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Focusing the lens of Conservation: A look into the Caimpugan Peatswamp forest of Caraga and its role in mitigating climate change

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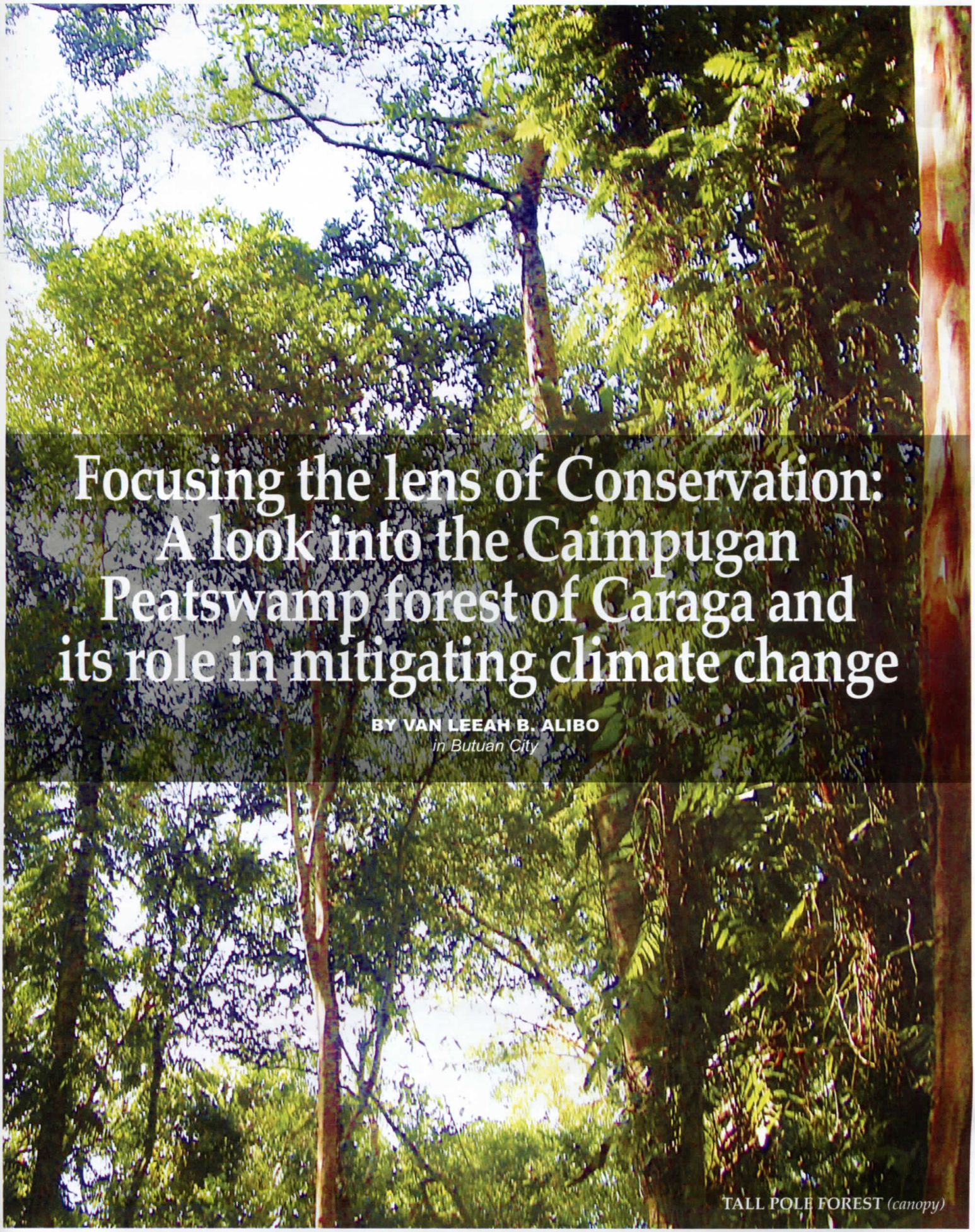

TALL POLE FOREST *(canopy)*

Irrefutable. Not one can argue the vital role of forests in mitigating the impacts of climate change. With half of a tree's biomass as carbon, forests hold substantial carbon pools that mitigate the emission of greenhouse gases back to the atmosphere. The release of this stored carbon aggravates global warming which brings consequential irregularities in our climate system. The impacts of climate change have put people in marginal areas to vulnerable positions when natural disasters strike such as typhoons, flashfloods and landslides to name a few. Since man is inevitably a part and parcel of the environment, conservation of natural resources is considered fundamental to ensure human survival.

