Global Sustainability Risk to India

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Abstract

Global economic risk management extends beyond India's borders and will have severe impact if not planned for accordingly. According to the World Economic Forum (2016), "A global risk is an uncertain event or condition that, if it occurs, can cause significant negative impact for several countries or industries within the next ten years." These risks include: ageing population, climate change, polarization of societies, rise of chronic diseases, rise of cyber dependency, rising geographic mobility, wealth disparity, shifts in power, and urbanization (World Economic Forum, 2016). This paper focuses on two primary sector**s** of the Indian economy: agriculture and water. In addition, discussions around the positive and negative aspects of global economic risks from natural disasters and the ways in which these risks have been accepted, avoided, mitigated or transferred in India. In conclusion, this paper presents a forecasting model on what to expect in these sectors over the next decade.

Introduction

Global risk covers a wide range of areas, from the risk of worldwide climate change, loss of ecosystems, major natural catastrophes, and man-made environmental catastrophes. Certain parts of the world and cultures are more vulnerable to certain global risks, while many of them affect the entire world and all of humanity. For instance, state collapse, governmental crisis, or large scale terror attacks are likely to occur in Africa, and man-made environmental catastrophes are likely in Eastern Europe, China, and India (World Economic Forum, 2016, p.28-34).

According to the Indian Brand Equity Foundation (2016) India's agricultural sector and water sector are all strategic locomotives to the continuous development of the Indian nation (IBEF, 2016). Risks have been identified within these sectors that if not managed, may cause future disruption to the economic growth of India.

Agricultural Sector

India's economic performance post reform has many positive and negative trends across sectors. While recent policies focus on industry and trade, one key feature observed in India's development has been the contribution of agriculture. Soon after gaining Independence from the British in 1947, Jawaharlal Nehru remarked: "everything else can wait, but not agriculture." (Loebenstein & Thottappilly, 2006) Over the years India has gained international acceptance as one of the leading exporters of commodities such as rice, wheat and other clusters of raw materials for other major agro-industries. India's geography is unique because it provides many favorable agricultural conditions, such as plain areas, fertile soils, long growing seasons, and wide variations in climatic conditions. India also has the second largest viable agricultural landmass worldwide, with 157.35 million hectares (Kaul, 2015).

India has one of the largest plain areas of the world in the form of Indo-Ganga Plain and on social and economic terms is the most important region in India. This plain stretches from the Indus River system in Pakistan to the Punjab Plain, and the Haryana Plain to the delta of the Ganga (or Ganges) in Bangladesh. The Indo-Gangetic (IGB) Basin, is one of the world's most populous, home to the people of the Indus Valley, one of the earliest civilizations in the world (Sharma, 2008). The IGB system drains waters from the southern Himalayan and the Hindu Kush (Water Tower) Asia, these waters carry silt and other valuable resources that are useful for crop irrigation. The Indo-Ganga Plain is an economic base for agriculture, forestry, fisheries, livestock, plus urban and industrial water requirements for approximately one billion people (Sharma, 2008). Agriculture contributed approximately 18% to the GDP of the Indian economy (Thenmozhi & Thilagavathi, 2014).

Aside from its favorable geographic location, India receives favorable amounts of rainfall, a necessary component for reliable agricultural production. The majority of India's population depends on cereal and pulse production for sustenance. Rainfall occurring over India during summer monsoon season (the major rainy season generally starts in June and ends in September) significantly affects the agricultural production of the country by providing water for the two-main crop growing seasons, Kharif (summer) and Rabi (winter). Recent studies done by India's Ministry of Agriculture Statistics show that 75% of India's annual rainfall comes from the monsoon season, which highlights the uniqueness of India's climatic contributions to its agriculture (EANDS, 2015).

