to forecasting than farmers, in the sense that they are involved in constant decision-making throughout the day based on ongoing weather changes.

While ethnographic research on weather knowledge in the Global South tends to focus specifically on forecasting among and for farmers in agriculture (Enock 2013; Haines 2019; Okonya and Kroschel 2013; Orlove, Chiang, and Cane 2002; Radeny et al. 2019; Roncoli, Ingram, and Kirshen 2002), research in the Global North concentrates more on scientific methods of forecasting for a much broader use (Cooper 2010; Daipha 2012; Demeritt et al. 2007; Hooke and Pielke 2000). This paints a reductive picture of a Global South at the mercy of nature versus a global North that, to a greater extent, masters the risks of weather through science produced in offices. The tendency to assume that the question of rain in non-Western contexts concerns agriculture or the threat of natural catastrophes has limited our knowledge of the multiplicities of forecasting in the Global South and its entanglements with a variety of risk

economies. By focusing on rain gambling, this article unfolds the creativity of rain practices in India, showing that people are not just victims of the unpredictability of nature, and that elements of agency, playfulness, and speculation co-exist with the rain-dependent economic system of agriculture. Along the way, I point toward parallels with forecasting practices in the global North, namely the trade in weather derivatives.

Although inspired by research on gambling, this article goes beyond its boundaries as a demarcated field of study. The anthropology and sociology of gambling has considered its significance in relation to society and culture. Money tends to be reduced to the medium that enables the players of these games to play out and reflect upon the social and cultural systems that they are positioned in, which can both have integrative and disintegrative effects in their relationship to the community (Basu 1991; Binde 2005; Malaby 2003; Mitchell 1988; Riches 1975). However, gambling *also* presents a unique possibility of studying money markets in the form of local engagements with risk and its commercialization in local (and global) markets. In this vein, more recent studies have attempted to capture the playful dimension of profit seeking (Bear, Birla, and Puri 2015; Cassidy, Loussouarn, and Pisac 2013), moving beyond a distinction between gambling and financial speculation historically colored by a moral framework differentiating legitimate risk-taking of the upper classes from the illegitimate risk-taking of lower classes (Fabian 1990; Stâheli 2013). Geertz's (1973) seminal article on cockfighting gambling in Bali points in a foot note to its parallels with Wall Street trading, while his focus on betting odds directs the reader toward understanding the cultural framework for volatile market values. However, this has been over-looked in the reading of his article (Puri 2020a). Inspired by Geertz, this article looks into betting odds (and not just the object of betting, whether cocks or weather), showing how rain betting is not only about predicting rain, but also about trading in a market, entangled in existing social and cultural systems, where the future is priced. Following historical research on gambling legislation in India that shows the interlinkage between rain betting and the futures trade in crops (Birla 2009), I take rain betting to be a vernacular form of speculation in futures.

This article thus sheds light on how rain betting is not only about betting on the weather and the direction it is heading, but also about betting on the movements of the market. Whereas rain comes rarely, the anticipation and unpredictability of the weather is magnified in the betting odds. These move up and down with changes in online weather forecasts or a sudden gust of wind, enabling bettors to buy and sell bets and to profit from changes in odds over time. This understanding of rain betting as a trade of bets on constantly changing prices highlights the temporality of forecasting, foregrounding limits in the usability of national forecasting data as well as the uniqueness of rain bettors' knowledge.

Rain bettors master forecasting as an ongoing activity of ultra-short term prediction that captures the speed at which the weather (and by extension betting markets) can suddenly change. A study of rain betting thus gives insight into the possibilities and limitations of publicly available weather information for both rain bettors and farmers. For them, the temporal and geographical scale of relevant weather information is extremely small, unlike the grand narrative of the yearly monsoon that stretches out over several months in the newspapers. Rain betting thus shed light on specifics of the weather in this particular ecological zone that can be relevant for developing weather prediction systems for farming and other sectors.

Before turning to rain gambling, I first establish the broader context for the interconnection between rain and risk in the area through a short introduction to the history of, present

conditions for, and cultures around agriculture and trade. I then go on to introduce rain betting from the vantage point of four men: a bookmaker, an elder who recalls how betting has developed over time, another elder attempting to make money from predicting rain fall, and a younger man who makes money from buying and selling bets. Along the way, I contextualize these practices with developments in official weather forecasting technologies as well as weather derivatives.

RAIN RISKS IN AND BEYOND KISHPUR

The landscape around the desert town of Kishpur stretches out in golden-brown slopes, broken up by vegetation into small fields. In technical terms it is a semidesert, but the locals call it a desert. This is an area with very scarce rainfall. If the monsoon comes as anticipated at the end of June, then, at the beginning of August, the landscape turns light green and flourishes until October, when lentils, beans, and millet—which need only a little rain—are harvested. However, as the fields are not irrigated due to both a lack of resources and the saltiness of the groundwater, farming is regarded as a risky enterprise. In fact, many refer to farming as a gamble (*jua*) and have additional jobs, such as cleaning government offices, driving ambulances, or selling biscuits, to secure themselves against the risk of famine.

