

Institute of Biodiversity and Environmental Conservation

Assessment of Environmental Policy Instruments along with Information Systems for Biodiversity Conservation in Bangladesh: A Case Study on Lawachara National Park

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DECLARATION

The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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DEDICATION

This dissertation is dedicated to my beloved wife, Advocate Motia Begum and daughters, Jorin Tasnim Parisha and Zarin Zahra Torsa, who were deprived of my presence during this research but remained my primary source of motivation and consistent moral supports throughout my higher study.

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ABSTRACT

Biodiversity is in the core field of environmental issues. The problem of loss of biodiversity has been raised as a very important global issue for several years due to the lack of dynamic policies, technological application, institutional support and stakeholder engagement. This study aimed to assess the environmental policy instruments including legal, *in-situ* and informational instruments for conserving of biodiversity through primary and secondary data analysis at Lawachara National Park (LNP) in Bangladesh, as a test site. Quantitative and qualitative related conservation data were obtained through field observation, interviews, field surveys, focus group discussions and informal discussion while secondary data were obtained from diverse sources. Key conservation instruments provided at the LNP and its challenges with gaps in policies for national park management are highlighted. The study shows that biodiversity-related legislations amended was highest in Bangladesh for the period of 2010 to 2016 with policy weight scoring 96% of LNP. The growth of National Parks maximized at but in low digital conservation services within the same period. This study represents the impact of sensor networks on wildlife to be compared to larger and smaller animals in a bright and dark environment, facilitating the design and use of modular tags. These results reflect the importance of conservation of biodiversity that the State provides. A scalable, modular and adaptable solution has been proposed with limited peripheral network systems for biodiversity protection. The study assessed that the existing conservation policy instrument is inadequate for national park biodiversity protection in Bangladesh. In addition, the study identified issues that should be the main priorities for policy integration, implementation and improvement with technological array in order to foster LNP's management objectives for ensuring the sustainability of biodiversity conservation systems. The improvement of environmental policy instrument assessment has been sluggish, compared with several other conservation tools, and various performances

are still below par. Scientific knowledge is indispensable in national park biodiversity management but such knowledge is poorly identified. The input uniqueness of research findings of them should influence the assessment of the conservation policy instruments used to deal with them. If assessment of such instruments is allowed without due to reflection of information implicated, there is a huge jeopardy of recognizing only trifling impacts and near to the ground effectiveness. However, careful assessments can facilitate future research to make better conservation decision-making in the creation of environmentally fundamental and innovative instruments. Lastly, the study suggests future research trajectories of a new collaborative alternative approach to drive the methodological agenda and recommendations on ways to further incorporate the demanding bio-environmental conservation policy instruments towards national park biodiversity management.

Keywords: Biodiversity, Policy Instruments, Information Systems, Lawachara National Park, Bangladesh.

Penilaian Polisi Instrumen Alam Sekitar dengan Sistem Maklumat Pemuliharaan Biodiversiti di Bangladesh: Kajian Kes di Taman Negara Lawachara

ABSTRAK

Biodiversiti adalah bidang teras dalam isu-isu alam sekitar. Masalah kehilangan biodiversiti telah dibangkitkan sebagai isu global yang sangat penting selama beberapa tahun disebabkan oleh kekurangan dasar dinamik, penerapan teknologi, sokongan institusi dan penglibatan pihak berkepentingan. Kajian ini menilai instrumen dasar alam sekitar termasuk instrumen undang-undang, in-situ dan maklumat untuk memulihara biodiversiti melalui analisis data primer dan sekunder di Taman Negara Lawachara (TNL), Bangladesh, sebagai tapak ujikaji. Data pemuliharaan kuantitatif dan kualitatif kajian ini diperoleh melalui pemerhatian lapangan, temubual, tinjauan lapangan, perbincangan kumpulan fokus dan perbincangan tidak formal, sementara data sekunder diperoleh daripada pelbagai sumber. Instrumen pemuliharaan utama yang disediakan di TNL dan cabaran yang dialami dalam dasar pengurusan Taman Negara telah diserlahkan. Kajian ini menunjukkan bahawa pindaan di Bangladesh untuk undang-undang berkaitan biodiversiti adalah tertinggi dalam tempoh 2010 hingga 2016 dengan penelitian dasar mendapat 96% TNL. Pertumbuhan Taman Negara pulapada tahap maksimum tetapi kurang dalam perkhidmatan pemuliharaan digital pada tempoh yang sama. Kajian ini mewakili kesan rangkaian sensor pada hidupan liar untuk dibandingkan dengan haiwan yang lebih besar dan kecil dalam persekitaran yang terang dan gelap, yang memudahkan rekabentuk dan penggunaan tag modular. Hasil Kajian ini mencerminkan kepentingan menyelaraskan pelan pemuliharaan biodiversiti yang disediakan oleh Bangladesh. Penyelesaian berskala, bermodul dan yang bersesuaian telah dicadangkan dengan sistem rangkaian periferi terhad bagi perlindungan biodiversiti. Penilaian kajian menunjukkan bahawa instrumen dasar pemuliharaan yang ada tidak mencukupi bagi perlindungan biodiversiti Taman Negara di Bangladesh. Di samping itu, kajian ini mengenalpasti isu-isu yang harus menjadi keutamaan bagi integrasi, pelaksanaan dan penambahbaikan dengan pelbagai teknologi untuk memupuk objektif pengurusan TNL

bagi memastikan kelestarian sistem pemuliharaan biodiversiti. Peningkatan penilaian instrumen dasar alam sekitar agak lembap, berbanding dengan beberapa alat pemuliharaan lain, dan pelbagai prestasi masih tidak boleh dipercayai. Pengetahuan saintifik tidak boleh diketepikan dalam pengurusan biodiversiti Taman Negara namun pendedahan terhadap pengetahuan saintifik tersebut sangat kurang. Keistimewaan input kedua-dua masalah dan penemuan penyelidikan ini mempengaruhi penilaian instrumen dasar pemuliharaan yang digunakan untuk menanganinya. Sekiranya penilaian terhadap instrumen tersebut dibenarkan tanpa gambaran informasi, maka risiko untuk mengenalpasti kesan-kesan akan meningkat ke tahap merbahaya. Dalam pada itu, penilaian yang dilakukan dengan teliti dapat memudahkan penyelidikan masa hadapan untuk membuat keputusan pemuliharaan yang lebih baik dalam penjanaan instrumen dasar alam sekitar dan inovatif. Akhir sekali, kajian itu mencadangkan trajektori penyelidikan masa hadapan dengan pendekatan alternatif kolaboratif baharu untuk memacu agenda metodologi dan cadangan tentang cara untuk terus menggabungkan instrumen dasar pemuliharaan biodiversiti yang menuntut ke arah pengurusan biodiversiti Taman Negara.

Kata kunci: *Biodiversiti, Polisi Instrumen, Sistem maklumat, Taman Negara Lawachara, Bangladesh.*

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LIST OF ABBREVIATIONS

ABI	Association for Biodiversity Information
ABS	Access Benefit Sharing
ABT	Aichi Biodiversity Targets
ACCF	Assistant Chief Conservator of Forests
ACF	Assistant Conservator of Forests
ACM	Adaptive Co-management
ACR	Access Collection & Research
AIGA	Alternative Income Generating Activities
ALNP	Administration of Lawachara National Park
ANP	Analytic Network Process
AP	Action Plan
APAP	Asia Protected Area Partnership
APFNet	Asia Pacific Network for Sustainable Forest Management
ARP	Afforestation and Reforestation Programme
ARTS	Automated Radio Telemetry System
BACC	Bangladesh Anti-Corruption Commission
BAR	Benchers Advocates Railing (The whole body of Lawyers)
BBS	Bangladesh Bureau of Statistics
BCHM	Biodiversity Clearing House Mechanism
BCCI	Biodiversity Conservation Corridor Initiative
BCDM	Biodiversity Career Decision Making
BCCM	Biodiversity Career Commitment Measures
BCTI	Biodiversity Career Thoughts Inventory

BD	Bangladesh
BDIS	Biological Diversity Information System
BDT	Bangladesh Taka (Bangladesh Currency)
BELA	Bangladesh Environmental Lawyers Association
BER	Bangladesh Economic Review
BFD	Bangladesh Forest Department
BFRI	Bangladesh Forest Research Institute
BIS	Biodiversity Information Systems
BLI	Birdlife International
BMAPU	Black Mamba Anti-Poaching Unit
BMS	Biodiversity Monitoring Systems
BNP	Banff National Park
BOG	Board of Governor
BRAC	Bangladesh Rural Advancement Committee
BRC	Biodiversity Related Conventions
BRGB	Biodiversity Research Group of Bangladesh
CAIS	Centre for Academic Information System
CASVE	Communication Analysis Synthesis Valuing Execution
CBBC	Community-Based Biodiversity Conservation
CBD	Convention on Biological Diversity
CBNRM	Community-Based Natural Resource Management
CBO	Community Based Organization
CCF	Chief Conservator of Forest
CCI	Community Conservation Integrity

CEESP	Commission on Environmental, Economic and Social Policy
CEGIS	Centre for Environmental and Geographic Information Services
CEL	Commission on Environmental Law, IUCN
CFSMP	Central Forest Spine Master Plan
CHM	Clearing House Mechanism
CI	Conservation International
CIFOR	Centre for International Forestry Research
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CMC	Co-management Committee
CMS	Convention on the Conservation of Migratory Species of Wild Animals.
CNRS	Centre for Natural Resource Studies
COP	Conference of the Parties
CPG	Community Patrol Group
CREL	Climate Resilient Ecosystems and Livelihoods
CrPC	Criminal Code of Procedure
CSR	Corporate Social Responsibility
CWBMP	Coastal and Wetland Biodiversity Management Project
DBMS	Database Management Systems
DBS	Divisional Biodiversity Status
DCCF	Deputy Chief Conservator of Forests
DCT	Digital Conservation Technology
DFID	Department for International Development
DFO	Divisional Forests Officer