Trade in agriculture. India is the second top producer of rice and wheat in the world, contributing heavily to global trade, and is overall the seventh largest exporter of agricultural goods. As of 2013, Indian agricultural exports reached $39 billion, a $34 billion increase from 10 years earlier in 2003 (USDA, 2014). Ultimately, the effects of a global crisis on agriculture trade, will in turn affect the Indian market. In particular, agricultural exports accounted for 10% of India's total exports, which included spices, rice and wheat, and fruits (IBEF, 2016). Minimum support prices (MSP), of rice and wheat are bought by the Indian government from Indian farmers. The increase in the MSPs has led to a surge in government stocks and a greater development in production. The growth in government expenditures on rice and wheat contributed to the amount of exports from India (USDA, 2014). Government support has allowed for exports of grains to increase by issuing stocks into the domestic market, allowing for Indian commodities to become more competitive through lower prices (USDA, 2014).

Risks associated with agricultural trade. India's role in the global market is significant, primarily for rice, exporting $7.1 billion since 2013 (USDA, 2014). According to data from the Agricultural and Processed Food Product and Export Development Authority (2016), Basmati rice, buffalo meat, grape and wine, dehydrated onions, garlic and clusters of other commodities are the leading exports identified to sustaining growth in India's food product exports. These commodities are mainly found in Haryana, Punjab, western Uttar Pradesh, and regions of Maharashtra.

Research indicates looming risks associated with trade that may negatively influence the Indian economy. Chakrabarty's Climate Change and Food Security in India (2016), clearly delineates that some of the chief risks to trade include shortages in agricultural supplies, climate change, and scarcity of resources. Because of India's reliance on agricultural exports, it is vital to consider the threats and possible solutions that might lead to continued agricultural production levels for the Indian economy.

Climate change and its effects. Another significant aspect of agricultural growth depends on the environment. Climate change in India has its own effects on the production of agriculture. Global radiation of long-lived greenhouse gases (LLGHGs) and short-lived climate pollutants (SLCPs) are the outcomes of anthropogenic climate changes in India, which has a negative impact on the cultivation of agricultural products (Burney and

Ramanathan, 2014). The Ministry of Environment and Forests (2007) produced a statement about the greenhouse gases admitted into the Indian environment:

> The agriculture sector emitted 334.41 million tons of CO2 eq in 2007. Estimates of GHG emissions from the agriculture sector arise from enteric fermentation in livestock, manure management, rice paddy cultivation, and agricultural soils, and on field burning of crop residue. Climate changes in specific rural areas that concentrate specifically on the production of agriculture, may ultimately lower the GDP of Indian states, inadvertently affecting the entire economy (India: Greenhouse Gas Emissions 2007).

Risks associated with climate changes. Due to anthropogenic activities frequently disrupting the world's atmosphere, rainfall events, the world's average temperature, and droughts are becoming hindering variables to economic risks globally. India is experiencing a warmer climate and these unprecedented spells of hot weather are projected to occur more frequently to larger areas (World Bank, 2013). As stated in the Impact of Climate Change on Indian Agriculture & Its Mitigating Priorities (2016), “India is home to extraordinary variety of climatic regions, ranging from tropical in the south to temperate and alpine in the Himalayan north, where elevated regions receive sustained winter snowfall,”(Chakrabarty, 2016).

Over time India has experienced irregular weather conditions such as heavy/low rainfall over certain regions. These changes in climate have led to droughts, flooding, and food scarcity in its agriculture sector. It is undeniable that water plays a key role in the production of agriculture. Due to the co-mingled relationship between agriculture and water, a further analysis of this risk observation is discussed in the water sector portion of this paper. Heavy monsoon seasons or droughts, also affect the livestock of India. New irrigation systems, under the Accelerated Irrigation Benefit Programme (AIBP), would allow for eight million hectares of land to now have irrigation (Sinha, 2016). Irrigation is important for agriculture, because it allows farmers to not be solely reliant on rainwater. However, Sinha (2016) states that there are over 142 million hectares of net sown land and only 64 million hectares actually use irrigation systems. Maharashtra, Andhra Pradesh, Orissa, Karnataka, and Gujarat were all approved for funding on irrigation projects (Sinha, 2016) which will undoubtedly have a positive result on agriculture, despite the changes in climate.