The weather risk and ways to secure against it have shaped the region. Despite its scarce rain and sky-high temperatures for many months of the year, Shekhawati, where Kishpur is located, has a long history of prosperity and is known as a cradle of Indian business communities that have made money as middlemen of trade. From the seventeenth century, Shekhawati benefitted from its strategic location on the Silk Road and other major routes for the transportation of silk, spices, grain, and opium, which were brought through the area partly because of its relatively low taxes. Once the British East Indian Company took over tax collection in the nineteenth century, merchants of the Marwari caste developed their expertise in brokerage and started moving to Calcutta and Bombay (Hardgrove 2005). The money they made was sent home to their families and used to construct large mansions (*haveli*) in their hometowns to show off their success and house their families. The Marwaris established vernacular forms of futures trading that allowed people to buy and sell products without delivery, trading only in fluctuating prices (Birla 2009). Such markets were located in havelis in the main marketplaces of Calcutta, which, with their open courtyards, were ideal locations for this enterprise. Merchants trading in price changes needed frequent weather updates from around the country. Marwaris shared information about weather conditions and the arrival of the rains from the Bay of Bengal first by using morse codes signaled from hilltops, telegraph, writing with charcoal on trains, and later by telephone (Hardgrove 2005). Knowledge of the monsoon was basic to predicting the direction of prices; for example, less rain in an area could lift crop prices because demand would outstrip supply. Therefore, parallel to the futures markets for commodities, Marwaris also set up markets for betting on rainfall, using separate havelis specifically for that purpose.

At end of the nineteenth century, rain betting was banned in Calcutta (Birla 2009). In court it was argued that unlike the legal horserace betting, which demanded the skills of forecasting the performance of horses acquired through many years of close contact with horses (then associated with the military power of the British as well as of the Maharajas), rain betting

was to be considered a game of chance as rain was unpredictable. Yet, by then, the British East India Company had founded the Indian Meteorological Department (in 1875), one of the first of its kind, after failures of the monsoon had hit the company's profits hard. Rain bookmakers therefore argued that the weather could be predicted through scientific means; moreover, unlike horse racing, the rain could not be manipulated. The British held, however, that the Marwari bookmakers dealing with priced future outcomes of both rain and agricultural produce could not be trusted. This was at a time when both racecourses and closed financial markets based on British monopoly were established as legal alternatives to trading in future uncertainties in the bazars (Birla 2009). As with other forms gambling, the imposition of a ban did not eliminate the popular activity. Rain betting continued to exist, but some bookmakers moved to other locations, such as Delhi and Bombay, where similar legislation banning rain betting was subsequently introduced over the next twenty years (Birla 2015); others returned to Rajasthan.

The gambling legislation introduced at the end of the nineteenth century is still more or less intact. Other than the state-managed lotteries legalized through the Indian constitution in 1950, horserace betting continues to be the only legal form of gambling. While some rain bookmakers moved back to Rajasthan, many of the Marwaris who went to the large cities became successful businessmen, gave up rain betting, and eventually cut the bond to their ancestral towns. Walking down the streets of Kishpur is like walking through a living museum, full of beautiful buildings that are falling apart. Despite new sources of income from migrant work in construction in the Middle East, the dusty town of 100,000 inhabitants remains underdeveloped in the eyes of locals, who characterize it as a place with dirt roads and cows blocking the streets. The inhabitants, farmers and traders alike, dream for their children to escape and use much of their household budget to send them to one of the region's many local private schools. This is partly due to the limited possibilities for generating a profit from the area, not least since the irrigation systems that have brought prosperity to farmers in neighboring regions have not made it here. Farming remains completely dependent on the rain, which often comes for only a few days each year.

The Green Revolution in India, commenced in the 1960s with the aim of lifting India out of poverty, sharpened the focus on the effectivization of farming (Kumar 2016). Production was no longer simply left at the mercy of nature. Instead, it was increasingly controlled and manipulated through the use of irrigation systems, fertilizers, and pesticides. As part of this transformation, an infrastructure of farming experts was built to educate farmers in how to use weather predictions to adjust their farming practices. Ideally, weather forecasting could benefit agriculture: sowing and harvesting could be timed, the necessity of fertilizers assessed, and specific genetically modified seeds varieties could be planted depending on how much rain they would optimally need. However, as forecasting was never considered reliable enough, the effectivization of farming in India has mostly been through irrigation and the adaptation of fertilization adjusted to actual rather than predicted rainfall. Irrigation has, to some extent, made farmers less dependent on the timing of rainfall. However, 50% of all farmland remains unirrigated; in Kishpur the proportion is closer to 90%.

When I came to study weather uncertainties in and around Kishpur, I was surprised to see how little attention farmers paid to weather forecasts. The local farmers grow primarily millet and lentils, which demand minimal water. They agreed that the weather is essentially unpredictable and the only thing they can do once the seeds have been sown is to hope or pray to God

for the best possible outcome. Thus, to understand their engagement with future weather, these farmers' practices of prayer are more relevant than their use of weather information.

