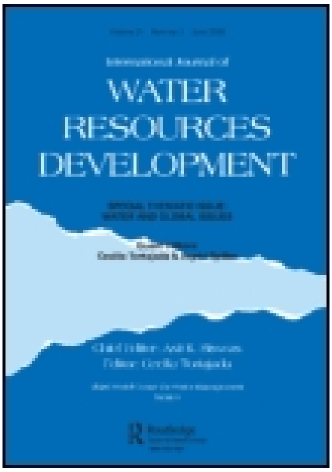

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Mikiyasu Nakayama [a] & Miko Maekawa [b]
[a] Graduate School of Frontier Sciences , University of Tokyo , Japan
[b] Wisdom of Water (Suntory) Corporate-Sponsored Research Program , Organization for Interdisciplinary Research Projects, University of Tokyo , Japan
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Mikiyasu Nakayama[a]* and Miko Maekawa[b]

[a]*Graduate School of Frontier Sciences, University of Tokyo, Japan;* [b]*Wisdom of Water (Suntory) Corporate-Sponsored Research Program, Organization for Interdisciplinary Research Projects, University of Tokyo, Japan*

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Countries with large potential for hydropower generation can seize large benefits by connecting their hydropower stations to transboundary power grids and trading electricity with other nations. Such benefits include income from selling hydropower; construction of hydropower stations not otherwise financially viable; certified emission reduction (CER) credits from a clean development mechanism as defined in the Kyoto Protocol; and allocation of more resources for environment conservation and resettler livelihood rehabilitation. Buyer countries can also reap gains from such a partnership, namely the importing of cheap electricity, diversification of energy sources to improve disaster preparedness, reduction of greenhouse gas emissions, and CER credits in the developing world. Possible shortcomings in terms of regional and domestic uncertainty should be addressed in designing and implementing transboundary power grids so that these impacts are prevented or mitigated.

Keywords: ASEAN; GCC; hydropower; power grid; SAARC

Introduction

Countries in Asia and the Pacific, Japan in particular, have traditionally advocated ‘energy independence’ in terms of electricity supply. Therefore, the power grids of these nations have seldom been connected to those of other states. If any, the amount of electricity traded is very limited.

However, the days of ‘energy independence’ may now be over. Development of (at least) a couple of regional power grids has been suggested in Asia. These days, initiatives towards the development of regional power grids are rapidly emerging. It seems that not energy independence but energy interdependence is the option for the future in Asia, if not everywhere.

Significant progress has been seen in the accelerated construction of power grids in ASEAN (Association of Southeast Asian Nations). It has been agreed to expedite the process and complete the project in the 2020-to-2030 timeframe (Bernama, 2012). This clearly shows the policy transition from independence to interdependence in Asian countries.

Even in Japan, where connection to the energy grid of another country was never seriously discussed in the past, discussions became very active after the energy crisis caused by the Great East Japan Earthquake of 11 March 2011 and the subsequent

*Corresponding author. Email: nakayama@k.u-tokyo.ac.jp

shutdown of nuclear power stations. Masayoshi Son, founder and chairperson of the Japan Renewable Energy Foundation and a communications tycoon, suggested that the existing power grid in Japan be connected to power grids in East Asia (Figure 1) so that Japan could import electricity from Korea, China or Russia (Obe, 2012). This proposal by Son was criticized by the mass media, even before he officially launched the concept (Ikeda, 2011), because many Japanese people are reluctant to rely on power from Korea, China or Russia, with which Japan has territorial disputes about islands, prompting fears of possible 'island or electricity' threats by these countries. Hiroya Masuda, chairperson of the Japan Policy Council, proposed connecting Japanese power grids to those in Asia (see Figure 2) without going through China, Korea or Russia (Masuda, 2012).