States like Punjab, the breadbasket of India is a perfect location to exemplify how these natural occurrences have a potential to negatively impact India’s agriculture. “Large parts of north-western India, notably the states of Punjab and Haryana, which account for the bulk of the country’s rice and wheat output, are extremely water-stressed,” (Chakrabarty,2016). With the population expected to increase, the demand and consumption of grains will increase domestically, but projections show the production of food will yield a low growth.

One major climate change that may have long-lasting effect on Indian agriculture is the increase in temperature throughout the states. According to the World Bank (2013), India’s climate has become much warmer and 2016 is on pace to be the hottest. The surge in extreme heat may spread through various areas of India, specifically to the rural community, impacting agriculture, and consequently hindering economic growth. Other contributing factors that can possibly affect the economy are heavy sets of rainfall, scarcity in the water supply, and a rise in sea water that may reach the crops and destroy them (World Bank, 2013).

The Paris Climate Change Agreement. India is already taking active steps to resolving the issue of climate change on Indian agriculture. On October 2, 2016, the birthday of India’s peace leader, Mahatma Gandhi, Prime Minister Narendra Modi and India’s United Nations Ambassador, Syed Akbaruddin, signed the agreement to seize climate changes and make the planet green friendly. India currently releases 4.5% of greenhouse gas emissions

worldwide. The agreement states that all countries who approve of the plan must establish a method to reduce a rise in global temperatures. As for India, it has set that by 2030 it would begin producing 40% of its electricity with instead non-fossil fuel (Hersher, 2016). India should continue to pursue this plan, because it would result in a positive outcome for its economy.

Water Sector

This paper has identified agricultural production as a major element in the prosperity of the Indian economy and determines that active measures should continue to be taken to prevent and mitigate risks due to the changes in climate. Production of agriculture would be shockingly low or non-existent without sufficient water availability. Adversely, uncontrolled water supply can have a negative impact on agriculture if too much is exposed to crops. India's water crisis has long been an overlooked influence on its economic growth. Water, as a whole is becoming a scarce resource. According to the World Bank Group (2016), "Water security is still considered to be among the top global risks in terms of development impact," and it also acts as an essential part of Sustainable Development Goals, as defined by them. India's economy is growing and will increase the demand for water in all contributing sectors. In addition to rapid economic growth, the increase in population throughout India also contributes to water shortage. Furthermore, climate inconsistency targets water availability and creates the opening for extreme droughts or flooding in the near future, hindering crisis management and stability in imports and exports. Water is a driving force within the domestic and industrial agricultural sector. Supply chains, productivity, competitiveness, health, and environmental aspects will be affected by a water shortage, a global risk that can harm the economy as a whole.

Risks associated with water. The rapid, growing population sets up competition for demand leading to the limited sourcing of water. Households, agriculture and farming, and other service sectors all utilize water, setting up a broad spectrum of consequences for the future of the nation. Furthermore, the high population rate has led to India progressing less than half the rate of other countries around the world in sanitation, according to the World Health Organization (2012), a condition that is exacerbated by water stress, in particular regions of India. On a global scale, water is deemed a finite resource. The demand for water is becoming a more difficult resource to satisfy, with or without environmental variability. It is because of a rapid, growing population, scarce water supply, contaminated waters, as well as the rise in agriculture in the industrial sector that the water crisis persists.

Water scarcity. Water scarcity is defined as the lack of sufficient water quantity to meet basic needs, as well as the deficit in access to clean water quality. Water proves to be insufficient amongst the people of India due to the consistently rising population and the extreme hot weather spells increasing in many parts of the country. Water stress and water scarcity classification is based on availability of water; a country undergoing water stress has less than 1,700 cubic meters per person per year while a country with less than 1,000 cubic meters per capita per year is classified as water scarce (Luthra and Kudu 2013). India has the second highest population in the world, with 1.2 billion, as per the 2011 census, but usable water has been estimated to be about 700 to 1,200 billion cubic meters (bcm) (Luthra and Kudu, 2013). This means that India is only obtaining around 1,000 cubic meters per year for each individual in the country. India's water wealth has dropped significantly over the years. For example, the water supply per capita per year in 1951 was estimated at about 5,200 cubic meters and dropped to 1,588 cubic meters by 2010, which if consistent, will drop to 1,401 cubic meters by 2025 (Sharma, 2015). India receives about 4,000 cubic kilometers of annual precipitation (including snowfall) per year, however, it should be noted that distribution of rainfall is scattered, and time-based, and varies in availability across India (Indian Water Resources Society, 2005).

