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How extreme floods amplify food insecurity in rural Pakistan

Pakistan, a country where more than 65% of the people live off agriculture, faces food insecurity (Government of Pakistan, 2020). On the Global Hunger Index, Pakistan ranks 102nd of 125 countries (2023). A variety of problems contribute to food insecurity in Pakistan. But there is one increasing cause which is extensively damaging: extreme floods. These floods are caused by the monsoon, which effects are amplified by climate change. This essay will explain how this monsoon works, and how it can lead to so many problems when it comes to food security. Finally, several solutions will be introduced.

Pakistan is a country located in South-Asia with a population of approximately 241,49 million people (FAO, 2024). Of all these people, 62.27% live in rural areas and about 37.4% work in the agricultural sector (The world bank, 2022). The political system can be described as a parliamentary democracy (Food and Agricultural Organization of the United States, 2024) with radical Islamic elements (Kaplan, 2012). Citizens of Pakistan can vote to fill seats in the national assembly. A party needs 134 seats to form a government. Voting for the national assembly happens every five years. Senate seats are filled by the provincial assemblies. They have 6-year terms but staggered elections every three years. In both the national assembly and the senate, certain seats are reserved for women or specific population groups to make the government more representative. This seems a fair system, however the military has a lot of influence on politics, even if they are not directly in a position of power (Chughtai, 2024).

On average, a Pakistani household consists of 6,45 people (Esri Demographics team, 2022). The average monthly salary is 81,925 Pakistani Rupees which equals to 272,25 euros (World Salaries, z.d.). Though that seems a really small amount, the costs of living in Pakistan are relatively low (Numbeo, z.d.). The vast majority of people have access to electricity. In urban areas, this share is around 100% and in rural areas around 90% (The World Bank, 2021). However, Pakistan does often face outages or complete power shutdowns (TIMESOFINDIA.COM, 2023). Access to clean water is complicated. Only 36% of the population has access to safe water (Globalwaters, z.d.). In addition, tap water in Pakistan is not potable. For drinking water, one has to go to a shop or tap point (Wasim, 2021). The Pakistanian diet consists of three meals: breakfast, lunch and dinner. Eating habits vary by area and culture but common meals include wheat based flat breads such as roti, and curry dishes such as chicken curry. Rice is also very popular (Munyon, 2023).

Pakistan's healthcare system consists of a private and public sector. One advantage of going to a private clinic is that there are no long waiting lists. In addition, private care meets higher standards, and the clinics are quiet. The public sector is funded by the government. Although treatment in a public hospital is free, in some cases patients still have to pay for their own medicine. Public healthcare is also of lower quality and there is a waiting list for certain treatments. There are no

hospitals in remote areas, making good healthcare poorly accessible to people in these areas (World Health organization, z.d.).

Equivalent to the Pakistani health care system, the education system also has a public and private sector. Educational standards in private schools are high, and classes are small. Also, these schools often offer extra curriculums. If you can't afford private school you could go to a public school funded by the government (International Trade Administration, 2024). But not everyone chooses to send their kids to school. Children in remote areas often have no choice but to help at home. Between ages 5 and 16, 44% of children do not go to school (UNICEF, z.d.). As a result, literacy rates are low. The literacy rate for 2019 was 58% (*Pakistan Literacy Rate*, 2019). Girls in particular do not go to school, this is due to the role of women in Pakistani cultures. In addition, the quality of public education is often poor (The Global Economy, n.d.).

Pakistan has a surface area of 796.100 square kilometers (Trading Economics, 2024). About 305.000 of these square kilometers are agricultural land. This means that approximately 38% of the land is cultivated. Farms in Pakistan are small-scale. More than 90% of farms are smaller than five hectares, and many of these farms are under two hectares (Pakistan Bureau of statistics, 2024). The largest economic sector in Pakistan is services, followed by agriculture, and then industry. About 62% of agriculture is livestock farming. Pakistan is best known for its basmati rice and wheat, but relatively most money is made from cotton and sugar beet. Approximately 70% of Pakistan's exports are agricultural products (News Publishing, 2022).