These initiatives to develop transboundary power grids require stable and secure supplies in the region. Electricity generation by wind and solar power is expected to increase in future but these systems will still need technological advancements to compete with existing thermal or hydro power stations on installation and operation costs. Among renewable energy sources, hydro is the most established and proven technology to generate electricity and it is also considered one of the cheapest (Matsuo, 2012). Hydropower generation is also reputed to have the lowest carbon footprint among the various power-generation systems (Dey & Lenzen, 2000; Hondo, 2005; POST, 2006). Promotion of hydropower will also contribute to 'greening' electricity generation till more refined technology for solar and wind power generation is established.

For the owner of a hydropower station in a developing country, generally speaking, selling electricity to a developed nation could imply that a higher tariff may be charged than in selling the same amount of electricity to the market of the developing world.[1] This can be realized with a transboundary power grid which connects a 'seller' in the developing world to a 'buyer' in the developed world.[2] Laos, for example, presently sells electricity generated at its Nam Ngum 1 and Nam Theun 2 hydropower stations to Thailand.[3] The tariff of the electricity trade for Nam Ngum 1 hydropower station was said to be less than USD0.02 per kWh (International Rivers Network, 1999), while the same for Nam Theun 2 hydropower station was reported to be USD0.047 per kWh (Greacen & Palettu, 2007). The price of electricity in transboundary trade may be limited to the tariff

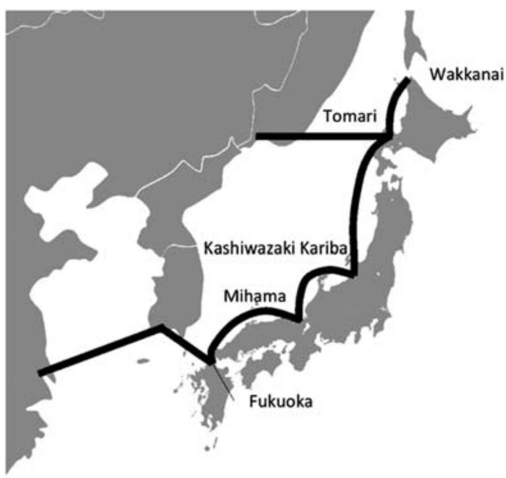

Figure 1. East Asian Super Grid. Source: Son (2011).

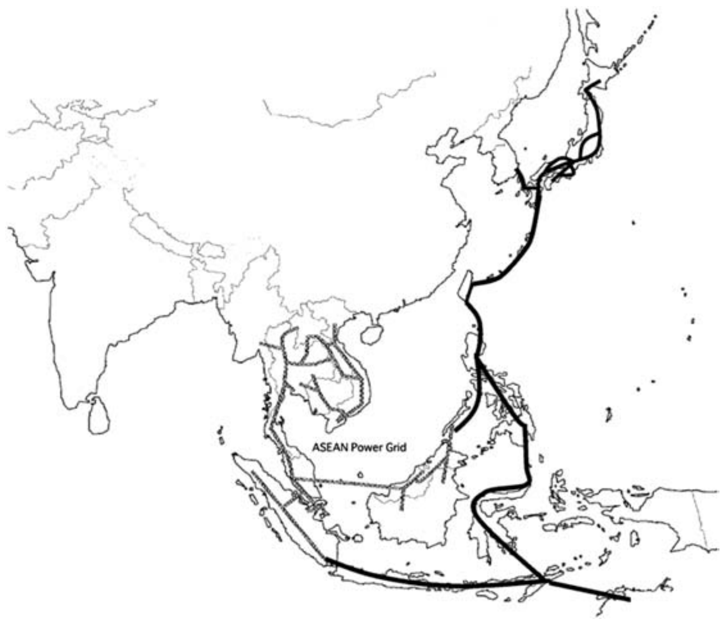

Figure 2. Asia-Pacific power grid proposed by the Japan Policy Council. Source: Masuda (2012).

of electricity in the buyer country. The domestic electricity tariff in Thailand in 2007 was USD0.085 per kWh (World Bank, 2012a). This figure was higher than Laos's domestic tariff of USD0.054 per kWh in the same year. Presently, the domestic tariff in Japan is around USD0.30 per kWh. This high tariff is because the production cost of electricity in Japan by thermal power station is as high as USD0.12 per kWh in these days (Matsuo, 2012). Thus, if Laos were to be connected to Japan by a power grid, Laos could charge a much higher tariff for electricity, simply because Japan can pay more for a unit of electricity than Thailand can.