In an article on the "ethics of wealth" among farmers in India and the role of prayers to gods and goddess of fortune, Gregory (2018) emphasizes that regional variations in religious practices are linked to regional variations in ecological zones. Whereas the farmers he spoke to prayed to Lakshmi, the goddess of wealth who is often portrayed with grains, water, and gold, Hindu farmers around Kishpur primarily prayed to Hanuman and some had a shrine located inside their fields. Hanuman, also known as the monkey-god, is believed to have a special insight into and access to groundwater, since in the Ramayana epic he traveled across the earth through an underground tunnel in his heroic struggle to free the goddess Sita and unite her with her husband, Rama, the upholder of moral order. Although only the prosperous farmers have wells, a connection to groundwater reserves remains an ideal. More importantly, Hanuman represents strength, perseverance, bravery, and intelligence, which are the defining values of both the farmers and businessmen of the area.

There was agreement among farmers that rain could be produced with help from gods through prayers organized by priests. However, this was a method that took several days and required villagers to come together and collect a large sum of money for the local priest. It was used less and less because it was too expensive, and, I was told, people liked to use their money for other things nowadays, such as data for their cell phone as well as their children's education. Without such collective attempts to try to direct rainfall, farmers agreed that farming was ultimately a gamble dependent on personal luck or *kismet*. A family's investment in seeds and farm labor might sustain the family with food for the following year. If lucky, they might even generate a profit from selling surplus to the market. But if it barely rained that year, everything could be lost. Even though they thought of farming as gambling, it was still considered a good activity as one could provide the family with fresh food while maintaining a healthy body through farm work. Gambling on rain, in contrast, was considered bad, as was most forms of gambling (which is also morally condemned in Hindu scriptures such as the *Manusmriti*. Farmers acknowledged that rain gamblers were experts in predicting rainfall (and a few secretly engaged in betting). Yet they would not go to rain bettors for advice as they were considered too busy with their gambling and the place where they could be found was not considered proper. At this place, called *satta* bazar (*satta* referring both to making deals in futures markets and to gambling), one could also buy hashish, tickets for illegal lotteries organized by the Mumbai mafia (*matka*), and prostitutes.

RAIN GAMBLING MARKETS

As I walked into the *satta* bazar in the dry heat a week before the monsoon was expected to arrive, at first glance there did not seem to be any activity at all. I approached some old men with simple clothes and only a few teeth who were hanging out in front of a tea shop and asked them about rain betting. They pointed me to Vinod, one of the main bookmakers in Kishpur. At first, I was a bit scared. He was a big man with large features and rough skin covering his body, which was clad in a sarong and a white tank top. Aggressively, he looked me squarely in the eyes and asked what I wanted. I replied nervously that I wanted to bet that it would rain. He said that if I placed the bet before the evening the odds were 5/1, which meant that if I gave him

500 rupees, I could make 2500 rupees if it rained. I placed 500 rupees into his large, rough hands. He laughed at this rather unusual situation, as did the other men who had gathered around us. I spent the rest of the day alongside other bettors hanging out outside a deserted haveli and nearby chai shops close to the downpipe, looking up at the sky, but there was no rain in sight.

It took a while to gain Vinod's trust; he was worried that I was a spy. He had been at the police station just a couple of days before, since he had not been able to pay a large enough bribe—or license, as he called it—to keep the betting market going. Until he had more money to give them, he was keeping a low profile, as were the bettors. Bettors call a bookmaker a *dalal*, which means a broker, a term also used in the agriproducts trade. Vinod however liked to call himself the *satta* king, the gambling king, which made everyone around him laugh. Despite dealing with large numbers of bets, he did not issue receipts. In his pocket he kept a cigarette box on which he noted in code the bets he was taking. A couple of times a day, his son would drive up on a scooter and put the numbers from his father's cigarette box into a larger account book, where he kept a more formal record of what was owed to whom.

Vinod also kept his cell phone in his pocket. It rang constantly with people asking for the odds and placing bets. Since an estimated 90% of all betting is done through the bookmakers, their odds are representative of the market as a whole. There is some interpersonal betting, but once amounts exceed 500 rupees the bookmaker gets involved to ensure payment. Bookmakers charge around 5% of all betting income. This covers bribes and the risk of nonpayment among bettors as well as the bookmakers' income. It also covers the expense of buying *chai* and snacks delivered from the street shops as part of their customer care for those who come to bet with them in person. Vinod told me that he had started out as a rain bettor but had had success as a bookmaker. He was a man of a low caste, whose family had given up farming a generation before. He lived in a newly constructed house built with money made from bookmaking, which sat next to his older shack, now used for his cow.

