

Rain Water Harvesting for Sustainable Biodiversity Conservation at Lawachara National Park in Bangladesh: A Study on Policy Challenges

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Abstract: An assessment on the rain water management policy at a protected area for conserving biodiversity was undertaken. The study focuses on the current status of biodiversity with respect to ecological changes and community environmental awareness at the Lawachara National Park (LNP) in Moulvibazar district of Bangladesh. The contemporaneous era of modernization and globalization indicates a lot of comfort and luxurious life where lead to an alarming situation of huge environmental degradation integrated with all the apprehensive activities. Now a days the entire sectors in the world economy is facing massive challenges to deal with the global warming, climate change, environmental problems, loss of biodiversity and its consequences present one of the most important threats to the protected areas. Due to all these reasons, the Convention on Biological Diversity (CBD) have started modifying its activities and strategies through Aichi Targets to ensure protection to our natural resources and environment, particularly biodiversity conservation at protected areas. Everyone exploits them but none can conserve profoundly due to lack of scientifically effective policies, tools and methods in national park areas. The study explores the present uniqueness of inland water management, land use, environmental and forest policy towards Lawachara National Park for Biodiversity Conservation according to Aichi Target 11 of the CBD. The study examined the exclusivity of the tools to enhance conservation through existing approaches, technology, literature reviews, observations, reconnaissance findings and undertook interviews with park managers, Team Leader of Co-management Committee, Indigenous Community Leader, Academics, Biodiversity Specialists, Water Management Officer, Botanists, Zoologists, Researchers, Environmental Lawyers, land user, Learners, Policy-Maker, Local Government Leaders, NGOs and effective key stakeholders. All data were sorted and analysed using SPSS software for development of priorities Logic Model. About 55% of the respondents agreed that rain water should be harvested at LNP during rainy season as for importance of biodiversity information. The study showed that 42% and 55% of the respondents respectively stated that it is essential and very essential for the authority to undertake the necessary action to fulfill the Aichi Target of CBD at the existing protected area management. During winter and summer season water scarcity tends to highly ecosystem services at LNP. This scarcity assessment will support policy and decision-makers in assessing options to modify existing policies which will develop initial long-term strategic plans for rain water harvesting and implement effective policies for sustainable biodiversity conservation. The study also highlights on the steps, initiatives, benefits and future of rain water harvesting technology in Bangladesh context. Moreover, the study regarded the need for protection of biodiversity at LNP while reducing the water scarcity, removing illegal hunting and loss of biodiversity issues during dry and winter seasons. Overall, the research revealed that terrestrial water harvesting at protected areas requires policy improvement for sustainable conservation. However, policy makers and relevant

bodies need to be trained on biodiversity and water to make them more effective. Finally, the study suggests future research trajectories using a new collaborative approach to drive methodological agenda and recommends ways to further incorporate the need of upcoming generation on water management policy at protected areas in stimulating environmental sustainability.

Keywords: Biodiversity; National Park; Rain Water; Sustainability; Water Policy

Introduction

Rainwater harvesting is the process of capturing, conveying, and storing rainwater for future use. It has existed as a water supply source technique since circa 1500 B.C.^[1]. The notion of rainwater harvesting can be dated back over 4000 years when developed various rainwater harvesting technologies and constructions such as agricultural dams, runoff control methods, and reservoir or cistern construction in urbanized areas^[2]. Water captured by rainwater harvesting systems provides a main source of portable water, supplement source of potable water, and a supplement source of non-portable water (*i.e.*, toilet flushing, irrigation and car washing). The use of rainwater harvesting systems occurs mainly for non-portable water supplies but it has recently become an important alternative water resource to address the water shortage in urban and sub-urban areas among developed countries^[3]; ^[4]. Rainwater harvesting systems can be easily implemented at the home, commercial, and community levels^[5]; ^[6]. The application of rainwater harvesting in both rural and urban areas of developing countries is well documented ^[7]; ^[8]; ^[9].

Water is essential oil for living beings. Without water, nothing exists in the earth. It sustains the biodiversity either inland or marine protected areas. But day by day, policy-makers and other bodies face enormous problems due to loss of biodiversity particularly at protected areas. Everyone exploit them but none can protect them due to lack of proper policy. Water resources management has been contributed the most important role for protecting nature at national park and will remain essential forever both local, national and global policies. According to Aichi target 11 that by 2020, at least 17% of terrestrial and inland water areas and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services which are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascape¹⁰. Well governed and effectively managed protected areas are a proven method for safeguarding both habitats and populations of species and for delivering important ecosystem services^{11, 12, 13, 14, 15}. For these purposes, water harvesting is essential for the

¹ Hunt, Ph.D., P.E., William F. and Laura L. Szpir, 2006. Urban Waterways, Permeable Pavements, Green Roofs and Cisterns, Stormwater Treatment Practices for Low Impact Development. NC State University and NC A&T University Cooperative Extension.

² Mays, L.; Antoniou, G.P.; Angelakis, A.N. History of water cisterns: Legacies and lessons. *Water* **2013**, 5, 1916–1940.

³ Campisano, A.; Gnecco, I.; Modica, C.; Palla, A. Designing domestic rainwater harvesting systems under different climatic regimes in Italy. *Water Sci. Technol.* **2013**, 67, 2511–2518.

⁴ Hajani, E.; Rahman, A. Reliability and cost analysis of a rainwater harvesting system in peri-urban regions of greater Sydney, Australia. *Water* **2014**, 6, 945–960.

⁵ Vieira, A.S.; Beal, C.D.; Ghisi, E.; Stewart, R.A. Energy intensity of rainwater harvesting systems: A review. *Renew. Sustain. Energy Rev.* **2014**, 34, 225–242.

⁶ Belmeziti, A.; Olivier, C.; Bernard, D.G. A new methodology for evaluating potential for potable water savings (PPWS) by using rainwater harvesting at the urban level: The case of the municipality of Colombes (Paris Region). *Water* **2013**, 5, 312–326.

⁷ Ghisi, E.; Bressan, D.L.; Martini, M. Rainwater tank capacity and potential for potable water saving by using rainwater in the residential sector of southeastern Brazil. *Build. Environ.* **2007**, 42, 1654–1666.

⁸ Islam, M.M.; Chou, F.N.F.; Kabir, M.R.; Liaw, C.H. Rainwater: A potential alternative source for scarce safe drinking and arsenic contaminated water in Bangladesh. *Water Resour. Manag.* **2010**, 24, 3987–4008.