Bhutan presently sells about 80% of its hydropower to India, with 20% for domestic consumption (Kinga, 2012; Rahaman, 2009; Rahaman & Varis, 2009). The tariff for electricity trade from Bhutan to India in 2007 was (as a matter of fact) as low as USD0.0288 per kWh (Bhutan Power Corporation Limited, 2007). Even today, the tariff is still only USD0.0367 per kWh (Chhetri, 2012). Bhutan may thus enjoy increased income by getting electricity customers other than India.

It should also be noted that some developing countries maintain fairly high tariffs for electricity, e.g. the Philippines at USD0.175 per kWh and Cambodia at USD0.177 per kWh (World Bank, 2012a). This implies that selling electricity to these countries also provides the seller (e.g. Bhutan and Laos) with similar benefits to the trade with Japan but smaller. Developing countries should also be considered potential customers of electricity.

Only a small fraction of Nepal's hydropower potential has been developed. On the one hand, political disorders in the country have hampered hydropower development. On the other hand, India's historical "energy (electricity) independence" policy (Kamat, 2010) may have been another factor which has prevented Nepal from selling hydropower to India. If connection between Nepal and China becomes feasible technologically (thanks to superconducting cable) and politically, connection to transboundary power grids (even beyond China) and subsequent electricity trade with other states may also accelerate Nepal's exploring of its hydropower potential.

If a country may sell electricity at a higher price to a new customer, via a transboundary connection, it may lead to the construction of expensive-to-build but environmentally benign hydropower stations. The income received from electricity sales enables the nations to allocate more money for environmental conservation and livelihood rehabilitation of involuntary resettlers.

However, transboundary power grids are double-edged swords, for they may bring about implications for domestic and transboundary contexts. This article suggests how these potential risks could be addressed to prevent or mitigate negative impacts.

Technical feasibility of regional power grids

Developing a global power grid is not a very new idea. In his 1981 book *Critical Path*, Buckminster Fuller suggested the development of an Ultra-High-Voltage World Electrical Grid to integrate the world's electrical-energy networks. Fuller imagined that continents on this earth could be interconnected with 1500-mile (2400-km) transmission lines. He suggested connecting the American electrical grid to hydropower stations in the extreme north-eastern part of Russian across the Bering Straits.

Fuller is regarded as one of the earliest proponents of renewable energy sources. His extensive energy research documented how we can produce enough energy for everybody in the world while phasing out all use of fossil fuels and atomic energy (Buckminster Fuller Institute, 2012). His global power grid concept would be the essential instrument for realizing this vision.

Some of the proposed super-grid concepts are based on the assumption that superconducting technology and very-low-loss power transmission lines could be put into practical use in the near future, say by 2030 or so. On the order of three to five times the power can be transmitted in a superconducting cable, with the same or less loss, compared to a conventional cable (Jones, 2008). Other proposed regional power grid concepts, however, do not need power lines with superconductors; they can be developed with ordinary (non-superconducting) HVDC (high voltage, direct current) transmission lines.

Can Laos sell hydropower to Japan without superconducting cable? The distance between the cities of Kogoshima in southern Japan and Vientiane in Laos is about 3200 km. This implies that about 4000 km of power line is required to connect the two countries. To put the conclusion first, connecting Laos and Japan by power line is feasible even with existing non-superconducting technology (ABB, 2011).

