XIV WORLD FORESTRY CONGRESS, Durban, South Africa, 7-11 September 2015

Forest and tree benefits to food security of rural households in Bangladesh

Ronju Ahammad[1], Natasha Stacey[2], Terry Sunderland[3]

[1]Research Institute for the Environment and Livelihoods, Charles Darwin University, Northern Territory, Australia, Ronju.Ahammad@cdu.edu.au
[2]Research Institute for the Environment and Livelihoods, Charles Darwin University, Northern Territory, Australia, Natasha.Stacey@cdu.edu.au
[3]Forest and Livelihoods Programme, Center for International Forestry Research (CIFOR), Bogor, Indonesia, t.sunderland@cgiar.org

Abstract

Forest resources are widely recognised as sources of social, environmental and economic benefit for rural people in developing and least developed countries. The direct and indirect benefits of forest and tree uses can be significant for enhancing food security at household level. The diversity of forests and tree product uses are related to the availability, accessibility and sustainable uses of the resources. However, a lack of adequate information on tree uses often undermines potential opportunity for integrating these resources in local food production, improving dietary diversity and sustaining valuable ecosystem services.

Bangladesh has diverse forest areas (e.g. Hill, Sal, Mangrove and Village forests) comprising 17 percent of its total lands. Diverse forest and non-timber forest products benefit hundreds of millions of people to secure their food needs, income, and primary energy. Mostly forest and tree products enhance dietary diversity and nutrient enriched foods in remote communities in the country. However, the availability and accessibility of forests and trees and their products are changing due to over-exploitation and management patterns. The government manages more than 60 percent of forest lands of which many areas have limited local community access. In some regions, rural households manage trees outside of forests under different agroforestry systems including home gardens as vital sources of foods.

The aim of this paper is to present the diversity of forest and tree benefits for food security of rural households in Bangladesh. Different types of forests and tree products are identified to understand their contributions in enhancing food security.

Keywords: forests, income, trees, land uses, food security, Bangladesh

1. Introduction

Forests as one of most environmental and economic resources support the wellbeing of human societies. The direct and indirect provisioning services of forests and trees like food, nutrition, income, energy and shelter benefits rural people in developing and least developed countries (Jamnadass *et al.* 2011; Sunderland 2011) as well as contributing to watershed and pollination in agroforestry systems (Millennium Ecosystem Assessment 2005). Plant based non timber forest products (NTFPs) like coconut, mushrooms, and animal's bushmeat cover 0.6% (or 10.9 kg per capita) of all food consumption globally (FAO 2014) which are highly nutritious diets (Vinceti *et al.* 2013). In addition to direct consumption benefits, 2.4 billion people cook and 750 million people boil water with wood fuel as the only energy options to reduce the risks of water-borne diseases (FAO 2014). Apart from that, 13.2

million people (0.4% of global workforce) are engaged in formal employment in the forest sectors while 41 million in the informal sectors is generating incomes critical to enable access foods.

Globally food production systems are facing increasing challenges to meet the growing demands of a population expected to reach 9 billion people by 2050 (Vinceti *et al.* 2013). Sustainable productions and maintaining accessibility to energy and nutrient rich foods are vital to improve food systems worldwide (Padoch and Sunderland 2013; Powell *et al*. 2013). Forests and tree products including wide range of NTFPs (fruits, vegetables, and different animal products) can fulfill wide range of micro-nutrient rich foods to complement dietary diversity (Sunderland *et al.* 2013; Colfer 2008). A global study indicates that forests and trees act as safety net or seasonal gap fillers through providing nutrient foods and incomes during low-agriculture crop production and natural disasters (Wunder *et al.* 2014). In fact, forests cover 31 percent of global land uses and only 30 percent of this is used in production of wood and NTFPs that contributes to food systems of rural households (FAO 2010). Agroforestry systems with agriculture crops, trees and livestock farms generate wide range of social and environment benefits to 1.2 billion people for enhancing food production (Jamnadass *et al.* 2013). However, gross estimate of forest dependency and diverse benefits to food security are not entirely accounted due to incomplete data in many countries (FAO 2014).

The roles of forests and trees uses are increasingly recognised as critically important for foods and income sources of large rural population in Bangladesh (Miah *et al.* 2012; Rahman *et al.* 2014). Three major forest areas in the country includes hills, sal (named as Sal-*Shorea robusta* plant species) and mangroves which provide direct and indirect benefits to rural people for accessing local foods (Fig.1). Government control accessibility in these forests while people also manage tree outside forests in home garden or with agriculture. The available information shows that people depend on natural forests (i.e., owned by government) and trees in agroforestry systems for diverse forest and tree products (Table 1).