⁹ Mohammad, H.R.M.; Bahram, S.; Fereshte, H.F. Assessment of residential rainwater harvesting efficiency for meeting non-potable water demands in three climate conditions. *Resour. Conserv. Recycl.* **2013**, 73, 86–93.

¹⁰ Convention on Biological Diversity (CBD). 2010. Aichi Target 11. CBD 2011-2020.

¹¹ Ervin, J, et al. 2010. Making Protected Areas Relevant: A guide to integrating protected areas into wider landscapes, seascapes and sectoral plans and strategies. CBD Technical Series No. 44.

existing plants, animals and others microbes at protected areas for their paraphernalia during even or odd seasons. It depends on life-cycle with sustainable growth and development. Rainfall and soil water are essential portions of all terrestrial ecosystems particularly biodiversity conservation at national parks which provides possessions and amenities for all humans well-beings. Accessibility and properties of water governs ecosystem efficiency towards agriculture and biodiversity conservation systems (BCS). The BCS suffer when rain and soil water becomes scarce due to vicissitudes from wet to dry seasons or during within-seasonal scarcities. Environmental problems, loss of biodiversity, climate change, demand for development and already diminishing state of ecosystems augment to these difficulties so that upcoming challenges to tolerate our ecosystems are accelerating.

Researchers in Bangladesh had made several efforts to develop a framework of water harvesting with biodiversity conservation policy systems in Bangladesh particularly for Lawachara National Park in Moulvibazar district. A number of problems had been identified by ecologists, biodiversity specialists, environmental lawyers and other pertinent stakeholders which include *in-situ* conservations regarding inside water scarcity round the year at Lawachara National Park for plant and wildlife survival which is shown in the Figure 1. During rainy season, a paramount water contains inside the protected area but in dry and winter seasons water scarcity remains huge amount. In this time, some wildlife migrates to the adjacent water body, meanwhile illegal hunters attacked them. On the other hand, some water plants and animals also migrate or endangered due to scarcity of water at protected area.

Protected Areas (PAs) are the most commonly used tool for biodiversity conservation in developing countries. In Bangladesh, there are 38 protected areas including national parks and wildlife sanctuaries designated and established in accordance with formal legal systems declared under the provisions of the Bangladesh Wild Life (Conservation and Security) Act 2012. According to Section 5 (1) of the Bangladesh Environment Conservation Act, 1995 which states that "If the Government is satisfied that an area is in an environmentally critical situation or is threatened to be in such situation the Government may, by notification in the official gazette declare such area as an ecologically critical area"¹⁶. About 15% of their combined area falls under PAs in the World¹⁷. These PAs are legal restrictions on human access and use within their boundaries and force penalties on law breakers according to rules and regulations.

The overall objective of having the above efforts is to enhance the capacity of developing countries for protected area management with alternative model on policies and regulations for effective biodiversity conservation through rain water harvesting to support the implementation of the Convention on Biological Diversity (CBD). For these reasons, this study attempts to develop a framework related to the Biodiversity Conservation through natural water harvesting indicating the Lawachara National Park in Moulvibazar district of Bangladesh.

Rain Water Harvesting to Improve Biodiversity Conservation

Water is an integral part of ecosystems functioning whose presence or absence has a bearing on the ecosystems services as a whole¹⁸. Generally maximum amounts of water are utilised to produce the ecosystem services desired

¹² Secretariat of the Convention on Biological Diversity (2008). Synthesis and Review of the Best Available Scientific Studies on Priority Areas for Biodiversity Conservation in Marine Areas beyond the Limits of National Jurisdiction. Technical Series No. 37.

¹³ Secretariat of the Convention on Biological Diversity (2008). Protected Areas in Today's World: Their Values and Benefits for the Welfare of the Planet. Technical Series No. 36.

¹⁴ Secretariat of the Convention on Biological Diversity (2008). Implementation of the CBD Programme of Work on Protected Areas: Progress and Perspectives. Abstracts of Poster Presentations at the Second Meeting of the Ad Hoc Open-ended Working Group on Protected Areas, 11–15 February, 2008 in Rome, Italy Technical Series no. 35.

¹⁵ Langhammer, PF. et al. (2007) Identification and Gap Analysis of Key Biodiversity Areas: Targets for Comprehensive Protected Area Systems. IUCN World Commission on Protected Areas Best Practice Protected Area Guidelines Series No. 15. IUCN, Gland, Switzerland. <http://data.iucn.org/dbtw-wpd/edocs/PAG-015.pdf>.

¹⁶ TBEC (The Bangladesh Environmental Conservation Act), 1995, Section-5(1), Ministry of Environment and Forest, The Government of People's Republic of Bangladesh, Dhaka.

¹⁷ WDPA (World Database on Protected Areas), 2011, available at www.wdpa.org

¹⁸ UNEP (United Nations Environment Programme). 2009. Rain Water Harvesting: A lifetime for human well-being. A Report prepared for UNEP by Stockholm Environment Institute, Nairobi, Kenya. ISBN 978-92-807-3019-7. Pp.1-80.

to ensure provisioning of basic necessities of food, fodder, fuelwood, furniture, fund and fibres. Water and good services are part of providing ecosystems that need for an intelligent management retort not least in relation to food reduction. Healthy ecosystems include the providing food, water, fibre and genetic material with regulating floods and soil erosion for supporting the formation of soil, photosynthesis and nutrient recycling¹⁹.

Existing research and farm-level and regional development programs aimed at improvement of the rainfed systems have shown that proper development and use of the water harvesting system is the first entry point for success for most of these initiatives²⁰; ²¹. Investment in rainwater harvesting is important in meeting not only the Millennium Development Goals (Table1) on reducing hunger but also on reducing poverty and ensuring environmental sustainability. Rainwater harvesting for crops is therefore, closely related to soil system management; namely, the actions taken to improve infiltration into the soil and to increase water holding capacity and fertility functions in the soil²².