Asea Brown Boveri (ABB), an electrical-equipment manufacturer based in Switzerland, provided the 2000 km of HVDC transmission line between the Xiangjiaba Dam and Shanghai, which has a transmission capacity of 6400 MW. It is the world's longest and highest-capacity power line, with line efficiency of up to 93% (ABB, 2011). If two sets of this system were connected to span 4000 km, a line efficiency of 86% might be attained. Transmission and distribution losses in the United States as a whole are estimated at 6.1% (ABB, 2007). In India, average transmission and distribution losses are officially estimated at 23% of the electricity generated (Bhalla, 2000). Sending hydropower from Laos to Japan is thus considered feasible with the existing technology.

Connecting Bhutan (Thinphu) to Japan (Kagoshima) would require at least 3900 km of power line. Whilst feasible, connecting these two countries ought to be regarded as an extreme case, with Bhutan in the central part of South Asia and Japan in the far east of East Asia. Countries in between may experience much smaller transmission losses in electricity trade among them, for these countries do not need such long transmission lines for connections among them as would be needed to connect Bhutan to Japan. It would be safe to assume that connecting the power grids proposed by the Association of South East Asian Nations (ASEAN), South Asian Association for Regional Cooperation (SAARC) and Gulf Cooperation Council (GCC) is feasible even with the existing non-superconducting technology and that extending the ASEAN power grid to East Asia (namely Japan and Korea) would be remote but also feasible, even with non-superconducting cable.

Benefits for electricity-selling countries of connecting hydropower stations to transboundary power grids

The following financial and non-financial benefits are envisaged for seller nations of electricity if they connect their hydropower stations to transboundary power grids:

- Increased income from selling hydropower to both developed and developing countries that are willing to buy electricity at a higher price than other nations
- Construction of hydropower stations otherwise not financially viable
- Certified emission reduction (CER) credits through a clean development mechanism (CDM) (International Hydropower Association, 2010)
- Use of additional income from electricity trade for more expenditure for conservation of environment and livelihood rehabilitation of resettlers

Bhutan, for example, presently sells 80% of the hydropower produced in the country to India. This implies that only 20% of the electricity generated is consumed domestically and that hydropower stations are major income generators for the nation. Bhutan has a significant feasible hydropower potential of around 23,760 MW, of which just over 5% has been tapped (World Bank, 2010a). Bhutan thus has many possibilities for further development of hydropower stations and increased national income from export receipts.

Similarly, Laos presently sells electricity only to Thailand. Laos has been selling hydropower to Thailand since 1971, following the completion of the 150 MW Nam Ngum Dam 1. In 1998, the 210 MW Theun Hinboun Dam began selling power to Thailand as well (Greacen & Palettu, 2007). Laos now sells 1000 MW of electricity, produced by the Nam Theum 2 Dam, to Thailand (Souksavath & Nakayama, 2013). Further construction of new hydropower stations is planned, including the Xayaburi Dam to be built on the mainstream of the Mekong River (Watcharejyothin & Shrestha, 2009). Of the 23,000 MW of exploitable potential hydropower in Laos, about 15,000 MW are internal to the country, and the remaining 8000 MW represent the country's share in the mainstream Mekong, jointly with one or more riparian countries (World Bank, 2010b). To date, about 1838 MW of hydropower generation capacity has been installed, with another 1372 MW under construction and 3041 MW in the advanced planning stage with commissioning targeted before 2015 (World Bank, 2010b). Laos can also further develop hydropower stations and increase national income.

The Kyoto Protocol aimed at emission reductions through project-based greenhouse gas (GHG) emission crediting or emission trading. The clean development mechanism (CDM) is one of the measures defined in the Kyoto Protocol to enhance cooperation among industrialized and developing countries in reducing emissions. The CDM is based on cooperation between industrialized and developing-country parties and project participants. It enables the countries with emission reduction obligations to achieve emission reduction credits from projects in developing countries. Once a CDM project has been certified, emission reductions by the project become certified emission reductions (CERs). Industrialized countries may add CERs to their assigned amounts and thereby offset domestic GHG emissions (Streck, 2004).

