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Water as an Economic Complexity in Pakistan

Munawar Sabir

University of the Punjab, Lahore

ABSTRACT

Irrigated agriculture constitutes a large share in the economy of Pakistan. Majority of the population is directly or indirectly dependent on this sector. The poverty alleviation drives and overall economic development of the country is linked with the progress in this sector. This, in turn, is based on availability of water that is becoming scarce following earlier two decades of affluence. The scarcity of water has a direct linkage with phenomenally growing population on one hand and, alongside, gross mismanagement of the water resources that includes very low efficiency in the use of water. This study provides a hashish appraisal of the complex casualties and implications of this dreadful scenario. The analysis of water issue in Pakistan is analyzed with the help of PEDA model, encompassing the variables of population, environment, development and agriculture. Though the challenges keep multiplying, yet there seems no significant and viable policy framework that may address or, at least, relieve this state of high stress. The opinion and resources keep squeezing, the population keeps multi dying and the economy stays in disarray.. The analysis of water issue in Pakistan is analyzed with the help of PEDA model, encompassing the variables of population, environment, development and agriculture. In context of water Pakistan went from surplus in 1950 to relatively abundant in 1980; water stressed by about 2010 and will be water scarcity by 2035.

KEYWORD: Population, Environment, Development, Agriculture, PEDA Model

Introduction

Water crisis in Pakistan has also a strong correlation with overpopulation and consequently economic development of Pakistan. Water scarcity in Pakistan has become a major source of economic problem and affecting the agriculture sector very badly. At the time of independence in 1947, Pakistan's population was manageable and water was sufficient to meet the agricultural, industrial, drinking and sanitary needs of that time. According to Dr. Farrukh Saleem, Executive Director Centre for Research & Security Studies, the per capita water availability in 1947 was $5000m^3$ which reduced to $1200m^3$ in 2008 and is expected to further

reduce to 800m3 by 2020 (Irfan Bukhari, 2008). This water scarcity is directly proportionate to the growth of population as in 1947 the total population of Pakistan was 31 million as against the current estimated 180 million (Pakistan's population to double by 2050, 2009).

With the growing population, demand for fresh water has increased manifold. According to Dr. Ashfaq Ahmed, the former chairman of Pakistan Atomic Energy Commission (PAEC), "the root case of the global water crisis, especially in the third world countries, is population" (Daily Times, 2003). Rapid population growth has placed pressures on increasingly scarce water resources (EESI, 1999). Recent estimates of the scarcity of water reveal that by the year 2025 "at least 40% of the world's 7-8 billion people will face a serious crisis in terms of fresh water availability." (Franklin White, 2002). The situation of water scarcity in Pakistan is already severe with a bleak future forecast. According to Franklin White (2002), the water crisis in Pakistan has left millions of people in urban and rural settings to drink brackish or contaminated water (Franklin White, 2002). The impact of water scarcity in agricultural sector in Pakistan is even more severe. According to Dr. M.E. Tusneem, chairman of the Pakistan Agricultural Research Council, "Last year was an exceptionally good year for the agriculture, which grew about 7.5 percent. Our average agricultural growth in the last 10 years has been 4 per cent. But this year, our agriculture will only come close to 3 per cent," (Pakistan economy: Pakistan's crops face water crisis, 2006).

There is a multitude of factors that contributes to the scarcity of water in Pakistan. However, population explosion is one of the most significant factors that need to be considered while formulating any sustainable water policies (United Nations 2003a).

The water crisis problem, which is compounded by low water efficiency, is reaching a chronic level. In Pakistan, water is treated as a free good and a panacea to water scarcity is found in the engineering solutions. Concerns about the deterioration of water quality are also increasing due to the rising competition for water (Khan, 1999). The problem facing the water sector at the local, national and global level show that the era of plenty has ended and the era of scarcity has begun. Contrary to economic theory's prediction that water resource use efficiency improves when resource becomes scarce, water use is becoming less efficient, whereas, water resources are shrinking day-by-day (Dinar, 2005).