In Kishpur, there were three other bookmakers who could be found daily at the *satta* bazar. Bookmakers spread their bets among one another to minimize risk. If one took a lot of bets on rain, he would himself place bets on rain with another bookmaker, who might have accepted proportionally too many bets on no rain. Thereby, they both secure themselves against dependency on specific outcomes of the weather, making their money from the 5% betting fee. Depending on their cash-flow, some bookmakers could take up to 5 million rupees in bets per day, but Vinod's limits were closer to 500,000 rupees. As most bets were on credit and balanced one another, he had to pay out no more than a maximum of 50,000 rupees a day, a sum that he could easily win back the next day. With limited job opportunities in the town, some of the regular bettors stated that they made a living from rain betting. Others included shop owners, who sat outside their small open-air stores with time to observe the rain, and men who did not need to bring in a steady income since they lived in a joint family and were simply rain betting as a way of passing the time. Not all bettors came in person to the bazar; bets could also be placed over the phone, allowing people from cities where the prohibition against rain betting was enforced to bet. Vinod took bets from areas extending to a radius of 300 kilometers.

In Kishpur, I met an old Marwari man, Om, who had worked as a bookmaker in a rain betting haveli in Calcutta from the 1960s to the 1990s. According to him, it was the only rain betting haveli left at that time and it had approximately 800 betters coming daily to bet between 500,000 and 5 million rupees (equivalent of approximately 15% of the current registered

turnover of horserace betting in India as a whole). Of the bookmakers, 80% were from the Shekhawati, and of those, half were from Kishpur. There were around eight other havelis in the close vicinity that housed illegal betting markets on shifting prices, mostly of precious metals, which also depended on the development of the monsoon. As a bookmaker, Om told me, he could earn up to 500,000–600,000 rupees in one season. The two-story haveli had bookmakers on the ground-floor, the first floor had clothes shops, and up on the roof people would stand to observe the sky and the tin can used as a rain gauge. When they started having too many problems with the police, Om moved back to Kishpur, where he remained involved in weather prediction, but now as a bettor rather than a bookmaker because he thought the risk of people defaulting on repayment was too high. In Calcutta, bettors paid when placing their bets, but in Kishpur, betting (like many other kinds of market transaction) was mostly done on credit or *viswas* (trust). This placed the bookmaker at the mercy of the debtor, whose luck might not start turning for many months. Ideally payment was supposed to be made at the end of the day, but with completely new bettors like me, the betting was done in cash.

Betting practices vary along with the weather conditions in terms of both time and place. In Kishpur, in May and early June, bettors can bet on whether there will be rain during particular weeks. These rains are officially called pre-monsoon showers. During this time, bettors also continue betting on *gadda*, the appearance of a dark cloud that blocks the sun. *Gadda* betting is the primary mode of weather betting after the withdrawal of the monsoon (usually in September) until the middle of June, when the rain betting kicks in. Sometimes there are sudden showers in the winter season from December to February. As soon as there is a forecast of heavy cloud indicating the possibility of rain, cloud-betting flips over into rain betting. Overall, betting on rain is much more popular than cloud betting, especially during the monsoon when betting is divided into two daily timeslots, divided by sunrise and sunset.

Rain betting is thus adapted to the local climate. In Calcutta, where it rains more often but in different volumes, I was told by Om that people were betting on the rain exceeding 2.5 oz and reaching a level of 15 oz, as measured in a large tin that had been used for cooking oil. In a betting center located in the middle of the Thar desert, by contrast, I was told that betting could come down to counting the number of raindrops on a plate. In Kishpur, the amount was irrelevant as bets were placed on whether or not rainwater would come out of a particular down pipe. The roof of the building, which is used for grain storage (and previously also for online trading in stock and derivative markets) is flat. If it only drizzles, the rain is too light for water to start running out of the pipe. For this to happen, there has to be *nalli* (pipe) rain; the clouds will suddenly gather as the wind starts blowing, followed by a heavy shower lasting less than twenty minutes. This is a rather rare occurrence in these dry areas. Normally, it rains like this on only four days or so during the monsoon. Some years, a given place will have more of such days, but in other years it will not rain at all. To be able to make accurate predictions that capture the timing, location, and volume of rain demands an intimate relationship to both the weather and the people inhabiting the area.

SKY OBSERVATIONS VERSUS SCIENTIFIC FORECASTING

Motilal came daily to sit next to the water pipe in close vicinity to Vinod. He was an old man with shiny eyes and a long, white beard, a brahmin by caste who had retired from a government

job. Many of the bettors I met belonged to the Banya (merchant) or Brahmin (priests and teachers) castes and had been trying to make money in gambling and trade in various ways. Only a few were farmers (of the Jat caste), despite my expectation that it would be among the farmers that I would find weather expertise. Brahmins, like Motilal, are known as masters of knowledge. Since both rain betting and trade involve knowledge-based prediction, Brahmins enter the risk markets with confidence alongside members of the trading castes. Motilal lived in a nearby small deserted haveli, standing in ruins, along with his younger brother who sold ayurvedic medicine. Many other bettors pointed him out as someone with knowledge (*gyan*) of the monsoon. He told me that his method was one of "seeing the *rang* of the sky." *Rang* means color, but is often also used as the word for mood. You look with the eyes but also with the mind, Motilal told me. He said that he got up early every morning to watch the sky from his roof top and get a sense of it. He took great pride in the fact that he could predict using only his eyes and no technology (he had an old phone without internet access). He paid attention to changes in wind direction and speed, the color of the sky, and the shapes of the clouds, but also used his body to "measure" the humidity level and temperature. When Motilal was at the *satta* bazaar, however, he often kept his eyes on a red flag on top of a temple to observe the direction and intensity of the wind. This was vital information, as rain was known to come from particular directions at different periods of the year. It would also tell him who within his personal network he should go to for other kinds of information.

