The Social and Environmental Impacts of the Hua Na Dam and Khong-Chi-Mun Project: The Necessity for More Research and Public Participation

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Abstract

The Khong-Chi-Mun (KCM) project is a large water diversion project in northeastern Thailand (Isaan). This mega-project, scheduled to be built over a 42-year period, involves the construction of concrete dams, rubber weirs, irrigation canals, electric pumping stations and associated infrastructure along the Mun and Chi rivers and their tributaries. At an estimated cost of 228 billion Baht (US$5.59 billion), the project was originally intended to divert water to approximately 4.98 million rai (7,970 km^2) of land in 15 provinces from Nong Khai to Ubon Ratchathani. The Hua Na Dam, located on the Mun River in Sisaket Province, is the largest dam in the KCM project. Construction began in 1992 and was completed in 2000, although the gates have not yet been shut.

In the case of the Hua Na Dam project, communities have had very little involvement. They were originally told a small, 4-meter-high rubber weir would be built, but instead a 17-meter-high cement dam with 14 gates was created. Salinity; destruction of traditional irrigation systems; flooding; and loss of farming, wetlands and fisheries stand to significantly impact the local lands and livelihoods. As no environmental or social impact assessments, land surveys or water demand studies have been completed, some local communities are gathering their own information on how they use their water resources and the likely impacts of the dam.

If the Hua Na Dam is to be put into operation or other similar projects to be constructed, past problems must be clearly addressed in order to not repeat mistakes. The environmental and social impacts, as well as compensation and mitigation plans, must be clarified through participatory studies involving the government, academics and the local communities. In this way, water resources can be developed in a more equitable and sustainable manner.

Introduction

The Mekong River Basin is the largest in Southeast Asia, with a drainage area of 795,000 km^2. The river, stretching 4,200 kilometers, flows through China, Burma, Thailand, Laos, Cambodia and Vietnam, and is a sustainer of life in these countries. It supports agriculture, fisheries and vast wetlands, all vital to the population in these regions. The Chi and Mun river basins form the largest subbasin of the Mekong, with a drainage area of 119,570 km^2, covering over two-thirds of northeastern Thailand. A large portion of the land

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in this region is used for agriculture. Rice is farmed in the lowlands, and a number of crops such as tapioca, kenaf and maize are farmed in the highlands.[1]

Northeastern Thailand, commonly called Isaan, is the driest and poorest region of the country, covering 106 million rai of land (170,000 km^2). It has the largest population, with 25 million people living in 19 provinces. On average, the residents of this region have the least education and lowest incomes. An estimated 80% live in rural areas. The region over the Khorat plateau faces very high temperatures, above 30 degrees Celsius during the hot season, leading to a high evaporation rate. The soil is generally dry and infertile, resulting in relatively low rice yields. The average annual rainfall is about 1,300-1,400 mm/year, approximately 80% of which falls between May and October, while water is usually scarce between late November and early May.[2]

The Khong-Chi-Mun (KCM) project was intended to solve the problem of arid soils by supplying water for irrigation and domestic consumption to 15 provinces across the Isaan plateau, a plan that would encourage farmers to switch from rainwater cultivation to reservoir irrigation in order to increase crops for export.[3] By controlling the water flow, the project was also designed to help prevent floods.[4] Furthermore, it was intended to increase the number of jobs in rural areas, thus helping to prevent migration of labor to Bangkok.[5]

The KCM project is one of the largest Mekong sub-regional water diversion schemes. It was approved in 1989 and scheduled to be built in three phases over 42 years, starting in 1992. The original intention was to first pump water from the Mekong in Nong Khai Province and direct it through a system of canals, rivers and lakes to the Chi and Mun rivers. The Chi River originates from the eastern slope of the Phetchabun Mountain Range in Chaiyaphum Province, flows through central Isaan and converges with the Mun River west of the city of Ubon Ratchathani. The Mun River originates in the mountains of Khao Yai in Nakhorn Ratchasima Province and flows east through southern Isaan until it empties into the Mekong in Ubon Ratchathani Province. The plan was to build a series of canals and approximately 30 dams or weirs along the Mun and Chi rivers and their tributaries, along with dikes, irrigation canals, electric pumping stations and associated infrastructure.[6] The project was estimated to cost 228 billion Baht (US$5.59 billion)[7] and divert water to approximately 4.98 million rai (7,970 km^2) of land.[8] The first stage would include 13 projects that would provide water to 2.323 million rai (3,720 km^2), with a budget of 39,508 million Baht (US$968 million).[9]

History of the KCM Project

In 1989, following a severe drought in Isaan in the previous year, the Department of Energy Development and Promotion (DEDP) within the Ministry of Science, Technology and Environment

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submitted the KCM project to the Cabinet for approval. The KCM was approved and granted an initial budget of 18 billion Baht (US$441 million) for the building of irrigation canals, buildings and other facilities between 1990 and 1992.[10] Construction on the dams began in 1992, although no studies on the environmental impact, suitability of soils for irrigation or water demand had been completed. In response to the lack of demand studies Dr. Prakob Wirojangud, former dean of Khon Kaen University Faculty of Engineering, later said that "the only demand for the project is among politicians and technocrats."[11] A feasibility study was not done until 1992, after construction was well on its way.[12] In 1992, the new National Environmental Quality Act required an Environmental Impact Assessment (EIA) for the KCM project. As the KCM has many subprojects, the EIA was broken into a number of smaller studies, many of which were not ever completed. In 1993, an "Experts Committee to Analyze the Environmental Impacts," which had been appointed by the Ministry of Science, Technology and Environment, criticized the feasibility study and KCM project, saying that the design of the project did not suit the landscape of the region and that there was a significant lack of transparency in the process. They found that the study lacked sufficient research on the geological conditions and substantially underestimated the impact of salinization. The committee expressed further concern that the project would cause the loss of forest land, massive displacement of local residents, increased prevalence of the liver fluke snail, destruction of historical sites, as well as increased erosion of riverbanks and sediment buildup along the Mun and Chi rivers. They criticized the plan to divert water from the Mekong River, thereby decreasing its volume by 6,580 million m^3/year.[13]