When people are denied access to clean water because of human activity or otherwise, they are constrained by vulnerability, ill health and poverty. At present, roughly 1.1 billion people in the developing countries lack access to clean water (UNDP HDR 2006). This is especially evident in Pakistan that continues to face a number of serious socio-economic problems, which merit immediate action, if current trends towards endemic poverty and pervasive underdevelopment are to be altered. The causal relationship between man and water is especially evident in this region: water begets human vulnerability and achievement, while human activity begets the quantity and quality of water. Indeed, the economy is both a

pressure and a victim of hydrological change. The overexploitation of water resources for the economic growth precipitates hydrological change, ultimately limiting availability of water resources.

Despite human ingenuity and technology, water shortages beyond a specific threshold constrain the ability of a society to function. This is particularly the case for Pakistan, a particularly agriculture dependent country where availability of sufficient water is critical to sustain the economic growth through its agricultural products.

Previous studies have shown that "the quantity of water available for personal and domestic hygiene is more important than the quality of water consumed" (Esrey et al. 1991 p. 7). However, in fact, the improved water quality helps in reduction of diarrhoea, which is prevalent in most of the Pakistani villages. According to the report published by the USAID, "Water-borne infections such as cholera, typhoid fever, and dysentery also burden the public health system and can impose significant economic losses. Safe water alone can reduce diarrhea and other related diseases by up to 50%, but an estimated 62% of Pakistan's urban population and 84% of the rural population do not treat their water." (PUR water purification reaches Pakistan, n.d.).

Aside from the quality, the value of water is a difficult concept to express. The economic value of water has increasingly been considered within the context of water resource management, reflected by the proliferation of literature pertaining to valuation. Baumann and Boland (1998) wrote "water is no different from any other economic good. It is no more a necessity than food, clothing, or housing, all of which obey the normal laws of economics." Conversely, Barlow and Clarke (2002) proclaim it as a "universal and indivisible" truth that "the Earth's fresh water belongs to the Earth and all species, and therefore must not be treated as a private commodity to be bought, sold, and traded for profit...the global fresh water supply is a shared legacy, a public trust, and a fundamental human right, and therefore, a collective responsibility." Hanemann (2006) and Huggins (2000) concurred concerning the non-market value of water, yet argued for the utility of economic valuation, especially within the context of integrated water management programs, as it facilitates distribution. The FAO has also produced reports, such as the Economic Valuation of Water Resources in Agriculture (2003), which apply a techno-centric view to the economic value of water, berating the tendency of the international community to view access to water solely as a human right, but also as an essential component of industrial and agricultural processes.

One of the most common matters of concern for Pakistani population is the presence of Arsenic which has commonly been found in water especially in the Punjab province of Pakistan (I. A. Toor, S. N. A. Tahir, 2008). The study conducted by the authors (Toor and Tahir, 2008) showed that in the district Bahawalpur only, the arsenic concentration in drinking water was 92%. Rahim Yar Khan was the second most prominent city having below standard drinking

water with 86% arsenic concentration. According to Loska et al (2003), arsenic poses a serious threat to human health if its concentration is beyond permissible level in the drinking water. Thus, it is imperative for the health related policy makers to make substantial provisions to provide not only sufficient quantity of drinking water to the Pakistani population but also should provide better quality pure water in order to reduce public health vulnerabilities.

As numerical representations of water scarcity emerged, water scarcity began to be seen as a constraint to population growth. Falkenmark (1990) was among the first to examine the linkages between population growth and resources, stating in a Malthusian manner that water scarcity had the potential to decrease birth rates, increase death rates and influence migration patterns. This approach was augmented by Falkenmark and Widstrand (1992) who stated that water scarcity also affects relative wealth of specific countries, thus linking poverty and water scarcity. Gleick (1995) used this approach, projecting the effects of water scarcity on population growth within the 21st century. As urbanization rates began to inflate throughout the 1990s, scholars recognized the added stress upon water resources presented by the urbanization. Postel (1997) considered urbanization as a process that leads to the loss of irrigated land, thereby limiting food production required by growing populations. Meinzen-Dick and Appasamy (2002), Milton (2002) and Ducrot et al (2004) postulate that the added pressure on the agricultural sector is a consequence of an inter-sectoral competition for water resulting from urbanization. Kendy et al (2007) suggest that such competition induced by urbanization can ultimately reduce inter-sectoral competition, but this is based largely upon conditionalities, namely the reuse of wastewater and the adoption of water-saving technologies.