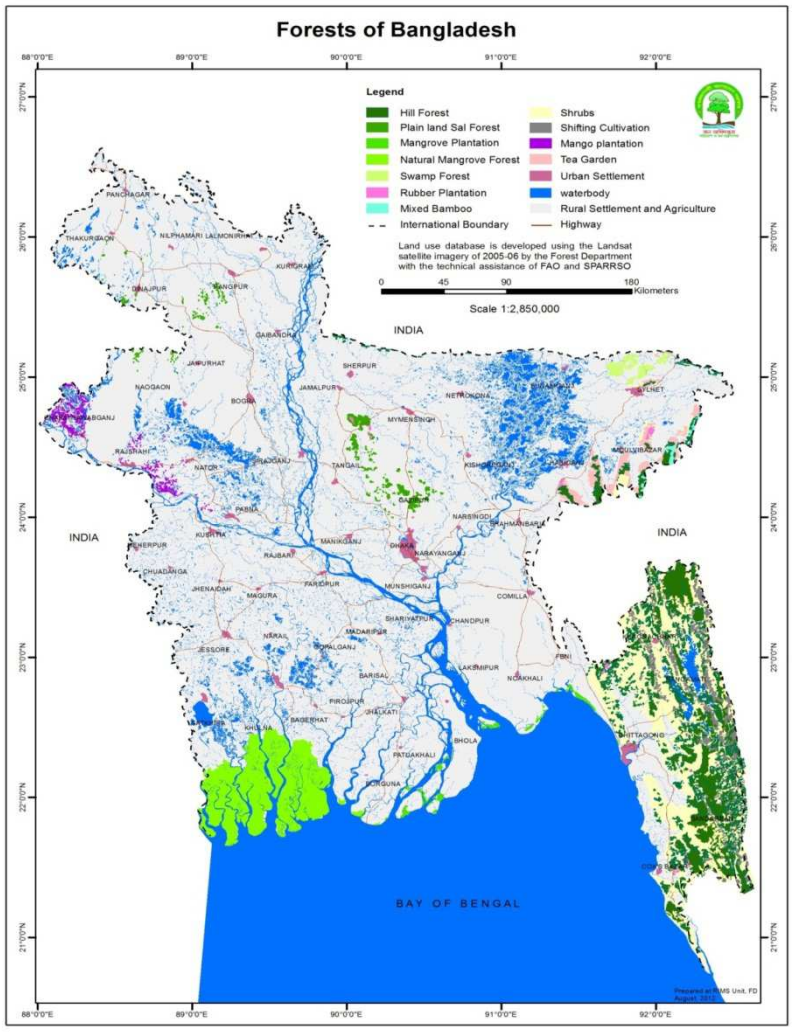

Fig. 1: Map of forest areas in Bangladesh (BFD 2015)

In the last two decades, Bangladesh has increased national capacity for securing food access of large population (GoB 2013). Though level of poverty and number of hungry people declined, food security still remains challenge due to population growth and limited land for cultivation. Agriculture practices cover 60 percent of land uses and provide essential foods to two-third of population in Bangladesh. But, lack of crop diversification or dietary diversity hinders availability of micro-nutrient rich foods (GoB 2013). To this

point, forest and tree products can supplement the food production through dietary diversity to increasing demand of growing population. But, the linkage of forest and tree benefits to food security is not entirely studied. A clear understanding is important how forests and trees can be managed for improving access to nutritious and diverse foods. This study has aimed to describe the potential roles of forests and trees in food security of rural households. Based on identifying different forest and tree products, patterns of uses, accessibility and availability, the paper discusses any potential scopes for integrating the tree benefits within food production systems.