Depending on the direction from which the wind was blowing, Motilal would call up friends and relatives in the surrounding villages to ask about the weather there. If it happened to rain in one of these places, it was likely (depending on the wind direction) that the rain would reach Kishpur. From villages around 20 kilometers away rain would normally take around half an hour to reach Kishpur. From such information and calculations Motilal would take a decision on what to bet. I saw parallel practices of information sharing in the grain market in town. Here traders in different regions called each other to ask whether it had rained and used this information as an indicator of the development of grain prices. On days when it rains in certain areas, prices drop as more produce is expected to come to the market.

However, even with information on rain in neighboring towns and villages one could not be sure of the outcome. Even if rain reached Kishpur town, it would not necessarily reach the downpipe. It could easily rain at one end of the street but not at the other. This was also the situation for farmers in the area; there had been years when farmers from the same village had harvested very different yields as some had had more days with rainfall than others. When rain clouds were getting closer to Kishpur the bettors would go up to the roofs of the nearby buildings to watch its movement.

National weather forecasting could predict that it might rain in a particular town or area, but not exactly where the rain would fall. Furthermore, online weather apps did not allow people to retrospectively check the weather in surrounding cities, for example, to see if it had been raining an hour ago in a city one hour's rain away. For most places in India outside the large cities, records of rainfall are made public only weeks after data has been collected and run through the bureaucratic machinery; even then these reports are difficult to access. There is thus a large time gap in weather information between current forecasts and past weather records. For all these reasons, Motilal made it clear that the national weather forecasts were not only useless but also incorrect. His perception of national weather predictions mirrored a more general critical perspective represented by frequent media reports on the failure to predict the monsoon.

Based on interviews with employers and online information from IMD I was informed that for many decades, India had relied on global weather prediction systems. This was partly due to an American ban on the selling of the supercomputer hardware necessary for complex forecasting, because the same technology could be used to develop nuclear weapons. But since the 1980s, Indian technology has been gradually catching up. National forecasting systems have reduced the scale of prediction from 70 km to 3 km, enabling more localized predictions. IMD's forecasting is primarily based on statistical models that compare weather data with data for the past 100 years. The idea is that if certain conditions are similar to past conditions, they are likely to develop in similar ways. However, these statistical models have not been able to predict detrimental weather phenomena, such as droughts in 2002, 2004, and 2006, all of which hit Rajasthan. In 2015, the IMD started testing dynamic systems that simulate weather conditions at particular localities in order to calculate how certain variables change in relationship to one another over days. In 2018, the Indian state bought the fastest-yet supercomputer in India for US$438 million to use for weather forecasting, and in 2019 it was announced that India will invest a further US$633 million in forecasting over the next ten years with the aim of improving weather predictions. This is approximately ten times more than IMD's annual budget.

Even with these developments, complaints continue to be raised in the media about the failure to predict the monsoon. These often concern the monsoon as a singular seasonal event covering all of India and focus on two main factors. The first concerns time, namely, the so-called onset of the monsoon (i.e., the date that it will first hit the coast of South India) and the estimated dates at which it will gradually be pulled inland as a result of temperature differences between land and sea. The second concerns volume, namely, the amount of water that will fall, measured as a percentage of what is considered a normal monsoon. When the first monsoon forecasting goes public at the beginning of the year, Indian futures markets react immediately, affecting the price of everything from rice to gold. The forecasts also are used for agricultural planning. For example, if drought is forecast, farmers are encouraged to sow seeds that are more drought resistant (although in Kishpur most farmers used seeds from the previous year's produce). When the rain season is over, the forecasts are assessed and the difference between the forecasted and actual rain is calculated. In 2019, in the area of Shekhawati, there was 66% more rain than had been predicted.

Such monsoon predictions are classified as seasonal forecasting. The data for them are collected twice a day from local observatories positioned around the country, or from automated weather stations that send measurements every ten minutes via satellite. According to an IMD forecaster, the problem with the automated stations is that they do not give an estimation of cloud cover nor the kind of clouds in the sky. This data requires the kind of human visual observation practiced by rain bettors.