External criticism of the KCM project was voiced by Vietnam and Cambodia. From the beginning, both countries were very concerned about the decrease in water flow downstream from the project and its effect on their agriculture and fisheries. According to the Mekong Committee's 1975 Joint Declaration of Principles for Utilization of the Waters of the Lower Mekong Basin, Cambodia and Vietnam would have the right to veto the project, as it would affect the mainstream of the Mekong River. Thailand, concerned about the possibility of the project being vetoed, threatened to pull out of the Mekong Committee and cancelled a Committee conference in 1992. After several years of conflict, the United Nation Development Program stepped in to facilitate discussion. By April 1995, the four countries of Laos, Thailand, Cambodia and Vietnam composed the "Agreement for Sustainable Development of the Mekong River," which led to the creation of the Mekong River Commission (MRC). The agreement took away downstream countries' rights to veto projects, only requiring the countries to inform the others if they intend to divert water from the Mekong during the dry season, thus removing Cambodia and Vietnam's right to veto the KCM project.[14]

In 1994, the Thai Cabinet of Prime Minister Chuan Leekpai, eager to move the project forward, responded to the ongoing debates and pressure from Vietnam and Cambodia, as well as the concerns of the Experts Committee, and issued a resolution reducing the size of the KCM project.[15] This changed the focus

of the KCM project from diverting water from the Mekong to developing water resources within Isaan. This change reduced the irrigated area of the project from 4.98 million rai (7,970 km^2) to 868,500 rai (1,390 km^2).[16] The Cabinet further passed a resolution to study the salinity of the area, although this study, conducted by Khon Kaen University, did not begin until 1996 and is still not complete.[17] By this time, five of the KCM dams in the first stage were already completed, while eight dams were in the process of construction.

A considerable number of dams have been constructed in Isaan under three different government departments: the Royal Irrigation Department (RID), the Department of Energy Development and Promotion (DEDP) and the Electricity Generating Authority of Thailand (EGAT). According to the Natural Resources and Environment Network of Isaan, by 2000 this amounted to 246 large and medium dams.[18] Cumulatively, these dams have had immense impacts on the region. There has been an extremely large amount of flooding in agricultural and residential areas. The first nine dams of the KCM project alone displaced 15,120 families.[19] Irrigation-induced salinity has become a large problem. Wide areas of wetlands and forests have been destroyed. The ecosystems have been changed, impacting local flora and fauna as well as agricultural crops. The *Mimosa pigra*, a non-native invasive weed, for instance, has virtually taken over the entire wetlands area surrounding the Rasi Salai Dam, blocking many native species from normal growth, since reservoirs provide an ideal habitat for the spread of the weed.[20] In some areas, the number of species of fish, as well as the size of the fish catch, has been reduced. Many communities have lost their traditional means of water resource management, such as waterwheels, air turbines, small weirs and ponds. The Natural Resources and Environment Network of Isaan, predicts that 167 historical sites will be submerged as a result of the KCM project.[21] All of these changes have significantly impacted community life and well-being.

Instead of stepping back and analyzing the past problems created by dams, the government is currently putting forth a proposal for a new Water Grid project under the Department of Water Resources and is looking to vastly extend the KCM project. The Water Grid proposal includes subprojects throughout Thailand, although much of the water will be drawn from basins in Laos and Cambodia as well as the Saloween River, which flows along the Thai-Myanmar border. This project proposes to bring irrigation water to 23.4 million rai (37,400 km^2) of land in the wet season and 9.7 million rai (15,500 km^2) in the dry season, as well as provide 14,150 million m^3/year of water for industry and 400 million m^3/year for domestic consumption. As a whole, 7 million families are expected to benefit.[22] If the Water Grid project goes through, it will further expand many of the issues associated with the KCM projects.

The Hua Na Dam

The Hua Na Dam, located on the Mun River in Nong Gow Subdistrict, Kanthararom District, Sisaket Province, is the largest dam in the KCM project. It was originally estimated to bring water to 154,000 rai (246 km^2) of land from 15 pumping stations. However, as a result of the cancellation of plans to divert water from the Mekong, the project has now been reduced to 80,000 rai (128 km^2) in the rainy season and 15,000 rai (24 km^2) in the dry season.[23] Two pumping stations that use vertical mix pumps will provide this water. The first pumping station, PL3, located 60 km upstream from the Hua Na Dam in Rasi Salai District, Sisaket Province with its 50,770 meters of subcanals, is slated to provide water to 50,000 rai (80 km^2) of land. The second, PL8, located 10 km upstream from the Hua Na Dam in Kanthararom District, Sisaket Province is to provide water to 30,000 rai (48 km^2) of land through its 36,900 meters of subcanals.[24] The RID plans to pump water to 3,500 families in these areas,[25] and contends that this will help boost local family income 10,000 Baht/family/year (US$245/family/year).[26] Currently, the RID hopes to store 96.95 million m^3 of water at a maximum height of 114 meters above sea level. The catchment area is 53,184 km^2, approximately one-third of northeastern Thailand, and the average annual runoff is 9,195 million m^3/year.[27]

As with the rest of the KCM subprojects, the Hua Na Dam was originally created under the DEDP, which claimed a 4-meter-high rubber weir would be constructed. Instead, a 17-meter-high cement dam spanning 207.5 meters across the river with 14 gates was built. The RID states the length of the reservoir will be 17 km.[28] However, many feel that there will be significant flooding all along the river between the Hua Na and the upstream Rasi Salai dams.[29] According to the RID, the distance between these two dams is 95 km.[30] Construction began on March 16, 1992. The body of the dam was completed by 1994 and the gates were added in 2000, although they have not yet been shut. The operation of the dam was transferred from the DEDP to the RID in 2003. The cost of the structure of the dam itself, not including the closure dam on the original channel of the Mun River, was about 1.144 billion Baht (US$28 million).[31] As of April 2005, the total amount spent on all aspects of the project was 2.150 billion Baht (US$52.7 million), which includes the dam itself, pumping stations and other associated infrastructure.[32]