Table 1: Forest types, distributions, management regimes and diverse products in Bangladesh

Forest types	Distributions	Management regimes	Key products	Sources of information
Hill forests (tropical wet evergreen and semi-evergreen)	South-east (Rangamati, Bandarban, Khagrachari, Chittagong and Cox's Bazar districts) and North-west (Sylhet district) region (see Fig. 1)	- Government ownership - Co-Management programme with local community for protected area management - Customary ownership	- Wood fuel - Medicinal plants - Wild vegetables and fruits - Timber - Bamboo - Grasses - Wild animals - Rattan - Betel leaves and nuts	Chowdhury *et al*. 2010; Mukul 2011; Mukul *et al.* 2007; Kar and Jacobson 2012; Miah *et al.* 2003; Nath *et al.* 2003; Mia *et al.* 2012; Islam and Nath 2014; Roy 2008
Sal forests (tropical moist deciduous)	Central (Dhaka, Tangail and Maymensingh districts) and North (Rangpur and Dinajpur districts) region	- Government ownership - Participatory plantation with local community	- Wood fuel - Wild vegetables and fruits	Begum 2011
Mangroves (natural and planted)	South-west (Khulna, Bagerhat and Satkhira districts)	- Government ownership	- Thatching plants (Goal pata- *Nypa fruticans*) - Honey - Fishes	Iftekhar and Takama 2008; Zohora 2011; Abdullah 2014
Village forests (home gardens)	Broadly planted trees around home or with agriculture in rural areas across the country	- Individual	- Wood fuel - Fruits - Timbers - Bamboo - Rattan	Motiur *et al.* 2006 Rashid 2009 Salam *et al.* 2000

2. Methodology

Food security can be understood as the situations when all people at all times have physical and economic access to sufficient food to meet their dietary needs and food preferences for a productive and healthy life (Pinstrup-Andersen 1999). Key dimensions of food security are: (1) the available supply of adequate quantities of food of appropriate quality from natural and cultivate systems either through domestic production or imports; (2) the ability of households to gain foods from households or other sources to meet a nutritious diet; and (3) the means for acquiring nutrition, energy and other health

benefits; and sustainability of sufficient and accessible foods. Researches addressing the direct forest and food relationships are not adequate globally. Forests and trees can be conceptualised within food security dimensions as their availability contributes to direct food consumption, indirect income increase ability of individuals to purchase foods (CIFOR 2014). Forest products are sources of energy and people's healthcare, and supporting ecosystems services like soil enrichment, pollination and protection of agriculture and fisheries from disasters like flooding (Mohamed-Katerere and Smith 2013). Forests and food security relationships can be understood through classifying the products and their accessibility, availability and utilisation patterns.

This study follows a qualitative approach for content analysis of forest related different products and their uses. At the initial stage, information of forests and tree benefits for food contributions are collected through searching relevant articles in Google scholar, Web of Science and Science Direct databases. Our search in global literatures largely found two major forests and tree product benefits for subsistence and cash-income in rural livelihood context. We narrowed down focus in Bangladesh context by using key words 'forests' 'livelihoods' 'forest and tree products' 'food security' issues and selected more than 15 articles for review (Table 1). The available studies provide information on local community's dependency on specific forest and tree products in government and home garden.

For this study we only classified the use patterns to understand how these might benefit the food systems at local context. Following the specific forest and tree products in Bangladesh, the study synthesised the key uses for direct food and nutrition, wood fuel energy, health care and income benefits (Table 2). This study noted any variations related to different management (government and private) of forests and trees to understand how these influence uses, availability and accessibility of particular products (Table 2).

3. Results

3.1. Forests and tree foods

Natural forests and agro-forestry systems generate plant and animal foods in rural areas of Bangladesh. Bamboo shoots, different fruits, nuts and vegetables are major plant based foods (Miah *et al.* 2012; Zohora 2011). Wild vegetables are widely recognised source of regular foods in remote locations of indigenous people in their forest lands and shifting cultivation farms. Bamboo shoots are used as important source of foods to cope with dietary shortfalls during the pre-harvest seasons of rice in south-east hill forests (Chittagong Hill Tracts region) (Rahman 2011) and central Sal forest areas (Begum 2011). Rural people access to wide range of tree fruits used as seasonal foods from their traditional home garden or agroforestry systems. The availability of wild vegetables and fruits provide diversity of foods and easy accessibility to nutrition sources of poor households in rural areas. In home garden or agroforestry systems, tree fruits are increasingly cultivated for securing food and nutrition sources during crisis period of a year when adequate access to food is not possible (Rahman *et al*. 2012).