Water scarcity has important implications upon the health. The World Health Organization (WHO) has produced a swath of publications pertaining to the correlation between water and health such as: Water Quality Interventions to Prevent Diarrhea: Cost and Cost-Effectiveness (2007), Combating Waterborne Disease at the Household Level (2007), Costs and Benefits of Water and Sanitation Improvements at the Global Level (2004). Most of these reports, though informative, are tools of bureaucracy. Water for Life (2003) and Water: A Shared Responsibility (2006) by UN-Water, each providing extensive information on the water crisis, ultimately proposing expensive, extensive reforms which require immense investment to initiate and maintain. Health is a rather "sexy" topic, and thus presented in a rather sensationalized manner in order to impact the reader. Authors from academia, on the other hand, such as Sachs et al (2004), Shambaugh et al (2001) and Baumann and Boland (1998) considered the interplay between health and other social dilemmas, namely poverty, conflict and the urban environment respectively. They maintain that health and sanitation are only possible with improved access to clean water.

At the time of independence in 1947, Pakistan's population was manageable and water was sufficient to meet the agricultural, industrial, drinking and sanitary

needs of that time. But, with growing population, demand for food also increased manifold. Improved agricultural practices in the past three decades, however, allowed Pakistan to substantially increase crop yields as well as the value added agriculture. Pakistan's food and fiber production due to development of water-resources and irrigation infrastructure has somehow kept pace with the demand, but over the period yield increases slowed down and development of water resources fell victim to political controversy. Slow yield increases combined with the shortage of investment and irrigation institutional shortcomings, is leading to the deterioration of the infrastructure as well as inefficient and inequitable use of scarce water.

The problem, which is compounded by low water efficiency, is reaching a chronic level. Concerns about the deterioration of water quality and the environment are also increasing due to rising competition for water (Khan, 1999). Absence of adequate drainage for saline effluent is resulting in increased pollution loads on the river system and salinisation of farm lands. Problems of water logging and salinity were exacerbated after 1960, when Pakistan under the Indus Water Treaty sold out two eastern rivers (Beas and Sutlej) to India, and in return received sums from the World Bank for replacement works. That certainly brought much prosperity to some sections of the population, but an unanticipated outcome was the emergence and spread of the ills of water-logging and salinity (Iyer, 2005).

PEDA Model

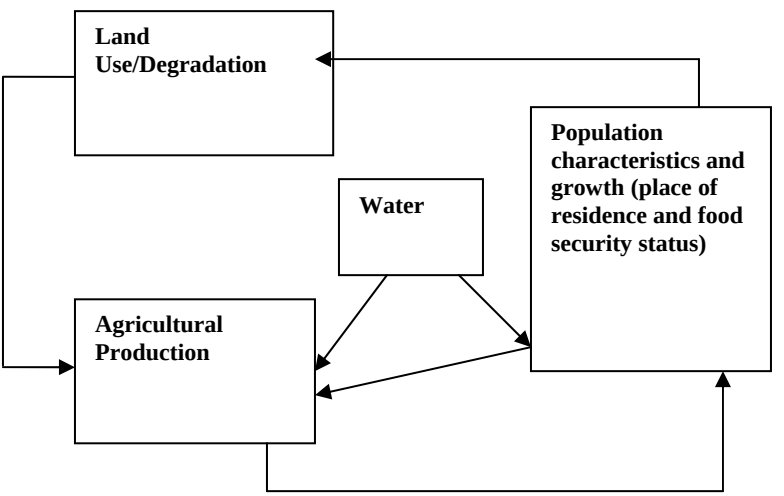
PEDA Model is an interactive computer simulation model to illustrate the interactions between population changes (P), the envrionment (E), socio-economic development (D) and agriculture (A). The PEDA model is an advocacy tool to illustrate the likely impact of alternative policy options on the food security status of the population. As food security is a factor of developments in the areas of population, envrionment, agriculture and socio-economic development, the model demonstrates the relationships between these fields as well.

The simulation exercise in PEDA consists of three steps. First, (multi-state) population projections are carried out to determine the size and characteristics of the population. Simultaneously, the model estimates the food availability as the sum of food production and net trade. Agricultural production is considered as factor of the natural resources stock (land and water); the size and productivity of the labour force (endogenously determined by the model through the population projections) and technological inputs and innovations in agriculture. In a third step, the estimated available food is distributed over the population following a non-linear food distribution curve to determine the fraction of the population that will be food insecure.