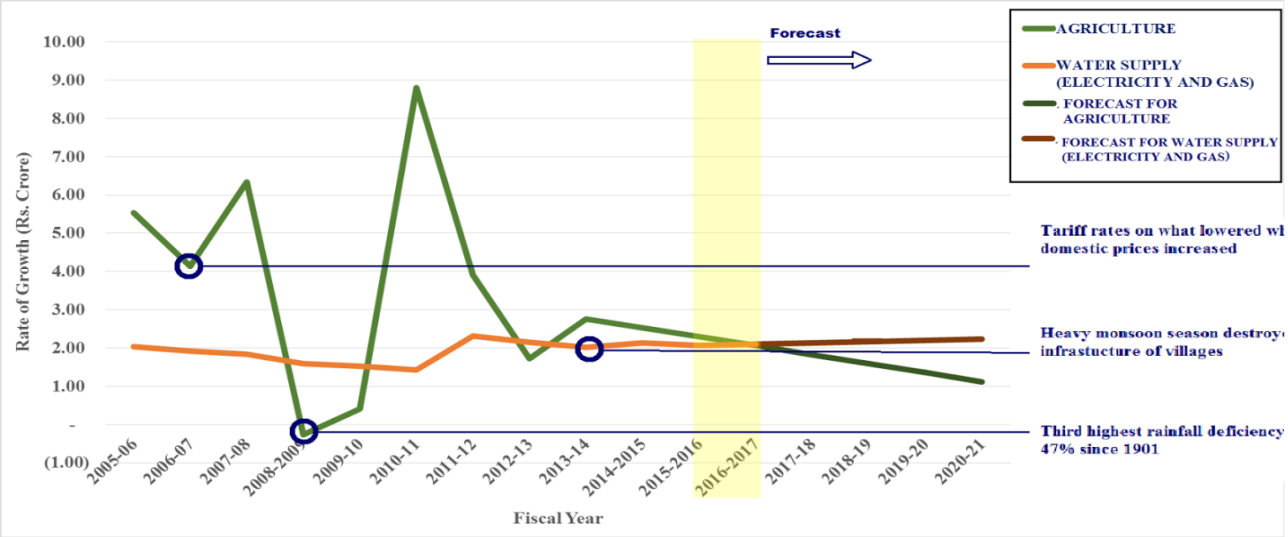
There is significant interdependence in India's agriculture and water sectors. Farmers have an enormous role in India's decreasing water supply. For instance, groundwater supply is diminished due to the over-extraction by the people of India, but mostly significantly by

farmers using traditional techniques unchanged for centuries. It has been analyzed that as much as 54 percent of India's groundwater wells are plummeting (Shiao, Maddocks, Carson, and Loizeaux 2015). Groundwater is water found underground in spaces in soil, sand and rock. It is a free, unblocked resource that anyone can access under their own land. Farmers, especially those residing in dry, unevenly precipitated areas, rely on groundwater for irrigation. Because the ownership of land is already vastly disintegrated, over-extraction is common and expected. In a way, the Indian government already provides electricity and water to farmers for free because they finance farmer's electric water pumping and places no limit on the capacity of groundwater penetrated. The government's support of water pumping is essentially supporting the damaging of the electrical grid, depletion of the groundwater resource as a whole and excessive water use. Groundwater is also a vital source of drinking water in both urban and rural India, and impact to this source is highlighted as a root cause of India's water crisis. Additionally, in 2010 alone, India extracted 251 bcm of groundwater and the rate of extraction has only been growing since then, a significant increase since 1980 when the rate of extraction was baselined at 90 bcm (Luthra and Kundu, 2013). Irrigation is important as Prahbat Singh (2015) states that more than 60% comes from groundwater, and accounts for up to 80% of total water usage in India.