Wild animal foods of forests are not regular in diet, but meats and honey have contributions to food systems of people living in forest areas (Miah *et al.* 2012; Zohora 2011). Natural mangroves has a plenty of NTFPs sources, especially honey production enriched with nutrition provides seasonal and supplementary dietary needs of people (Abdullah 2014). Forest ecosystems also harbor wetland habitats and generate environmental services for biodiversity to sustain on these (Iftekhar and Takama 2008). Mangroves and swamp forests cover 40 percent of total natural forests that protect fish habitat. This also generates additional food sources, particularly fish protein to local communities. The actual contribution of forests to foods and nutrition values will be much larger with diversity of tree management outside forests in home garden or agroforestry systems (Salam et al. 2000; Rahman et al. 2012).

Table 2: Summary of key forest and tree products, uses and accessibility patterns (High=++++, Moderate=+++, Less=++)

Forest and tree products including NTFPs	Utilization					Availability and accessibility		
						Government controlled		Privately owned tree outside forests
	Direct food	Income	Primary energy	Health care	Constructions	Natural forests	Plantations	
Wild foods (vegetables/bamboo shoots/roots etc.)	++++			++		+++	++	+++
Fruits	+++	++++		+++		++		++++
Wood fuel			++++		+++	+++	+++	++++
Timber	++	++++	++		+++	++	++++	
Bamboo & Rattan	+++	++++			+++	+++		++++
Honey	++	++++		++		++++		
Thatching plants		+++			++++	++++		

3.2. Primary energy

Forests and trees provide 48% of total energy sources in Bangladesh (Jashimuddin *et al.* 2006). At least 80% of rural populations use wood fuel for boiling and cooking foods (Miah *et al.* 2003). By using wood fuel, people can boil open-source water collected from ponds and lakes for household uses, mostly secure critical safety health needs for pregnant women and children. The total number of population who avoid water-borne diseases by accessing wood fuel is not accounted in the country. But, more than 65 million people are benefiting directly by using wood fuel in the country. Poor households secure 70-80% of wood fuel from government owned natural and plantation forests (Miah *et al*. 2003; Begum 2011). People also access wood fuel by using their trees from home garden and use agriculture crop residues for primary energy (Table 2). Wood, branches and twigs are commonly used tree products of wood fuel. On overage 44% of total population directly use wood fuel which are only slightly different due to access patterns in government forests and tree outside forests (Miah *et al.* 2003).

3.3. Primary health care

Numerous plants products support primary health care of rural people. About 40 different trees, shrubs and herbs are valuable medicinal foods (Mukul *et al*. 2007). Leaves, fruits, flowers and barks are used as foods and external uses. Rural people including indigenous communities use traditional knowledge to cultivate and maintain medicinal plants as key sources of health care (Miah *et al.* 2012). Locally

available plant medicines are useful to avoid more than thirty health related ailments (Mukul *et al*. 2007). People rely on government forests and home gardens for direct consumption of different trees for health care. Among rural people, large land-holding family maintain multi-purpose trees in home gardens and cultivate medicinal plants with agriculture crops for cash incomes (Rashid 2009). Compared to commercial producer, poor households have much more dependency on government forests for collection of medicinal plant products. However, poor families have less access to medicinal plants due to increasing protection measures in government forests.

3.4. Income benefits

Forest and tree products generate direct and indirect income benefits for accessing foods. A wide range of NTFPs including wild foods, fruits, wood fuel, honey, bamboos, canes, betel leaf and nuts are largely used as subsistence and cash income sources of rural households (Table 2). People involved in collection of small-scale processing works of NTFPs derive incomes for supporting food access (Kar and Jacobson 2012). NTFPs related economic activities provide informal employment of 0.5 million people (Rashid 2009). Poor people secure their household food sources on regular and seasonal basis by gathering and selling of the products. Low-income people depend on NTFPs for subsistence income and secure their foods. However, households who access home gardens own timber and fruits as income generating sources (Motiur *et al.* 2006). Moreover, government and NGO funded plantation and conservation programmes provide alternative income benefits. These programmes have significant roles to improve household capacity to secure food options for poor community.

4. Discussion

The demand of food for burgeoning population and maintaining sustainable production are becoming simultaneous challenges in Bangladesh. Diversity of land uses with intensive agriculture cultivation has increased food grains in the last decades, but accessing affordable and nutritious foods is still the case in rural areas. Forest and trees may contribute a range of food sources though these are not clearly explained within broader food security dimensions. Often the use of forest foods are negligibly addressed as minor sources of household diets, but these can be vital micro-nutrient sources if properly addressed. This is not only limitations in improving tree management locally, but also to secure nutritious food sources from this sector. Traditional knowledge of local people has important roles for identification and conservation of valuable forests and trees in securing forest foods.

