**Ecosystem Type: WETLANDS**

**Category: Natural Hazard Mitigation**

1. **Materials**

***Supplier*** – Wetlands supply oxygen during natural hazard events. For example, wetlands have the ability to adsorb wastes that come from volcanic eruptions, such as carbon dioxide and sulfur dioxide (NASA, 2017; Mikutta and Rothwell, 2016). When wetlands transform both carbon dioxide and sulfur dioxide into their organic state, the plants release clean oxygen to the air. The process of plants using carbon dioxide and releasing oxygen is photosynthesis. Oxygen also leaves these ecosystems through transpiration, which is the loss of water vapor from wetland leaves (Shoemaker, W.B. et al., 2015; Huryna, H., Brom, J., and Pokorny, J, 2014). Lastly, wetlands provide foundations for properties susceptible to degradation, especially development on the coast vulnerable to sea level rise.

***Driver*** – Transforming wetlands into alternative land use affects the way that these ecosystems mitigate natural hazards such as providing oxygen for clean air during a volcanic eruption. For example, draining wetlands for agriculture and development increases the rate of subsidence (Sidle, Benson, Carriger, and Kamai, 2013). Subsidence is the collapsing of soil and rock mostly due to human activities including the extraction and draining of water. The collapse of soils is accelerating the loss of wetlands (Sidle, Benson, Carriger, and Kamai, 2013). This loss reduces the number of wetlands that can provide clean air services to mitigate natural hazards like volcanic eruptions. The draining of wetlands also creates a risk for existing landowners who rely on the foundation these ecosystems provide for coastal properties (Sidle, Benson, Carriger, and Kamai, 2013). As coasts degrade from subsidence, these properties are more susceptible to irreversible and expensive damages.

***Demander*** – not applicable

1. **Nutrition**

***Supplier*** –not applicable

***Driver*** -not applicable

***Demander*** - not applicable

1. **Energy**

***Supplier*** –not applicable

***Driver*** -not applicable

***Demander*** - not applicable

1. **Mediation of Waste, Toxics, and Other Nuisances**

***Supplier*** – Wetlands clean wastes that result from natural hazard events such as flood events, volcanic eruptions, and fires. Research shows that wetlands treat metals, toxics, and wastes from water (Qasaimeh, AlSharie, and Masoud, 2015; Westbrook, Brunet, Phillips, and Davies, 2011; Functions and Values of Wetlands, n.d ). In fact, rice paddies in eastern India survived a cyclone that hit in 1999 because wetlands that buffered the crop filtered out polluted floodwater (World Wetlands Day, 2017). Wetlands have also been documented to clean out oils, which can be useful for natural hazards that may cause an oil spill (Groudeva, Groudev, and Doycheva, 2003).

***Driver*** – Land cover affects the ability of wetland plants and animals to filter and adsorb pollutants for natural hazard mitigation. Removal of wetlands for agriculture and development can aggravate the loss of wetlands. This will decrease the land available for naturally filtering out toxics.

***Demander*** – not applicable

1. **Mediation of Flows**

***Supplier*** – Wetlands supply terrestrial and aquatic species to control the flow of water and sediment loads that result from natural hazards. For example, in 2012, wetlands helped to avoid more than $625 million in damages from Hurricane Sandy (World Wetlands Day, 2017). Specific types of wetlands, like mangroves, have dense roots that help bind and build up soils to slow down water and reduce erosion (Gala and Young, 2015; Spalding, Mclvor, Tonneijck, Tol and van Eijk, 2014). This is important for coastal development susceptible to land subsidence and sea level rise. It is crucial to note that wetlands will not *prevent* flooding, but rather lower flood peaks and dissipate downward momentum of floodwaters (Gala and Young, 2015; Functions and Values of Wetlands, n.d.). For example, a wetland decreased floodwater volume by 3.7% in the Rate river watershed of Manitoba (Gala and Young, 2015).

***Driver*** – Transforming wetlands into agricultural and development lands decreases the ability for wetland species to control the flow of water and sediment loads. Increased urbanization can increase the nutrient loading in wetlands. This may cause the wetland to exceed its capacity to retain pollutants, reducing the ability for them to perform nitrification, sedimentation, and adsorption (Bassi, Kuma, Sharma, and Pardha-Saradhi, 2014).

***Demander*** – no literature review available at this time

1. **Maintenance of Physical, Chemical, and Biological Indicators**

***Supplier*** – Wetlands supply terrestrial and aquatic species that filter water and trap sediment that comes from flood events. Wetlands can trap sediments using their roots, which slows down the rate of erosion after an event (Gala and Young, 2015; Spalding, Mclovor, Tonneijck, Tol, and van Eijk, 2014). As result, the wetlands will prevent the distribution of nutrients that are adsorbed onto the sediment particles. This is especially important for reducing the amount of potential phosphorous loading in water resources.

***Driver*** – Wetland functions change when land use modifications occur around them. During natural hazard events, wetlands get impaired with contaminated flood and rainwater. The effects of this contamination is exacerbated when land is changed into agricultural and development purposes. Urbanization changes in the National Capital Territory of Delhi impaired over 232 wetlands that can no longer be revived (Bassi, Kumar, Sharma, and Pardha-Saradhi, 2014). A reduced number of wetlands can increase issues that occur from natural hazards like increased flooding and unstable land cover.

***Demander*** – not applicable

1. **Spiritual, Symbolic, Religious, and Social Experiences**

***Supplier*** – not applicable

***Driver*** – not applicable

***Demander*** – not applicable

1. **Physical and Intellectual Interactions w/ Biota, Ecosystems, and Land/Seascapes**

***Supplier*** –not applicable

***Driver*** -not applicable

***Demander*** - not applicable

**Sources:**

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