The CDM allows entities based in developed countries to carry out emission-reducing projects in less affluent ones and generate tradable carbon credits corresponding to the volume of carbon emission reductions. CERs may enable developed countries to offset their GHG emissions, thereby working towards meeting Kyoto targets, while enabling cleaner development in developing countries (International Hydropower Association, 2010).

The Asian Development Bank (ADB) has supported the construction of the Dagachhu Hydropower Project in Bhutan, which will export power to India. The project has been registered as the first cross-border CDM project. The project will help reduce GHG emissions by displacing fossil fuel–based power generation in India with renewable electricity imported from Bhutan. The estimated average annual emission reductions from this project will be the equivalent of 500,000 tons of CO_2 (ADB, 2010).

Countries with high hydropower potential (e.g. Bhutan, Nepal, Laos) are unable to generate additional emission reductions within their own countries by implementing renewable electricity generation projects. This is because their domestic electricity grids are already largely based on renewable hydropower energy, which is already low in GHG emissions. These countries can benefit from CDMs only by exporting clean electricity to neighbouring countries with more carbon-intensive power generators (ADB, 2010). For these nations, connection to transboundary power grids is essential to being entitled to the CDM.

Hondo (2005) calculated the life cycle of CO_2 emission factors for various power-generation schemes and concluded that the life-cycle GHG emissions per kWh of electricity generated are 975 g CO_2/kWh for coal-fired (the highest among thermal power-generation systems), 518 g CO_2/kWh for liquefied natural gas (LNG) combined cycle (the lowest among thermal power-generation systems), and only 11 g CO_2/kWh for hydro (the lowest among all power-generation systems).

These facts imply that a country may save about 0.5 to 1.0 kg of CO_2 emission per kWh of electricity generated by switching the source of electricity from thermal to hydropower generation. However, many developed countries have developed nearly 80% of their hydropower potential. For example, Norway produces 87%, Japan 88%, and the United States 72% of their economically exploitable potentials (World Bank, 2012b). The share of hydropower as a source of energy in Japan is presently around 8% (Agency for Natural Resources and Energy, 2012). Since Japan has very few possible dam sites for further hydropower production, this figure can at best be increased only by a few per cent (Agency for Natural Resources and Energy, 2012). Purchasing ‘clean’ electricity from abroad through transboundary power grids is thus a very attractive option for Japan with respect to meeting power demands without increasing CO_2 emissions.

The amount of additional income from the CDM depends on various factors around a particular hydropower station. While few solid figures are found in articles, as an example, the New Energy Foundation (NEF) has suggested that if a CO_2 reduction unit is 0.5 kg CO_2/kWh and each carbon credit costs USD5 per ton of CO_2, the additional income generated would be USD0.0025/kWh and CO_2 reduction effects would then correspond to between 4% and 8% of the price of electricity (NEF, 2003). The CDM mechanism thus gives substantial impetus to developed countries to assist hydropower development in developing countries.

Developed countries may, as a part of their Official Development Assistance (ODA) activities, create CERs with CDM-certified projects in the developing world. The share of carbon credit revenue is subject to negotiation between the provider of the ODA and the recipient, while no modality yet exists in this regard (Choden, 2012).

Benefits for industrialized countries of purchasing hydropower produced in the developing world through transboundary power grids

Industrialized countries can also enjoy a series of financial and non-financial benefits by importing hydropower from abroad. For instance, they could import electricity from foreign countries at a lower price than domestically produced electricity. This would also bring diversification of energy sources and therefore improvement in disaster preparedness.