Tree outside forests in agroforestry or home gardens can ensure a sustainable and nutritionally balanced food system. Essentially trees outside forests along with agriculture crops and seasonal fallow lands can integrate productivity and biodiversity conservation which generate vital goods and services. Nevertheless, forest based essential ecosystem services are not widely recognised for their benefits to agriculture production and food security. Trees provide essential supporting services like pollination for enhancing cultivation of nutritious fruits and vegetables which are important apart from staple crops. Planting fodder trees can improve soil fertility and alternatively secure availability and accessibility to protein sources (e.g., milk, meat) by livestock rearing. Water provisioning services increased with tree coverage are essential to enhance crop productions.

In order to integrate the forests within food security it would be important to recognise their availability, accessibility and utilisation patterns. Accessing any forest foods will depend on availability and household capacity of natural capital (i.e., land). Large landholding families have much more access to available dietary options from their home garden than poor and landless people. Contrarily poor people have limited access to the government forests that has reduced availability and accessibility of diverse

foods for their households. Declined accessibility to forests may exacerbate seasonal food deficit in geographically constrained remote community in the country.

5. Conclusions

The contributions of forests to global food supply may be negligible, but quality of the foods is more important in the local food systems. Forests and trees support food security and nutrition in a number of ways, but these will need a close recognition in policy and practice of Bangladesh. A wide range of trees outside forests including wild foods can be managed sustainably with diverse land uses to secure easily accessible and essential micro-nutrient within the diet of rural population. Mostly indirect benefits of cultivating trees within home gardens or in combination with agriculture may be enhancing ecosystem services if appropriately managed.

Local knowledge, differences in household capacity and demand of land uses should be considered in increasing tree based food options. Overall identification of diverse tree products and development of local capacity including community and institutions for sustainable management may increase cultivations of nutrient sensitive species and their appropriate market. Adequate external institutional supports would be necessary to develop better design of tree-crop management at households. The institutional supports for home garden management with multi-purpose plant species may secure more than one uses of different trees, herbs and shrubs at rural households and increasing access to diverse food sources.

References

Abdullah AN. 2014. *Livelihood strategies of people surrounding the sundarbans mangrove forest.* Doctor of Philosophy Thesis, Charles Darwin University, Australia.

Begum R. 2011. People's livelihoods and involvement in co-management of Madhupur National Park, Bangladesh. USAID Contract No EPP-I-00-06-00007-00: 156-170.

BFD. 2015. Forests of Bangladesh, Bangladesh Forest Department, viewed 20/04/2015. http://www.bforest.gov.bd/index.php/forest-management/map

Chowdhury MSH, Koike M, and Muhammed N. 2010. Embracing collaborative protected area management for conservation: an analysis of the development of the forest policy of Bangladesh. *International Forestry Review,* 11(3):359-374.

CIFOR. 2014. *Forests, food security and nutrition*. Center for International Forestry Research.

Colfer CJP. 2008. *Human health and forests: Global overview of iissues, practice and policy*. Earthscan, London, UK.

FAO. 2010. *Global forest resources assessment*. Food and Agriculture Organization of the United Nations, Rome, Italy.

FAO. 2014. *State of world's forests: enhancing the socioeconomic benefits from forests*. Food and Agriculture Organisation, Rome, Italy.

GoB. 2013. Milleneium Development Goals: Bangladesh Progress Report 2012. Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.

Iftekhar M and Takama T. 2008. Perceptions of biodiversity, environmental services, and conservation of planted mangroves: a case study on Nijhum Dwip Island, Bangladesh. *Wetlands Ecology and Management*, 16(2): 119-137.

Islam MJ and Nath TK. 2014. Forest-based betel leaf and betel nut farming of the Khasia indigenous People in Bangladesh: approach to biodiversity conservation in Lawachara National Park (LNP). *Journal of Forestry Research*, 25 (2): 419-427.

Jamnadass R, Place F, Torquebiau E, Malézieux E, Iiyama M, Sileshi GW, Kehlenbeck K, Masters E, McMullin S and Weber JC. 2013. Agroforestry, food and nutritional security, *Unasylva*, 64 (2), p241.

Jashimuddin M, Masum KM, and Salam MA. 2006. Preference and consumption pattern of biomass fuel in some disregarded villages of Bangladesh. *Biomass and Bioenergy*, 30 (5):446-451.

Kar S and Jacobson G. 2012, NTFP income contribution to household economy and related socio-economic factors: Lessons from Bangladesh. *Forest Policy and Economics*, 14:136-142.

