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NATIONAL LEVEL ASSESSMENT OF MANGROVE FOREST COVER IN PAKISTAN

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Abstract. Mangroves ecosystems consist of inter tidal flora and fauna found in the tropical and subtropical regions of the world. Mangroves forest is a collection of halophytic trees, shrubs, and other plants receiving inputs from regular tidal flushing and from freshwater streams and rivers. A global reduction of 25 % mangroves' area has been observed since 1980 and it is categorized as one of to the most threatened and vulnerable ecosystems of the world.

Forest resources in Pakistan are being deteriorating both quantitatively and qualitatively due to anthropogenic activities, climatic v and loose institutional management. According to the FAO (2007), extent of forest cover of Pakistan in 2005 is 1,902,000 ha, which is 2.5% of its total land area. Annual change rate during 2000– 2005 was -2.1% which is highest among all the countries in Asia. The Indus delta region contains the world's fifth-largest mangrove forest which provides a range of important ecosystem services, including coastal stabilisation, primary production and provision of nursery habitat for marine fish. Given their ecological importance in coastal settings, mangroves receive special attention in the assessment of conservation efforts and sustainable coastal developments.

Coastline of Pakistan is 1050km long shared by the provinces, Sind (350km) and Baluchistan (700 km). The coastline, with typical arid subtropical climate, possesses five significant sites that are blessed with mangroves. In the Sindh province, mangroves are found in the Indus Delta and Sandspit. The Indus Delta is host to the most extensive mangroves areas and extends from Korangi Creek in the West to Sir Creek in the East, whereas Sandspit is a small locality in the West of Karachi city. In the Balochistan province, mangroves are located at three sites, Miani Hor, Kalmat Khor and Jiwani.

Contemporary methods of Earth observation sciences are being incorporated as an integral part of environmental assessment related studies in coastal areas. GIS and Remote Sensing based technologies and methods are in use to map forest cover since the last two decades in Pakistan. The national level forest cover studies based upon satellite images include, Forestry Sector Master Plan (FSMP) and National Forest & Range Resources Assessment Study (NFRRAS). In FSMP, the mangrove forest extent was visually determined from Landsat images of 1988 – 1991, and was estimated to be 155,369 ha; whereas, in NFRRAS, Landsat images of 1997 – 2001 were automated processed and the mangroves areas was estimated to be 158,000 ha.

To our knowledge, a comprehensive assessment of current mangroves cover of Pakistan has not been made over the last decade, although the mangroves ecosystems have become the focus of intention in context of recent climate change scenarios. This study was conducted to support the informed decision making for sustainable development in coastal areas of Pakistan by providing up-to-date mangroves forest cover assessment of Pakistan.

Various types of Earth Observation satellite images and processing methods have been tested in relation to mangroves mapping. Most of the studies have applied classical pixel – based approached, there are a few studies which used object – based methods of image analysis to map the mangroves ecosystems. Object – based methods have the advantage of incorporating spatial neighbourhood properties and hierarchical structures into the classification process to produce more accurate surface patterns recognition compared with classical pixel – based approaches. In this research, we applied multi-scale hierarchical approach of object-based methods of image analysis to ALOS – AVNIR-2 images of the year 2008– 09 to map the land cover in the mangroves ecosystems of Pakistan. Considering the tide height and phonological effects of vegetation, particularly the algal mats, these data sets were meticulously chosen. Incorporation of multi-scale hierarchical structures made it easy to effectively discriminate among the land cover classes, particularly the mudflats from sparse mangroves, at their respective scales.

Results of current image analysis deciphered that the overall mangroves cover of Pakistan is ~ 98,128 ha. Mangroves cover along the Indus Delta is estimated to be 92, 412 ha that is ~94.17 % of the total mangroves area of the country. 1,056 ha of the forest thrive in Sandspit, whilst the remainin 4,660 ha mangroves occurs along the Makran coast in 3 isolated pockets at Miani Hor (4,018 ha), Kalamat Khor (407 ha) and Jiwani (235 ha). Overall accuracy of land cover maps, from 250 ground reference points, was estimated to be 83.2% (kappa value .7301; kappa variance .0029) which was considered acceptable for optical data in a semi-aquatic environment.

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