DNA	Deoxyribonucleic Acid
DNPCS	Digital National Park Conservation Systems
DPSIR	Drivers-Pressure-State-Impacts-Response
DoE	Department of Environment
EAAFP	East Asian Australasian Flyway Partnership
EC	European Commission
EDIT	European Distributed Institute of Taxonomy
ECA	Ecologically Critical Area
ECC	Environment and Climate Change
ECCB	Environmental Clearance Certificate, Bangladesh
ECNEC	Executive Committee for National Economic Council
EE	Environmental Education
EIA	Environmental Impact Assessment
EOS	Earth Observation Systems
EPI	Environmental Performance Index
EPI-BCS	Environmental Policy Instruments-Biodiversity Conservation Systems
ERA	Ecological Risks Assessment
ERD	Entity Relationship Diagram
ERMO	Ecological Risk Management Operation
ERMSS	Ecological Risk Management Support System
ETR	Eco-technological Risks
FA	Forest Act
FAO	Food and Agriculture Organization
FAU	Forest Administration Unit

FDS	Forest Department Sarawak
FGD	Focus Group Discussion
FRIM	Forest Research Institute of Malaysia
GBP	Green Banking Policy
GBS	Green Banking System
GDP	Gross Domestic Product
GDSS	Group Dicision Support System
GEF	Global Environment Facility
GEP	Global Economic Prospects
GFA	Global Forest Atlas
GFI	Governance of Forests Initiative
GFW	Global Forest Watch
GIGA	Green Income Generating Activities
GIS	Geographic Information Systems
GIZ	German Federal Enterprise for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit)
GNSS	Global Navigation Satellite System
GoB	Government of Bangladesh
GPRS	Global Packet Radio System
GPS	Global Positioning System
GRR	Global Risk Report
GSM	Global System for Mobile Communication
GTF	Global Tiger Forum
GTI	Global Tiger Initiative

HBI	Heart of Borneo Initiative (Malaysia)
HGDP	Home Garden Development Programme
HRIS	Human Resource Information System
HSBC	Hongkong Sanghai Bank Corporation
IAS	Invasive Alien Species
IASDB	Invasive Alien Species Database
IASIS	Invasive Alien Species Information Systems
IBDIS	Integrated Biodiversity Information Systems
ICDP	Integrated Conservation and Development Programme
ICEM	International Centre for Environmental Management
ICT	Information and Communication Technology
ICTP	International Conventions Treaties and Protocols
IELP	International Environmental Law Project
IFAW	International Fund for Animal Welfare
IIED	International Institute for Environment and Development
IM	Information Management
IMED	Implementation, Monitoring and Evaluation Division
IMF	International Monetary Fund
IMS	Information Management System
IONDB	Integrated Online National Database
IPAC	Integrated Protected Area Co-management
IPBES	Intergovernmental Platform on Biodiversity and Ecosystem Services
IPCC	Inter-governmental Panel on Climate Change
IPPC	International Plant Protection Convention

IPR	Intellectual Property Rights
IRG	International Resources Group
IS	Information Systems
ISNA	Impact of Sensor Network on Animals
ITIS	Integrated Taxonomic Information Systems
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
IUCN	The World Conservation Union (update renamed)
KBDM	Koordinationsstelle Biodiversitäts Monitoring
KIBP	Constant Improvement Bio-environmental Policy
KNP	Kruger National Park
LGED	Local Government and Engineers Department (Bangladesh)
LULC	Land use /Land cover
MEA	Millenium Ecosystem Assessment
METT	Management Effectiveness Tracking Tool
MFF	Mangrove for Future
MLJPA	Ministry of Law, Justice and Parliamentary Affairs (Bangladesh)
MNRE	Ministry of Natural Resources and Environment (Malaysia)
MoA	Ministry of Agriculture (Bangladesh)
MoC	Ministry of Commerce (Bangladesh)
MoE	Ministry of Education (Bangladesh)
MoEF	Ministry of Environment and Forests (Bangladesh)
MoFL	Ministry of Fisheries and Livestocks (Bangladesh)
MoFSC	Ministry of Forests and Soil Conservation (Nepal)
MoI	Ministry of Information (Bangladesh)

MoL	Ministry of Land (Bangladesh)
MoLGRDC	Ministry of Local Government and Rural Development and Cooperatives (Bangladesh)
MoLJP	Ministry of Law, Justice and Parliamentary Affairs (Bangladesh)
MoMDE	Ministry of Mahaweli Development and Environment (Sri Lanka)
MoSICT	Ministry of Science, Information, Communication & Technology (Bangladesh)
MoWR	Ministry of Water Resources (Bangladesh)
MP	Master Plan
NACOM	Nature and Conservation Movement (Bangladesh)
NASA	National Aeronautics and Space Administration
NBSAP	National Biodiversity Strategy and Action Plan
NCS	National Conservation Strategy
NCTB	National Curriculum and Textbook Board (Bangladesh)
NEMAP	National Environmental Management Action Plan
NFP	National Focal Point
NFR	National Forest Rules (Sarawak)
NGO	Non-governmental Organization
NNL	No Net Loss
NPD	National Programme Document, Bangladesh Forest Department
NPFF	National Park Facts and Figures
NPMP	National Park Management Plan
NPNR	National Parks and Nature Reserves (Sarawak)
NPS	National Parks of Sarawak

NRM	Natural Resource Management
NSAPR	National Strategy of Accelerated Poverty Reduction
NSDS	National Sustainable Development Strategy
NTFP	Non-timber Forest Products
NSP	Nishorgo Support Project
NP	National Park
OECD	Organization for Economic Co-operation and Development
OIIS	Online Integrated Information Systems
OILNPBD	Online Integrated Lawachara National Park Biodiversity Database
OS	Operating System
PAA	Political-Administrative Arrangements
PAB	Protected Areas in Bangladesh
PAME	Protected Area Management Effectiveness
PANCU	Personal Area Network Control Unit
PAP	Political Administrative Programme
PBR	Plant Breeders' Rights
PC	Panel Code
PD	Political Definition
PES	Payment for Ecosystem Services
PEES	Political, Economic, Ecological and Social
PESTEL	Political, Economic, Socio-cultural, Technological, Ecological, Legal
PF	People's Forum
PoWPA	Programme of Work on Protected Areas
PPA	Public Policy Analysis

PPPA	Public Private Partnership Authority
PPPCU	Public Private Partnership Central Unit
PPP	Public Private Partnership
PVP	Plant Variety Protection
RAMSAR	Ramsar Convention on the Conservation of Wetlands of International Importance especially as Waterfowl Habitat
RAPID	Real-time Anti-Poaching Intelligence Device
RAPPAM	Rapid Assessment and Prioritization of Protected Area Management
RC	RAMSAR Convention
RDRS	Rangpur Dinajpur Rural Sangstha
REDD+	Reducing Emissions from Deforestation and Forest Degradation
RFID	Radio Frequency Identification
RIMS	Resource Information Management Systems
RNSS	Regional Navigation Satellite System
RTC	Rainbow Tree Care
RWH	Rain Water Harvesting
SAWEN	South Asia Wildlife Enforcement Network
SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advice
SBE	Sabah Biodiversity Enactment
SCBD	Secretariat for the Convention on Biological Diversity
SDG	Sustainable Development Goals
SF	Sarawak Forestry
SIS	Species Information System
SMART	Spatial Monitoring and Reporting Tool

SPARRSO	Space Research Remote Sensing Organization
SPE	Sabah Park Enactment
SRCWP	Strengthening Regional Co-operation for Wildlife Protection
SRRR	Shifting Railway Route and Vehicle Road
STR	Save The Rhino
SWOT	Strength-Weakness-Opportunity-Threat
TCPRB	The Constitution of the Government of People's Republic of Bangladesh
TDWG	Taxonomic Databases Working Group
TEEB	The Economics of Ecosystem and Biodiversity
TIS	Taxonomic Information Systems
TRAFFIC	The Wildlife Trade Monitoring Network
TRIPs	Trade Related Intellectual Property Rights
TUII	Technology-Use-Incentive-Information
UNIMAS	Universiti Malaysia Sarawak
UNCCD	United Nations Convention to Combat Desertification
UN	United Nations
UNODC	United Nations Office on Drugs and Crime
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Organization for Education, Science and Culture
UNCLOS	United Nations Convention on Law of the Sea
UNFCCC	United Nations Framework Convention on Climate Change
UNFF	United Nations Forum on Forests

UPOV	Union Internationale Pour la Protection Des Obtentions Vegetables (International Union for the Protection of New Varieties of Plants)
USAID	United States Agency for International Development
VCF	Village Conservation Forum
WB	World Bank
WCMC	World Conservation Monitoring Centre
WCNH	World Cultural and Natural Heritage
WCPA	World Commission on Protected Areas
WCR	World Competitiveness Ranking
WCS	Wildlife Conservation and Security
WCTC	Wildlife Crime Tech Challenge
WCTP	Wildlife Crime Technology Project
WDPA	World Database on Protected Areas
WEF	World Economic Forum
WFP	Water-Forest-Park
WHC	World Heritage Convention
WMNC	Wildlife Management and Nature Conservation
WNCC	Wildlife and Nature Conservation Circle
WPO	Wildlife Protection Ordinance (Malaysia)
WPR	Wildlife Protection Rules (Malaysia)
WW	Wildlife Watch
WWF	World Wide Fund for Nature
XML	Extensive Markup Language

CHAPTER 1

INTRODUCTION

1.0 Background of the Study

Policy instruments have a key role in improving the status of our environment. Environmental Policy Instrument is the process of placing environmental considerations at the heart of government decision-making on environmental issues among others includes loss of biodiversity, climate change and decrease ecosystem services. Biodiversity is the central agenda when global environmental issues discussed (CBD, 2010) with responds to national environmental issues and interlinks with policy instruments. Environmental policy instruments are tools used by state government to implement these environmental policies through national, regional and global commitments for national park biodiversity conservation.

Bangladesh is a ratified state party of the Convention on Biological Diversity (CBD), which stated that by 2015, each state party should develop the National Biodiversity Strategy and Action Plan (NBSAP) as a conservation policy instrument according to Aichi Biodiversity Target 17 (CBD, 1992). Thus, Bangladesh developed the revised NBSAP towards national park biodiversity conservation for the long-term period (DoE, 2016). Moreover, the NBSAP is also the major mechanism for existing biodiversity protection to be made into national policies for each State Party to show how countries have responded to the UN agenda on sustainability (Ismail, 2012).