According to the rain bettors, the limitations of national forecasting are linked to governmental deficiencies. When they talked about the inaccuracy of official forecasting, they pointed to the local weather station positioned 5 km outside the town on the outskirts of the agricultural university, an institution that educates experts to guide farmers in how to deal with weather uncertainties. When I visited the weather station, I was shown the outdated equipment being used to measure hours of sun, humidity, and rainfall. The data is sent to Rajasthan's meteorological institution, which interprets it and sends it on to IMD. Reflecting a more general public skepticism about the technologies of the Indian state, the rain bettors distrusted the collected data, complaining that there was a lack of responsible staff to properly record it. This made

someone like Motilal a personification of real weather expertise. Unlike farmers, who often look at the ground while working, rain bettors keep their eyes on the sky. Like meteorologists with satellite images, they pay attention to weather changes as they take place, yet at a much more localized level using their bodies as instruments.

RAIN ARBITRAGE

Despite the inaccuracies of forecasting data, the weather predictions now available through weather apps such as AccuWeather and BBC weather, *were* of value in the betting market, but as indicators of changes in the odds for rain rather than of rain itself. For example, if a weather app suddenly updated its information from a 50% to a 70% chance of rain in the evening, this was not taken to mean that it was very likely to rain, but that it could come close; it was therefore likely that there would be some cloud cover (which may or may not lead to rain). Such information would prompt bettors to place bets on rain that they could sell on to bookmakers by betting against rain when clouds appeared and the odds for rain started dropping, and those for no rain began to hike.

This method of betting was practiced by several of the rain bettors I met, including Hari, a man in his forties, who has made it his work to bet on changing odds. I never met Hari at the *satta* bazar but walked past him daily on the corner of the street where I lived, where he would sit playing cards. As I got to know him, he invited me to his family temple further down the street. Hari is from a Brahmin family. He lived with his elderly father and the family of his younger brother, who worked as a priest and had a shop selling chips, cigarettes, and cell phone credit. As with many families in the area, his wife lived in the city of Jaipur with their children to enable them to study at the school there. He had made money for their studies by working in construction for ten years in Dubai. The family also generated income from selling milk from their sixteen cows and through donations for performing priestly services. When his father was active as a priest, he performed rituals for the rain to come, but as mentioned such rituals were not practiced much anymore.

For rain bettors, prayers were of little use, since prayers to someone like Indra, the king of all gods and god of rain, were not answered with particular timings for the rain. Although I never saw it myself, I was told that some bettors would pray to Lakshmi, the goddess of wealth, on top of the roof where the water came down through the downpipe, but this was for her help in bringing prosperity, not rain as such. According to Hari, rain bettors were dependent on their luck but also their insight into how the market worked. Hari, like other rain bettors, gambled on more than the rain. In 2011, when betting on commodities prices became popular in Kishpur, he had lost 400,000 rupees in just six months after betting on silver and crude oil prices that then dropped. He said that he had not known the market well enough since it worked at a much larger scale, but he had made up the money in the rain betting market, which he believed he was able to predict well.

Unlike Motilal, Hari does not make money from knowledge of rain but from knowledge of the market. He makes money from betting on the monsoon *not* coming. In the evening, he checks the forecast for the following day. If there are no or only a few signs of rain, he starts taking bets from various bettors who are betting that there will be rain. This is called "eating" the bets. Hari buys bets when pay-out odds are low and "sells" them/bets against

when the pay-out odds have increased. For example, in the evening, he can bet with people who believe that it will rain the following day, by himself betting on no rain while these bets are inexpensive in the sense that in case it does rain, he will only have to pay, let's say 1000 in order to make a profit of 1000 at the odds 1 (rain) to 2 (no rain). The next day, at a moment where there are no signs of any clouds, the bets for no comes in demand, and increases to the price of 5000 rupees for the possibility of making 1000 rupees profit at the odds 5 (rain) to 1 (no rain). He then takes 500 of the profit of 1000 he would make in case there was no rain, and put it toward rain at that odds. If he stops here, in case it rains, he would loose the 500 but win 2500, making a profit of 2000. He has created a situation where he makes money no matter what outcome as he has bought bets at a low price and "sold" them again at a high price. Often he does not stop at that point, but continues buying and selling bets, betting for and against rain, as they change prices along with weather changes creating several "cuts" of secured money. "I only care about the rate, up and down" he told me. He also takes bets far in advance, with men betting on rainfall within a particular week offering low pay-out odds because of the lengthy timespan. As it gets closer to that week with no sign of rain, he sells the bets with better pay-out odds. So, he benefits from people's tendency to anticipate that it will rain, and also from attempts at long-term forecasting. For example, there is a saying that 180 days after there has been fog there will be rain. "This kind of thinking is only good for farmers," Hari remarked, explaining that while it may be more or less true, it is not precise. So, he will bet against such long-term predictions based on traditional knowledge and make money on rapidly changing odds. The point is that Hari makes money from taking advantage of tendencies in market behavior rather than in weather behavior.