The theoretical inspiration for PEDA comes from the “vicious circle model” that was originally developed by Partha DasGupta (Cambridge University) and others. The vicious circle assumes a causal chain of interactions between poverty,

high population growth, envrionmental degradation and decreasing per capita agricultural production (see box). The vicious circle can be broken through several possible interventions in the field of food production, food distribution, education, envrionmental protection and population dynamics. The objective and advantage of a quantitative model like PEDA is to help users and policy makers to think in terms of the outcomes of alternative policy scenarios and, most importantly, to consider the nexus issues within a holistic framework.

Central, or characteristic to the PEDA model is its population or human development based approach. It views human beings and their characteristics (education, health status, food security status and place of residence) both as the agents of social, economic, cultural and envrionmental change and as those who are the first at risk suffering (or benefiting) from repercussions of these changes. The economic envrionment (e.g. the importance of markets in distributing goods) plays only an intermediate role and is not seen as an end in itself nor the primary objective of the modelling exercise. In this, the population-based approach differs from much of the development economics literature.



Box: Vicious Circle of high population growth, land degradation and low agricultural productivity

PEDA Model and Water

Water only becomes a problem for food production if the demand (including household consumption and industrial consumption in addition to agricultural demand) exceeds the supply. Water supply, however, can vary greatly according to short- and long-term natural fluctuations in the rainfall. It is greatly influenced by the surface structure, the pattern of river basins and groundwater systems, and it can be strongly influenced by human engineering (dams, irrigation, etc.). Because

water is so important for sustainable development and follows complex non-linear dynamics, the PEDA models developed by IIASA all have water modules that tend to be at least as complex as the population modules.

Analysis of Pakistan Through PEDA Model

Population

According to the United Nations Development Programme's (UNDP's) latest report, 12% of the population do not have access to improved water sources and 39% are without access to adequate sanitation facilities (UNDP, 2002). UNDP projections suggest that the population will pass 204 million by 2015 (UNDP, 2002). By 2015, almost half of the population will be living in the urban areas, putting additional pressure on already-strained municipal facilities (UNDP, 2002). In the absence of an adequate domestic water supply, people will begin to dig their own wells and indiscriminate groundwater exploitation will increase manifold, leading to further pollution of natural aquifers. Lack of sanitation and drainage facilities with no provision for sewage treatment will lead to further pollution of freshwater drinking supplies. Without water-quality monitoring and testing, incidence of waterborne diseases will continue to increase and diseases like guinea worm, which had been eradicated from Pakistan, will resurface (South Asia Regional Water Vision, 2000).

Pakistan's very high population growth rate of 2.5%, which will bring its population to over 200 million by 2015, is partially responsible for its water problems (UNDP, 2002). Part of the reluctance to practice family planning is rooted in culture and religion. Many Pakistanis believe that Islam forbids family planning and that selling water is against Islam. In fact Islam takes no such position, but illiterate peasants cannot read the Quran for themselves to discover this (Faruqui *et al*., 2001). Moreover, dramatic gains in family planning are possible, even in Muslim countries. For example, Iran cut its population growth rate by more than 50% (from 3 to 1.47%) in less than a decade by stressing to its population that equity—a primary principle in Islam—was threatened by unrestrained population growth (Peterson, 1999).

Environment

Pakistan's forests are found mostly in the north, in mountain areas that are catchments and watersheds. Yet, by 2025, there may hardly be any forests left in the country. According to *Pakistan's Water Vision for 2025*, deforestation is occurring at a rate of 4% per year (South Asia Regional Water Vision, 2000) Reduction in forest resources could reduce carbon sinks in upland areas and drive temperatures up. Increased temperatures from diminishing carbon sinks and global

warming could speed up snowmelt in the summer and increase flows being discharged during short periods in the Indus River system. Increased seasonal variability will increase drought during the winter and flooding during the summer (South Asia Regional Water Vision, 2000).