This Thesis assesses environmental policy instruments with information systems in Bangladesh that related to biodiversity conservation towards national parks. The study

distinguishes four basic types of policy instruments for biodiversity conservation: (a) Legal Instruments, (b) *In-situ* Instruments, (c), Informational Instruments, and (d) *Ex-situ* Instruments. There are some functions of these instruments, which discussed in sub-section 2.2 in details. The research relates to national park, so the choice of policy instruments is the first three in number instruments, which are legal, *in-situ* and informational instruments. The study considers policy instruments through examining NBSAP to determine whether and how the NBSAP contributes to mainstreaming biodiversity across policy sectors using Clearing House Mechanism (CHM) in Bangladesh to halt biodiversity loss. Conservation of biodiversity within national parks requires rapid access to data such as the spatial and temporal distribution of species and their habitats within environmental context (Murray *et al*., 1997) through using digital conservation (Hobern *et al*., 2014). Previous research on national park of biodiversity informatics excels its origins (Wurman, 1989) to utilise databases and the internet as a tool to manage and publish data on biodiversity information (Costello and Vanden, 2006; Costello *et al*., 2006). According to Article 6 of CBD, each party should develop the Biodiversity Clearing House Mechanism (BCHM) for enhancing digital conservation (CBD, 1992), but till date, Bangladesh has not been involved in BCHM according to the global requirements as well as stakeholders' communication (DoE, 2016).

The major consideration of this Thesis is on the Lawachara National Park aspect including environmental, legal, policy, institutional and technological frameworks for the conservation of biodiversity that are used by the co-management team in the National Parks of Bangladesh. In the context of the LNP, there are various challenges confronting biodiversity conservation and management policy initiatives and important including present status of existing policies (NFP, 1994), development of national park, rain water harvesting provisions, ecotourism management, removal of invasive alien species, stakeholders'

engagement and the application of conservation technology in the management of existing park.

1.1 Problem Statement

Various instruments are merged occasionally in a policy mix to tackle a assured environmental problem. These Environmental problems generally occur through over-exploiting natural resources and mode of consumption of services and systematic products (Mickwitz, 2003). Rapid loss of biodiversity tends to be at the foremost of conservational issues as they potentially disturb the bio-systematic functions (Sachs *et al*., 2009; Kaeslin *et al*., 2012; Alamgir *et al*., 2014; Sohel *et al*., 2014). This loss of biodiversity is one of the most thoughtful global environmental apprehensions (dos Santos *et al*., 2015), which have been raised during various planetary precincts (Steffen *et al*., 2015) as a domineering worldwide issue for several years. Everyone exploits biodiversity but none can conserve it due to lack of dynamic policies, institutional supports, stakeholders' engagement, and ecotourism services, control measure of invasive alien species and application of conservation technologies. Thus, appropriate and specific policies are required to curb rapid losses of biodiversity. National Parks (NPs) are often targeted on lands with the least political resistance to their establishment, and thus typically face the least anthropogenic threat.

Due to lack of sound assessments can cause significance for the understanding of biodiversity related update rules and regulations for development of indicators and indices, which permit changes and trends to be observed and transformed over time. To date, there is no up-to-date comprehensive model developed incorporating the diverse pertinent political, environmental, socio-cultural, technological, economic, institutional and legal processes for National Park Biodiversity Management.

The study highlights on stimulating sustainable use of ecosystem to incorporate most of these components including involvement of stakeholders, institutional participations, update policy integrations, and conservation technologies. This research illustrates to conservation of biodiversity for LNP management with indispensable tools for studying changes of conservation systems and their impacts in order to provide justifiable policy options.

1.2 Justification of the Study

Biodiversity conservation generally develops strategies connecting the supportive assortment of environmental policy instruments. These conservation instruments interlink with six principal goals of the strategy, such as:

(i) National Park Biodiversity Conservation.

(ii) Sustainable use of ecosystem services.

(iii) Reducing environmental pollution.

(iv) Access benefits sharing of genetic resources.

(v) Digital conservation with Biodiversity Clearing House Mechanism

(vi) Raising social awareness for biodiversity conservation as one of the top priorities to society.

The electronic media, political speeches and policy decisions have rarely focused on biodiversity conservation issues than the gross domestic products' growth, trade issues and financial markets for global environmental concerns. The study articulates justification of policy instruments for environmental concerns through biodiversity conservation towards National Park (NP) to measure how policies and technological tools enhance the effectiveness of ecosystem service contributions to Bangladesh. Changes in NP biodiversity

status are imperative to be recognised due to insufficient data availability and comparability, inadequate methodologies to measure natural resources impacts and shortage of reliable scientific information for effective nature conservation. This information is increasingly understood for species abundance as a resource but only partly takes into account in quotas, subsidies, monitoring and enforcement. The same applies to community-based ecotourism, which is critical to long-term stakeholders' participation. The current emphasis on 'evidence-based policy making' is hard to meet if even basic information on natural capital stock and its changes is missing. The study intends to help policy makers by providing information and tools to measure the value of what they are managing. The justification of the study necessitates the instrumental analysis of bio-environmental conservation policies at NP in Bangladesh to share feedback on update policy formulations with decision-making and augmenting digital conservation for the present and upcoming generations that will be effective and efficient at national, regional and global perspectives.

1.3 Research Questions

Based on the research problems the following are four major research questions:

(a) Are the existing policy instruments for conserving of biodiversity towards national park in Bangladesh adequate?

(b) How effective are the implementations of environmental policy instruments concerning biodiversity conservation in the NP of Bangladesh context?

(c) How the options of diverse stakeholders are interlinked in biodiversity information systems tools in Bangladesh?

(d) Can the Wildlife Conservation and Security Act 2012 be improved further as a conservation instrument for national park biodiversity protection in Bangladesh?

1.4 Objectives of the Study

These study objectives are to assess the implimentation of environmental policy instruments, namely legal, *in-situ* and informational instruments for conservation of biodiversity in Bangladesh.

The specific objectives of the study are:

(i) To assess biodiversity policy instruments in Bangladesh with reference to Lawachara National Park (LNP).

(ii) To determine impacts of gaps in the above, if any, on the existing conservation policy and technology assessing to LNP and its sustainability.

(iii) To recommend strategies to enhance efforts towards sustainable use and management of Lawachara National Park.

1.5 Scope of the Study

The research aims to improve biodiversity policy options and technology applications. To date, there is no comprehensive model developed incorporating the diverse pertinent ecological, economic, technological, institutional, individual and societal processes for national park management in Bangladesh. This research goes to incorporate most of these components including involvement of local actors, institutions and update policy with digital conservation to protect the biodiversity for national park management with the indispensable tools for studying changes of biodiversity conservation and their impacts in order to provide justifiable policy options. In the aspect of biodiversity protection, research and development, policy formulation, planning, implementation and monitoring, performance evaluation, training for professionals etc. can improve aggregate conservation. The scope of work is disseminated to the Ministry of Environment and Forests (MOEF), Bangladesh Forest

Department (BFD), Resource Information and Management Systems (RIMS), Space Research and Remote Sensing Organization (SPARRSO), Information Communication and Technology Division (ICTD), and other relevant sectors.

1.6 Significance of the Study

The significance of this study is to indicate a framework for policy analysis to be applied in Lawachara National Park (LNP), in order to assess the performance of policy instruments for ensuring the sustainability of biodiversity conservation systems as well as the provision of ecosystem services and preservation of natural capital in Bangladesh. This research is essential to recognise and study features of active application connecting to environmental policy instruments for biodiversity conservation. A detailed of the advance and execution of national park biodiversity of Bangladesh was performed. The research scope of this study was established. The Bio-environmental policy research attempts to bring together the application of conservation policy with information systems and national park management techniques with community-based conservation and integrated cost effective modeling of biodiversity at LNP in Sylhet division of Bangladesh. This conservation policy research will help to protect biodiversity and improve policy incorporating through the awareness among local communities, policy-makers, and relevant local government institutions. This research also attempts to build effective global models and apply the knowledge through integrated community-based Biodiversity Conservation Policy techniques for managing the national parks.

CHAPTER 2

LITERATURE REVIEW

2.0 Biodiversity and National Parks

Biodiversity is the variety and variability of living organisms (CBD, 1992). National parks (NPs) are instrumental in supporting biodiversity conservation while providing many benefits to the society. Globally, these benefits are on an increase. Their management requires consideration of their multiple functions to enable combination of relevant ecological, economic and social aspects (Liaison Unit Vienna, 2000). The 113,000 NPs and similar protected areas in the world cover approximately 6% of the Earth's land surface (Ceballos *et al*., 2015), covering some 149 million square kilometres (NPFF, 2016). In the Asian region, there are 10,900 protected areas covering 13.9% of the terrestrial environment and 1.8% of the marine and coastal areas (Juffe *et al*., 2014). These protected areas, unfortunately, are under threat and losing biodiversity rapidly. The main threats to these protected areas are over-exploitation of biodiversity due to high population density and increasing demands from a globalised markets, as well as habitat loss and degradation in adjacent areas.

Additional problems are now emerging which are particularly difficult to solve (Lafferty and Meadowcroft, 1996; Weale, 1992). Among them are excessive invasive alien species, deforestation, poverty, fragmentation and illegal wildlife trade, man-made fire and other interferences that urgently need to be addressed (Juffe *et al*., 2014). Biodiversity and national parks interlink with environmental conservation policy instruments as courses of action which are intended to influence the national park community (Lundqvist, 1996). Conserving of Biodiversity is the idealistic agenda of global environmental concerns, which is a unique

variety of life (Wilson, 1988) on our planet. This biodiversity underpins national economy and well-being (EC, 2015) to conserve present and upcoming generations.

2.1 Environmental Policy Instruments for Biodiversity Conservation

Environmental Policy Instruments are tools / mechanisms concerning environments used by governments/ authorities to achieve desired environmental effect / policy objectives (Gunningham and Young, 1997). Environmental Policy Instrument (EPI) is the process of placing environmental considerations at the heart of decision-making (UNEP, 1992; CBD Secretariat, 2010) on environmental issues among others includes loss of biodiversity, climate change and decrease ecosystem services (Muhumuza and Kevin, 2013).