New weather apps that give increased access to hourly predictions have made it clear that not only the weather, but also the predictions keep changing. These changes in online data move the betting market by moving the odds. Therefore, despite the fact that it does not actually rain that much, during this period there is always activity in the betting market. The odds for specific betting periods change in response to updated online weather forecasts or information on rain clouds in remote areas likely to reach Kishpur. Bettors found that official short-term forecasts were sometimes able to predict that rain was coming to an area, but not the actual time it would fall; it might even come a day or two early or late since the speed of the rain clouds can change. It was also difficult to predict whether there would be drizzle or a heavy downpour, and where the exact location of rainfall would be. Thus, they used online weather information as an indicator of where the odds market was heading rather than when rain would come down the downpipe. They were not betting on the weather as such, but on the odds. This is similar to traders' betting on derivatives, which mostly involves speculation on daily price changes rather than predictions of long-term future market events (Miyazaki 2013; Zaloom 2006). Similar to how things work in commodities markets, rain bettors try to make money through arbitrage. Commodities traders attempt to make profit margins out of price changes, buying a derivative when the price is low and selling when it is high; rain bettors do the same with odds. During the rainy season, bettors place bets many times during the day, as they keep betting for and against rain, depending on how the odds are changing.

Having come to the area intending to compare the rain risk for farmers in the fields and in gambling, I discovered that rain betting was not practiced by farmers, but by people living in

the town involved in different kinds of small business. Rain gamblers thus had a market approach to the rain as reflected in the trade in odds. These changing odds reveal something about the characteristics of the weather during the monsoon season in this area that the local perspective of farmers highlighted in other research does not show.

WAITING FOR CHANGING ATMOSPHERES

The main activity in rain betting involves waiting. In Marwari, the language of the region, the "monsoon" (deriving from *mausam*, which means weather in Arabic and Hindi) is called *chaumaso*, which refers to the four months when there is a chance that it might rain. During the chaumaso in Kishpur, the weather sometimes seems to stand still; the sky is blue and there is practically no wind. During such times, rain bettors sit and chat. Their hang-out locations move around, following the spots of shadow from the boiling sun. They drink *chai* and smoke cigarettes and on occasion hashish. The bettors do not talk with each other about their daily lives but discuss the weather and tell jokes, often sexual in nature. The jokes trigger laughter and sometimes shouting when someone feels provoked. It is a predominantly male space. Once in a while, a snake charmer comes by or a *sadhu* asks for alms, and the bettors share some of their money.

It might not seem as if much is going on, but the rain bettors and bookmakers have to be present to react to sudden weather changes. At the tiniest rustle of the leaves of a tree, the chatting stops the chatting stops, and everyone waits. If the sound continues for more than a few seconds, the activity level shifts. Vinod will get up from his plastic chair, look at the sky, and start shouting out his odds, which he might have adjusted at that moment. If the wind seems to get consistently stronger, the bookmakers will shout louder and louder. Bettors place their bets by shouting the amount they want to bet, and the bookmaker shouts back a couple of times to confirm the odds. Then the better throws down his arm to signal that he has placed that bet (on credit). This can go on for a while, with the odds dropping further the longer the wind continues or if clouds gather in the sky.

Often the wind slows after a while, the clouds disappear, and things calm down again. However, sometimes they do not and the changes in the weather will intensify as heavier clouds gather, the temperature drops, and one can feel small rain drops on the skin. This is when the rain bettors move from the open area with a full sky view toward the pipe. Some will crawl up on the roofs of surrounding buildings from where they can see the water on the downpipe building's roof. At this point, the odds can come all the way down to 5/100. If you stake 100 rupees that it will rain, you will win only five rupees, but stake five rupees that it will not rain and you can win 100. Sometimes, even when it rains hard, it does not rain long and heavily enough for rain to come through the downpipe. As the rain slowly stops, the odds start rolling in the other direction. Sometimes, the rain can pick up again, and the odds come back down.

I had previously experienced rainfall in the fields surrounding the town but did not absorb its detail until I was observing the odds. Fluctuating along with minute shifts in the air, the betting odds make visible in numbers real-time changes in the weather. As they are adjusted to what people are betting, they show the aggregated ongoing assessment among bettors of the likelihood of rain. The odds also make apparent the speed at which the weather can shift. Until

recently, the forecast for the whole day for the whole area around Kishpur was printed in the newspaper. With online forecasting apps, the weather has been broken down into hours, but these apps still do not show what happens within those hours to intensify or decelerate the pressure that can lead to rain. Their temporal scale does not match the actual temporality of the weather as an everchanging atmospheric organism.

The instance of accelerating odds provides an insight into the interface between weather forecasting and market monitoring. At a certain point, as the odds speed up, rain bettors shift from observing the sky to "observing" prices. The activity of betting then becomes about predicting market directions while negotiating the price of the bets. It may be more accurate to refer to rain betting as betting on atmospheres. McCormack (2015) takes the climate as conceptual inspiration for understanding changes in the affective space or "atmospheres" among traders in financial markets as they react to moving prices that can create a sense of urgency. He describes this as a change in pressure and temperature among people. In the context of rain betting, this change in atmospheres has both a meteorological and an affective dimension that go hand in hand.