Table 1. Role of water harvesting to ensure environmental sustainability, in achieving the Millennium Development Goals 7)

Millennium Development Goals(MDG)	Role of water harvesting in achieving the MDGs
Goal 7. Ensure environmental sustainability	Upgrading rainfed agriculture has substantial payoffs for society. Rainwater harvesting based watershed programs generated large on-and off-farm employment opportunities, and conserved soil and water resources (Sharma <i>et al.</i> , 2005) ²³ .
a. Reduce biodiversity loss, achieving by 2010, and a significant reduction in the rate of loss.	Improved rainfed agriculture reduces the pressure on forests, grazing lands, wetlands and other fragile ecosystems and helps to improve biodiversity. Better use of green water improves biodiversity on 80% of the land area (Bruce <i>et al.</i> , 1999) ²⁴ .
b. Reduce by half the proportion of people without sustainable access to safe drinking water and sanitation.	Rain water harvesting structures, especially based on rooftop rainwater harvesting is the most economical and surest way of providing water for drinking and sanitation even in the remotest areas. With small additional investment its safe use can be ensured (van Koppen <i>et al.</i> , 2008) ²⁵ .

¹⁹ Millennium Ecosystems Assessment (MEA). 2005. Ecosystems and human well-being: synthesis. Island Press, Washington D.C.

²⁰ Joshi, P.K., A. K. Jha, S.P. Wani, Laxmi Joshi, RL Shiyani. 2005. Meta analysis to assess impact of watershed program and people's action. Comprehensive Assessment Research Report 8, International Water Management Institute, Colombo.

²¹ Rockstrom, J., N. Hatibu, T.Y. Oweis, S.P. Wani, J.Barron, A. Bruggeman, J. Farahani, L. Karlsberg, Z. Qiang. 2007. Managing Water in Rainfed Agriculture. In. Molden, D. (Eds.). Water for Food, Water for Life:

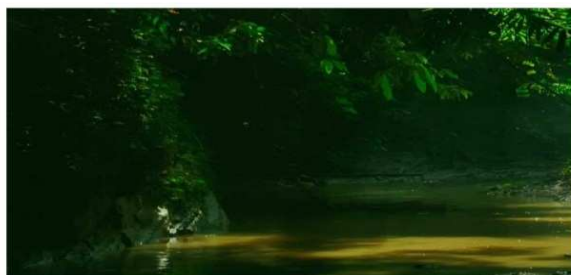
A Comprehensive Assessment of Water Management in Agriculture. London: Earthscan, and Colombo: International Water Management Institute. Pp. 315-352.

²² Sharma, B., Madziva, F., Rwehumbiza, F. B., Bouitfirass, M., Boufaroua, M., Mourid, M.E., and Salem, A.O. 2009. Rainwater Harvesting in the Management of Agro-Ecosystems, Chapter Four, Rainwater harvesting: a lifeline for human. United Nations Environment Programme/SEI, Rainwater Harvesting, ISBN: 978 - 92 - 807 - 3019 - 7. P.33.

²³ Samra, J.S. 2005. Policy and institutional processes of participatory watershed management in India: Past lessons learnt and future strategies. In. Sharma, B.R.; Samra, J.S.; Scott, C.A.; Wani, S.P.(eds.).2005. Watershed Management Challenges: Improving productivity, resources and livelihoods. International Water Management Institute, Colombo, Sri Lanka. pp.116-128.

²⁴ Bruce, J.P., Frome, M., Haites, E., Janzen, H., Lal, R.Paustian, K. 1999. Carbon sequestration in soils. J. Soil and Water Conservation, 54(1): 283-289.

²⁵ Van Koppen, B., R.Namara, C. C. Stafilos-Rothschild. 2005. Reducing poverty through investments in agricultural water Management: Poverty and gender issues and synthesis of Sub-Saharan Africa Case study Reports. Working paper 101. International Water Management Institute, Colombo.



1. Water body at Lawachara National Park during Rainy Season



2. Water body reduces after two months at LNP.



3. Water body reduces severely after three months



4. Water body reduces scarcely during dry season



5. Water body consists yearly adjacent at LNP.



6. No water body during winter season inside LNP

Figure 1: Showing the Existing Water Body at Lawachara National Park (LNP) in Moulvibazar, Bangladesh

Biodiversity Conservation related National Laws and Policies

Bangladesh is a developing country but its biodiversity is enriched. Biological diversity is the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems²⁶. Biodiversity is defined as genetic and species diversity of all species or sub-species of flora and fauna living in aquatic, terrestrial and marine ecosystems or diversity of their ecosystems²⁷. It is used to describe the number, variety and variability of living organisms in a given assemblage²⁸. Protected areas (PA) serve a vital role in providing *in-situ* conservation of biodiversity and the ecological processes that maintain it. A good network of protected areas forms perhaps the pinnacle of a nation's effort to protect biodiversity²⁹, ensuring that the most

²⁶ CBD (1992). *Convention on Biological Diversity*. Text and Annexes, the Interim Secretariat for the CBD Geneva. URL: www.cbd.int/doc/drafts/guidelines-ia-en.doc

²⁷ Wildlife (Conservation and Security) Act. 2012, Article 2(15), Legislative and Parliamentary Affairs Division, Ministry of Law, Justice and Parliamentary, People's Republic of Bangladesh, Dhaka, Bangladesh

²⁸ Pearce, D.W. and D. Moran. 1994). *The Economic value of Biodiversity*. London: IUCN & Earthscan Publications Ltd

²⁹ Linguee. (2014). URL: www.linguee.fr/francais-anglais/traduction/le+cour...

valuable sites and representative populations of important species covers in a variety of ways³⁰. In Bangladesh, PA means all sanctuaries and national parks but community conservation areas, safari parks, eco-parks, botanical gardens also declared by the Government under Sections 13, 17, 18 and 19 of Chapter IV and special biodiversity conservation area established under Section 22 of Chapter V and national heritage and kunjaban (dense small forest) declared under Section 23³¹. National Park is a comparatively large area of outstanding scenic and natural beauty with the primary object of providing education, research and recreation facilities to the public, and are managed for conservation of natural environment of plants and wild animals and outstanding charming scenery. All these are declared by notification and officially gazette under Section 17 of this Act³².