Miah D, Ahmed R and Uddin BM. 2003. Biomass fuel use by the rural households in Chittagong region, Bangladesh. *Biomass and Bioenergy*, 24 (4): 277-283.

Miah MD, Chakma S, Koike M and Muhammed N. 2012. Contribution of forests to the livelihood of the Chakma community in the Chittagong Hill Tracts of Bangladesh. *Journal of Forest Research*, 17 (6): 449-457.

Millennium Ecosystem Assessment. 2005. *Ecosystems and human well-being: synthesis*. Island Press Washington, DC, USA.

Mohamed-Katerere JC and Smith M. 2013. The role of ecosystems in food security. *Unasylva*, 64 (241): 14-22.

Motiur RM, Furukawa Y, Kawata I, Rahman MM and Alam M. 2006. Role of homestead forests in household economy and factors affecting forest production: a case study in southwest Bangladesh. *Journal of Forest Research*, 11(2): 89-97.

Mukul SA. 2011. Changing consumption and marketing pattern of non-timber forest products in a competitive world: case study from an urban Area of north-eastern Bangladesh. *Small-scale Forestry*, 10 (3): 273-286.

Mukul SA, Uddin MB and Tito MR. 2007. Medicinal plant diversity and local healthcare among the people living in and around a conservation area of Northern Bangladesh. *International Journal of Forest Usufructs Management*, 8 (2):50-63.

Nath T, Makoto I, Islam M and Kabir M. 2003. The Khasia tribe of northeastern Bangladesh: their socio-economic status, hill farming practices and impacts on forest conservation. *Forests, Trees and Livelihoods*, 13(4): 297-311.

Padoch C and Sunderland T. 2013. Managing landscapes for greater food security and improved livelihoods. *Unasylva*, 64 (241): 3-13.

Pinstrup-Andersen P. 2009. Food security: definition and measurement. *Food Security*, 1:5-7.

Powell B, Ickowitz A, McMullin S, Jamnadass R, Padoch C, Pinedo-Vasquez M, Sunderland T. 2013. *The role of forests, trees and wild biodiversity for nutrition-sensitive food systems and landscapes.* The Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO), p24.

Rahman M. 2011. *Deforestation and forest conservation in Tanchangya community*. Nishorgo Network, Dhaka, Bangladesh.

Rahman SA, Imam MH, Snelder DJ and Sunderland T. 2012. Agroforestry for livelihood security in Agrarian landscapes of the Padma floodplain in Bangladesh. *Small-scale Forestry*, 11(4):529-538.

Rahman SA, Rahman MF and Sunderland T. 2014. Increasing tree cover in degrading landscapes: 'Integration' and 'intensification' of smallholder forest culture in the Alutilla valley, Matiranga, Bangladesh. *Small-scale Forestry*, 13:237–249.

Rashid A. 2009. *Management of medicinal plants in Bangladesh: issues and challenges of sustainability*. Masters thesis, Upsala University, Sweden.

Roy BCS 2008. *Fuelwood, alternative energy and forest user groups in Chunati Wildlife Sanctuary: Connecting communities and conservation: collaborative management of protected areas in Bangladesh*. East-West Center, Honolulu, pp 209-226.

Salam MA, Noguchi T, and Koike M. 2000. Understanding why farmers plant trees in the homestead agroforestry in Bangladesh. *Agroforestry Systems*, 50(1): 77-93.

Sunderland T. 2011. Food security: why is biodiversity important? *International Forestry Review*, 13(3): 265-274.

Sunderland T, Powell B, Ickowitz A, Foli S, Pinedo-Vasquez M, Nasi R and Padoch C. 2013. *Food security and nutrition: the role of forests*. CIFOR, Bogor, Indonesia.

Vinceti B, Eyzaguirre P and Johns T 2008. The nutritional role of forest plant foods for rural communities', Human Health and Forests. A Global Overview of Issues, Practice and Policy. People and Plants International. *Conservation Series*, pp63-96.

Wunder S, Börner J, Shively G and Wyman M. 2014. Safety nets, gap filling and forests: a global-comparative perspective. *World Development*, 64:S29-S42.

Zohora FT. 2011. *Non-timber forest products and livelihoods in the Sunderbans*, rural livelihoods and protected landscapes: co-management in the wetlands and forests of Bangladesh. Nishorgo Network, Dhaka, pp 99-117.