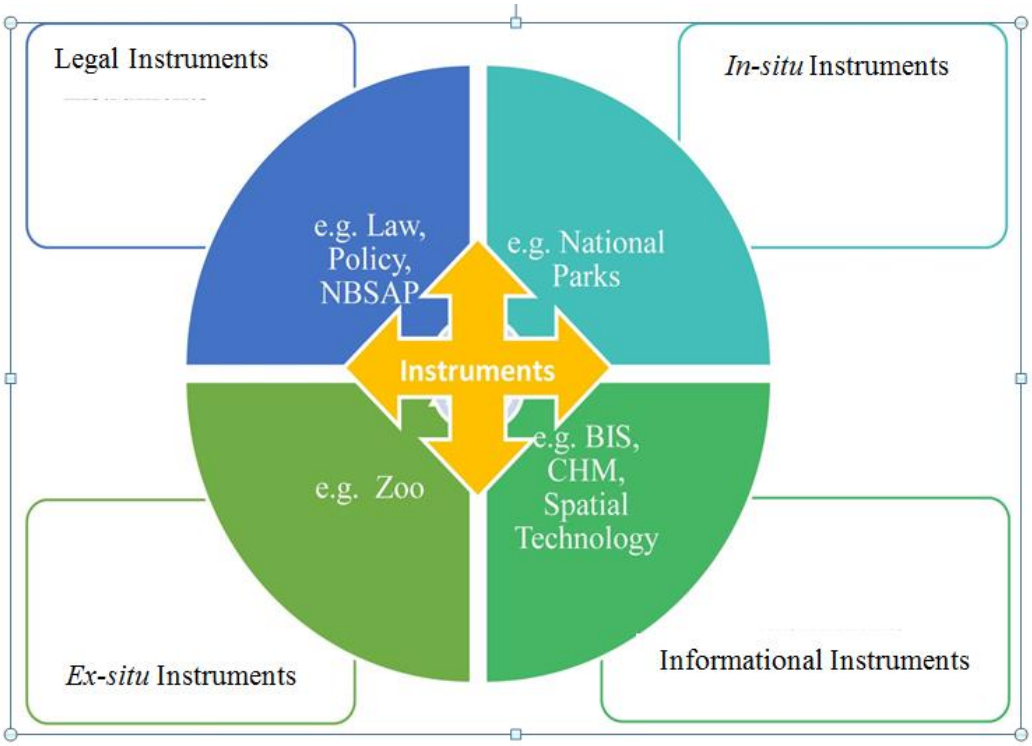


Figure 2.1: Environmental Conservation Instruments (UNEP, 1992; CBD Secretariat, 2010)

Some instruments and strategies are being used to address the specific threats (Groom *et al*., 2006). Biodiversity is the core equitable of environmental conservation issue in connection with these stated policy instruments (Figure 2.1).

2.1.1 Evolution of Conservation Policy Instruments

United Nations (UN) is the main initiator for global biodiversity conservation. For this purpose, the UNO developed Agenda 21 (UN, 2003) and then organized the Convention on Biological Diversity (CBD) through Earth Summit in 1992. Now the CBD contains 198 state party and agency. The CBD developed Aichi Biodiversity Targets (ABT) 2020 with conservation instruments towards protected areas management of each ratified State Party, which as shown in Figure 2.2.

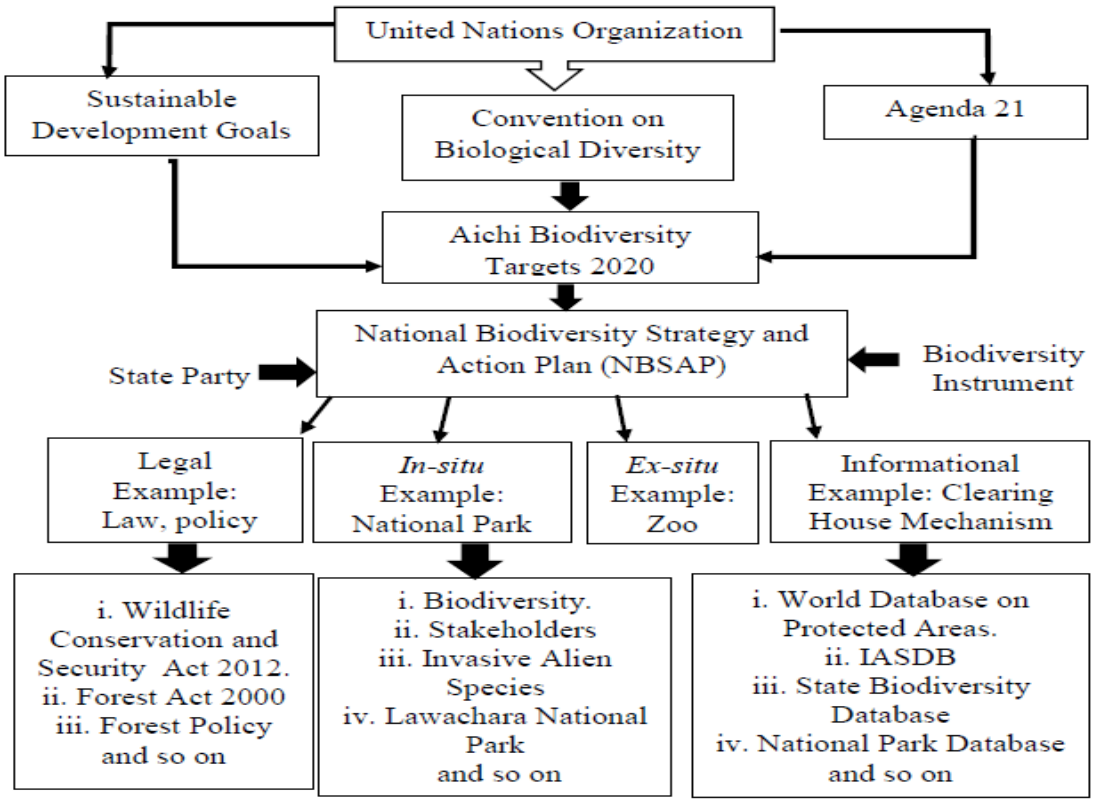


Figure 2.2: Evolution of Biodiversity Policy Instruments (CBD Secretariat, 2010)

The National Biodiversity Strategic Plan is a conservation instrument, mentioned in the ABT which every state party should develop this instrument as a national biodiversity conservation instrument in connection with national parks.

2.2 Types of Policy Instruments for Biodiversity Conservation

Environmental policy instruments are essential for biodiversity conservation (Kareiva and Marvier, 2012). Several environmental policy instruments are meant for biodiversity conservation (Deke, 2008). There are three environmental policy instruments, which selected on the priority of policy of CBD in connection with law, protected areas and clearing house mechanism related to biodiversity conservation (KBDM, 2006; Mbale *et al*., 2005). These are: (i) Legal instrument, (ii) *In-situ* instrument, and (iii) Informational instrument. Bangladesh is a ratified State Party of CBD with commitement to the selected these three instruments.

Table 2.1: Different environmental instruments for biodiversity conservation

Name of Environmental Conservation Instruments	For Examples	Sources
(a) Legal Instruments	Law, Policy, and National Biodiversity Strategy and Action Plan (NBSAP)	(ABT, 2010; Böcher and Töller, 2007; Wei, 2014).
(b) *In-situ* Conservation Instruments	National Park, Wildlife Sanctuary	(ABT, 2010; Wei, 2014; Geldmann *et al*., 2015).
(c) Informational Systems Instruments	Biodiversity Information Systems (BIS), Biodiversity Clearing House Mechanism (BCHM)	(Böcher and Töller, 2007; CBD, 1992; OECD, 1994; Vedung, 1998; Mickwitz, 2003; Winfield, 2014.
(d) *Ex-situ* Conservation Instruments	Genebank, Zoos, Botanical Garden	(Wei, 2014; ABT, 2010).

Environmental policy instruments can be classified on the basis of which of various stages they are focused at. Since these stages are connected, they are affected irrespective in stated dimensions, as shown in Figure 2.3.

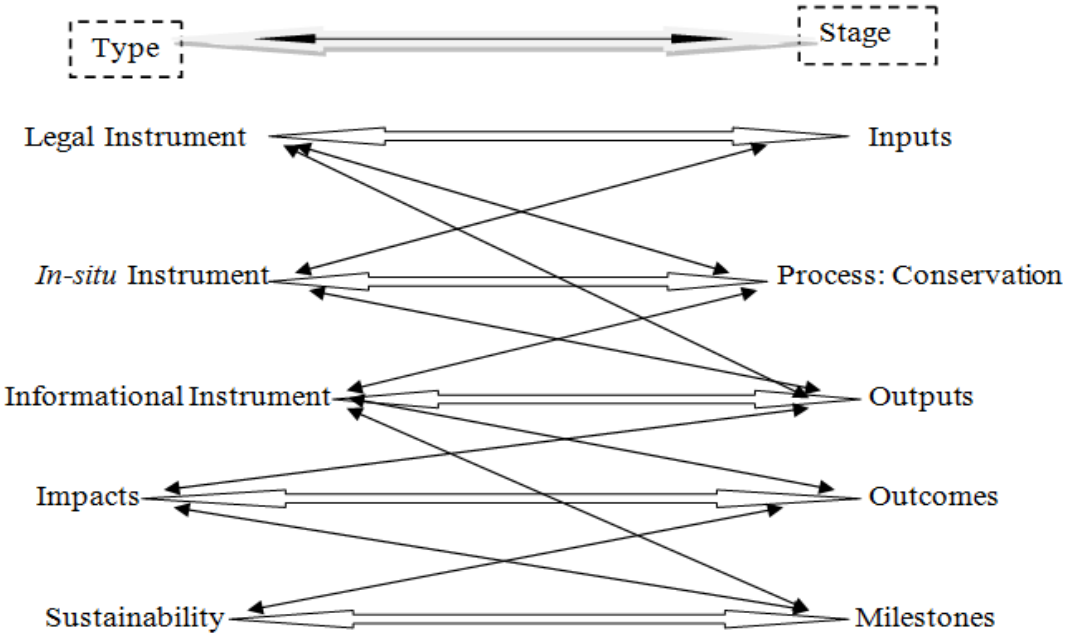


Figure 2.3: Two dimensions of policy instruments (Mickwitz, 2003)

2.2.1 Legal Instruments

Legal instrument directly controls or confines ecologically detrimental actions by authorising the reduction or restraint (Hahn *et al*., 1991) of damaging activities. Legal instruments aim at modification of the set of options open to agents. The use of this instrument has been the most common public intervention approach in the environmental policies of ratified CBD State Parties. This approach is often called "Command-and-Control" with varying degrees of justification (OECD, 1994). The main legal instruments are well known and include law, policy and strategic plan as well as some government orders, schedules and directives (Ackerman *et al*., 1985). While it often lacks the tractability and efficacies related with direct conservation-based tactics, it offers an effective means of unpromising the intractable (UNEP, 1992), the inept, or the uncompromising, who may demonstrate insensitive (Skelton *et al*., 1995) distribution to educational, motivational, property right, informational, intentional, and price-based instruments. The legal systems in

the conservation instruments may also be requisite to reserve the possibility of other relevant instruments (Bardach and Kagan, 1982). Moreover, regulatory instruments may be discriminatory, and are difficult to revise as new information becomes obtainable. However, some positive legal management enhance necessary to protect biodiversity from undomesticated animals and other threats. According to Article 18A of the National Constitution of Bangladesh, the objective is to the Government of Bangladesh (GoB) encourage safeguarding and recovering the environment and to protect as well as to secure the natural assets, biological diversity, forests flora and fauna and other relevant areas for the current and upcoming nations (TCPRB, 2012). Therefore, the GoB produced the Wildlife Conservation and Security Act 2012 including legal instruments and protection systems, but no legal instruments for the protection of undergrowth species effectively, although these species is a part of national park biodiversity.