During the construction of the dam, the Thai parliament passed the Enhancement and Conservation of National Environmental Quality Act or the 1992 Environment Act, requiring an EIA for projects of this magnitude. A feasibility study for the Hua Na Dam was produced in 1992 by the Asian Engineering Consultant Company, which the DEDP had hoped would be an EIA. This study found that the project would have some benefits during the dry season, though the farmers could still use water pumped from the Mun River without the dam. Furthermore, if proper drainage were not put in place, the dam would have large negative impacts.[33] This study, however, did not fit the framework that the Ministry of Science, Technology and Environment mandated for an EIA study and thus was not approved. Under the Environmental Law of

1992, the Office of Environmental Policy and Planning required that an EIA for the Hua Na Dam be conducted under the appropriate framework.[34] Local villagers, aware of the devastating impacts that previously occurred as a result of the upstream Rasi Salai Dam, which was in operation between 1993 and 2000, have continued to urge the government to complete a proper EIA for this project. In 1999, the DEDP again promised the villagers that although they could not halt construction on the dam, they would not shut the gates until an EIA study was completed.[35] Despite these promises, an EIA has yet to produced. Furthermore, water demand studies, land surveys, and Social Impact Assessments (SIA) have not been completed, leaving no plan for compensation or mitigation. Fearing that these studies will not be done and not trusting the conventional EIA to account for all of their concerns, local communities have been documenting information about their livelihoods, wetlands and local water resource management with the help of a local non-governmental organization (NGO), the Natural Resource and Environment Network of Isaan, since 1998. Some information, such as land ownership documentation, has been collected by locals and submitted to the RID. Despite the immense knowledge that locals have about their own livelihoods, many fear that their input will be dismissed as biased.

The Sisaket branch of the RID is still stating that they plan to complete land surveys under 114 meters above sea level, salinity studies and an EIA before they shut the gates.[36] The purpose of an EIA is normally to determine if the project benefits outweigh the costs and if not, discontinue the project. If the decision is made to go forward with the project, then the study can help to identify potential problems in order to plan for mitigation and compensation. Thus it is imperative that these studies be completed before the gates are shut.

Within the next four years, the RID plans to have completed the closure dam on the old waterway of the Mun River, perform necessary maintenance on subcanals, improve the dam site by adding more gravel to the banks, build a road at the PL3 pumping station in Rasi Salai, repair the electric control system for the dam, and finish construction of the irrigation canals that have yet to be completed.[37] The total cost of maintenance and construction over the next four years is projected to be 209.2 million Baht (US$5.13 million).[38]

Lack of Transparency and Public Participation

The decision-making processes regarding the KCM project and the Hua Na Dam were very rapid, meaning that information was not properly distributed and research clarifying the impacts was not completed. Few people in the local communities were aware of the massive scale of these projects. Many of the large dams**,** the Hua Na Dam included, were referred to as *faai yang* or small rubber weirs that could be inflated to raise water levels during the dry season, though not exceeding the river banks, and deflated when

no longer required in the rainy season.[39] Numerous villagers in the local area of the Hua Na Dam expected the small rubber weir that was described and are still very frustrated with the fact that a massive cement dam was constructed instead. A few noted that they would not have supported the project had they known the truth. Villagers, believing the flooding from the weir would not exceed the riverbanks and would help provide water, were once generally in support of the project.[40]

The lack of transparency reflects the problems of conventional top-down policy and decision-making processes. The government was responsible for the entire process of planning and implementing the project, but did not make room for locals to become involved. There were no public hearings, participatory EIAs or other mechanisms to enable community feedback to reach the decision-making table. In addition, as responsibility for the project has shifted from one department to another, information has become more dispersed and inaccessible. No one department or organization seems to have even the basic facts. Even the RID, which is directly responsible for the dam, sends people to several other government departments to find out such information. Local residents claim that information they send to the RID is often lost, requiring them to send it several times. This puts a lot of stress on the locals, as they take time off work and farming to collect information.[41] Although members of the Assembly of the Poor, a national people's movement that fights for local rights in development projects throughout Thailand, have had meetings with the government to express many of their concerns, they believe that these meetings rarely achieve helpful results. They feel that the officials make many promises but seldom follow through on them.

After villagers became aware of the large size of the dam, they began to worry about how it would impact their communities. Concerned members of the Assembly of the Poor, representing those who were affected by the Rasi Salai and Pak Mun dams, as well as the Natural Resource and Environment Network of Isaan, have been involved with villages slated to be impacted by the Hua Na Dam since 1998 and have expressed their misgivings about the project. The local villagers held protests with up to 1,000 people at the dam site in 1998, 1999 and 2000. On March 16, 2000, after several years of struggle, hundreds of villagers gathered at the dam site and wrote up their demands. These included not blocking the natural waterway of the Mun River; lowering and clearly marking the level of the reservoir; completing a land survey and an EIA; providing compensation; and clearly informing people of the government's plans. They remained at the dam and at the Government House in Sisaket until October of 2000.[42]

In response to the demands of the local villagers, the government unblocked the old waterway of the Mun River, began to install reservoir markers and granted 3 million Baht (US$73,500) to complete land surveys. The markers, supposedly installed at 115.5 meters above sea level, are inconsistent in height, leaving the villagers still unsure of the specific areas that will flood. Furthermore, when the RID took over the project in 2003, they put in new markers, which were supposedly at 114 meters above sea level, though

they also were not consistent in height. Substantial progress was made on the land surveys; however, the allocated funds were insufficient to complete the work. Currently, villagers are demanding that the surveys be completed, the environmental impacts be properly assessed, the markers and reservoir height be clarified, and compensation be settled before they shut the gates of the dam.[43]

Although the RID has made a few attempts to address local concerns, the general lack of public participation and community involvement has contributed to the people now feeling as if the project was imposed and that they did not have a significant role in the process. The lack of information, ownership and agreement over the project, and the fact that villagers had to protest for years to have basic demands heard have all helped to create public opposition, which is likely only to increase as the time for shutting the gates draws closer.

