

RESEARCH REPORT

Development of a methodology for biomass: an assessment in two river deltas in Fiji

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Abstract: This is a report of empirical work in the context of a Master thesis at the University of Hamburg in cooperation with the German “Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)” as part of the regional REDD+ program “Forest protection in Pacific Island Countries”.

Keywords: mangroves, inventory, REDD+, carbon stock, Fiji



Figure 1: Group picture of the fieldwork team

The consequences of global climate change are more threatening than ever. The United Nations Framework Convention on Climate Change (UNFCCC) developed the REDD+ mechanism (Reducing Emissions from Deforestation and Forest Degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries) to foster activities in tropical forest countries to reduce greenhouse gas emissions from the forest sector, e.g. by reducing deforestation rates.

To enable countries to participate in REDD+ they must have a thorough knowledge about the carbon that is stored in the biomass of their forest ecosystems. In this context, the purpose of our study was to conduct a biomass survey in the mangrove forests of Fiji to determine their carbon content. While the measurement of mangroves is not unusual, it is difficult to obtain reliable data due to their growth habit. „Interlaced shrub“ would roughly describe the forest structure.

Before explaining the methodological details, we want to put our work into the socio-cultural context of Fiji. Here social aspects and communal life are of high importance in order to establish a fruitful collaboration and working environment in Fiji and with Fijians. Fiji oftentimes is described as a big family or a big village. It is important to mingle with people to recognize and learn the habits and traditions. During the four months we lived in Fiji, we gained a deep insight into the social structures, the tremendous importance of the family and the friendly interactions

amongst people. During the time that we were not camping in the mangroves, we lived together with a German and a Fijian family in the capital city Suva. Dr. Wolf Forstreuter, native of the “Lüneburger Heide”, has lived in Fiji for 27 years and has built a reputation in the field of remote sensing for the South Pacific. He shared his home with us and the Fijian family also gave us a warm welcome. ‘Aunt Sera’, the center of the family, taught us a lot about Fijian conventions and her four grandchildren, girls aged from one to seven, always brought life into the house.

Fiji has a mangrove forest of approximately 46.000 ha. Common among all types of mangroves is that they are saltwater tolerant plants (halophytic plants) and therefore grow on coastal shores and riversides, standing in water at high tide. Mangroves play a very important role in protecting these riparian zones by anchoring the landmass and therefore avoiding erosion or by reducing the force of storms. Also, mangroves play a very important role in marine ecosystems, e.g. as a breeding ground for many species of fish and shellfish. Furthermore, mangroves are part of many traditional practices of the Fijians.

Mangrove species are divided in red mangroves (*Rhizophora* spp.) and black mangroves (*Bruguiera gymnorhiza*). These represent around 76% of the mangrove forest. In addition, white mangroves are forming the forest between mainland forest and mangroves. For our survey we considered the woody above-ground biomass of red and black mangroves

occurring in the two largest river deltas in Fiji (Rewa Delta and Ba Delta) on the main island, Viti Levu.

The primary goal of our research was to develop a methodology for inventorying the mangrove forest. Especially *Rhizophora* spp. form a very overgrown shrub and do not explicitly form a trunk. A conventional inventory, as deployed for other forest types worldwide, based on measurable parameters such as diameter at breast height (at 1.30m height) and tree height was determined to be not feasible for our study. Another important goal of the study was to identify if the biomass of the mangroves can be related to other parameters. This would allow for estimating the overall biomass and carbon stock of Fiji’s mangrove forests without the need of destructive sampling.

The method was developed jointly by the Head of the Institute of World Forestry, Prof. Dr. Köhl, employees of GIZ and the Fiji Forestry Department. The actual inventory was implemented along transect with a length of 162 meters (transect = sample plots along a given line). In each transect four 3x3 meter sample plots are located with a spacing of 50 meters between each plot. Over a period of 65 days, we surveyed 40 plots. On every plot, a destructive sampling of the existing vegetation took place. A destructive sampling includes the complete collection of the biomass and the measuring of several other parameters. For this purpose, the occurrence of the two dominant species (*Rhizophora* spp. and *Bruguiera gymnorhiza*) was documented first. Next, the entire



Figure 2: Doing fieldwork



Figure 3: Doing fieldwork

biomass inside the plot was sampled destructively and weighed on the spot to obtain the green weight (i.e. weight of woody biomass including water content). Afterwards, samples of various tree components (roots, trunk, branches, leaves) were transported to the laboratory of the project partner 'Pacific Community' (SPC), where the samples were kiln dried (i.e. absolutely dry without water content) and weighed again. Hereby, the biomass of the mangrove species can be determined and put into relation to the fresh weight measured in the field. The results allow estimating the above-ground biomass and respectively the carbon content of the mangrove forest in Fiji. Under REDD+ a value based on the total quantity of stored carbon can be assigned to the forest.

Before the fieldwork could start, we first had to enquire an entry permit from the "Chief" of the village. This happened with a ceremony known as "Sevu- Sevu" where we explained our intentions to the Chief and gave a kava root (*piper methysticum*) as a present. Kava has an important traditional value in Fiji as it is used in a variety of social contexts. It is prepared by finely grounding the root and washing the

powder out with (river-)water. The kava potion is then drunk in a traditional ceremony. Kava is said to have a calming and relaxing effect. While the consumption of the river water poses no problem to the locals, in our case it caused rather uneasy effects. After the chief has accepted the kava root and the ceremony has taken place, the enquirer belongs to the village and can implement his project. Adding to this, usually a fisherman from the village was assigned to our team to get access to the mangrove areas with his boat.

Entering the mangroves and accessing the plots was often only possible at high tide. However, most of the work was only feasible at low tide. Therefore, we had a period of four hours every day to work efficiently. This period changed every day by 50 minutes. Getting up early is a common habit in the Fijian culture as most people go to church before starting their work. Thus, we were already in the mangroves with the first rays of dawn. Working and living with our Fijian colleagues was always cheerful. A day without laughing is a lost day and there was no such day. We camped regularly in the respective study areas and cooked together with

our Fijian colleagues, who quickly became our friends. The Fijian cuisine can be described as quite natural and starchy. Many roots, such as Cassava or Dalo are an important part of Fijian dishes. Fijians have a very close relationship to nature and so many groceries, e.g. tea, nuts, crabs, fish and clams were collected in the mangroves and prepared later.

Our survey team was comprised of employees of the Fiji Forestry Department, a Fijian student and a forestry apprentice. In addition to the energetic support during data collection and fieldwork our colleagues also became familiar with the inventory method enabling the Fiji Forestry Department to conduct a national mangrove inventory independently in the future.

Beyond our personally enriching experience, working on the project and with our Fijian colleagues, our goal is to share our valuable survey. With this project we hope not only to make a statement about methods for biomass collection and CO₂ storage but also to substantiate the importance of the mangroves ecosystem in Fiji and to sensitize people to its importance with regard to climate change.

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