Responsive. Philippines is a country responsive to the call of conservation. With an economy heavily based on natural resource extraction, local institutions have been involved in many forest conservation initiatives since decades past. Alarmed by the rapidly decreasing rate of forest cover in the country and the need to attain the delicate balance between development and ecological integrity, collaborative efforts have been done in selecting priority forest conservation sites. However, something is still amiss. What has been signed and stipulated as conservation sites on paper are barely protected on the ground. This issue requires a zooming in of our lenses. Unless this disparity between existing policies and actual on-site implementation is not addressed, then all the lengthy discussions in the upper and lower houses to have a bill passed shall be made futile. **Almost Overlooked.** Inasmuch as all natural ecosystems play important roles, it is never possible to conserve all of them. Doing so would entail high economic costs and jeopardize development. Hence, conservation requires the ability to identify key ecosystems as priority areas. What has been overlooked so far are the peatlands—or better yet peatswamp forests. It would not surprise me if this would be your first time to hear of such kind of forest. This is because of its rarity and often times its misidentification as a marginal land. The plight of its unpopularity compared to other forest types in the country has lead to its relative ease for exploitation and land use change. On the basis of many topographic positions and humid climate conducive for peatswamp forest formation in the country, it is quite strange that only few peat areas have been identified at present. If the pace of degradation outruns our ability to identify these vital ecosystems, then conservation programs might be a little late.

Positively serendipitous, portions of the Caimpugan peatland is situated within the delineated boundaries of the Agusan Marsh Wildlife Sanctuary (AMWS) under the National Integrated Protected Areas System (NIPAS). This protected area is within the Northeastern Mindanao Key Biodiversity Area (KBA). With the proposed expansion of the AMWS boundaries, the whole of Caimpugan peatland will be covered.

This article shall try to present the reasons why the protection of peatswamp forests, most specifically in Caimpugan, Agusan del Sur, is of primary importance and urgency. This is basically a call for existing conservation policies to be stringently implemented. Peatlands are not just any other ordinary forest types. These are irreplaceable ecosystems, and are too costly when left undervalued.

1. Peatlands in general, which includes peatswamp forests are **globally important ecosystems being the most carbon-dense ecosystems of the terrestrial biosphere** (Holden, 2005).

In the advent of climate change, curbing greenhouse gas emissions has been a global agenda. This concern has called for the urgency of protecting natural carbon sinks. With the role that peatlands play in significantly sequestering and storing carbon, it is time to bring on the spotlight to these ecosystems.

Located in the northeast portion of Agusan Marsh, Caimpugan peatland alone is estimated to store 22.9 million tons of carbon (Alibo et al.,, 2011) with an average of 4,742.305 tC per hectare. Analysis of satellite images show that the area is a 5,437 hectare peatswamp forest covering the provinces of San Francisco and Talacogon in Agusan del Sur. These estimates are within the range of estimates of Rieley (2008) for tropical peatlands which is 150-250 tC/ha for aboveground and 250->5,000 tC/ha for belowground. The key C pool in the peatland ecosystem is its peat soil which in the case of Caimpugan is 25 - > 300 times higher than its combined aboveground C storage. Total C storage estimates of Alibo et al., (2011) for Caimpugan peatland are remarkably higher than any other studied forest types in the country. For natural forests in the Philippines, recent studies report that they contain 86-201 tC/ha while old-growth forests was estimated to contain 185-260 tC/ha (IPCC, 1996). At present condition, the peatland is considered an active site in storing C and if conditions for its perpetuation are maintained, can serve as an efficient long-term C sink.

These significant C sinks cover only three per cent or some four million sq. km of the Earth's land area *(Parish et al., 2008)* but is equivalent to 30% of terrestrial carbon , 75% of all carbon in the atmosphere, 90% of all carbon stored global plant biomass and twice the carbon stored in forests **(***Parish et al., 2008)***.** A conservative estimate of the C storage of Southeast Asian peatlands is 52 Gt of which is 10-26 per cent of the total global peat carbon store (Page et al., 2008).Tropical peatlands make a significant contribution to terrestrial carbon storage because of their relatively faster peat and carbon accumulation rates resulting to considerable thickness and higher carbon content (Immirzi & Maltby, 1992). Carbon is stored in peatlands as carbon is taken up by plants and become assimilated in their tissues during the process of photosynthesis. The anaerobic condition in the waterlogged peatswamp forest retards decomposition of organic matter sourced from the aboveground vegetation. As net accumulation of organic matter over decomposition prevails, so is carbon continually stored and being prevented from release back to the atmosphere.

2. Caimpugan peatland is **important in biodiversity conservation as a highly rare ecosystem,. It is perhaps the only remaining example of this kind of forest in the whole country** .