The Cost-effectiveness of Large-scale Irrigation and Electric Water Pumping Strategies

The KCM Project and Hua Na Dam subproject have the stated purpose of providing irrigation to the region's generally dry and sandy soil. Supplying irrigation will be costly for both the government and farmers. If the KCM and Hua Na Dam projects are going move forward, it must be clear that the amount of water stored reflects actual demand, and that farmers are willing and able to pay the electricity costs for pumping water.

Electric water pumps were first used in Thailand in 1965 to consume the extra electricity created by the Nam Pung Dam and to bring water to higher grounds not served by the gravity-based irrigation systems. By the year 2000, 1,937 water pumping stations were constructed throughout Thailand, with a supposed irrigation area of 3,187,772 rai (5,100 km^2). Of these stations, 975 were in Isaan, irrigating 1,631,135 rai (2,610 km^2). Although the DEDP claims that each pump project should irrigate an average of 1,500 rai (2.4 km^2), the actual area has been about 210 rai (0.34 km^2) per pump, as most farmers only used the pumps when the rainy season came late, most not willing to invest in the extra expense of the dry season crop. Despite this discrepancy, the government has not evaluated the pumping stations as to why farmers are not using them, continuing to define success as the number of pumps put in place.[44] The RID has traditionally used the less expensive gravity-based irrigation methods, which eliminate the electricity cost for local farmers.

According to Prakob Wirojangud of Ubon Ratchathani University, in reference to the Hua Na and Rasi Salai dams, "The projects cannot provide water to the local people in the areas. The people living along the Mun River have their own water management systems that provide sufficient water . . . The government claims large areas would be irrigated, but the figures are a hoax."[45] As Wirojangud notes, electric water pumping and its associated dams and canals are replacing locally developed technology, making it hard to maintain local knowledge and management. For instance, people have traditionally used Isaan's numerous

small and large streams, lakes, bogs and ponds, which are often associated with the seasonally flooded forest or wetlands. Although water is normally ample in the wet season, locals have developed technologies such as water wheels, small dikes, and underground water wells, which they can use in case of long periods without rain. The only times that they need water are during extreme droughts or the dry season.

During the dry season, however, the evaporation rate is very high, and farmers would need to pay for the pumping costs, likely at the rate of 80 Baht/hour (US$2/hour), which has been used for other KCM project. This would make a dry season crop unfeasible for a large number of farmers, many of whom would actually take a loss on crops during this season. Instead of investing in costly rice farming during the dry season, farmers have learned that they can get what vegetables they need from the wetlands and seasonally flooded forest, where they both collect what is naturally available as well as grow numerous vegetables and other crops.

Lessons from previous subprojects of the KCM have been completely disregarded. In the case of the Kumpawapi and Mahasarakham dams, for instance, although all the irrigation infrastructure was complete, the local people stated that they did not want to plant a second rice crop. This was because of low yields, salinity of the irrigation water, and the expense of the water, electricity and chemical fertilizer necessary for dry season crops. The Khumpavapee project caused large floods, as dikes blocked the streams from flowing into the Nong Han Lake, and the canals blocked local access to the lakes and streams that they had traditionally used for irrigation. In total, about 3,000 rai (4.8 km^2) of land were damaged, affecting 1,200 families.[46] Despite these failures, similar projects are being pushed forward without addressing past problems.

Especially in this year of drought, there are certainly farmers that do want the irrigation water from the dam. In the villages slated to gain water from the dam, many feel that the dam is a good way to go about bringing them this needed resource. They say that since the dam is already built, the gates should be closed immediately. In late spring, 2005, 4,963 villagers, mainly from the areas to be served by the PL8 pumping station, signed a petition asking for the dam gates to be shut.[47] However, some claim that they were misled by the petition, believing that it related to receiving compensation for the dam.[48] Others, aware of what they were signing, noted that the real reason they would like the dam is that it would provide a road across the river, giving them much easier access to Ubon Ratchathani, the nearest large city. But even accounting for these concerns, villagers in this area consistently express the need for more water. In the village of Puey, Kanthararom District, for instance, many of its 600 families are begging for water and feel that the dam should be shut. According to a local district official, Mr. Kriangkrai Wangkul, 90% of the residents grow chili peppers and onions for the market during the cold and dry seasons after they finish growing rice for consumption in the rainy season and need more water to do this, especially during March, April and May. He

did not feel, however, that the project should store so much water that it caused flooding that would exceed the riverbanks. He feels that if the water is supplied, the income for families in his village will be raised by 20,000 Baht/year (US$490/year).[49] However, many of the villagers throughout the area slated to receive water are not aware that they will have to pay the electricity costs, some stating that they are not sure if they will use the water if payment is required. Some of them also say that other alternatives such as ponds, wells, canals or the originally planned rubber weir would be enough to supply water to their farmlands. Very few are aware of any potential impact of salinity on their farmlands.[50]

The Salinity Problem

Even if it were clearly established that the amount of water being stored reflects demand and local farmers are willing and able to pay, salinity is likely to nullify irrigation benefits. The lack of an EIA means salt levels in the local area were not adequately examined before the project was built. It was estimated by Somari Arunin of Thailand's Land Development Department in 1984 that 17% of Isaan's total area was already affected by salinity.[51] Despite prior studies identifying the salt domes that lie just under the surface and substantial evidence that construction of reservoirs in areas with shallow groundwater spreads salinization, these issues were ignored in project planning stages and have yet to be adequately addressed.