Pakistan is predominantly arid. Hallmarks of arid climates are: hot summers and cool winters. In Pakistan, winter and spring are very dry. But the period from June to September sees a lot of rainfall, so much rainfall that it leads to extreme floods (World bank group, 2012). The extreme floods are caused by the southwest monsoon, also known as the Asian summer monsoon. This monsoon occurs when during summer, the sun warms up the vast landmass of South-Asia. The warm air rises causing an air shortage over southern Asia. As a result, cold air currents are drawn in from over the Indian Ocean. This is moist air that produces huge amounts of rain. Therefore, between 70% and 80% of the annual rain in South-Asia falls between June and September, under the influence of the monsoon (France 24, 2022).

This monsoon is essential for agriculture, but it is becoming increasingly extreme because of climate change. Since 1970, Pakistan's weather has become more irregular. The monsoon has, at times, skipped Pakistan and at other times dropped so much precipitation that it led to these severe floods mentioned before (Fountain et al., 2022). In both cases, it greatly affects agriculture. Climate change has caused earth's average yearly service temperature to rise by 1 degree celsius since the pre-industrial area (Climate Change: Global Temperature, 2024). This temperature rise is causing the Pakistani land mass to warm up more, resulting in a greater contrast between land and sea. Climate change is also allowing more moisture to be held in the atmosphere. Moisture that, as the air rises, becomes rain. Another factor that has a large influence on rainfall patterns during the monsoon is El Niño Southern Oscillation, ENSO for short. It is an irregular pattern of change in wind and sea temperatures. The warm phase of the sea is called El Niño, the cold phase of the sea La Niña. Besides being one of the driving factors, ENSO strongly influences the amount of rainfall during the monsoon. During the El Niño phase, the monsoon drops much less rain because the air carried by the onshore winds is less humid. This leads to droughts. But what is interesting regarding the flooding problem is that during the La Niña phases, the monsoon drops more rain. The ENSO pattern is already very irregular and thus unpredictable, and climate change amplifies this irregularity. Since the late 20th

century, ENSO events are less frequent, but when they do occur, they are more extreme causing more rain to fall in Pakistan during La Niña (Kakoti et al., 2023).

Extreme floods cause major problems in Pakistan's food supply. For example, the June to August floods in 2022 wiped out 1.7 million hectares of farmland, and 800.000 livestock. The floods immersed one third of the country. This damaged the water system in the flooded area causing 5.1 million people to rely on contaminated water, contributing to malnutrition since diseases such as diarrhea prevent people from absorbing the nutrients in their food (Unicef, 2023). These floods particularly affect people in rural areas. After all, they rely heavily on agriculture for their income and food supply (Food and Agricultural organization of the United Nations, 2023). Floods also damage infrastructure. Thousands of kilometers of roads and bridges are unusable. This makes especially rural areas poorly accessible for transporting food and other resources. Also, Pakistan was already suffering from inflation, and due to the food scarcity this will be exacerbated. Poverty will worsen because wages are not rising as fast as the rate of inflation. That means food that is available will become unaffordable for many, particularly those who are already living in poverty. (Ministerie van Buitenlandse Zaken, 2022). On top of all this, buildings in rural Pakistan often have poor construction which, in case of floods, causes extensive damage (France 24, 2022).

As stated previously, floods have a significant impact on agricultural and livestock yields. The problem will remain current, and will continue to grow along with climate change. That is why I suggest Pakistan invests in minimizing the damage which flooding can cause, and providing the rural citizens with knowledge and tools to make their villages secure and safe. I propose that rural farmers are educated about alternative types of agriculture. This way, when the fields of the rural farmers flood along with the local infrastructure, cutting off the food supply, the rural citizens have other sources of food.

I believe that investing in floating agriculture can provide resistance to high food insecurity during periods of flooding. The principle is simple: when the water level rises, the fields rise with it (Yeung, 2023). Floating farming is already fairly common practice in Bangladesh, a country that also regularly has to deal with flooding caused by the monsoon. In Bangladesh, the crop yield of these floating fields is, on average, 16 kilos of vegetables per 3 to 4 months. Some farmers claim they earn more from the floating fields than traditional fields (Practical Action, 2021).