More technically, the Caimpugan peatswamp forest is identified to be an ombrotrophic peatdome. Peatdomes or bogs are specific peatland types identified by their "domey" shape with usually flatly shaped inner parts but in the highest elevation. Peatdomes are raised and so are not flooded by adjacent rivers which means that they are fed only by rainfall,hence, ombrtrophic. The Caimpugan peatdome is located at $8^0$22'-$8^0$27.5'N and $125^0$45'-$125^0$55.6' E, within the northeast portion of Agusan Marsh. The Caimpugan peatland is characterized as a tropical peatswamp forest

TRISTANIA *(orange trunk)*

(Fernando, et al., 2009). Its forest formation occurs in areas where the water table is higher than the surrounding areas and where the peat is about 50cm deep or more. The peat soils are Typic Toposaprists (Alibo et al., 2011) which are basically organic soils with control sections at its advanced stage of decomposition. Understanding the implications of this soil characteristic is vital in defining its present and future role in climate change mitigation. With the profiles sampled, soil morphological features point to saying that there have already been episodes of lowered water table levels in the past that had cause C emissions. Since the control sections are of sapric materials, it can only take for the organic matter a short period of exposure to oxidation before C will be emitted in the future.

Another interesting feature of Caimpugan peatland is the presence of a "pygmy forest" in the center of the peatland surrounded by a ring of slightly taller forest or the "intermediate forest" followed outwardly by a much taller forest or the "tall pole forest". This is in consonance with the accounts of Whitmore (1984a) and Page et al., (2006) that a concentric zonation of vegetation and a catenary sequence of forest subtypes, from the edge of the formation to the center, is typical to many peat swamp forests. Based on recent satellite image of the area, the formation is approximately 7.1 x 9.5 km and consists of two distinct zones. The outer zone of tall forest is about 3,400 ha and is 1 km wide on the eastern side and up to 4 kms wide on the western side (Davies, 2006 as cited by Fernando et al., 2008). The trees on this tall pole forest zone can reach up to 35 m tall and 54 cm in diameter at breast height (dbh). The intermediate forest is characterized by trees which can reach from up to 14 m and with trees having a dbh typical of a tall pole forest rarely occurring. Meanwhile, the pygmy forest is characterized as having trees which can grow up to 3 m and usually having a dbh of <5 cm until. In the areas sampled, the pygmy forests have less dense canopies and the communities of trees are not intact compared to the other two vegetation zones. This characteristic furthermore represents a succession in time, where the innermost peat layer is thicker, being the oldest formed. These manifestations are reported to be a strong evidence of the presence of a peat dome, since the surface of the peat swamp is convex with higher deposits of peat accumulating in the center which receives only rainwater. The poor nutrient availability in the central portion is manifested by the stunted growth of trees. On the other hand, the outermost zones in the Caimpugan peatland has a denser community of taller and bigger diameter trees. According to Whitmore (1984a) and Page et al. (2006), this zonation is believed to mirror the conditions of decreasing fertility towards the center. In addition, these soils are acidic with pH ranges of 2.74 - 4.55 at different horizons. This shows that the high concentrations of hydrogen ions (caused by the low pH of these peat soils) mean that toxic components damaging the plant growth become more soluble whereby toxic levels of manganese, iron, aluminum, phenols and tannins are common in the acid peat soils (van den Eelaart, 2005). Iron and manganese are clearly manifested in the

SPHAGNUM MOSS *was observed matting the forest floor of some portions of the pygmy forest.*

reddish-black coloration of the peat soils in Caimpugan as well as the presence of pools common in the pygmy forest with "blackwaters".

3. **Caimpugan peatland comprises a unique assemblage of distinct , harsh-tolerant species**

In general, the waterlogged and acidic conditions within the Caimpugan peatland are relatively harsh compared to other forest types in the country. The area has also shallow and deep pools. Based on observations, vegetation have developed adaptations and fauna are limited only to those which can tolerate and have found refuge in the area. As evidence, adventitious roots among trees are found as well as flying buttresses that help provide stability in the waterlogged substrate.

Fernando et al. (2010) which states that the most prominent and distinctive tree in the Caimpugan formation is a species of *Tristaniopsis*, with its bright red-orangish and scrolled outer bark together with *Calophyllum* and another of *Syzygium*; the latter being stilt-rooted. Rapid biodiversity assessments in the area (Fernando et al., 2010) shows that other tree species include the tall *Mangifera caesia, Garcinia ruba, Teijsmanniodendron ahernainum, Fagraea racemosa,* and species of *Weinmannia, Syzygium, Palaquium, Arddisia, and Cinnamomum*. Furthermore,at least one dipterocarp *Vatica*, is known to occur in the area. The forest floor is dominated by the spiny-leaved sedge *Lepironia* articulate growing up to 2 ms tall. The most common climber is the fern *Stenochlaena palustris* which densely covers many tree stems. Some other vines include *Hoya obscura, Nepenthes mirabilis*, and a number of aroids. Only two species of climbing palms or rattans (*Plectocomia elongata* and *Calamus multinervis*) are present. No other erect palms are known to occur in this formation. Epiphytes are frequent, including *Myrmecodia tuberose* and *Asplenium nidus*, that grows low even in stilt roots. *Medinilla teysmanii* also occur as a low, woody epiphyte. The inner zone of the Caimpugan peat swamp formation is about 2.5 x 5 km and covers approximately 800 ha (Davies, 2005). The forest canopy in this zone is lower, ranging from 7 m at the transition zone to 4 m at the center, and the trees have smaller stem diameter. The species composition is largely similar to that of the outer zone with *Tristaniopsis* still common, along with a species of *Calophyllum* and *Syzygium*.