In Bangladesh, there are some laws and policies related on biodiversity conservation towards protected areas management. These are: (i) Wildlife (Conservation and Security) Act, 2012, (ii) Forest Act, 1927 (amended 2000), (iii) The Bangladesh Environment Conservation Act, 1995, (iv) National Forest Policy, 1994, (v) Forestry Master Plan, (vi) Environmental Policy, 1992, (vii) Plant Quarantine Act, 2011, (viii) Environmental Court Act, 2010, (ix) The Constitution of the People's Republic of Bangladesh (Article 18A), (x) Bangladesh Water Act, 2013, (xiii) Code of Criminal Procedure, 1898, (xiv) Code of Civil Procedure, 1908, (xv) Penal Code, 1860, (xvi) Agriculture Policy, (xvii) Land Law and Policy, (xviii) National Biodiversity Strategy and Action Plan, and (xix) National Education Policy 2010, (xx) National Tourism Policy 2010. These laws and policies are enacted with the hope to change the way how we think about the law as a system of power and control. These relates to preparation of species documents, editing, customization and the management of ecosystem services that are related to environmental law. Very little efforts had been made to sustainably protected biodiversity due to inefficiency of prevailing conservation laws and policies. Before any action with the potential for adverse effects can be taken, the law requires that adequate information to be developed, utilized, and clearly documented in all decisions³³. Except for other jurisdictions, the protected area managers around the globe recognize the value of marshaling the best available information to support decision-making in the complex milieu of parks and protected spaces³⁴. Attempts are made here to determine if the mentioned laws and policies can be utilized in the integrated water management mechanisms in national park, and that the information flow and decision-making could enhance biodiversity conservation which can be better than traditional system. Till to date Bangladesh has no proper integration policy for conserving biodiversity through natural water harvesting at Lawachara National Park.

Methodological Approach

Study Site

Bangladesh is a developing country with enriched biodiversity, the world largest deltaic region lies in the northeastern part of South Asia between 20°34' and 26°38' North latitude and 88°01' and 92°41' East longitude. Total 38 protected areas cover an area of 2, 65,981ha (about 10.72% of total forest area), which accounts for 16% of the total area managed by the Forest Department and less than 2% of total area of Bangladesh³⁵. It includes 17 National Parks, 21 Wildlife Sanctuaries and 12 other conservation sites³⁶ which are shown in the Figure 2. The survey was undertaken at Lawachara National Park (LNP) which was declared as a National Park in 1996 with 1,250 hectares of highly diverse hilly evergreen forest under the legal status of the Wildlife Preservation Act-1974

³⁰ Vreugdenhil, D., Terborgh, J., Cleef, A. M., Sinitsyn, M., Boere, G.C., Archaga, V.L., and Prins, H.H.T. 2003. Comprehensive Protected Areas System: Composition and Monitoring. Shepherdstown, USA: World Institute for Conservation and Environment. Web: www.linguee.fr/francais-anglais/traduction/le+cour...

³¹ Wildlife Conservation and Security Act, 2012, Article 2(43), Legislative and Parliamentary Affairs Division, Ministry of Law, Justice and Parliamentary, People's Republic of Bangladesh, Dhaka, Bangladesh.

³² Wildlife Conservation and Security Act, 2012, Article 2(14), Legislative and Parliamentary Affairs Division, Ministry of Law, Justice and Parliamentary, People's Republic of Bangladesh, Dhaka, Bangladesh.

³³ Miller, A.B. 2001. Managing data to bridge boundaries. In D. Harmon (editor), *Crossing Boundaries in Park Management: Proceedings of the 11th conference on Research and Resource Management in Parks and on Public Lands*, pp.316-320. Hancock, MI: The George Wright Society.

³⁴ BNP (Banff National Park). 1994. Case Study: The Banff-Bow Valley Study and Information Technology, Canada.

³⁵ Hossain, M.K. 2001. Overview of the forest biodiversity in Bangladesh. In: *Assessment, conservation and sustainable use of forest biodiversity* (CBD Technical Series no. 3). Secretariat of the Convention on Biological Diversity, Montreal, 33-35 pp.

³⁶ PAB (Protected Areas of Bangladesh), URL: <http://www.bforest.gov.bd/index.php/protected-areas>.

(This Act is now repealed and current Wildlife Conservation and Security-Act 2012). The LNP is situated in the Union and Upozilla of Kamalgonj in Moulvibazar district of Bangladesh coordinates with $24^{\circ}32'12''N$ $91^{\circ}47'03''E$. the park is a critical home for several primate species including the only ape of the country, the Hoolock Gibbon (*Hylobates hoolock*). The park is also a hotspot for biodiversity with several species of a new and regional record for Bangladesh³⁷.

Data Collection

Various data collection methods were employed in the study to collect both secondary and primary. The methods include existing policies review, observations, semi-structured interviews, and questionnaires. Semi-structured interviews were used and selected based on the representation point of view and additionally in regard to their relevance to the conceptual questions³⁸. Additionally, key informants from the relevant administrative, analyst, specialist on biodiversity, water management officer, professional, environmental lawyers, Park Manager, Team Leader of Co-management Committee, Leader of Indigenous Community, Academics, Learners, Researchers and local users were interviewed on the existing phenomena. Secondary data were collected from journals, books, Bangladesh Bureau of Statistics (BBS), Forest Department (FD), Space Research Remote Sensing Organization (SPARRSO), Government institutions (Forest department, Ministry of Environment and Forests, Forest College and Training Centre, Water Resource Institute, Universities, International /National-NGOs, Stakeholders and relevant other sources.