Deforestation also leads to erosion, which increases the sediment levels in rivers, further diminishing the storage capacity of the reservoirs. Already, the storage capacity of the water reservoirs Tarbela and Mangla is slowly decreasing due to siltation—according to the UN's update on the drought situation in September 2002, capacity at Tarbela has declined from 9.7 to 7.3 million acre feet (MAF), and capacity at Mangla has fallen from 5.3 to 4.6 MAF (Resident Coordinator of United Nations, Pakistan, 2002). Seepage from ageing canals and flood irrigation, without adequate drainage, have caused massive water losses and water logging, which reduces crop output (UN OCHA IRIN, 2002a). Inadequate drainage has caused widespread salinisation of soils, which are then unfit for production. Projections of grain production in *Pakistan's Water Vision for 2025* show a shortfall of 11 million tons by 2010 and 16 million tons by 2020 (South Asia Regional Water Vision, 2000). By 2025, Pakistan will be short of major food crops by 28 million tons and the government will be forced to import edible oils and large quantities of wheat (South Asia Regional Water Vision, 2000). Yet, with growing external debt, little hard currency and an inadequate industrial base, it will be difficult, if not impossible, for the government to finance the rising import bill. Food scarcity could create famine-like conditions in the country.

Development

The Government of Pakistan in-line with the supply-side-economics, proposed building several dams and canals on the upper reaches of the Indus River. Kalabagh Dam is one of the controversial projects that according to the government officials will generate 2,400 megawatts of power. Later the capacity may well be increased to 3,600 megawatts. If that happens, it will make Kalabagh one of the largest hydroelectric dams in Asia (Pakistan Water Gateway, 2005). The total cost of civil and power facilities for this project is estimated at US $5 billion. However, with the advent of new coalition government led by the Pakistan People's Party, the project seems to be shelved for the time being. The other project is the Greater Thal Canal, with its branches, will be 1,221 miles long. The project is estimated to cost US $610 million. As per schedule the project will take seven years to complete and will provide irrigation facilities to 1.9 million acres in the Punjab province.

The proposed projects will generate hydroelectric power for the country's benefit, provide irrigation water for 4 million acres of land in other dry parts of the country, and employ as many as 3,500 people. These are valuable and significant benefits; however, there are certain problems with the proposed projects that are continuously being down played by the Government of Pakistan. The problem

here is not only the water scarcity and the growing demand for energy, but also the government's misplaced priorities. However, the government defines the problem differently than the people who are likely to be affected by the proposed projects. According to Deborah Stone (Stone, 1989) problem definition is about attributing bad conditions to human conditions, instead of fate or nature. Human conditions, not natural conditions are the ones that require governmental action. One of the primary concerns is that people of the lower riparian provinces envision the impact from the proposed dams as detrimental to their socio-economy. As proposed, the project will consume much of the Indus River's water, and will further lower the outflow of river-water to the sea, resulting in erosion and degradation of the delta, which is already in bad condition.

It will adversely impact the agricultural economy, especially cotton, rice and sugarcane production, and the livestock that depend upon an abundance of fodder in the lower reaches of the Indus Basin. It may deteriorate the quality of the remaining water in the river, adversely impacting fisheries and the underground water recharge. Thus availability of fresh drinking water may be greatly affected. Therefore, it is not just a matter of the quantity of water for agriculture, but also its quality that must be considered. With increasing population and competition with other sectors, such as industry and municipal entities, will likely to increase the water quality concern and risk for the agriculture to produce food and fiber for the present and future population. But, the question arises, are the government and her lobbyists unaware of this? According to Ross and Cobb (1999) the materials resource differential of the two sides are strikingly uneven and these differences are the most important factor in accounting for why a particular issue does not receive serious attention from the relevant government agency. The government has vast resources and it has effectively used all of its resources to block the consideration of alternative resources of water conservation and development.

The Government of Pakistan is aware that the existing water strategies based on the incrementalist approach are not going to work for long. Until early 1990s, water in Pakistan was managed through five-year, and ten-year perspective plans. The Government of Pakistan pursued water policy formation in 1992, and prepared the national water policy draft. The preparation of water policy draft was a part of the program of sector policy studies that was financed under phase- I of the national drainage program. The national policy draft (which is yet to be approved) claimed to have input from several stakeholders including federal departments/agencies, provincial governments, non-governmental organisations, farmer's representatives and resource management specialists. However, there is no mention of the process that facilitated the development of water policy, the coalitions involved and their belief system that might have affected the policy development. The national water policy (draft) seems to be a good effort on part of the government, but comes short of addressing the critical issues of water scarcity, water rights including water for environment, potential impact of climate change on water resources, involvement of stakeholders including civil society in the

policy making process.