To construct these floating fields, farmers collect water hyacinth, a water plant used to make a square raft. There are no rules to bed size, but usually the beds are made long and thin. This way, farmers can easily reach the crops from their boats. To make sure the beds don't float away or get damaged by strong winds or storms, they are secured with long bamboo stakes (Ministry of Agriculture, z.d.). The water hyacinth will rot, after which cow manure and silt will be added (Sunder, 2022). Farmers can also choose to use the decomposing beds they made last year instead of cow dung and silt. To strengthen the beds, and make sure the farmers are able to stand on them, bamboo is laid on this dense layer of water hyacinth, after which more water hyacinth is added to make the beds even more compact (Ministry of Agriculture, z.d.). Some seeds can be directly placed in the field, but for most plants it is necessary to grow a little seedling outside the field and plant them in the field later. In this case, seedlings are placed in little balls of peat soil or water plants, after which the little soil balls get wrapped in coconut coir (Sunder, 2022).

By using floating agriculture, the land can still be used for growing food when the area floods. In addition, supplies for the fields can be obtained locally making the technique relatively cheap. The

only investment the Pakistani government or ngo's will have to make, is in education about the technique (Sunder, 2022). In Bangladesh local and international ngo's have already taken the initiative to spread the knowledge about this technique by training farmers (Ministry of Agriculture, n.d.). And in 2013 the Bangladesh government approved a 1.6 million dollar project to promote the use of soilless cultivation. With this money they were able to help 12.000 families (Sunder, 2022). Another advantage is that in order to make the floating beds, water hyacinth is harvested. Water hyacinth is a plant species that can quickly become a pest due to its rapid reproduction. Therefore, reaping this plant will improve biodiversity in waterways (Wahid et al., 2019). Rice can also be grown on floating fields (Ministry of Agriculture, n.d.), alongside a variety of vegetables and sometimes even spices (WHH, n.d.). This is advantageous because, as mentioned earlier, rice is an important part of many staple meals in Pakistan. Different things are often grown interchangeably on floating fields, which reduces the risk of pests. Weeds growing between the crops, mosquito breeding and plant diseases are also rare in floating fields (Ministry of Agriculture, n.d.). The floating fields can also be moved, making it a great solution to those who temporarily lost their homes due to the flood damage (CANSA, n.d.).

The floating fields can be used in ponds or canals, but also in waterlogged areas (CANSA, n.d.). That is why I think learning the local communities in the elevated Balochistan provinces about making retention ponds, can also contribute to food security and reduce flood damage in rural areas. This province has a mountainous landscape. Here, water slides down the hillslopes so the land there is often dry and eroded. Retention ponds are made by making an empty pond at the side of a hill. When it starts to rain excessively the water that slides down the hill will be caught by this construction. The pounds can be made with relatively inexpensive materials such as sand and stones. If rural citizens are taught to construct and maintain these ponds, this is not only a cheap solution, it can be beneficial for the Pakistani farmers. Because increasing the capacity to hold water in the elevated Balochistan provinces will not only help reduce flooding in the lower-lying Sidhn provinces, it also ensures that farmers in mountainous areas can use the floating farming technique in these retention ponds (Michelogiannaki et al., 2022).

But floating fields also have drawbacks. For instance, communities of smallholder farmers and their families will have to come together and work together, as bed-making and gathering the materials requires manpower. It is also difficult to transport the food produced through the villages because the infrastructure is still damaged during floods (CTCN, 2016). In addition, climate change is causing the water inland to become increasingly salty. As mentioned earlier, water hyacinth is an invasive plant because it grows quickly. But that only applies to non-saline water. In the future, obtaining materials for the beds might become more difficult (Ministry of Agriculture, n.d.). On top of that, the floating rafts cannot withstand large amounts of rainfall, which can occur during the rainy season (Sunder, 2022).

To summarize, Pakistan is a country that faces many challenges when it comes to food security. One of these problems is the Asian summer monsoon. This monsoon causes extreme floods, damaging agriculture and livestock as well as infrastructure and buildings. Those living in rural areas are particularly affected, as they are highly dependent on agricultural yields. The influence of the monsoon on the Pakistani climate will continue to increase due to climate change. Therefore, I suggest that the Pakistan government and ngo's in the region should take the initiative to educate farmers about smart and flexible farming. One way to do this is by introducing floating agriculture to them. Floating farming is a technique with its downsides. But I am convinced that if rural communities come together, and are engaged by their government or other organizations. Adapting to

the changing climate, possibly by making and maintaining the floating fields, is feasible. This way, rural farmers will be able to feed their families during the monsoon season. Even when their land is flooded.

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