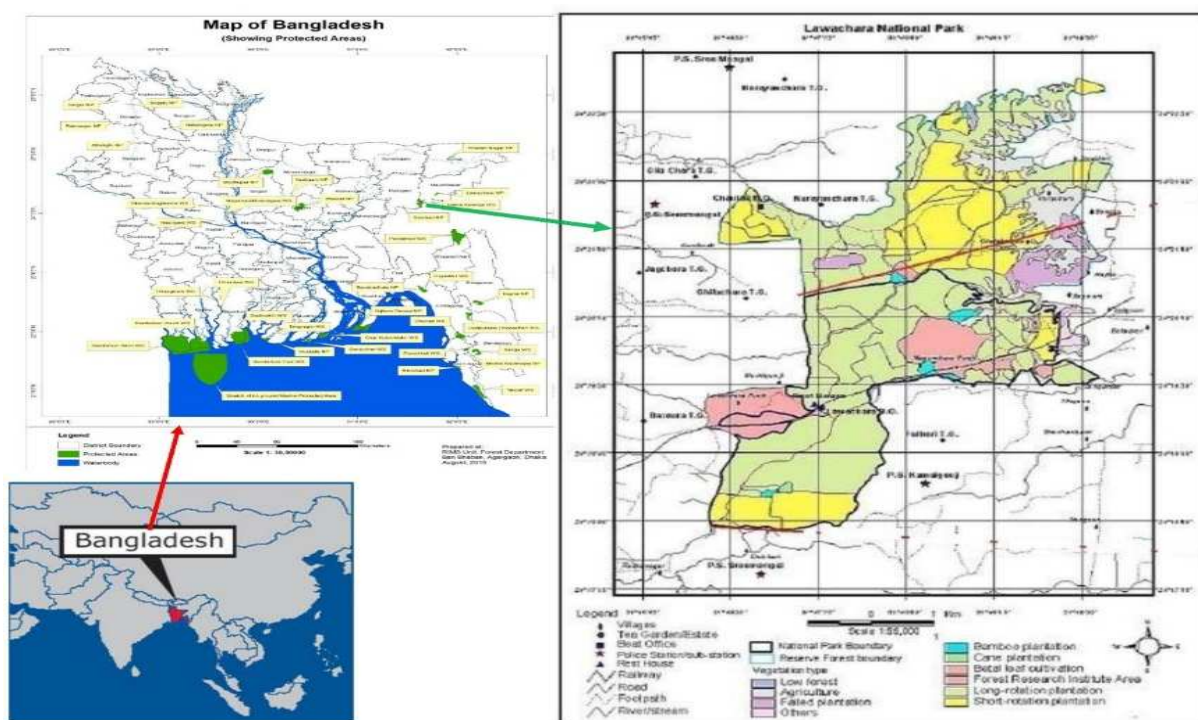


Figure 2: Showing the study area of Lawachara National Park with all protected areas in Bangladesh³⁹.

Data Compilation

At first, all the general information regarding the occurrence of biodiversity and water management including policies in the protected area and their diversity, status and distribution are collected and tabulated in an organized manner. After the data were collected, they were checked properly for accuracy, by using the crosschecking method, i.e. checking the same information from the different sources and verify the sources of information. Information regarding the initiatives of the authority towards the conservation of biodiversity were also collected through

³⁷ RUFFORD. (2014). URL: www.rufford.org/files/75.07.05%20Detailed%20Final...

³⁸ Waset. (2014). URL: www.waset.org/publications/14873

³⁹ Nishorgo Support Project. 2005. Lawachara National Park, Bangladesh Forest Department-USAID

different relevant secondary information and field survey, which are carefully compiled and evaluated. Then the information included preparation of data master sheet and their manipulation into convenient forms used in the result and discussion section subsequently. The primary and secondary data compiled with the renowned MS Excel and relevant software.

Data Handling and Analysis

Data obtained from the field were analyzed using standard data analysis software. In this research study, deductive strategies were used to present the results that ascertained through the interpretations made with the combined Supervisor and Investigator after collecting the data, organizing the data, classifying the data and then figuring out the relationships that existed⁴⁰ using the relevant software such as MS Excel, SPSS and update software on policy research. All questionnaires received were analyzed using the, statistical software used to generate general statistics on their trends from the responses.

Results And Discussions

General Information of Kamalganj Sub-district

Lawachara National Park is situated at Kamalganj sub-district in Moulvibazar district of Bangladesh. There are seven sub-districts in Moulvibazar district which are shown in the Table 2 including total area, land area, reserve forest and riverine area (km²). Kamalganj has 485.26 km² total area including 372.62 km² and 112.64 km² land and reserve forest areas respectively but no riverine area which is shown in the Figure 3a. Besides, average size of household is 4.99 in Kamalganj subdistrict where population density is 534 per sq. kilometre which is affected environmental problems and climate change towards biodiversity at Lawachara national park showed in the Table 2. On the other hand, Kamalganj has 20 nursery and 7 brick kilns but no horticulture centre, poultry farm and dairy farm than other sub-district in Moulvibazar which is shown in the Table 3.

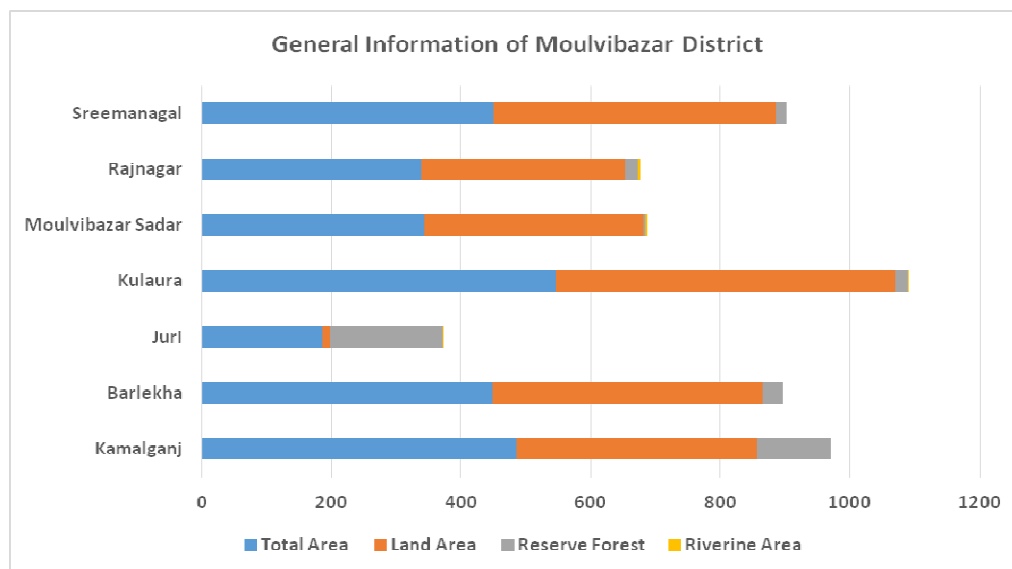


Figure 3a: Showing general information of sub-district at Moulvibazar district including total area, land area, reserve forest and riverine area in (km²)⁴¹.

⁴⁰ WASET. (2014). URL: www.waset.org/publications/14873

⁴¹ BBS (Bangladesh Bureau of Statistics). 2013. Moulvibazar District Statistics 2011. Statistics and Information Division (SID), Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh. Pp.1-117.

Table 2: Number of Total Population, Household and Density at different sub-districts of Moulvibazar district⁴².