Contaminated water. Another cause of India's water crisis is poor water quality. Water scarcity due to natural phenomenon and possible climate change, can also be impacted by contamination, pollution, and improper management of wastewater. Contaminated water is the outcome of a deficient amount of water-treatment facilities as well as the deferred investment in urban wastewater treatment processes. India is surrounded by 14 major river systems, but the rivers are not suitable for drinking or washing. The World Health Organization (2012) approximates that 97 million people in India lack access to safe water. Polluted waters can cause harm to the health of India's population as well as add to the already impending insufficient water supply available for use.

Almost every river surrounding India is polluted to some extent due to the fact that approximately 50 million cubic meters of untreated sewage is discharged into them each year (Mistry, 2012). Wastewater, also known as sewage water, can easily run off into water sources and bring on a freshwater crisis. Wastewater is simply a combination of sewage, storm water, and everyone's "already used water." Sewage water consists of: human wastes, food leftovers, oil, soap, fats, sand and other chemicals with high concentrations of toxic metals, fluoride, and Nitrates (Mistry, 2012). Wastewater is a water bowl along with a hint of trash, chemicals, and germs that can damage the environment and people's health. Not treating wastewater before discharging back into waterways pollutes sources of groundwater (Balasubramaniam, 2014. Polluted water seeps into the ground and contaminates agricultural products when used for irrigation. It is a cyclical event that can harm many of India's sectors. The World Bank estimates that 21% of contagious diseases are related to unsafe water (World Health Organization, 2002).

Figure 1. Rate of Contribution from Primary Sector to GDP



Sources : Central Statistical Organisation (CSO), Statistics Times, Planning Commission Gov. of India, RBI, Ministry of Finance

Methods

Impacts on Agriculture. Figure 1 demonstrates the contribution agriculture has on GDP and how it has fluctuated and increased between the years of 2005 up until the projected forecast of 2021. The focus is the sharp decline in 2008-2009 and what may have caused it. Therefore, it is important to understand the impact water has on the agricultural sector. Agriculture production and water are closely related. Approximately 90% of total water is used for agriculture, 80% of land is under cultivation, 65-70% is irrigated, and 55-60% of workers are in the agricultural sector (Narula, Fishman, Polycarpou, Modi, 2011). Monsoon seasons are of utmost importance to poor Indian farmers. Cultivation of their crops depend, in part, on whether there has been a fulfilling monsoon season or not. The monsoon season is crucial for agriculture because it contributes 18% to the national GDP and employs many of the Indian population. In 2009, the monsoon season was particularly shorter than normally anticipated. In Punjab, a major rice growing state in India, rice flourished because of a groundwater irrigation system, according to Stellar (2009), who also pointed to an increase in energy prices because of the excessive pumping of water. The model in figure 1 shows a corresponding sharp decrease in GDP in 2008-2009 when the drought occurred.

Approximately 253 districts of India were declared drought affected in 2009, and in some instances, like in Andhra Pradesh, they witnessed deaths of farmers (India: Drought, 2009). In figure 1, there is a sharp decrease in agricultural production during 2009 as well, pointing up the inextricable link between water and agriculture. The lack of rain that caused crops to wither, also suggests an increase in price for those that were already fully produced. Figure 1 also suggests that there would be a downward trend in agriculture for the forecasted years of 2017-2021 if the sector is not appropriately managed.

Impacts on water. Climate variability influences the great water crisis that India currently faces. India has been a witness of various accounts of natural disasters that revolve around water sourcing that affect economic sectors. In the summer of 2013, India faced an extreme flooding event due to a heavy monsoon season. The monsoon season, lasts from July to September, but can begin as early as late May or early June. In the summer of 2013, the monsoons arrived two weeks early and blind-sided the nation, leading to little or no crisis readiness (See figure 1). The downpour that occurred for several days in the mountainous area, caused glacial lake dams to cave in.

