Forests and Water: A Policy Perspective

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Abstract

Asian policymakers need to know how changes in land uses and practices related to forests affect flooding, dry season stream flow, and water quality. Based on their beliefs about these relations policymakers often ban logging or introduce expensive projects. Many key stakeholders believe that logging and deforestation increase flooding and the damage floods cause, but there is only evidence for this in relation to smaller and less severe floods. It is also widely believed that logging and clearing forest reduce dry season stream flow, but whether that actually occurs depends on rainfall patterns, soils, topography, geology, and the type of vegetation. Forests generally improve water quality, although not always. More research is needed on the magnitude of the water quality effects, particularly as regards drinking water.

Key words: hydrology, policy, floods, water, logging, deforestation

Introduction

The news media in Asia always runs stories about how logging and deforestation lead to major floods. For example, in November 2003 a big flood swept through Bohorok in North Sumatra and over one hundred people were killed. Indonesia's President, Megawati Sukarnoputri, the Minister of Environment and the Vice-President blamed illegal logging (CNN, 2003). However, the Minister of Forestry said illegal logging had nothing to do with it. Then local NGOs attacked the Minister for defending the logging companies. The press printed stories about the disagreements, but no one made much effort to find the truth.

Logging bans

Trying to figure out how deforestation and logging affect flooding is an important policy issue that can have huge implications for millions of people.

The best example is China. After the catastrophic flooding of the Yangtze and Yellow Rivers in 1999 that killed thousands of people and caused thirty billion dollars in damages, the government banned logging in large parts of the country. More than one million people lost their jobs as a result of the ban (Yuexian, 2001). The Chinese logging ban also had a great impact on

the forests of Russia, Indonesia, Myanmar and Papua New Guinea. Since the Chinese stopped cutting their own natural forest they had to import large amounts of forestry products, and that encouraged widespread illegal logging (Sun, Katsigiris and White 2004).

It was the same story in Thailand and the Philippines. Both those countries banned logging after politicians and the press blamed loggers for creating floods, and many people lost their jobs as a result (Guiang 2001; Lakanavichian 2001).

Forests and floods

The basic theory about why forests should reduce flooding is simple (Bruijnzeel 1990). First, forests have higher levels of evapotranspiration, and all the extra water that returns to the sky is not available to cause flooding. Second, more forest means more water will sink into the ground, rather than run off to the streams and rivers and cause floods. Third, forests generally have lower levels of soil erosion. So less soil fills up the streams and rivers that could make them shallower and easier to flood.

The reality is more complex, and even though foresters have been looking at this issue for more than a century scientists still cannot answer some key questions.

If one looks at catchments smaller than about one hundred square kilometers, the results look pretty much like as one might expect. More forests mean smaller floods. However, when one looks at much larger watersheds or tries to analyze the massive floods that kill thousands of people and cause billions of dollars in damages the results are less clear. Most studies that have looked at large-scale and major floods have not been able to detect a strong relation with either deforestation or logging (Calder 1999; Chomitz and Kumari 1998; Enters 2000; Watson, Vertessy, and Grayson 1999).

There seem to be four main reasons why scientists have been unable to show that land use changes affect larger and more severe floods the same way they affect smaller and less severe floods.

The first reason is poor data. It is difficult to get as good a long-term data set for large watersheds as one can have when he or she does a small-scale catchment experiment. That is particularly true in the tropics. Poor data makes it hard to see what is going on.

The second problem is that in most large catchments forest clearing and logging affect a smaller percentage of total area than in small catchments. A controlled catchment experiment can completely modify the land use in one location and leave the second location unchanged and analyze the difference. However, scientists cannot control land use in large watersheds and the land use changes that occur there usually affect only a fraction of the total area, so they are harder to detect. Large watersheds also have a lot of confounding variables that make it harder to separate out the specific role of land use change. For example, the amount of water consumed for irrigation or household use is likely to be changing at the same time that land use changes.

A third aspect when you are dealing with large watersheds is that generally it only rains in one part of the watershed and not in others. Flooding is more likely to happen on those rare occasions when it rains throughout the watershed, rather then just in one part. In large watersheds that aspect is likely to have a greater influence on flooding than whether the forests have been logged, but it isn't relevant for small watersheds.

Finally, forests only help to make rainfall flow into the ground rather than into the rivers and streams until the soil becomes saturated. After that, the water stops infiltrating into the soil and it all flows into the waterways. When you have really major floods the soils become saturated early on; and once they are saturated it does not matter whether you have forest (Lull and Reinhart 1972).

In summary, everything suggests that logging and forest clearing is less important in large and severe floods than in minor ones, but much is still not understood. Meanwhile politicians and the news media keep blaming most big floods on logging.

Forests and dry season stream flow

The situation when it comes to the relation between forests and dry season stream flow is similar. Only here the science is even more complicated.

In many countries local people and politicians say that streams and rivers have dried up because forests have disappeared. And many governments and non-governmental organizations promote tree planting to bring back the water in the dry season and recharge the aquifers.

In this case the simple theory gives more mixed results (Bruijnzeel 1989). On the one hand, forests usually have higher levels of evapotranspiration than other types of vegetation, so more water gets lost from the system back into the atmosphere. That means that the total annual water yield generally lower if there is a forest. The result will be less water, not more.