Sub-district	Total Population	Household	Average size of HHs	Density / sq. km.
Kamalganj	259130	51895	4.99	534
Barlekha	257620	44192	5.83	574
Juri	148958	27509	5.42	800
Kulaura	360195	66465	5.41	660
Moulvibazar Sadar	342468	62881	5.41	995
Rajnagar	232666	43070	5.40	688
Sreemanagal	318025	65165	4.86	706

Table 3: Number of Nursery, Horticulture Centre, Poultry Farm, Dairy Farm and Brick Kiln at following sub-district of Moulvibazar district.

Sub-district	Nursery	Horticulture Centre	Poultry Farm	Dairy Farm	Brick Kiln
Kamalganj	20	0	0	0	7
Barlekha	16	0	140	58	12
Juri	4	0	39	9	3
Kulaura	30	1	214	19	11
Moulvibazar Sadar	28	1	99	65	19
Rajnagar	6	17	173	47	6
Sreemanagal	18	0	308	80	0

Water resource management is a substantial issue from several dimensions such as development of water bodies for upcoming generations, biodiversity protection of available water bodies at protected areas to prevent different arguments. A paramount issue is water-its availability, harvesting, quality, distribution and management. General hydrological information is essential to develop water resources and protect them at Lawachara National Park through rain water planning, harvesting and running water resources policy which is based on seasonal requirements and demand from the point of view of the whole protected area. However, no systems of the fundamental statistics of water resources legacy and incorporation for plant and wildlife has been established at lawachara national park. The main purpose of lawachara national park is to conserve viable and representative populations of species and ecosystems in perpetuity with ecological amplitude and seasonal priority. These populations of species and ecosystems are enhanced on temperature, rainfall and overall humidity which is shown in the Table 4 mentioning maximum temperature 34.1 in 2008 where rainfall 3356 mm including 79% humidity. The rain water storage depends on land positioning system including high land, medium and low land which are shown in the Table 5 indicating high land 60108 hac where 1741 hac low land. So, there is a fluctuation on land positioning systems.

Table 4: Temperature, Rainfall, Humidity during the year of 2008 to 2011

Year	Temperature		Rainfall (millimetre)	Humidity (%)
	Maximum	Minimum		
2008	34.1	8.2	3356	79
2009	33.2	10.7	2407	78
2010	34	8.7	1868	63.7
2011	23.7	8.6	2071	78.8

⁴² BBS (Bangladesh Bureau of Statistics). 2013. Moulvibazar District Statistics 2011. Statistics and Information Division (SID), Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh. Pp.1-117.

Table 5: Area (ha) of high, medium and low land in 2008

Sub-district	High Land	Medium Land	Low Land	Total Land
Kamalganj	60108	34612	1741	96461
Barlekha	13133	6256	12182	31571
Juri	31023	14324	11458	56805
Kulaura	36175	73410	17112	126697
Moulvibazar Sadar	8490	39239	14042	61771
Rajnagar	7125	31235	11765	50125
Sreemanagal	14169	12160	16590	42919

The Government of People's Republic of Bangladesh has developed new Act on the Wildlife (Conservation and Security) Act 2012. Till to date it is update law on wildlife conservation and security which is enhanced on biodiversity at protected areas in Bangladesh. After reviewing, there are some suggestions regarding next generation biodiversity at protected areas which are shown in the Table 6.

Table 6: Suggested guidelines for the Wildlife (Conservation and Security) Act-2012, Water Policy in Bangladesh

SI #	Particulars	Suggested Guidelines
(i).	Rain Water Harvesting (RWH)	Need mention properly the formation of RWH according to the Aichi Target 11 of CBD.
(ii).	Definition of Biodiversity	Need clearly definition of biodiversity with undergrowth species protections and according to guidelines of CBD
(iii).	National Biodiversity Strategic Action Plan (NBSAP)	Need technological and community based update NBSAP
(iv).	Species Conservation	Need appropriate security with also undergrowth species management except alien and invasive species.
(v).	Endangered Species Protection	Need proper perpetuation with modern technological arena and application of national ICT-Act
(vi).	Silvicultural Operations	Need community species stratifications with restrictions on massive weeding, thinning, pruning and poaching/stampeding
(vii).	Illegal Killing and Illicit felling	Need removal network of political biasness and inherent power of administration
(viii).	Responsible for enforcement of Legislation	Need departmental enforcement team with modern technological arena for state-of-the-art monitoring, set-up and legal action according to NBSAP
(ix).	Biodiversity Research Group (BRG)	Need mention properly the formation of BRG according to NBSAP
(x).	Co-management Team and others	Need proper biodiversity conservation knowledge and scientific guidelines among co-management team members, policy bureaucrats and managers
(xi)	Individual National Biodiversity Policy	Need National Biodiversity Conservation Policy and relevant guidelines according to CBD

Rain Water Harvesting at Lawachara National Park

There are several spots where indigenous community stay at Lawachara national park and harvest rain water for various purposes which are shown in the following Figure 3-8 successively. The Indigenous people are involved in rain water harvesting inside the lawachara national park where they sustain their livelihood.



Figure 3: Rain Water Harvesting through digging pond for irrigation and other work activities for the Indigenous Community inside the Lawachara National Park.



Figure 4: Rain Water Harvesting through digging small pond for agroforestry activities for the Indigenous Community during dry season inside the Lawachara National Park.



Figure 5: Storing Water through digging cemented well adjacent house of Indigenous Community for their daily activities inside the Lawachara National Park.



Figure 6: Storage Rain Water through digging small pond adjacent their house of Indigenous Community for daily activities inside the Lawachara National Park.



Figure 7: Setting Water Pump for daily drinking water and other activities for the Indigenous Community inside the Lawachara National Park.



Figure 8: Setting Plastic Drum for Water Preservation among the Indigenous Communities inside the Lawachara National Park.

The Protected Area and Freshwater Biodiversity Challenge

Freshwater habitats are the most species rich per unit and their biodiversity is being lost faster than either the forest or marine biomes, with a 50% decline in the freshwater species population index in the 30 years since 1970, according to WWF's Living Planet Report 2002. Bangladesh faces on natural calamities and seasonal variations and lack of proper information. So, there are some of challenges facing conservation of freshwater ecosystems and future guidelines for LNP formation and supervision. Freshwater habitats are those ecosystems that depend on water flows for their environmental health, and can include caves, reservoirs, floodplains, lakes, pans and estuaries⁴³.

