Curtailing Deforestation in Indonesia: Improving Forest Mapping and Monitoring using Drones Technology

Indonesia is home to one of the world's largest tropical forest, mangrove, peat land, and biodiversity; more than 130 million hectares of forest in size.[1] At the same time, Indonesia is also the fourth most populated country in the globe and the largest growing economy in South East Asia. Many times, Indonesian Government faces policy problems in balancing between growing the economy through its exploitative measures or preserving the environment and the ecosystem. Unable to benefit environmental protection in real values, the economic interests almost constantly prevail.

The most apparent environmental destruction is deforestation. Indonesia has been losing its forest since 1950 with an alarming rate. According to a new report published in the Nature Climate Change journal, Indonesia now has the highest rate of deforestation in the world.[2] As much as 6 million hectares of forest was lost between 2000 and 2012. The largest forest losses occurred in Sumatera and Kalimantan Islands, the two of the three largest islands. The forest mainly converted into logging and plantation concessions. Yet, a large portion also has turned into degraded land. The resulting environmental damage and biodiversity loss is frightening.

Not only that, since deforestation in those islands has been complemented with forest fire, the excess of smoke has created massive haze in the region, crossing the boundaries of the neighboring countries. Indonesia's Disaster Management Agency recorded nearly 50,000 Indonesians are suffering respiratory ailments during the 2013 South East Asian haze crisis. Global Forest Watch detected 3,101 "high confidence" fire alerts on the island of

[1] Indonesian Statistical Agency. Forest Area by Provinces. 2014. http://www.bps.go.id/tab_sub/view.php?kat=3&tabel=1&daftar=1&id_subyek=60&notab=4

[2] Time Magazine. "Indonesia no has the highest rate of deforestation in the world". 2014. http://time.com/2944030/indonesia-now-has-the-highest-rate-of-deforestation-in-the-world/

Sumatra in February to March in 2014 alone, substantially more incidences than 2013 in the same period. According to World Resources International, roughly half of the fires are burning on land managed by pulpwood, palm oil, and logging companies.[3] Yet, the blame passed around among government officials, logging and plantation companies, local farmers, and indigenous communities. Unfortunately, the law enforcement so far has been successful to prosecute the most vulnerable people; the local farmers and indigenous communities.

The inability of the government to tackle deforestation is reasonable considering the vast forested area to be managed with limited resources available. Some factors that have been identified as critical barriers include:

- Lack of accurate and comprehensive geospatial information
- Unclear designation of productive and protected forest boundaries
- Overlapping logging, plantation, and mining concession licenses
- Inadequate quantity and capacity of rangers and equipment on the ground
- Insufficient budget allocated in forest monitoring, supervision and control
- Low awareness and understanding of the government officials[4]

Despite those challenges, the government remains subjected to do all the work; enforcing the law, protecting the environment, and managing the forest sustainably. This is proven to be ineffective. The clearest example would be the failure of the Ministry of Forestry to provide an accurate forest map. Until 2012, only 12% of the total forest has been clearly delineated[5]. As a result, tenure conflicts have been thriving in the forest boundaries.

[3] World Resources Institute Blogs. 2014. "Fires in Indonesia Spike to Highest Levels Since June 2013 Haze Emergency." http://www.wri.org/blog/2014/03/fires-indonesia-spike-highest-levels-june-2013-haze-emergency
[4] World Resources Institute. 2014. "Indonesia's Forest Moratorium: Impacts and Next Steps." http://www.wri.org/sites/default/files/indonesia-forest-moratorium-next-steps.pdf
[5] World Wild Fund Indonesia. 2014. Indonesian Natural Resources Management should be Focused on People. http://www.wwf.or.id/?27040/Pengelolaan-Sumber-Daya-Alam-Indonesia-2012-pro-kapital-2013-Pemerintah-harus-Pro-Rakyat

According to a report, there were more than 300 tenure conflicts in 2013 alone.[6] This report indeed has not covered all 19,420 villages around the forest. Indigenous people are the one most vulnerable in this conflict, frequently driven out from their land to accommodate expanding concessions.

Other unresolved problem is forest monitoring. In a concessional area, the company is responsible to monitor and manage the forest. In a protected area, police rangers are dispatched to patrol the forest. For both instances, the deployed personnel will not be able to cover the area. Currently, there are only 3,122 forest rangers to cover an area of 132 million hectares of forest, far from 1:500 hectares ideal ratio.[7] It is clear that this impose a huge blind spot in forest monitoring, supervision, and control.

The government needs to find better approach to manage the forest, starting with clearly designate and map the forest boundaries. In 2011, Indonesian Government initiated the One Map Movement to start developing accurate and accountable geospatial information in single portal and database.[8] Geospatial Information Agency, National Space and Aviation Agency, and other ministries have been working together to provide reliable maps and satellite images, supported by international organizations such as United States Forest Service, Norway Government, United Nations, World Resources Institute, etc. The resulting geospatial information is referred for other policies, such as the national moratorium on new forest licensing.