2.2.2 *In-situ* Instruments

In-situ Instruments relate to biodiversity conservation through national parks (Lacy, 2010) areas. According to the Article 8 of CBD structure (1992), every State Party shall have the *In-situ* conservation instrument for national biodiversity conservation (Table 2.2). *In-situ* Instruments are very important for biodiversity conservation in Bangladesh, as a ratified State Party of CBD. These instruments are national parks, wildlife sanctuaries and nature reserves. This national park is a cornerstone in connection with in-situ instrument for biodiversity conservation enhancing national, regional and global perspectives. In Bangladesh, the National Park areas management are weak; resulting in severe degradation and losses of natural habitats and ecosystem services (Turley *et al*., 2016).

Table 2.2: Different policy parameters for *In-situ* Conservation.

Article	*In-situ* Conservation related Objectives	Actions
8 (a)	To generate a method of national park areas where unique actions requisite to be occupied to preserve biodiversity	National Parks (NPs) Conservation Systems
8 (b)	To develop, if essential, strategies for the choice, establishing and managing of national park areas wherever distinctive actions requisite to be reserved to reserve biodiversity.	Development of NPs Management
8 (e)	To Stimulate ecologically wide-ranging and justifiable advancement in regions nearby to privileged zones through an outlook to advancing security of the mentioned parts;	Sustainable development
8 (f)	To acclimatize and reestablish abandoned environments and encourage the reclamation of endangered species, inter alia, over the improvement and employment of strategies or further controlling policies.	Afforestation and Reforestation programmes
8 (h)	To preclude the outline of the mechanism or eliminate those invasive alien species which lurk ecologies, habitations or species.	Removal of Invasive Alien Species
8 (k)	To improve or sustain essential regulations and/or other directing requirements for the safeguard of susceptible species as well as existing populations.	Legislation formulation

(Source: ABT- Aichi Biodiversity Targets, 2010)

2.2.3 *Ex-situ* Instruments

Ex-situ means 'out of habitat' or 'off site-boundary'. It is the preservation mechanisms of biodiversity among from their habitats (Lacy, 2010; CBD, 1992). It is safeguarding tool that transfers a smudge species from its natural environment. This system incorporated with different components, such as (i) DNA (Deoxyribonucleic Acid) storage, (ii) captive breeding (Jule *et al.*, 2008; Snyder *et al.*, 1996), (iii) seed storage, (iv) Dawdling growth storage, (v) herbarium collection (Cherry, 2009) and so on. The key functions of *ex-situ*

assemblages are the saving and protecting of endangered heritable apecies as well as the manners of species for re-establishment where such species is susceptible in its natural site as the Artcle 9 of the constitution of CBD (CBD, 1992) as shown in Table 2.3.

Table 2.3: Principally for the functions of effecting *Ex-situ* actions

Article	***Ex-situ* Conservation related objectives**	**Tasks**
9 (a)	To assume actions on behalf of the *ex-situ* preservation of mechanisms of biodiversity, rather in the state of basis of such instruments.	*Ex-situ* conservation
9 (b)	To generate and safeguard services for *ex-situ* protection of and study on flora, fauna and microbes, rather in the state party of source of inherited assets.	Conservation research plan
9 (c)	To embrace events for the repossession and restoration of endangered species and for their re-establishment into their expected environments beneath suitable surroundings.	Recovery and rehabilitation

(Source: ABT- Aichi Biodiversity Targets, 2010)

The worldwide losses of biodiversity, such as amphibian species is mostly undertaken over captive breeding for the minor body dimension, stumpy conservation (Bowkett, 2009) necessities, repetitive rearing and in elevation fertility of frogs tolerates a quick accumulation of incarcerated populations (Maxted, 2001), particularly germplasm sequencing in Bangladesh.

2.2.4 Informational Instruments

Information is a policy instrument aiming at altering the priorities and significance indicator for biodiversity conservation attached to environmental issues (Mickwitz, 2003), for example: (a) resources information management systems, (b) environmental information, and (c) biodiversity informatics. Informational instruments highlight on different biodiversity related information resources (Linguee, 2014) including the distribution of the

outcomes for sufficient solutions (Johnstone *et al*., 2006) towards national park biodiversity. According to Soberón and Peterson (2004) sated that provision of biodiversity information (can improve national park management of common property resources (Balmford *et al*., 2005), such as wildlife, fisheries and plant diversity. Generally, informational instruments are considered to be equitable if the information is widely disseminated (Connolly *et al*., 1997) in a noninterventionist manner, which the OECD (1994) used the term 'suasive instrument'. Where such instruments provide information that harnesses self interest, they prove financially attractive and self-enforcing; with continuing enticements on behalf of conserving of biodiversity as well as justifiable use (Emeka *et al*., 2014). During biodiversity agreement with the potential for adverse effects, the law requires adequate information to be developed, utilised, and clearly documented in all decisions (Miller, 2001).

Moreover, they use information for advantage as of requiring entrance to pertinent evidence to locality, recover, assimilate, and spread over the disseminated data (Elliot, 2008; Randow, 2012). Considerable prevailing biological diversity and bionetworks evidence sack be extensively reprocessed (Randow, 2012) at the protected area as the system has not yet transformed into an automated layout intensely. Although diverse layouts, agreements, or technological tools, which is problematic to really assimilate evidence as supplementary than one basis or structure (Elliot, 2008; Randow, 2012) to determine how to use this information to best predict existing biodiversity among sets of areas (Stein, 1997) specifically at national parks.

2.3 Public Policy Analysis Framework

According to Kumaran (2014), public policy implies the administrative perspectives relating to decision according to identify public problems. The collection of decisions occupied with a set of actors through the intention of determining a public deviant and detailed authorized rules (Knoepfel *et al.* 2007, 2011).

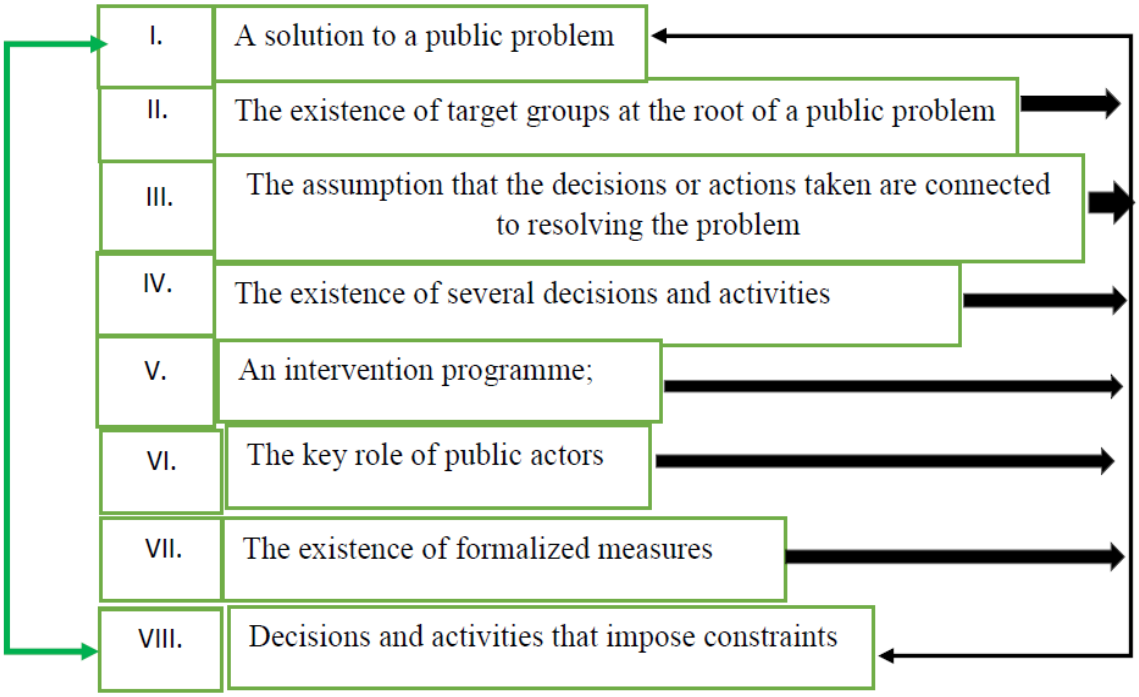


Figure 2.4: Several components of public policy and their relationships (Source: Meny and Thoenig, 1989).

Public policy analysis (PPA) consists of the learning of the action of public authorities within society (Meny and Thoenig, 1989), which is associated with political science, public administration and law with various components.

These various components included a solution to public problems, existence of target groups, and assumption of relevant actions, activities, intervention programmes, key roles, formalized measures and imposed constraints as shown in Figure 2.4. These stages can be

compared to the stages of problem solving (Howlett and Ramesh, 2003) showed in Table 2.4.

Table 2.4: Similarities between the policy cycle and the stages of problem solving

Phase	Steps of Public Policy	Problem clarifying
I	Priority-based agenda setting	Problem recognition
II	Recognized based Policy formulation	Proposal of solution
III	Selected Policy Implementation	Putting solution into effect
IV	Decision making for solution	Choice of solution
V	Effective conservation policy evaluation	Monitoring based results

(Source: Howlett and Ramesh, 2003)

2.3.1 Various Approaches in Policy Analysis

The present trends in public policy analysis can be divided into four main categories based on their focus on specific fields of analysis (Draelants and Maroy, 2007; Knoepfel *et al*.; 2011), as follows in Table 2.5.