A sudden felt change in humidity at a point when the flags were indicating an intensification of wind caused a shift in the mood among the bettors, the wind changing not only the betting odds, but also the space. The betting bazar was transformed from a relaxed space where friends hung out drinking chai into a competitive space marked by a sense of urgency, as men stood against each other shouting out odds. This kind of intensified atmosphere around volatile odds has similarities with descriptions of life in the trading pits of financial markets before they went online (Zaloom 2006).

Weather derivatives were first introduced at the Chicago Board of Trade in 1999 after one of the most powerful recorded occurrences of El Nino caused flooding and drought around the world, including in India. They were created primarily for farmers as a way of hedging against weather risks, but quickly grew into a 32 billion dollar market as speculation in futures trading escalated in the years leading up to the financial crisis (Randalls 2010). Weather risks play an increasing role in financial markets, as reflected in the growing spectrum of financial instruments that price risks connected with both seasonal variations in weather and extreme weather events and unexpected fluctuations in temperature. Weather derivatives are sold as ways to hedge risk in agriculture but also in other service businesses affected by the weather, as well as offering future traders ways to make money (Cooper 2010; Johnson 2013; Pollard et al. 2008; Pryke 2007; Randalls 2010; Štulec, Petljak, and Naletina 2019). Betting on the weather has thereby been integrated into the financial system, which affects us all. Yet, the distinct rain gambling practices of elder men in the deserts of India remain illegalized, based on a legislative system that separates the gambling of the poor from the financial maneuvering of the rich (Birla 2009).

RAIN PERSPECTIVES

When I have told people about rain betting in India, I have usually been met with surprise and laughter. The image of a rain bettor seems to add to the stereotypical image of the exotic irrational village Indian. It also seems to show the extremities that people will go to in the search for something to bet on. However, in some respects betting on rain is an archetypical

form of engaging with risk uncertainty. In many ways, the weather is a perfect system to take risks on. It is both predictable and unpredictable, in constant change, and connected to both local and global processes, and it can arouse considerable emotion in people as their livelihoods depend on it. Rain betting is a phenomenon that not only provides insights into the weather but also the interaction between weather and people in contemporary times, when more or less everything, including the weather, is commercialized. In this context, weather uncertainty is not a problem but the very foundation of possibilities for play and profit. Rain is not only an indicator of production; the weather is a constantly developing and unpredictable natural phenomenon. Contrary to popular assumptions, the foundation of finance (and gambling) is not predictability and calculation but uncertainty and speculation (Appadurai 2012; Bear, Birla, and Puri 2015).

Vernacular forms of gambling on the weather, such as rain betting, when seen in the context of a weather-dependent economy, show how changes in the weather create changes in markets and how people are bound together through the weather, information networks, and monetary transactions. Approaching the monsoon as a phenomenon that ties weather and people together, this article has taken the activities of rain bettors, seen in comparison with the work of farmers, meteorologists, and financial market traders, to be an example of a vernacular form of futures trading. Its study of rain bettors' forecasting practices has also illustrated the limitations of short-term scientific weather forecasting, which is used to predict betting odds rather than the weather. This opens up an alternative "local perspective" on the Global South to that of farmers, who have been the focus of previous research. I suggest that rain bettors in fact provide a more detailed local perspective on the monsoon, as they pay much greater attention to the weather than farmers (who are busy working in their fields. There might also be other local experts or weather information collectors, for example among middlemen in the grain trade, for whom the forecasting of rain is central to decision-making. To predict the weather, rain bettors rely on their senses. They use cell phones to share information on weather conditions within their social networks rather than for accessing predictions through weather apps. The importance of such local human perspectives to weather knowledge is reflected in the similar sensory and social basis of newer weather technologies that use cell phone apps to collect information on real-time weather conditions among app users.

Due to climate change, the variability of the monsoon rainfall is expected to increase in India. While prices of agricultural products are becoming increasingly volatile, there are also examples of a different kind of ethics entering farming as farmers attempt to make money from market volatility in search of higher profits (Münster 2015; Puri 2020b). The Indian state is not alone in investing in weather prediction. A growing number of private actors, including international companies like IBM, are trying to enter the forecasting market with customized products that, through artificial intelligence, can be used for precision farming and early warnings of weather disasters. Such forecasting products can also be used for trading in weather derivatives. The immense difference between national weather forecasting and actual rainfall during the monsoon in 2019 led the Securities and Exchange Board of India to announce that they are now examining the feasibility of allowing weather derivatives to be traded on the National Commodity and Derivatives Exchange in India. Similar to the introduction of weather derivatives in the U.S., the argument is that this will allow farmers to hedge against the risks of extreme weather. But another important part of the story is that it will also allow foreign investors to bet on the Indian monsoon alongside traders and elder men in the deserts of Rajasthan. The interesting question then is where and how they will look for

expertise. All I can say is that I was invited for an interview with IBM to discuss my research, which revealed many overlapping points of interest. Both the tradition of rain bettors and modern forms of trade in weather derivatives and predictive technologies show how unpredictable weather represents not just a problem to be solved but also immense possibilities for profit. Only the future can reveal who will be the winners of these games.

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NOTE

1.   The names of the town and persons in the article are pseudonyms.

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