The protection of biodiversity at LNP can be reduced the water scarcity and removing illegal hunting outside the park during dry and winter seasons. Because, protected area promoters' prerequisite to prudently site park and stimulus sustainable use of natural resources within entire water body / catchments inside or outside park area to successfully conserve freshwater biodiversity with proper planning, observations and information. The importance of biodiversity information is essential to the respondents at the study areas related to natural water harvesting inside the national park area which are shown in Figure 9. About the 55% of the respondents opined their opinions as very essential, and 42% as essential with only 1% respondents gave 'no comment'.

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⁴³ Jamie Pittock. 2005. Challenges of Freshwater Protected Areas, WWF's Global Freshwater Programme. URL: <http://cambodia.panda.org/?17772/Challenges-of-freshwater-protected-areas>

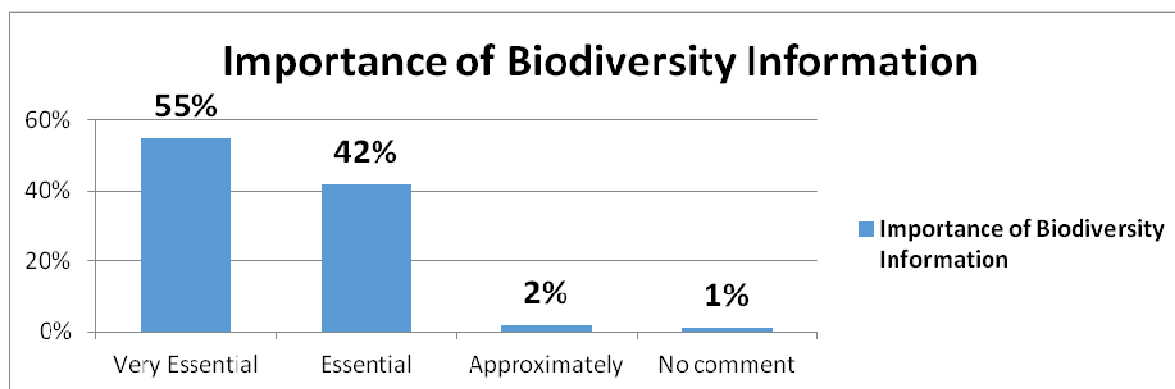


Figure 9: Importance of Biodiversity Information applying in the Lawachara National Park

Knowledge of Respondents in Biodiversity Conservation through Rain Water Harvesting

Knowledge of Biodiversity Conservation through rain water harvesting is important, because with the knowledge on this harvesting, the respondents need to know the worth of relevant parameters and activities that deals with the input, processing and output with the indigenous knowledge management systems. In the Figure 10, that the findings revealed that about 43% of respondents have simple knowledge for more informed research knowledge to maintain strappingly for sustainable protected area management as compared to 11% of respondents who claimed that they are 'more informed' of the rain water harvesting (RWH).

The results revealed that RWH implementation is surrounded with challenges which were mainly concern with management, administration, and community people involved in RWH implementation processes at Lawachara National Park in the north-eastern part of Bangladesh. Overall, the research was accomplished the terrestrial water harvesting at protected areas with requirements policy improvement for sustainable nature conservation to the effective policy makers.

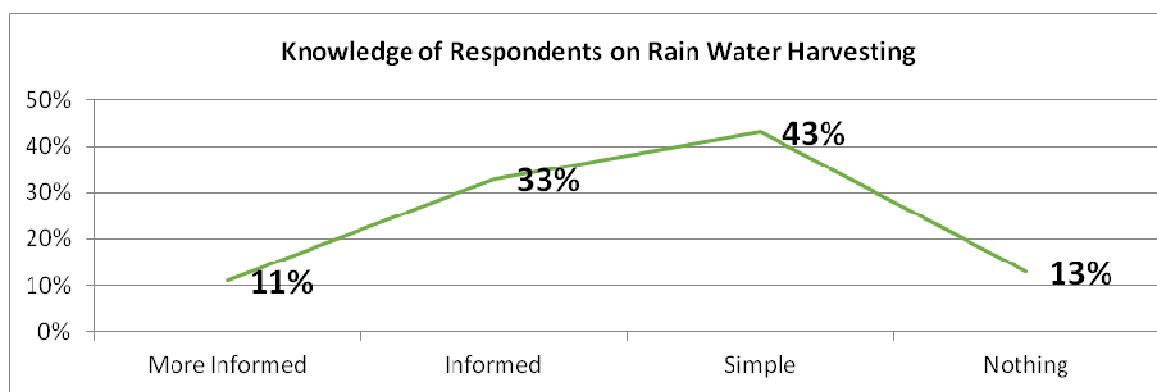


Figure 10: Knowledge of Respondents in Biodiversity Conservation through Rain Water Harvesting at Lawachara National Park.

Research Role Identification on Biodiversity Policy and Water Management

Biodiversity Policy and Water Management research are the paramount research at nature conservation field. So, they are the effective research field with natural science and technology that deals with the impact of activities on eco-systems. In the Figure 11, it can be seen that about 58 persons of academic respondents are performed their research role on biodiversity policy and water management to maintain research activities sturdily for sustainable protected area management where 2 persons of them are Postgraduate/Post Doctorate which showed in the Figure 5.

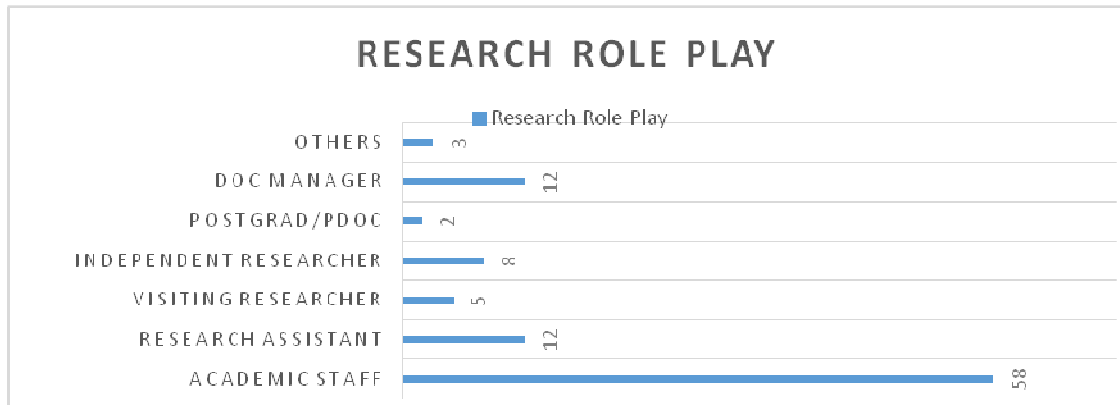


Figure 11: Research Role Play among stakeholders on Biodiversity Policy and Water Management for conserving biodiversity at Lawachara National Park.