Table 2.5: Policy Adoption Approach and Analysis

Policy approach	Policy analysis	Sources
Political science	Public policy analyses focusing on theories of the State.	Duran, 1996; Meny and Thoenig, 1989; Muller and Surel, 1998.
Academic approaches	Explanations of how public policy works from administrative science, economics and information science.	Anderson, 1975; Bothamley, 2002; Lasswell, 1951; Dye, 1976; Dunn, 1981;
Policy evaluation	Assessing the impact of policies, where socio-economics and public administration are reflected.	Althaus *et al.*, 2007; Lindbloom and Woodhouse, 1993; Patton and Sawicki, 1993; Parsons, 1995; Sabbatier, 2007.
Actual essence of public action	Policy analysis is a means of explaining as a revealing its nature to continue flow of decisions.	Bridgman and Davis, 2000; Dover, 2005; Knoepfel *et al.*, 2011; Howlett and Ramesh, 2003.

This attempts to link the policy approach with political philosophy of the State. It does not focus on the policy itself but seeks to understand the role of the public sector and how its role changes over time, why policy is introduced and how the policy action interfaces with the organisation of the public sector. The main concerns are the difficulty in selecting the appropriate evaluation methods, and the process of evaluation and implementation for improving public management and influencing decision-making. There are some policy approaches like political science, academic approach, policy evaluation and public action etc., are applied for policy analysis focusing on theories, works, information, socio-economic condition and administrative decisions.

2.3.2 Description of the Public Policy Analysis Framework

The analysis model as explained by Knoepfel *et al.,* (2011) borrows from all three existing described earlier and includes the three key elements – i.e. the resources, the actors and the institutional rules. There is a fourth element in this model, which is the substantive and institutional content of policy actions; these are the result of the direct and indirect games played by the actors, and may ultimately lead to either the reinforcement or undermining of the effectiveness of a public policy. Knoepfel *et al.,* (2011) asserts that these factors should be included as they directly influence the various stages of the policy cycle (Figure 2.5). Based on the stages of the policy cycle described earlier, Knoepfel *et al.,* (2011) described six types of products of policy analysis that can be considered in any study (Figure 2.6) as follows: (i) the political definition (PD) of the public problem: this includes the decision on the action to be taken by the public actor and the scope of the public problem to be addressed, as well as the identification of the probable causes by the public actors, (ii) the political-administrative programme (PAP): this includes the decisions taken by both public actors and

public bodies, in terms of formulating legislation and regulations,

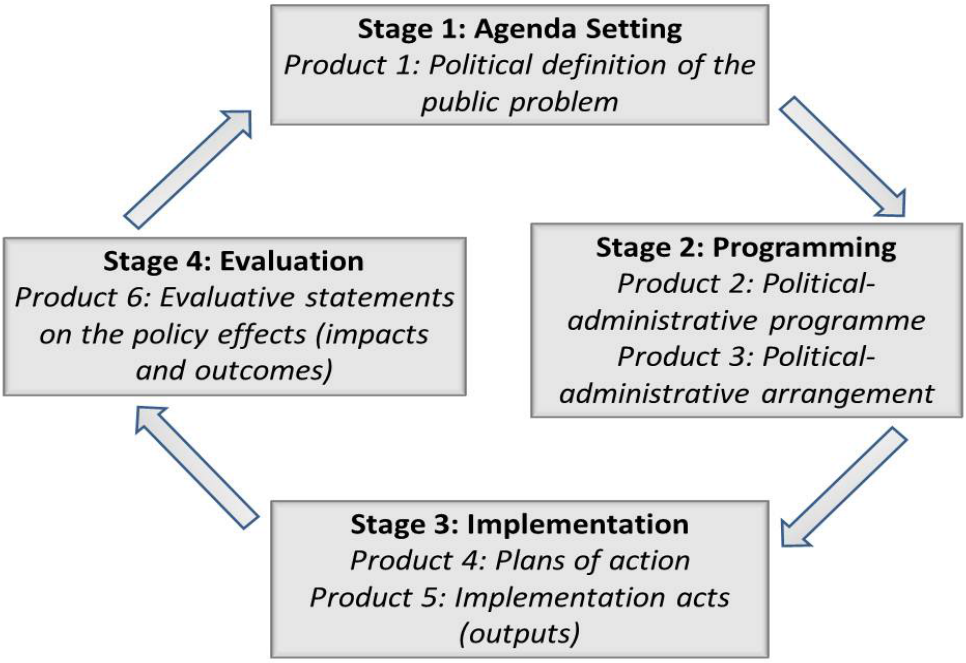


Figure 2.5: Key components of public policy analysis (Knoepfel *et al.*, 2011)

to make it possible for the policy to be implemented, (iii) the political-administrative arrangements (PAAs): this outlines the responsibilities of the public actors and the resources at their disposal to carry out the identified action for addressing a public problem, (iv) the action plans (APs): these are shorter-term plans for immediate implementation according to an agreed time-scale and also prioritises geographical location for implementation of certain actions, (v) the formal implementation acts (outputs): Outputs cover all activities and administrative decisions related to the action that has been recommended, (vi) to assess proclamations on the deviations in target group behaviour and on the impacts accomplished in terms of the determined problem. The types of policy products described above are used in Knoepfel's analysis model to develop the conceptual framework for the research.

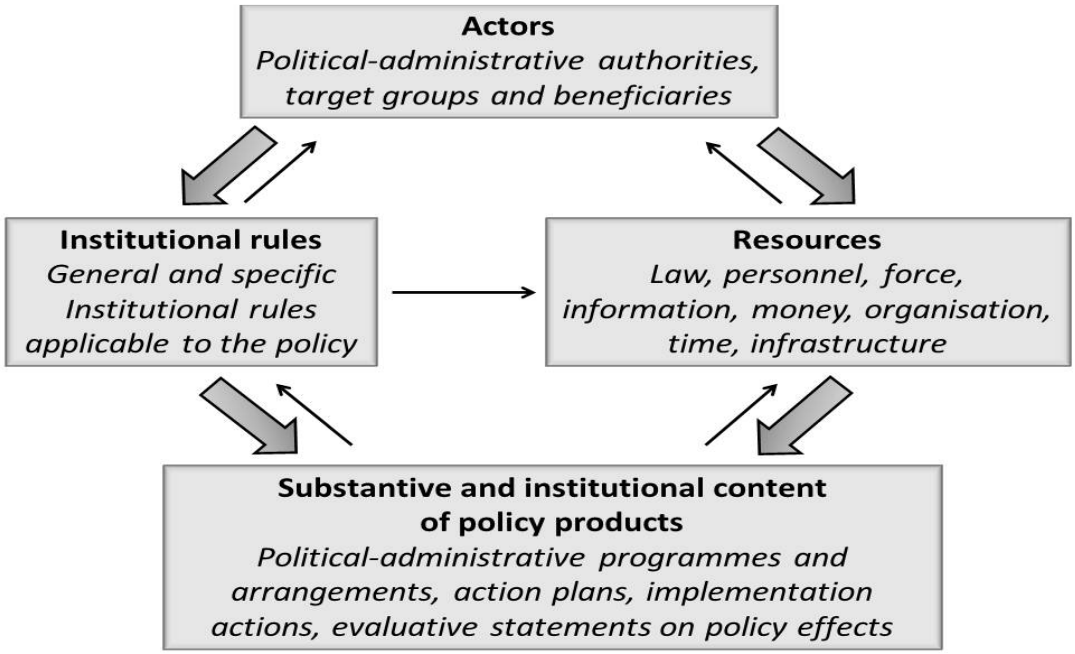


Figure 2.6: Policy stages and products (Knoepfel *et al.*, 2011)

2.3.3 Application of the Public Policy Analysis Framework

The Public Policy Analysis **(**PPA) framework described here is best used for an analysis of the impact of a public policy or when policy analysts are commissioned to carry out an expert evaluation of policies by legislative or executive bodies. For example, in the area of legislation to counteract environmental pollution, this framework can be used to analyse the efficacy of a policy for imposing restrictive instruments such as emission limit values. Here the framework will ensure that the analysis includes links to the end beneficiaries (for example, the neighbours of a polluting factory) and to the definition of clear objectives and evaluative criteria (for example, air quality that prevailed in 1960 to be defined as the target). It can also be applied for a comparative analysis where the implementation of the policy by different public authorities is to be evaluated. The features of the framework make it possible to evaluate the efficiency of public administration offering similar services, and for evaluating the efficacy of policy implementation and administration. In the case of direct agricultural payments, for example, the framework can be used to evaluate which would be

the most appropriate body to be responsible for the distribution of payments – whether it is the agriculture ministry with whom the farmers already enjoy a privileged relationship or the environment ministry, which may be opposed to the short-term interests of farmers.

2.3.4 Strengths and Weaknesses of the PPA Framework

The Public Policy Analysis (PPA) framework provides a comprehensive means and a clear approach for a general analysis of public policy, narrowing the complex issue down to four key elements. It explains the key elements that need to be considered in public policy analysis and the interaction between these elements. The framework can be applied in the context of a broad range of conceptualisations and interpretations of the state and its actions. Attention is given to the interaction among the stages of the policy cycle and can be applied regardless of the phase of the public policy being considered, whether it is policy development, implementation or evaluation. This examination under the same lens allows for the formal and informal links in the decision-making process to be identified in the policy cycle. The framework, therefore, allows for aspects that are heuristic, where the analyst makes his/her own discoveries from investigations, as well as analytical-causal, which suggests the causal links between the products observed and the actors. The framework also considers situations where administrative units manage more than one policy - the cases where administrative units manage only one policy is rare - by examining the administrative context as an important institutional dimension of the political-administrative arrangements (PAA) as one of the products of the policy cycle (Kumaran, 2014). The framework is limited in how it tackles the property relationships between the actors. For example, there are no details on how to consider the institutional economics aspects such as property rights, including use and access privileges, as instructive variables for the unsustainable use of a natural resource. The political economy of public policy is the way policy actually distributes

scarce public resources between competing interests. Additionally, use or protection regulations related to a natural resource have a direct influence on the impact of property and use rights. Thus, changes in regulations concerning a natural resource can revise the privileges liked by the policy performers. It is important to consider these issues in the context of the current study to gain a true understanding of the situation of biodiversity governance in Bangladesh, where the land rights of Indigenous peoples need to be considered in any study of conservation policy, particularly the interaction between policy, land rights and national park. Studies of conservation policies document the important role that property rights have on land (both use and access rights) and for policy implementation. These issues also include property rights, which are not explicitly addressed in the framework. The framework also does not specifically address the issue of sustainability of the resource to be managed, especially in terms of the uses of the resource. Any recommendation for change or improvement in the effectiveness of policy can only benefit from such a comprehensive discussion of the problem being addressed. The discussion of 'relevant social goals' engages questions of rights and needs, the normative dimension of the use of natural resources not only in terms of sustainability but in terms of the public good. The PPA framework does not seem to specifically incorporate this dimension of public policy (Kumaran, 2014).