Securing cheap electricity should be one of the major attractions for industrialized countries. This is one of the major arguments made by Masayoshi Son in his efforts to connect the Japanese power grid with China, Korea and Russia (Son, 2011). After the Great East Japan Earthquake, the need for diversification of energy sources and subsequent reduction of risk has also been pointed out in Japan as a means of disaster preparedness. Mr Son's Super Grid concept could also help in greening the electricity supply in Japan, because grid connections to China or Korea would enable Japan to purchase electricity from solar power produced in the Gobi Desert in China and Mongolia (Bradsher, 2009).

Increased revenue from selling electricity may induce a resource curse

The concept of 'resource curse', or 'paradox of plenty', refers to the observed phenomenon that countries with an abundance of natural resources, specifically non-renewable mineral resources, tend to have less economic growth than countries which lack these resources. A country's revenue from the selling of natural resources to other nations may accelerate the economic development of the state. It is also an important source of foreign currency, with which the state can reduce dependence on international aid. But the promise of rich natural resources is often spoiled by corruption and patronage, which confer benefits on small groups rather than on the population as a whole (Lujala & Rustad, 2011).

Auty (1993) first suggested the concept of the 'resource curse'. A survey by Sachs and Warner (1995) made this concept widely known. They showed that resource-rich countries tend to enjoy less economic growth compared to resource-poor nations. A recent survey by the United Nations (2010) showed that over the last 40 years, developing countries without major natural resources have grown two to three times faster than those with high resource endowments.

The presence of high-value resources can jeopardize peace (Lujala & Rustad, 2011). Slow-developing, low-income economies largely dependent on natural resources are more likely than others to face the risks of conflicts. This is because in a resource-rich country, various groups tend to struggle amongst themselves to secure concessions to those endowments rather than working together for the development of the country. Collier (2007, p. 5) asserted that:

> countries which have a substantial share of their income (GDP) coming from the export of primary commodities are radically more at risk of conflict. The most dangerous level of primary commodity dependence is 26% of GDP. At this level the otherwise ordinary country has a risk of conflict of 23%. By contrast, if it had no primary commodity exports (but was otherwise the same) its risk would fall to only one half of one percent.

The authors feel that hydropower may also lead to resource curse in some states which benefit from selling electricity to other nations. Provision of a new or additional renewable energy source is like the discovery of a new diamond mine for a state. The risk of the country's entering into civil war may significantly increase, as in the case of resource curse–driven lands.

The share of electricity exports in Bhutan's GDP was 21.8% in 2010, up from 10.1% in 2001 (Gross National Happiness Commission, 2011). Bhutan has the potential to develop a capacity of 23,760 MW, of which only 5% has been tapped. The installed hydropower generation capacity is projected to rise from 1488 MW in 2007 to 1602 MW in 2013. It has also been proposed by the government to add 10,000 MW of capacity by 2020 (World Bank, 2010c). If such a plan is realized, the level of dependence on electricity exports may soon exceed 26% of GDP. If Collier's theory (2007) is applicable to hydropower generation, the risk of destabilization of the nation may increase in Bhutan in a few years. Whether such a risk actually results in unrest within the state or is peacefully controlled by the government may depend on several factors. In Bhutan, which is known to be the most peaceful kingdom in Asia, such a risk may not become a source of national unrest. However, some hydropower-rich countries may be afflicted by the resource curse if the revenue from electricity trade is not used wisely for the sake of their population.

Very little research effort has been made to address the issue of possible resource curse in newly developed renewable energy sources, except by Gennaioli and Tavoni (2011). Their article addresses the possibility of corruption associated with wind power generation in Italy (not in the developing world), as a potential resource curse. Further research should be carried out to figure out how resource curse may manifest in the developing world with emergence of a new renewable energy source, including hydropower. The ways and means of avoiding such resource curse, or mitigating its impacts, should also be sought. Lessons from previous surveys on preventing or mitigating impacts of the resource curse related to various natural resources may provide us with insights.