Biodiversity Policy and Water Harvesting Logic Model towards Protected Areas

Biodiversity Conservation at Protected Area interconnects with rain water harvesting which is shown in the Figure 14, a Biodiversity Conservation and Rain Water Harvesting Logic Model has been developed that describes the relationship among inputs, activities/processing, getting outputs and intended outcomes including impact of Biodiversity Policy and Significance Model towards Protected Areas in Developing Countries, like Bangladesh. The logic model illustrates the highly interconnected nature of the work of Protected Areas including the linkages between the international, national and local levels. It also addresses the intended outcomes of the five key components.

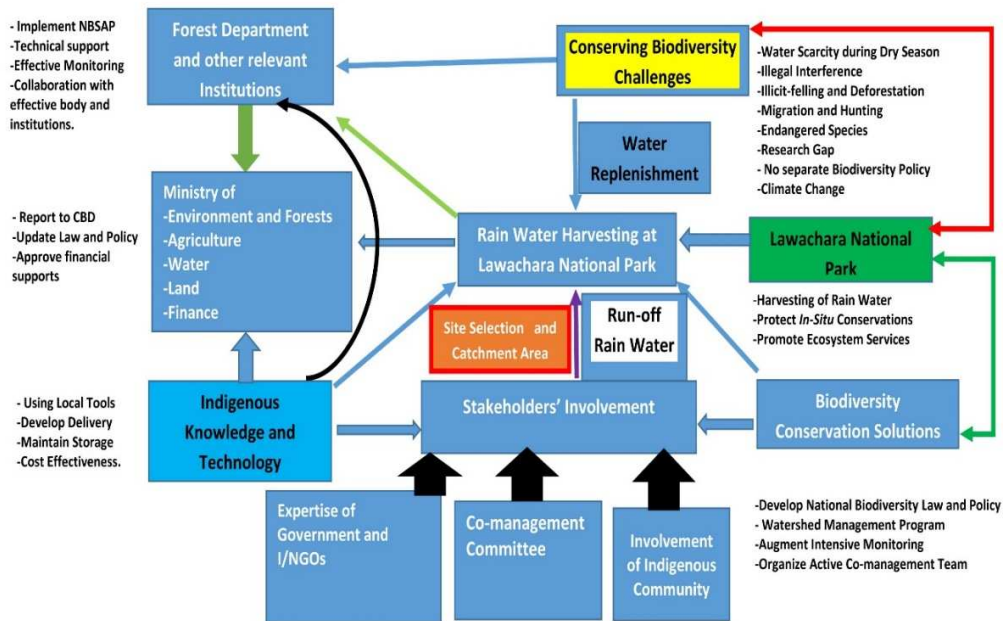


Figure 12: Showing the Framework on Rain Water Harvesting at Lawachara National Park

Every state will tend to separate economic, social and environmental factors at the policy, planning and management levels with prevailing systems on decision-making⁴⁴ for biodiversity conservation through protected areas improvement. According to National Environmental Policy-1992 stated as attempt to expand the state wildlife and

⁴⁴UN. 1992. Agenda 21: The United Nations Programme of Action from Rio. United Nations, New York.

biodiversity conservation with relevant research for transforming knowledge and experience⁴⁵. Besides, attempts will be made to bring about 20% of the country's land under the afforestation of the government and private sectors the year 2015 by accelerating the pace to achieve self-reliance in forest products and maintenance of ecological balance⁴⁶. From our research, we want to enhance for development the update bio-environmental conservation policy prioritizing the national biodiversity strategic action plans (NBSAPs) which is committed by the state party on the Convention of Biological Diversity (CBD) that was studied at Lawachara National Park in the north-eastern part of Bangladesh.

Individual, NGOs and Policy-Maker

Rain Water Harvesting Systems at lawachara national park proceeds the obligation of water supply out of the hands of the government, private and other sectors. The benefit of private RWH systems to the government has been documented in the existing country where national government has mounted rules and policies supporting the installation of RWH systems. It depends upon the involvement of all the stakeholders for suggesting actions of government, private sector, NGOs, Community members, water supply board, Water and Sewarage Company, Park Manager, Team Leader of Co-management Committee, Indigenous community Leader, Academician, Biodiversity Specialist, Botanists, Zoologists, Researchers, Environmentalists and Lawyers, Land-users, Learners, Local Government Leaders, Policy-makers and effective other stakeholders. Though the potentiality of job creations with RWH systems are separated scope of this observation, review, effect on the national park as a whole to enhance biodiversity conservation during summer and winter seasons and other socio-economic considerations to lead the important query for policy-makers thinking with the economical importance.

Conclusion

In the concluding, the study explores the rain water harvesting at protected areas to conserve the biodiversity. But proper policy integration and effective management are absent till to date for enhancing the fresh water biodiversity at Lawachara National Park. The Rain water harvesting reduce the water scarcity and removal illegal hunting during wildlife migrate outside at dry and winter seasons. Overall, the research was accomplished the terrestrial water harvesting at protected areas with requirements policy improvement for sustainable nature conservation to the effective policy makers and relevant bodies with interconnected training and social-technical arena which will contribute at national and global perspectives. Presumptuous trends in human demands for water continue unchanged and biodiversity losses continue at existing rates, the opportunity to conserve momentous proportions of the remaining biodiversity in fresh water will vanish before the 'Water for Life ' decade ends. Overall, the research suggests future research trajectories using a new collaborative approach to drive methodological agenda and recommends ways to further incorporate the demanding next generation water management policy at protected areas management perspectives.

⁴⁵Environmental Policy-1990, Ministry of Environment and Forest, Dhaka, Bangladesh.

⁴⁶Forest Policy-1994, Bangladesh Forest Department, Dhaka, Bangladesh.