2.4 Needs of Information Systems for Biodiversity Conservation

Biodiversity is the multiplicity and changeability of living flora then fauna in sphere. It is a multifaceted word, which indicates its specific objective as the changeability amongst alive creatures starting entirely home environment comprising, and so on, land-dwelling, sea as well as additional river ecologies and the environmental multiplexes of their aparts; this embraces variety surrounded by species (Soulé and Sanjayan, 1998), concerning species and

of environments (CBD, 1992). Human-beings live in the age of information with modernized technology (Kinuthia, 2008), which enhances the production, storage, and sharing of information with rules and regulations to make a significant facet of economic, cultural and scientific affairs at scales from local to global (Michael *et al*., 2006) biodiversity information. So, all human–beings are experiencing a digital revolution with an information explosion to become individuals highly susceptible to information anxiety or overload (Biggs, 1989; Holtham and Courtney, 1999). For this, information systems need for national park biodiversity conservation (Johnson, 2007) with database planning, designing, prototyping, testing and application including database security, as shown in Figure 2.7 with biodiversity database management system selection.

Information Communication and Technology (ICT) has become a driving force in the area of conserving of biodiversity and the establishing and managing of national parks (Eken *et al*., 2016; Henry and Armstrong, 2004; ICEM, 2003; Wilson, 2003). There is a great deal of academic discourse and debate around theories of the information society (Fuller, 2005) and national park areas. Database application design developed for biodiversity information systems to include database design, conceptual and logical design with data security (Coronel *et al*., 2013a). But to date, there is no effective national biodiversity database including clearing house mechanisms (CHM) as well as information systems in Bangladesh (DoE, 2015). Till to date most of State Parties of CBD including Bangladesh had not developed national park database with CHM for monitoring, reporting, evaluating, measuring effective performance (DoE, 2015).

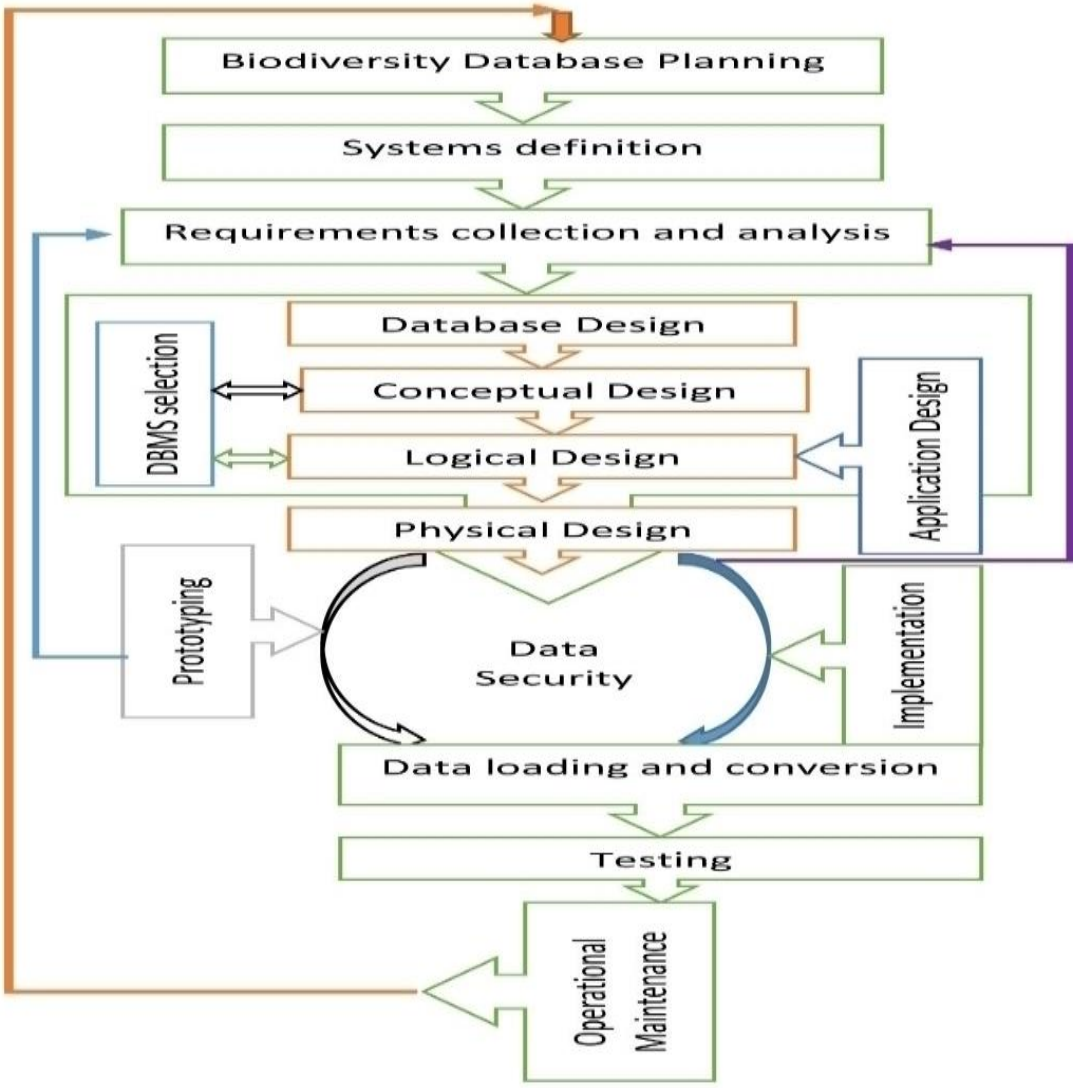


Figure 2.7: Biodiversity Database Planning and Prototyping (Coronel *et al*., 2013a).

2.5 Biodiversity Information Systems

Biodiversity information systems (BIS) is a dataset of biodiversity. The BIS can be used different purposes, such as:

(i) monitoring (Reyers and McGeoch, 2007),

(ii) bioregional planning (Smith and Wolfson, 2004),

(iii) identifying and categorizing threatened species (Tweddle *et al*., 2009),

(iv) understanding the impacts of global change on biodiversity (Coetzer *et al*., 2012; Skelton and Coetzer, 2011; Cherry, 2009; Skelton *et al*., 1995);

(v) developing mitigation strategies (Carlos *et al*., 2010);

(vi) informing sustainable harvesting programs; control of alien, invasive species (Foxcroft *et al*., 2009),

(vii) ecological niche modeling (Phillips *et al*., 2006),

(viii) disease vectors; environmental impact assessments (Coetzer *et al*., 2012) and

(ix) decision making on policy status of biodiversity protection.

Moreover, Researchers and scientists are being confronted to appropriate information systems from large scale level to national level for managing and embracing conservational justifiability (Watson *et al*, 2010). The system related with species conservation in general, existing environmental instrument assessment as well as scrutinizing through suitable options of correctness for conserving activities (Krigas *et al*., 2012).

In National park areas management, information technology for biodiversity includes biodiversity databanks, using spatial technologies, like GIS, GPS, RS and GNSS (Michael *et al*., 2006; RTC, 2016) in connection with spatial applications. Information Systems provide extents of evidence on a wide-ranging (Boddy *et al*., 2016) level for the implementation both as data and software uses conservation biology (Stein, 2008) to promote decision- making and disseminating through an administration (Laudon and Laudon, 2010). The BIS interlinked with taxonomic information systems (ITIS, 2017) and species information systems, which provides integrated information management of biodiversity.

2.5.1 Evolution of Biodiversity Database Models

The expedition for better biodiversity data management had navigated to numerous models that seek to resolve the earlier model's decisive inadequacies (He and Hubbell, 2011) and to furnish solutions to ever-advancing conservation data management requirements (Bisby, 2000). These models represent biodiversity information as to what a database is, what it should do, the modes of structures (Soulé and Wilcox, 1980) that should apply, and the technology that would be operated to implement these formations. The general data models show in thereabouts chronological order, which traces the evolution (Adams, 2004) of the major biodiversity data models (Coronel *et al*., 2013b). The biodiversity data models are (i) File system, (ii) Hierarchical and network, (iii) Relational database, (iv) Object-oriented, Object/relational (O/R), (v) XML, Hybrid DBMS, (vi) Key-value store, Column store, for example: Simple DB (Amazon), BigTable (Google), Cassandra (Apache) (Coronel *et al*., 2013b).

2.5.2 World Database on Protected Areas and Biodiversity

Every national park connected with global database (for example—WDPA), which is a comprehensive protected areas' network databank (IUCN and UNEP, 2011). It provides information on national parks (IUCN, 1993), wildlife sanctuaries and related areas status (Coad *et al*., 2015) of existing State Parties. These protected areas include on national park, wildlife sanctuary, nature reserve (terrestrial and marine) with relevant reports (UNEP-WCMC, 2017). According to WDPA (2017) total national parks of Bangladesh put its ID in the world database in protected area (WDPA), particularly national parks, located district and gazetted date. The WDPA uses for biodiversity information from the different state parties, institutions, researchers, developers, network specialist, decision-makers and stakeholders. It creates new global network (UNEP, 2013) on biodiversity information

systems as well as protected areas (PA-CBD, 2016) information systems interlinked with clearing house mechanism. But some developing countries can not develop their own clearing house mechanisms or relevant databases which connected with WDPA due to lack of technical, security or pertinent problems.