While a number of resource-rich countries lag behind in economic growth in comparison with resource-poor countries (Sachs & Warner, 1995), notable exceptions are Botswana, Chile, Malaysia and Norway (Luong & Weinthal, 2010; Stiglitz, 2007). To manage developing countries' natural resources, Stiglitz (2007) lists three major principles for governments to follow: *transparency*, pointing out the importance of open and transparent agreements; *ownership*, emphasizing that the developing country should remain the ultimate owner of the natural resource; and *fairness*, stating that natural resource rents belong to the country.

These three aspects, transparency, ownership and fairness, are given critical importance in the literature with respect to avoiding and mitigating the impacts of resource curse. The Norwegian experience provides a vivid example of how a discovery of oil could bring a blessing to the country. From the start of oil production in 1971, Norway grew remarkably. In the early 1970s, Norwegian planners, being aware of the negative impact of so-called Dutch disease, put in place measures to ensure the separation of resource revenues from the rest of the economy, the maintenance of a diverse productive capacity, and a sense of fair distribution of wealth (Gylfason, 2001a, 2001b; Larsen, 2004). In managing its oil resources, Norway decided to own and operate its own oil company, learning management skills from the private sector (Stiglitz, 2007). The government supported certain domestic industries, invested heavily in education, increased employment, issued an expenditure limitation policy of fiscal prudence, and established a transparent petroleum fund (with a limit of usage of 4% of the fund annually) (Larsen, 2004).

Noteworthy lessons can also be drawn from the comparison of former Soviet Union countries, Azerbaijan, Kazakhstan, the Russian Federation, Turkmenistan and Uzbekistan, in handling their mineral resources. Luong and Weinthal (2010) argue, by analyzing the cases of the mentioned five countries and mineral-rich countries around the world, that mineral-rich states are 'cursed' not by their wealth but rather by the structure of ownership of their natural resources. They conclude that, when private domestic companies can own the rights to develop the majority of shares (>50%) in the petroleum sector, this type of ownership yields the best results vis-à-vis full state ownership or private foreign ownership. The problem of full state ownership is that governing elites tend to legitimate their privileged access to mineral rents and at the same time tend to make wide distribution of those rents in response to high social expectations (Luong & Weinthal, 2010).

As Collier (2007) points out, resource dependency on primary commodities creates a risk of conflicts. He also points out that access by rebel groups to financial means generated by natural resources makes conflicts feasible. The example of the Kimberley Process for diamond mining and international marketing is one of the attempts to render the process of diamond trading more transparent to limit illegal access to diamonds and their benefits. The scheme started in 2003, and nearly 50 countries are members, including Botswana, Sierra Leone and South Africa (Maconachie & Binns, 2007). A report compiled by an American consulting firm, Management Systems International, notes that Debswana, a diamond company established in Botswana by the Government of Bostwana and De Beers, produced a gross profit of USD1.5 billion in 2001, with virtually the entire production being exported legally (Maconachie & Binns, 2007). The Kimberley Process is thus very instrumental in maintaining transparency in trade.

Transboundary power grid may impact regional security

The power of a country depends on various factors. Availability of resources (and resulting national income) is one of the major components. Many ‘resource-rich’ countries exist in this world. Many of these countries have more power in their region as compared with ‘resource-poor’ countries in the same region. Venezuela in South America or Nigeria in West Africa may be good examples, due to their oil production.

If a ‘resource-poor’ country develops some new renewable energy source, to the extent that the country becomes comparatively ‘resource-rich’ in the region, this will certainly change the power balance in the region.

Nepal has long been known to be very rich in potential hydropower generation; the amount has been estimated at 42,195 MW (Lama, 2007). However, Nepal presently is unable to enjoy increased national income through the development of new hydropower stations. Nepal has an installed hydropower generation capacity of only 527 WM (Lama, 2007). India is traditionally regarded as its sole potential customer of hydropower, while (as a matter of fact) a large-scale trade of electricity has not taken place between these countries.