In an assessment run by the Global Facility for Disaster Reduction and Recovery and the World Bank Group (2013), the damage of the flooding estimated a $1 billion loss in tourism revenue for the year, and projected that the total recovery period would amount to more than $3.8 billion in economic losses as a whole. There is striking evidence that disaster management relative to the global risk of floods from natural disasters such as the tsunami, impacts GDP as illustrated in the models from figure 1. Due to the fact that the monsoon season is not always consistent, with amounts of rainfall varying, there is a greater effect on agriculture and indirectly on the economy. When heavy flooding occurs, a high salt content also rises and has lasting effects on crops even after a flood recedes.

The model shows [figure 1] a clear relationship between the agriculture and water sectors. The ICIC Bank expects India's GDP to drop by 7.3 percent in the current fiscal year if poor rainfall occurs again, but is lower than the initial estimated rate of 7.8 percent (Bundhun, 2015). The direct relationship between agriculture and water shows that if the water supply drops, then the agricultural sector declines as well. When observing, that agriculture makes up a large portion of employment for Indian citizens, it should also be considered that a drastic monsoon season or dry periods can impact other industrial sectors. Apart from a heavy monsoon season putting India's infrastructure and sanitation at risk, it can also cause a loss of energy from blackouts and cause unreliable connectivity, or block out internet connectivity as a whole, which essentially puts much of the services sector at risk. Water supply sets the foundation for crop production and affects state incomes, services, prices, domestic spending and the Indian economy as a whole.

Figure 1 reflects that if left unchecked, the water sector GDP growth rate will be flat over forecast years 2017-2021. Figure 1 also reflects that if left unchecked, the agriculture sector GDP growth rate will be negative over forecast years 2017-2021.

Results

Forecast consideration. A time series analysis was used to identify the nature of these past crises to create a forecast for the years 2016 to 2021. The variables in the forecast include the impact of unmitigated risks from the previous 10 years to predict a decrease or an increase in the rate of contribution to the GDP. The agriculture sector in the model above (figure 1) finds a negatively linear impact of future unmitigated risks. An assumption to the continuous growth of agriculture is a six percent increase starting after 2016, whereas the impact of unmitigated risks results in about a 17% loss of contribution to GDP. For continuous upward growth, the impacts to agriculture must be addressed. Since impacts were caused by natural disasters and climate, it crucial to make suggestions that will allow the agriculture sector to recover promptly before the loss is carried over to the next fiscal year. On the contrary, the forecast for the water sector indicates an upward trend based on past values. According to the time analysis (figure 1), the forecast for the next five years predicts water consumption rates increase by 33% of the contribution to the GDP. This upward trend for water is expected to be reflected in the occurrences of monsoons and rainfalls, or the improvement of energy prices. Due to the strong linkage, it should be noted that an immediate crisis managed in the agriculture sector must also be addressed in the water sector.

In conclusion, this paper highlighted two of India's key economic sectors and examined their vulnerability to global risk. According to the Indian Brand Equity Foundation (2015) India's agricultural sector, water sector and its service sector are all strategic locomotives to the continuous development of the Indian nation (IBEF). However, we have found risks within each of these sectors that if not managed, may cause future disruption to the economic growth of India. Although there were other present risks, this paper provides an analysis on the risks that may have the greatest effect on the contribution to India's overall gross domestic product. These risks are climate change, trade risk, cyber security, terrorist attacks and water crisis.

A financial model [figure 1] has been provided that represents each risk sector and the rate of contribution to GDP over the years 2005-2020. This model shows changes in the contribution to India's GDP within the sectors selected over time. Examining key periods of change and mapping them to significant points of crisis, help develop the understanding of the potential threat various risks pose to the economy in India. This model also provides a projection forecast to reflect the amount of value added from each sector or industry if proper precautions are taken to manage the risks as identified. Therefore, the results in figure 1 would extrapolate that due to a dependency on water, a decline in agricultural production would occur if there is an insufficient amount of water supply; a recommendation to mitigate this prominent issue, is to adapt better irrigation systems and overall knowledge on water management.

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