Salinization in northeastern Thailand is not a new problem. In fact, it is in part a natural phenomenon. During the three different periods between 50 and 80 million years ago, northeastern Thailand was an inland sea. Each time the sea evaporated, it left a thick layer of salt, which was later covered by layers of clay, sandstone, siltstone and other sediments that form the clastics. These layers of salt and clastics make up the Mahasarakham Formation, which in Thailand lies in the Khorat and Sakon Nakorn Basins. When the Phu Phan Mountain range separating the two basins rose, it caused the salt layers and clastics to fold, forming salt domes that now lie as close as 20 meters below the surface. Groundwater has dissolved some of these salt layers and has spread salt even to areas that do not have underground rock salt.[52]

The presence of the salt domes very close to the surface, high water tables of salinated ground water, poorly drained soils and extended hot and dry periods make Isaan a prime location for issues of salinity. But the salinity in Isaan is only partially caused by geology and climate. Human actions such as deforestation, salt mining, and building reservoirs and irrigation systems have vastly increased the problem. If it were not for these activities, much of the salt would have been left undisturbed. Reservoirs and irrigation projects are of serious concern in northeastern Thailand because these projects rely on the low-lying river basin areas where the salt is concentrated and the domes are often just below the surface.[53] In Isaan, reservoirs raise the already high groundwater levels, and once the water is within a few meters of the surface, it flows upward through capillary action to the root zone and surface soils, bringing the salt with it. In the dry season, as the

water returns to the atmosphere through evaporation, salt remains in the surface soils and becomes more concentrated, often forming crests on the surface.[54] Moreover, the dikes and roads, built to support the dam and prevent flooding, will block water from draining back into the river, leaving water stagnant in some areas for a prolonged time and causing increased waterlogging and salinity. Furthermore, using the salty reservoir water for irrigation will salinate the fields it is used on and may seep into other fields in the area.[55]

Although a small concentration of salts in the soil is natural and even necessary for plant growth, excessive amounts are unhealthy and may even be lethal. Salinity decreases the water potential outside the plant root, in some cases even below the water potential inside the root. This means that as salinity increases, the ability of the plant to absorb water is increasingly impaired. Furthermore, high salinity also implies high levels of sodium, chloride. In large amounts, these ions can prevent the absorption of other elements such as potassium and calcium, leading to nutrient deficiencies, and in some cases even be toxic.[56] Different plants have varying threshold values for salinity. As salt concentrations exceed these values, the plants are increasingly affected until they can no longer survive.[57]

The plans for the KCM project were drawn up despite existing evidence from the government's own Land Development Department (LDD), which pointed to severe irrigation-induced salinity in northeastern Thailand already present in 1984. The LDD cited salinization in the areas irrigated by the Nong Wai irrigation project in Khon Kaen, the Kumpawapi project south of Udon Thani, the Lampao project in Kalasin and other schemes in Sakhon Nakorn, all of which are in Isaan.[58] Further evidence of salinity is apparent in the lands affected by the Rasi Salai Dam, upstream from the Hua Na Dam on the Mun River. Because of the salinity levels found in the reservoir, irrigation canals were never finished and the dam gates were opened for studying these impacts. The salt made nearby lands uncultivable, substantially decreasing rice production as well as destroying a large area of wetlands that the villagers depended on for their livelihoods. These unintended consequences meant that the project hindered rather than helped local farmers.[59]

Even in the project area of the Hua Na Dam itself, there is evidence that salinity is likely to be a large problem. Between 20 and 25 years ago, at least 11 villages in Kanthararom District, Sisaket Province began using irrigation canals containing water pumped from the Mun River. The majority of villagers using this water have stopped because of salinity, leaving the irrigation canals unused.[60] In a few villages, such as Gok, farmers claim that if they just use the water every 3-4 years to supplement their wet-season crops during especially dry years, it has not caused them any noticeable problems. They note, however, that any significant continual use would harm their crops.[61] This has been the case in villages that have attempted dry-season cultivation. In the village of Nong Booa, for instance, many residents note that they had previously used water pumped from the Mun River. The canals were completed and in use by 1979. By 1997, they had been entirely abandoned because the local farmland became salinated and many crops died. Thus the

irrigation canals currently lie in a state of disrepair. One farmer notes that it simply is not cost-effective to use the water. After several years of dry-season cultivation, his crops became salty and died. He got to the point where he was paying 1,200 Baht (US$29) for pumping and only harvested six bags of rice total from his 2 rai (0.003 km^2) of land during the dry season, meaning he could recover only about 30% of his costs in electricity. Now, after using rainwater for an extended period of time, he can harvest 30 bags of rice on the same land. He simply states "it is not rational to grow rice with salty water." He noted that there is plenty of water during the rainy season and that the loss of money and deterioration of soil quality because of salinity means it just does not make sense to grow dry season crops.[62]

Projects often do not include drainage as part of their original costs, as this would make most too expensive and thus unfeasible. Without draining excess water not absorbed by plants, the water will seep below the surface, causing the water table to rise, increasing waterlogging and salinity.[63] Many options have proven successful in helping to manage salinity in other projects, such as irrigation canal lining; dilution flow; surface drainage; and subsurface horizontal and tube well drainage.[64] Clearly, the most suitable options depend on the specific project. Although many of these techniques may help slow the process of salinization, it is unlikely that they would eliminate the problem. Even if the water is drained downstream of the dam, it may increase the salinity of this water, affecting downstream irrigation, municipal consumption and wildlife.[65]

As early as 1965, the Department of Interior noted that the only reason irrigation schemes have been successful in northeastern Thailand is that the water has come primarily from rainfall, which is low in salt content and requires only a small amount of ground-water movement. The report further noted that the irrigation projects in this area using water with even an average salt content would be "doomed to eventual failure without adequate drainage facilities, which in this area may not be financially feasible."[66] These warnings have too often been ignored. In case of KCM project, even though significant evidence suggests a high likelihood of salinity in the area, soils that drain very poorly, and high water tables, drainage has not been put in place.[67] With respect to the Hua Na Dam, the RID claims they will build a drainage system in about three years.[68] However, many are concerned that the money for this will not be provided.