If Nepal were connected to other countries, for example with China (assuming that it is technologically and politically feasible) through a super grid, it could develop new hydropower stations and enjoy a significant increase in national income by selling hydropower. This would certainly impact regional security in South Asia.

The United Nations (2005) considers additional international cooperation and conflict avoidance to be potential benefits for regional security from an international grid interconnection. The UN also identified potential threats to regional security, given the effects interconnections could have on international political relations and heightened vulnerability in each nation to political difficulties in other nations.

These possibilities sound reasonable. However, they are more theoretical considerations than lessons learned from past experiences in trading electricity. This may stem from the fact that the trade of electricity in the past was too small, in terms of amount of electricity traded and number of countries involved, to secure useful lessons. In this case, lessons should be sought in examples of ‘connection’ of types of energy sources other than electricity.

Excepting the analysis by Ali (2010), few researchers have carried out case studies of possible impacts of newly 'connected' energy sources on regional security. If shared water or natural gas among states serves as a harbinger of regional sharing of hydropower, it may be suggested that regional interdependence in resources (i.e. sharing of resources) does not endanger but rather enhances regional security. Relations of countries in the Mekong River basin, including China and Myanmar, are closer now, because these countries now have more reasons to share basin water resources than before. Ali (2010) examined pipelines in the Middle East and North Africa and concluded that the pipelines have improved the relations between Algeria and Morocco as well as between Italy and Libya. The pipeline within the Gulf region, passing from Qatar to the United Arab Emirates (UAE), has also contributed to the resolution of border disputes between the UAE and Oman and between Qatar and Saudi Arabia (Ali, 2010). These cases seem to suggest that development of regional power grid may ease tensions among countries in the region.

Research should be carried out to figure out how development of new renewable energy sources may change the economic and political balance of power of a region and how a 'soft landing' of such changes could be realized, without a significant impact on the security of the region.

Conclusions

The idea of providing Japan with electricity from solar power collected abroad is not very new. Kuwano in 1989 proposed the GENESIS project, aimed at supplying energy to the world exclusively through photovoltaic power generation. Based on projections of future global energy consumption, an area of land approximately 800 kilometres square (only 4% of the total existing desert area of the entire world) would be enough to meet the energy needs of all human beings (Hata & Isojima, 2009). The GENESIS project assumed that a global electric power network (with superconducting cables) would be built to interconnect and expand solar and wind power generators around the world (Hata & Isojima, 2009). Kuwano's GENESIS proposal was purely from an engineering viewpoint and few considerations were made of security implications.

The recent proposals for connecting Japanese power grids to those abroad by Son (2011) and others have more chances (compared to the GENESIS project back in 1989) of being realized, because Japan's purchasing electricity from abroad was not considered a viable option before the Great East Japan Earthquake (Son, 2011). Considerations should be made regarding the security implications (both domestic and regional) of these proposed transboundary power grids. Preliminary interviews with some of these Japanese organizations[4] reveal that the issue of security implications has not yet been addressed.

This article has tried to show, under the mentioned circumstance, how the issue of domestic and regional security issues should be addressed regarding the proposed transboundary power grids. Needless to say, more research efforts should be made to secure more clear-cut answers to the research questions. The authors, however, feel that (a) the development of transboundary power grids in Asia and the Pacific region is technically feasible; (b) the implications for domestic security (due to the resource curse) may be either avoided or effectively mitigated; and (c) the issue of regional security issues should be dealt with carefully, while fatal problems in this context may be prevented through efforts by the countries involved.

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Notes

1. A developing country starving for electricity (e.g. Bangladesh) may also offer a high tariff to purchase electricity from a developing nation.
2. A 'buyer' offering a high tariff could be a developing nation in some cases.
3. These dams are controversial in terms of their impacts on natural and human environment (Souksavath & Maekawa, 2013; Souksavath & Nakayama, 2013).
4. Interviews with relevant Japanese organizations were carried out under the condition that names of the organizations would be kept anonymous.

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