Though encouraging results in the policy side have been achieved, the situation on the ground is still susceptible to violation and destruction. Even

[6] Mancayo, Andiko S. 2013. “Indonesian Forest Tenure Struggle since Reformation”. http://www.academia.edu/6282012/Pergulatan_Tenurial_Hutan_Indonesia_Paska_Revormasi
[7] Metro TV News. 2014. “The quantity of forest rangers is far from ideal”. http://news.metrotvnews.com/read/2014/06/18/254377/jumlah-polisi-hutan-jauh-dari-ideal
[8] World Resources Insitute. 2014. Building National Forest and Land Use Systems: Lesson from Cameroon, Indonesia, and Peru. http://www.wri.org/sites/default/files/land-use-infomation-systems_working_paper.pdf

the forest moratorium failed to repress the increasing rate of deforestation and forest fire events. Effective and efficient practical solution need to be rolled out quickly by the government using the available resources. New technology should be utilized to improve surveying, mapping, monitoring, supervision and control in the forest. The government should share its workload by working together with the businesses, NGOs and civil societies.

The advent of Unmanned Aerial Vehicle (UAV) technology, or drones, complemented by high resolution imaging and radar, has revolutionized the landscape of mapping and surveying. Even though satellite can produce an image on a large area, the level of accuracy and resolution is varied to many factors, such as cloud cover, processing power, etc. Drones can fill that gap. Equipped with high resolution camera, drones can produce image that can be later processed into maps with higher accuracy. Survey and mapping purposed drones has been manufactured and operated in developed countries, such as United States.

In other field, drones are also utilized for military and intelligence purpose. Military drones have been deployed in a long range mission to collect accurate information in the enemy territory. The drones can even launch missiles to kill and destroy valuable target. All of which are done without jeopardizing the life of a pilot.

Private companies have already taken benefit from drones' technology, such as in mapping and surveying for mining explorations. By using drones instead of helicopters, the cost for surveying can be reduced up to 90%.[9] There is more precedence where drones technology is used beyond profit seeking activities. A project in Namibia succeeded to gather 500 volunteers to save rhinos and other wildlife from poaching at a wildlife reserve by

[9] Mining Global. 2014. "The Mining Sector Puts Drones to Work." http://www.miningglobal.com/tech/1167/The-Mining-Sector-Puts-Drones-to-Work

analyzing aerial photos.[10] For some law enforcer, drones already expected to be used for investigation and crime-scene mapping.[11]

The examples above signify the benefit of drones' technology in survey and mapping, gathering intelligence and evidence, and even initiate other particular action. These approaches can be used and adapted in the forest mapping and monitoring in Indonesia. Drones can be deployed in multiple locations to produce accurate forest maps and gather valuable information on the ground, particularly violations and crimes. In an appropriate scale, drones can cover the skies of Indonesian vulnerable forest strategically. Since anyone can take advantage of this technology, a joint working group among government officials, businessmen, civil societies and local communities can be developed to share tasks and responsibilities in forest mapping and monitoring.

If drones technology could be operational for forest mapping and monitoring, there are some potential impacts to follow:

- The bottleneck in accurate and comprehensive geospatial information, particularly in forest area, can be solved relatively quickly. Ministry of Forestry, in cooperation with Geospatial Information Agency and National Space and Aviation Agency, could then release an authoritative and clearly designated forest map that must be referred by every party. It will resolve concession overlap and increase law certainty for the concessions.

- Forest patrol can be done much easier, cheaper, and safer. Forest rangers, Local Governments and Police, businesses and local communities can work together in a task force to monitor, supervise and control forest

[10] CNN Opinion. 2014. "'Where's Waldo' ... but for science." http://www.cnn.com/2014/09/30/opinion/sutter-wildlife-crowdsource/
[11] North Bay Business Journal. 2014. "Drones show high promise for assisting law enforcement." http://www.northbaybusinessjournal.com/99938/drones-show-high-promise-for-law-enforcement/

area in their vicinity. It will provide accurate information and evidences on violation, breach, illegal logging, and forest fire incidences quickly. The impact should considerably diminish the incidences in 1-3 years; significantly reduce deforestation and forest fire in vulnerable forest area.

- The drones can also be utilized by indigenous communities to map their customary land for land title registration and village planning purposes. It will help them secure their land and minimizing tenure conflicts. In addition, marginalized and vulnerable communities can develop a better way to manage their natural resources sustainably.

- This technology can also be used by authorities in safety and security (search and rescue, monitoring and providing information from dangerous and difficult locations, disaster relief), health care (delivering medicine), exploration and development (aerial photography and remote sensing), and productivity (stockpile mapping, mine mapping & reconciliation and time lapse photography). It will improve data management and utilization for policy design, implementation and evaluation, both locally and nationally.

- In nature, the platform promotes transparency and accountability in forestry management, providing realtime situation of what is going on at the ground, from concession area to protected forest.

Drones technology utilization is one of the effective and efficient way in benefiting from Science, Technology, Innovation and Partnership. There are already a fast growing industry and civil society movement working in UAV platform. We could start with already ongoing partnership and movement, such as Micromappers, Aerial Clicker, and Drones Adventure, to a more scalable countrywide program. This will open opportunities for social

entreprenurs and high-tech startups to start their work in developing countries such as Indonesia.

We will harness cross-sectored cooperation by working together with national and international governments, law enforcers, business groups, research groups, think tank agencies, NGOs and crowd-sourced volunteers from around the world. This will be collaboration at work across borders to curtail deforestation in Indonesia, and beyond. It will foster creative solutions to global development challanges using advent technology, like drones, tackling one blind spot at a time.