Direct Impacts on Environment and Local Livelihood

The local communities will face many consequences of the dam and the flooding it will cause. Despite the fact that one of the aims of the KCM project is to help with flood control, many areas have seen a large increase in flooding since its construction. Although flooding existed before the project, this flooding served as an essential part of the wetlands ecosystem. In the past seven or eight years, after substantial construction on the KCM project had been completed, villagers in the Hua Na Dam area have complained of

floods inundating their homes and farms, often for several months at a time, since dikes and other infrastructure have prevented the water from draining, causing waterlogging and stopping some from farming altogether.[69] Villagers note that flooding occurred during years with heavy rain, the most severe in 2002, when the accumulation of rain forced the gates of the Lam Poa and Ubolratana Reservoirs to be opened, along with many other dams downstream as well. When this released water reached the lower areas of the watershed, massive flooding occurred.[70]

Flooding will also be a problem as a result of the Hua Na Dam itself. The local residents are very concerned and afraid of how this will affect their land and lives. They are also frustrated with the fact that the information from different government departments has been inconsistent, leaving many unsure of what area will be flooded. Furthermore, it is apparent that something is wrong with current predictions, as the dikes, which were supposed to protect the wetlands from the reservoir water, have already been damaged in some locations by flooding without the dam even being in operation.[71] Local residents are concerned flooding will only get worse after the gates are shut. When interviewed, local NGO leaders and villages expressed their concern about impacts from the Hua Na Dam and reservoir flooding in the areas described below. The problems they fear are similar to those that have resulted from other dam projects in the past.

Housing and Farmlands: In the village of Gok, Kanthararom District, 27 families lost their lands due to the construction of the dam itself. In Thailand, there are different kinds of land titles, some conferring greater ownership rights than others. According to a number of villagers, nine families, who had land titles of *Nor Sor Sam* were paid 20,000 Baht/rai (US$490/rai) for their land in 1992. Fourteen families with land titles of *Sor Cor* were paid 14,000 Baht/rai (US$343/rai) for their land, but only if it had been used for rice farming that year. As it had been a very dry year, many farmers decided to grow hemp instead of rice and were not compensated for these lands. Another group of four families did not have any land certificates and were told they must produce them in order to receive any compensation. These latter two groups totaling 18 families are demanding more money (between 20,000-30,000 Baht/rai or US$490-735/rai) for all of their lands. They have been fighting the government since 1992 and are still demanding appropriate compensation.[72]

With respect to other areas, flooding caused by the dam is the major concern. The dam is predicted to completely submerge the village of Nong Aung with 92 households.[73] An even larger area of farmlands will be inundated, affecting families in villages all along the 95 km between the Hua Na and Rasi Salai dams.[74] It is expected that there will be impacts in six districts: Amphur Muang, Kanthararom, Yang Choom Noi, Utomporn Phisai and Rasi Salai in Sisaket Province, and Warin in Ubon Ratchathani Province.[75]

As many of those in affected villages do not have titles to their land, despite their families living on the land for generations, they fear that the government will not give them compensation.[76] The Rasi Salai

Dam, which is about half the size of the Hua Na Dam, flooded a large number of houses. In many cases, the families had been previously informed that their homes would not be affected.[77] Moreover, as a result of increased flooding, families in the area faced a 76.6% decrease in rice yield from 1992, before the dam was built, to 1999, after the project was in operation.[78] Further confusion resulted from the process of trying to later identify land titles once the area was covered by the reservoir. Villagers were asked to come and identify their properties one at a time on an area map. As many villages had never dealt with maps before, there were many who had trouble, which resulted in conflicts and more confusion. Villagers in the Hua Na Dam area, fearing similar problems, have documented land titles and submitted this information to the local government. Some villages, such as the village of Nong Aung, have completely documented land ownership, while others have done little. The government has only agreed to look at land that is under the 114 meters above sea level, as this is the only area that it will take responsibility for. The RID states that they plan to survey 2,700 properties in three districts,[79] 2,328 of which have already been documented.[80] Although 3 million Baht (US$73,500) was put towards this study, the RID says that more will be needed to finish the survey. Many local residents are concerned that even if the survey is completed, they may not receive the land titles necessary for full compensation. Even if only 2,700 properties are flooded, one has to ask if this is really worth the costs, considering the number of families that will actually benefit. As of April 2005, the RID estimated that water would be brought to about 3,500 families,[81] and that is without taking into account that many of these will face resulting salinity problems.

Wetlands: In the past, natural floods have brought in silt that fertilizes the area for a few months each year, an indispensable part of the local ecology. However, the dam will block this rich material and a significant amount of water from reaching downstream ecosystems. The dam reservoir and associated dikes, which run along the entire length of the reservoir, will likely cause significantly more flooding, in some areas year round, damaging the wetlands ecosystem. The seasonally flooded forest along the riverbanks is a very important ecosystem rich in biodiversity. It provides breeding grounds for fish and helps to improve water quality. This community-shared land has long been used as a main source of livelihood in these communities. It is also a place where food, medicinal plants and building materials can be collected by the villagers. Many also grow rice in its rich soils. A number of villages, including Gudngong in Rasi Salai District and Poonsai in Kanthararom District, have also been using the wetlands as a source of clay for pottery. For many families, this is their main occupation.[82]

The dikes will further prevent over 30 tributaries of the Mun River from flowing into the reservoir, causing more flooding in the wetlands and farmlands. The RID claims that there will be a drainage system to remove excess water.[83] However, villagers do not believe that this will actually occur, as costs may be prohibitive. As this is community-shared land, many are concerned that there will be no compensation for the

loss of this critical resource.