On the other hand, if there is well established forest cover, it is likely that more of the water that does fall will inflitrate into the soil, rather than quickly running off. Some water that flows into the ground in the rainy season may not reach the streams until the dry season. So the percentage of total water available in the dry season should be higher. Thus, it is hard to know if having trees is more likely to lead to there being more water in the rivers and streams in the dry season or not. In some cases having trees will yield more water in the dry season and in some situations it will yield less. It depends on the climate, soil type, topography, geology, and vegetation, and how the land is managed.

Scientists do know some basic things. They know it is important to maintain cloud forests, particularly in drier areas, and that mature natural forests are less likely to dry an area than young fast growing plantations. Yet much is still not known. That is a major problem from the policy perspective because governments spend large amounts of money to encourage farmers to plant trees, and often they don't really know if they are making things better, or worse.

Maintaining clean water

As shown above, a surprising number of things still remain unknown about how forests affect stream flow. One thing that is known with some certainty is that forests help to keep water clean (Calder 1998; Chomitz and Kumari 1998). Soils under forests usually erode less and

provide a filter that helps to remove metals and chemicals. Trees also provide physical barriers that keep people and animals away from the water.

Those things are important. But it is one thing to say that and another to demonstrate it. Much more research is needed to document how many lives and how much money forests can save by keeping water clean. Many studies show how forests can help keep soil from from silting up large hydroelectric dams, but fewer focus on how forest can protect drinking water and irrigation canals. That area that needs much more work. There is also a need for more research about how much forest is needed to keep water clean and where it needs to be. In many cases it could be enough to keep some small strips of forests around the streams, rivers, and reservoirs, but no one really knows for certain.

Using research to make sound policy

Clearly, water is important. It is important to politicians, to the press, and to people's daily lives. Everyone wants to ensure they have enough clean water when they need it and that flood don't cause excessive damage.

Forests and trees influence how much water people have, when they get it, and how clean it is. But they often do so in ways that differ from what people expect. And even though scientists have been researching the topic for a long time in many cases they are still not very good at predicting how different land use changes will affect what happens to the water.

Policy makers in Asia have taken many measures designed to stop flooding and keep streams and rivers from drying up. These efforts have cost a lot of jobs and money and have not always achieved the desired outcome. In some cases they have even made the situation worse. Meanwhile, other measures that probably should have been taken haven't been.

Scientists need to help other people understand these things and work hard to understand them better themselves. These problems are often complex, and rarely have simple solutions. And it is important to be honest about the results of the research – even if sometimes it means that it would be better to have less forest.

Research by Japanese scientists can offer a lot of useful insights about this topic.

Combining together good research on forest hydrology with good research on forest policy can save money and jobs and can give people the clean water they need when they need it. In many cases it can also save forests.

Literature Cited

Bruijnzeel S (1990) Hydrology of Moist Tropical Forests and Conversion: A State of Knowledge Review. UNESCO International Hydrological Programme, Paris.

Bruijnzeel S (1989) (De)forestation and Dry Season Flow in the Tropics: A Closer Look. Journal of Tropical Forest Science 1, pp. 229-243.

Calder I (1999) The Blue Revolution, Land Use and Integrated Water Resources Management. Earthscan Publishers, London.

Calder I (1998) Review Outline of Water Resources and Land Use Issues. SWIM Paper 3, International Irrigation Management Institute, Colombo.

Chomitz KM, Kumari K (1998) The Domestic Benefits of Tropical Forests, A Critical Review. World Bank Research Observer, 13/3, pp. 13-35.

CNN. (2003) "Sumatra Flood, Loggers Face Action", November 6, CNN.com.

Enters T (2000) Methods for the Economic Assessment of the On- and Off-Site Impacts of Soil Erosion. Second edition, International Board for Soil Research and Management, Bangkok.

Guiang, ES (2001) Impacts and Effectiveness of Logging Bans in Natural Forests: Philippines In: Durst, PB, Waggener, TR, Enters, T, Cheng TL (eds) Forests Out of Bounds: Impacts and Effectiveness of Logging Bans in Natural Forests in Asia – Pacific. Food and Agricultural Office of the United Nations (FAO), Bangkok, pp 103-136.

Lakanavichian S (2001) Impacts and Effectiveness of Logging Bans in Natural Forests: Thailand In: Durst, PB, Waggener, TR, Enters, T, Cheng TL (eds) Forests Out of Bounds: Impacts and Effectiveness of Logging Bans in Natural Forests in Asia – Pacific. Food and Agricultural Office of the United Nations (FAO), Bangkok, pp 167-184.

Lull HW, Reinhart KG (1972) Forests and Floods in the Eastern United States. United States Department of Agriculture, Forest Service Research Paper NE-226.

Sun, X, Katsigiris, E, White, A (2004) Meeting China's Demand for Forest Products: An Overview of Import Trends, Ports of Entry, and Supplying Countries, With Emphasis on the Asia – Pacific Region. Forest Trends, Chinese Center for Agricultural Policy, and Center for International Forestry Research, Washington D.C.

Watson FG, Vertessy RA, Grayson RB (1999) Large-scale Modeling of Forest Eco-Hydrological Processes and their Long-term Effect on Water Yield. Hydrological Processes 13, pp. 689-700.

Yuexian, Y (2001) Impacts and Effectiveness of Logging Bans in Natural Forests: Peoples Republic of China In: Durst, PB, Waggener, TR, Enters, T, Cheng TL (eds) Forests Out of Bounds: Impacts and Effectiveness of Logging Bans in Natural Forests in Asia – Pacific. Food and Agricultural Office of the United Nations (FAO), Bangkok, pp 81-102.