Indicators of low nutrient status, the carnivorous *Nepenthes gracilis* was common in the stunted forest, but was not recorded in the outer high forest. *Cassytha filiformis* (Lauraceae), a parasitic climber, was also common, being typically found on nutrient deficient soils on Borneo (Davies, 2005). Mosses and lichens were very common on the trunks of the trees, and the abundance of *Sphagnum* moss was observed matting the forest floor of some portions of the pygmy forest. Nearly decomposing *Sphagnum* moss creates a spongy surface that causes one to bounce when stepping on them. According to Davies (2010), the stunted forest is in itself a mature forest because of the presence of flowers and seeds among trees.

Stilted roots of trees

White crested owl

4. **Caimpugan peatland is a crucial flood regulator.**

Peat soils exhibit high water holding capacities. During the rainy season, the peatland which is strategically situated within the Agusan Marsh absorbs a substantial amount of water and slowly releases it during the dry season. This buffering effect is essential in regulating floods in riverbank communities along the marshland which drain to the floodplains of Butuan.

With the apparent changes and unpredictability of weather conditions in the region, there is a probable increase in the vulnerability of floodplains and coastal areas in Agusan to the occurrence of flashfloods. Should there be a failure to protect and conserve Caimpugan peatland, then Butuan is up for a disaster.

5. Caimpugan peatland is exposed to ecosystem threats, and it is alarming. These threats inflict pressures to the peatland that endanger its ecological integrity.

A threat analysis (Alibo et al., 2011) identified drivers as mainly anthropogenic and institutional. Forest clearances in the peat periphery for agriculture as well as the indiscriminate burning of forest patches within the peatland are the most alarming threats which contribute to carbon emissions. Both local people and the dayos have been practicing this traditional farming practice. On the other hand, climatic variability is considered an imminent threat. In most areas visited within the peatland at the time of field sampling, water table was nearly at the surface of the peat which suggests anaerobic decomposition. However, this current ideal hydrology of the peatland is likely to be disrupted in the future considering the climatic prediction within Agusan Marsh shifting from no pronounced dry season the entire year into having distinct wet and dry season within a given year. This future climatic setting shall make the peatland vulnerable to fires in the advent of long dry seasons. The oxidation of a previously water-logged organic matter facilitates decomposition of the assimilated carbon to be released back to the atmosphere. The synergistic behavior of natural, anthropogenic, and institutional pressures inflicting the ecosystem should be addressed at this early stage to prevent the reversal of this ecosystem's function making it a C source. Since much less can be done to offset natural drivers of change, efforts should be prioritized for addressing the anthropogenic and the institutional drivers. It is also observed that responses do not directly address the drivers that bring about the pressures. Coordination and complementation of independent conservation efforts at various levels in the management hierarchy is recommended for a holistic and an effective conservation and protection program of Caimpugan peatland.

As of 2005 (IFAD-GEF Project), there have been two areas of peatland within the marsh that have been confirmed – one in the northern part of Bunawan, and the other in the west of Caimpugan. But, the former is almost totally cleared due to logging, burning as well as conversion to rice fields. Since Bunawan peat area is relatively degraded compared to Caimpugan peat area, an urgent call for management and conservation is necessary to keep what is left of it. Considering the potential anthropogenic disturbances that the Caimpugan area faces, it is essentially vulnerable in becoming a carbon source. This negation from being a C sink to a C source alters the ecosystem services the peatland provides.

Focus. It is just but high time to adjust the aperture. May it be acknowledged by the viewer that there is a need to put the focus on Caimpugan peatland. If policies are meant to serve as arms for the protection and conservation of peatlands, then policies should be in place and reinforced.

Given this opportunity to take a closer look into what the Caimpugan peatland has served, is serving and shall continue to serve, I believe that our lenses already point out to one subject matter.

I cannot help but expect action from the policy makers and implementors. Science has already said enough.

Van Leeah B. Alibo received her PhD in Environmental Science from the University of the Philippines Los Baños with researches focusing on the ecosystem functions of Caimpugan peatland. She is a faculty member at the Caraga State University, Butuan City and technical assistant to the Office of the Vice President for Academic Affairs.