Agriculture

Agriculture accounts for about 93 percent of the country's water use (WWF 2007, 7), employs 43.61 percent of the workforce, and contributes 21.8 percent of Pakistan's Gross Domestic Product (GDP) (FBS 2008b, 2008c). The true magnitude of Pakistan's "water scarcity" is made more striking when one considers that in 2007, agriculture was almost wholly dependent on the world's largest contiguous irrigation system to irrigate 19.07 million hectares of land (FBS 2008a, 65). Since Pakistan's irrigation is based solely on the Indus River and its tributaries, it is more vulnerable to supply shocks than it would be if its irrigation were drawn from multi-river systems.

Pakistan went from being relatively waterabundant in 1981 to water-stressed by about 2000, and will be waterscarce by 2035. Indeed, in one important sense, the story of Pakistani agriculture is a story of declining farm-gate water availability throughout its history (Bandaragoda 1996). Compounding the difficulty is the fact that Pakistan does not make efficient use of the resources it does have. Pakistan's wheat yield (a vital staple in Pakistan) is extremely low in both absolute and relative terms. It is understandable that wheat yields in the Pakistani Punjab would be lower than those in the United States (due to lower capital intensity in the production process, less access to inputs, and so on). However, the fact that the Pakistani Punjab's wheat yields are approximately half those of Indian Punjab (in both absolute terms and per unit of water used) attests to the inefficiency of the Pakistani Punjab's agriculture— and yet the Punjab represents the breadbasket of Pakistan.

So, considering the importance of water to Pakistan's economy and its relative scarcity, water conservation and use-efficiency should be high on Pakistan's list of national priorities. Unfortunately, they are not. A major factor behind the severity of the Pakistani water crisis is a historical legacy of bad policies, misgovernance, and corruption

Estimates have been made that Pakistan will soon be unable to produce enough grain to feed its people, and so it must embrace the concept of South Asian regional food sufficiency instead of self-sufficiency. This will entail growing fewer water-intensive crops such as wheat, rice, cotton and sugarcane. It takes about 1000 tons of water to grow a ton of wheat and 2000 tons of water to grow a ton of rice, water that could more strategically and sustainably be used in other areas (World Water Vision Commission, 2000). Similarly, Pakistan could import sugarcane from Cuba for less than half the cost of producing it (UN OCHA IRIN, 2002a). This will also entail an economic shift away from agriculture, which currently employs about 47% of the population, toward other sectors (UN Economic and Social Commission for Asia and the Pacific (ESCAP), 2000)). Policies aimed at educating and training farmers and farm workers who will

become unemployed and integrating them into the national economy will therefore have to be instituted.

Analysis of Pakistan through PEDA model highlighted that the countinously declining water resources possess significant threat to growing population needs. Pakistan is a feudal society dependent on irrigated agriculture. It faces grave water management challenges, including rapidly declining water availability, food insecurity, poor access to safe drinking water, pollution and political instability. Past government initiatives to deal with the crisis have been ad hoc and superficial. Fundamental change, consisting of three main elements, will be necessary to adequately deal with the crisis. First, the depth of the necessary change has to be accurately diagnosed. To avoid the realistic prospect of large-scale famine and massive political instability, Pakistan must go through cultural and paradigm shifts—dramatically lowering its population growth rate, significantly increasing literacy, and using substantially less water in agriculture.

The studies mentioned above, when considered as a holistic entity, provide a comprehensive view of the complex causalities and implications of water scarcity. Indeed, water scarcity in Pakistan, as a phenomenon, is endlessly intricate, a confluence of inter-connected stress factors. Plagued by its history, parched by its droughts and drowned by its floods, this region and its people face many challenges that pertain to water. Yet, there seems no authentic and significant water management policy that may address the water scarcity in this region. However, unfortunately the present government seems divided over the water allocation among provinces making the water scarcity even more severe instead of solving this issue with top priority and the future seems bleak and threatening, leading this region to be a victim of future droughts.

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Biographical Note

Dr. Munawar Sabir is Assistant Professor, Department of Geography, University of the Punjab, Lahore-Pakistan.