Livestock: Because buffalo graze in the wetlands, the flooding will cause them significant harm. In the case of the Rasi Salai Dam, the number of households owning and grazing buffalo decreased by 84% after the dam was shut, and the total number of buffalo being raised in the area decreased by 87%. As cattle can be grazed in both wetlands and highlands, they are not as affected as buffalo. However, the number of houses grazing cattle still decreased 15%.[84] Weera Lertprasertkul, a local farmer, noted that since there was no place to feed buffalo, all of the local residents had to sell them off significantly below the usual market price. Lertprasertkul sold his at the price of 100 Baht (US$2.45) for three buffalo. These livestock, which ordinarily sell for 7,000-10,000 Baht (US$171-245) normally serve as a form of local security in case of accidents or other financial difficulties.[85]

Fisheries: By destroying the wetlands and the fish breeding grounds, as well as blocking migratory species from moving up and down the river, the dam will cause the fish population to substantially decrease and certain species will be lost altogether. Villagers learned from the downstream communities near the Pak Mun Dam of how fisheries decreased so much that many locals could not catch enough fish to sell and some had to resort to actually buying fish. The World Commission on Dams (WCD) reported in 2000, that out of the 265 fish species recorded in the watershed in 1994, only 96 species were found upstream from the Pak Mun Dam and that the fish catch directly upstream from the dam decreased by 60-80% after the project was completed. The main causes for this decline were that migratory fish had been blocked and that spawning areas had either been flooded out or blasted, in the case of the rapids. The WCD reports that the total loss of fisheries in the area amounts to approximately US$1.6 million/year.[86]

Even though villagers report fewer fish in the Hua Na Dam area as a result of the Pak Mun Dam, fisheries still provide a significant amount of income for local communities. The stability of the village of Nong Aung, for instance, depends on fisheries, providing the community with income for their living expenses and education for their children.[87] If fisheries decrease, this income will be lost and a substantial amount of local knowledge on fisheries that has been developed and passed down through generations will gradually fade away.

Downstream Impacts*:* The diversion of water in Isaan is likely to reduce the amount of water and nutrient-rich silt that feeds fish and fertilizes the banks and floodplains of the river downstream, both locally and as far as Vietnam and Cambodia, where the KCM project threatens the agriculture, fisheries farming and ecological diversity in 70,000 km^2 of forest and floodplains.[88] Concern has been raised in Vietnam about the reduced water flow and increased salinization affecting the rice crops in the delta. Similarly, in Cambodia, there is concern about the lower water levels affecting fisheries in the Great Lake and Tonle Sap River and surrounding areas.[89]

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Community Impacts

Although it is clear that the livelihoods of the local people are very much connected to the environment and stand to be greatly affected by the dam, the communities will also experience other changes. The cultural and social fabric essential to community health will be threatened. Little research by the government has explored these wider effects of the Hua Na Dam. These impacts tend not to be included in the conventional impact studies as practiced in Thailand. However, local communities have raised concern about these issues.

Migration: Despite the claim that the KCM projects will decrease migration to big cities by providing local jobs, the opposite has been found to be the case.[90] Due to direct displacement from reservoirs or from loss of income, many families are forced to move or send some of their members to urban areas, mainly to Bangkok and industries in the eastern coastal provinces, to work in factories or perform other wage labor. In the urban slums, they often go without basic amenities such as electricity and running water. The separation of families can often cause psychological strain, especially on the children who are forced to grow up without their parents. Many villagers in the Hua Na Dam area anticipate the tension associated with resettlement. One woman in the village of Nong Aung said "flooding is my biggest concern. If it floods, I won't have a house. I don't have a place to move to. What about my children and grandchildren?" This fear for the future is common in the area.[91]

Internal Conflicts: As some believe they will receive the benefits of irrigation water and others fear the negative effects that may arise, there are already internal conflicts. People who previously peacefully coexisted are now at odds with each other over the issue of the dam. Such conflicts are breaking down relationships between the local government and villagers, among villagers themselves, and even within families. If the gates are shut, it is likely that these conflicts will only intensify. This has been the case in the communities affected by the Rasi Salai Dam. Many conflicts within and between villages have arisen over the dam and over ownership of wetlands and other resources that had been inundated by the project.[92]

Inundation of Archeological Sites and loss of Cultural Traditions: Important archeological sites have been found in Non Muang Gao, near the village of Nong Wai, and in Non Bak Khor, near the village of Non Peung, both of which may be flooded as a result of the Hua Na Dam. Ancient pottery and Buddha images, as well as clues to ancient systems of irrigation, have already been discovered, and no doubt there is much more that could be salvaged.[93] Villagers have also expressed concern about the possible loss of several important cultural and religious festivals dependent on the river, such as a boat racing festival held in October of each year and specific local traditions held during the Songkran Festival or the Thai New Year in April, which involve collecting sand at cites near the river.[94]

Health: Large reservoir dams have been connected to several health issues that could have possible impacts in the case of the Hua Na Dam project. The two major concerns are snail-borne diseases such as schistosomiasis (blood fluke infection) or opisthorchiasis (liver fluke infection) and mosquito-borne diseases such as malaria and filiariasis.[95] The World Commission on Dams noted that schistosomiasis, which is carried by the snail *Neotricula*, is probably the most serious health concern associated with the Pak Mun Reservoir, which is located downstream from the Hua Na Dam.[96] Just a year after the creation of the dam in 1995, the Electricity Generating Authority of Thailand (EGAT) found samples of *Neotricula* in the reservoir and other studies have documented its significant spread in the area. Opisthorchiasis, which is spread through liver flukes using *Bithynia* snails as hosts, has also become a concern near the Pak Mun Dam, as there has been an increase in liver flukes. General water quality is also a problem. The villagers in the area note that since the construction of the dam, they are not able to wash in the river due to the water hyacinths, which give them severe rashes.[97] In order to fully understand the health impacts, studies must be conducted over many years at a large cost and are thus often not completed.

Recommendations

Given the vast negative effects on the many communities near the dam, a tremendous irreversible loss to the environment, and the lack of any real benefits of closing the dam due to salinization, the dam gates should not be closed. Before the government pushes forward with the Hua Na Dam, the Khong-Chi-Mun project or even larger schemes like the Water Grid project, those making decisions need to take a step back and analyze whether these projects are actually providing the benefits originally claimed.

If, however, the government wishes to go forward with the project, it is imperative that the environmental and social impacts as well as compensation and mitigation plans be properly clarified. The national water policy should be redirected to address the demand side rather than just the supply side, so that water projects can better reflect what is actually needed. In order to do this, the top-down policy practice needs to be revised. The government should create a mechanism for community participation in the decision-making process, as mandated by the Thai Constitution Act of 1997. The local communities have detailed knowledge about their own livelihoods and life-supporting local environments. By tapping this knowledge, a better understanding of appropriate and sound development can be formulated. Community involvement will also help to solve problems ahead of time and prevent the kind of political tensions seen in other dam projects. There should be local participation in research studies, including the EIA, SIA, salinization studies and land surveys, as well as in the development of a complete compensation and resettlement plan that ensures the people's standard of living will not be reduced. It is significantly harder to clarify many of these issues after the gates are shut, as was made evident in the case of the Rasi Salai Dam. Furthermore, since the

purpose of the dam is farmland irrigation, it is necessary that the salinization problem be dealt with before the gates can be shut. It is also essential to determine whether or not people will actually use the water from the pumps and are willing and able to pay the price they will be charged.

Information gained from the Hua Na Dam and KCM project shows the need for significant reform of feasibility studies in general. It became clear that studies need to be completed prior to construction and implementation of the project and should include more detailed information on local livelihoods and technologies. Before final submission of impact assessments and feasibility studies, drafts need to be given to local communities for them to comment and make changes. The conventional impact studies or EIAs have focused primarily on the engineering and physical impacts, largely ignoring local community livelihoods, potential health issues and other social factors. When the government is allocating the budget and creating policies with respect to water in Thailand, authorities must recognize the interdependence of all aspects of the ecology and the lives of those who use it, rather than simply focusing on supplying more water.

Alternatives

Even though a great deal of expense has already gone into the Hua Na Dam and KCM project, it will cost much more to finish building the irrigation infrastructure, complete all assessment studies and pay for compensation and resettlement. Despite the large number of dams created in the name of bringing irrigation water to Isaan, only a small number of farmers in the region have seen any benefits. Rather than taking notice of the problems that have already been created by the KCM, the government is trying to expand water resource development further through the Water Grid Project. Pumping and diverting water long distances and creating reservoirs for irrigation is both incredibly costly and simply does not bring the benefits intended. Instead, it completely devastates the natural river system, often harming the livelihoods of the very people it claims to help.

If the present government policy is to go forward with similar projects, past problems must be clearly addressed in order not to repeat mistakes. The communities would be better off without the dam. However, as the need for water in Thailand grows, it is necessary for the government to look at how they can best meet this need, ideally by exploring less expensive and more sustainable solutions. The best alternatives are small, locally controlled projects that are based on catching rainwater, as opposed to depending on the river water from the main channel, which may be salty and creates a dependency on the level of the river. Although Isaan is very dry for a substantial portion of the year, there is a large amount of rain during the wet season. If this rainwater were more efficiently caught and stored, it could provide clean unsalinated water for longer periods. Investing in the creation of small ponds would be one method of doing this. This option would more closely reflect actual water demand as well as the traditional irrigation techniques in the region. It would also

prevent the ecological devastation caused from reservoirs and be much less expensive than large water diversion projects. Numerous experts, including Dr. Prakob Wirojanagud, Dean of the Faculty of Engineering at Ubon Ratchathani University, confirm this view. Wirojanagud states that small wells, weirs and ponds, as well as the enlargement of existing canals and small reservoirs can much better serve local needs than a large dam, which is more expensive and stores significantly more water than is necessary in the area.[98]

Water resources must also be conserved and used efficiently, thus reducing the need for supply-side options. This means developing better irrigation techniques and often using less water-intensive crops. Preventing water leakage would save a substantial amount. In Asian cities, an average of 35% of water entering the system is unaccounted for; in Bangkok the figure is 38%.[99] This loss is likely due to leakage, measurement problems and illegal connection[100] More water-efficient technologies ranging from water efficient toilets to micro-irrigation systems have proven very effective in conserving large amounts of water.[101] If the money that has been put into large dams were rerouted into improving traditional irrigation systems, maintaining existing projects and reducing water demand, a great deal of water could be conserved.

Conclusion

It has been the pattern that large development projects have been conceived and planned in academic and government institutions far removed from the communities that these projects are supposed to benefit and that will be affected by their implementation. Project planners have ignored local population concerns and have not completed adequate impact studies. Many problems related to large development projects could be predicted and dealt with if the decision-making process included those who are more familiar with the local area as well as those who stand to be directly affected. Many people suggest that villagers who are protesting such projects are getting in the way of "development" and are selfishly ignoring the greater benefits these projects will provide to the population as a whole. However, the KCM subprojects that are already in place, as well as numerous examples of similar projects the world over, show that this is not an issue of a few people having to pay the price for the overwhelming benefit of the majority. This is a case of many people being affected, with very few benefits for anyone with the exception of those gaining from construction contracts.

In the case of the Hua Na Dam, as the dam has not yet been put into operation, the opportunity exists to use what has been learned in the past and carefully analyze what might actually aid local communities. In order to do this effectively, more local involvement is necessary and more research into the effects is imperative. Without this inclusion and in-depth understanding, it will be impossible to achieve fair and sustainable development.

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Methodology

In conducting this research, I did a thorough search of existing literature in both Thai and English from academic institutions, government offices and other sources. I then interviewed villages and village leaders from areas slated to be affected by the Hua Na Dam, including both those living near the reservoir area as well as those slated to receive water, and have had some contact with villagers affected by the Rasi Salai and Pak Mun dams. I also interviewed people representing NGO and government offices.

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