2.5.3 National Park Biodiversity Database

Challenges to conserve biodiversity (Rands *et al*., 2010) augment towards national park except network technology. Database threat is the circumstances or experience indicating deliberate or unplanned, which undesirably disturbs a database structure as well as subsequently to the administration (Connolly *et al*., 1997b). The estimated losses of biodiversity on protected areas of some countries illustrated in the Table 2.6. It may be represented by individual, task or situation, which is expected to convey maltreatment to national park administration including hardware damage, software or data/information spoil, or breaking of customer buoyancy.

Table 2.6: Estimated loss of biodiversity in Asia (UNEP-WCMC, 2016).

Country	Estimated Biodiversity Loss	Carbon Stored
Bangladesh	32%	2%
Malaysia	7%	8%
Bhutan	5%	23%
Nepal	12%	5%
India	22%	67%
Pakistan	18%	4%
Myanmar	5%	9%
SriLanka	14%	10%
China	19%	11%
Japan	4%	12%
Germany	20%	27%

(Source: UNEP-WCMC, 2016).

According to Connolly *et al*. (1997b) various types of threat are listed under the areas where they would have an impact, namely,

(i) theft and fraud (unauthorised amendment of data),

(ii) loss of confidentiality (wire tapping),

(iii) loss of privacy (Blackmail),

(iv) loss of integrity (electronic interference and radition), and

(v) loss of availability (electronic interference and radiation) (Peterson *et al*., 2010).

2.5.4 Spatial Systems for Biodiversity Conservation

Dynamic, on-going research in the often overlapping fields of geographic information systems (GIS), spatial data structures (Fonseca, 2008) and algorithms, spatial databases, and computer graphics has provided geospatial applications with a rich set of techniques, general data structures, and algorithms (Samet, 1989); (Samet, 1990); (Shekhar *et al*., 1999); (Rigaux and Voisard, 2002); (Shekhar and Chawla, 2003). According to Ravan (2010), the Group Decision Support Systems (GDSS) ensures a widespread observation as the advancement of digital conservation technology, for example—WDPA, Spatial Database. These conservation technologies presented with update computerised technologies that implemented to make the GDSS in various national parks' biodiversity assessment options. The biodiversity information with Clearing House Mechanisms (CHMs) is an application of online spatial database systems. Ecologists and policy-makers have been elaborate in producing vast biodiversity related databases on different parameters, such as (i) the species, (ii) species status, (iii) species habitats, (iv) socioeconomic impacts, and (v) species monitoring (Vreugdenhil *et al*., 2003) and so on to compare on general support system to the spatial support system (Ravan, 2010) to know the present status for national biodiversity decision-making.

2.5.5 Digital Technology for Conservation of Biodiversity

Digital conservation refers to several types of dimensions (Arts *et al*., 2015), which enhance the national park conservation management, such as: (i) participatory governance, (ii) data on nature, (iii) data on people, (iv) data integration and analysis, (v) communication and experience, and (vi) data security and feedback (Wade, 2006). These dimensions enhance to digital technology for conservation of biodiversity. Update digital technology enhances to the conservation of biodiversity through data collection (Peri *et al*., 2011) researchgate, surveying, information sharing, technology transfer and growth of update law, policy and legislation (Pullin *et al*., 2013). But there are also some barriers on system security, authentication, update information and update software installations (Arts *et al*., 2015), lack of digital conservation apps (van der Wal and Arts, 2015) and misuse modern technology towards wildlife (Kays *et al*., 2011). Digital conservation is the broad range of development at the interface of digital technology and nature conservation (van der Wal and Arts, 2015).

2.5.5.1 Telematics: Emerging Technology

Telematics is the permutation of the words telecommunications and informatics, which is a branch of conservation information technology dealing with the long-distance transmission of computerized information. It is the integrated use of telecommunications with information and data communications emerging technology. It is the recognized technology of sending, receiving, real-time and online processing, monitoring, sensoring, tracking, capturing, storing and disseminating information relating to remote objects – like wildlife- via telecommunication devices (Kays *et al*., 2011). Under the "telematics" umbrella is the incorporation of Global Positioning System (GPS) and Global Navigation Satellite System (GNSS) technology with computers and mobile devices. It is also misusing technology towards loss of biodiversity.

2.5.6 Biodiversity Policy and Technology: Intervention Concept

Biodiversity policy connects with systematic technology for development of policy-making (Alexander, 1982). There is a reciprocal relationship between them connected with policy (Parsons, 1995) instruments for protecting and conserving biodiversity as shown Figure 2.8.

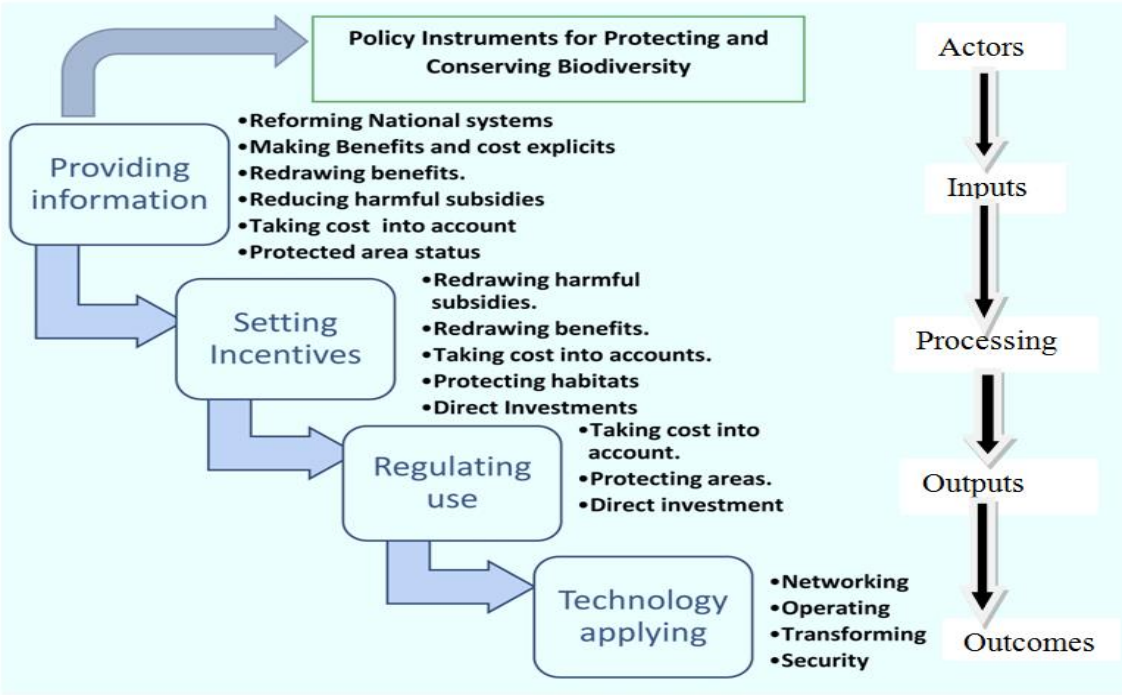


Figure 2.8: Technology-Use-Incentive-Information protecting biodiversity.
(Source: Modified Mickwitz, 2003)

Lack of proper policy design (Howlett, 2011), technology cannot be used towards national park for monitoring, data collecting and related tasks (BNP, 1994). Policy instruments provide conservation systems for the requirements of update information revising, insentives setting, regulating towards applying technology. These are: (i) Providing information (Thomas, 2006), (ii) Setting incentives, (iii) Regulating uses, and (iv) Applying priority technology. This is the new concept of TUII, means Technology-Use-Incentive-Information, which connects with national, regional and global network datasets. Biodiversity policy and

technology enhances the economic perspectives (TEEB, 2017; Pearce and Moran, 1994) through the effective policy instruments for protecting and conserving biodiversity through update technological arena for the present and future generations (Pimm *et al*., 1995). The intervention concept is a model of the microsteps or linkages in the causal path from program to ultimate outcome (Rogers *et al*., 2000) on the basis of the detailed assumptions of how the intervention is supposed to work (Weiss, 2000).

2.6 Level of Public Policy Instruments and decision-making

Policy instruments initiate after regulation and directorial pronouncements (Maetz and Balie, 2008), which connected with various stages of decision-makers' opinions (Alexander, 1982). These options cycled with setting of policy agenda, formulation, decision, implementation, and evaluation which as shown in Figure 2.9. This policy and decision-making (Turnhout *et al*., 2007) cycle provides constitutional competencies for repartition of national institutions and sectoral integration (Braat *et al*., 2008). These policy levels are related with administrative decision-making and predominant structure of public management in order to disseminate of policies and legislations (Dryzek, 1983). The current development to relocation or representative an accumulative portion of countrywide capabilities and policymaking actions on national park biodiversity conservation to divisional as well as to local administrations and organizations is of specific consequence in the stated setting (Schmithüsen, 2001). Cross-sectoral impacts influence on biodiversity policy and technology positively. Cutting–edge issues among the forest sector, environment sector and supplementary subdivisions outcome from related policies (Ehrlich and Wilson, 1991), which enhance an instantaneous or an unintended inspiration on the performance of property-owners, forest user group, governmental as well as non-governmental interventions.

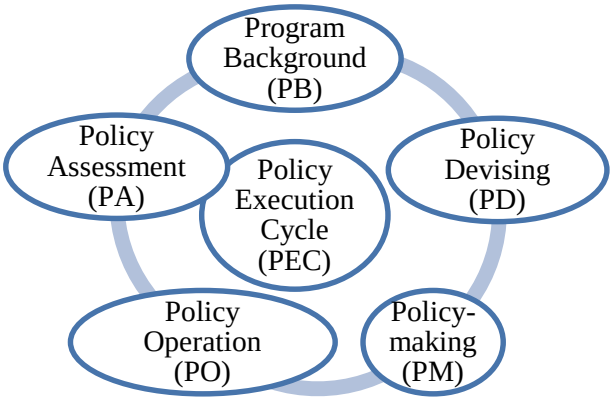


Figure 2.9: Level of Policy Execution stages (Schmithüsen *et al.*, 2001).

Furthermost difficulties in the existent earth narrate various concerns, which peak to the limitations of lawfully demarcated regulations options or prescribed abilities of administrative sections. Governmental resolutions in one regulation are vigorous essentials which touch unswervingly or circuitously additional rulesas usual affirmative and undesirable reflections (Schmithüsen *et al.*, 2001; Schmithüsen, 2001) for ramifications in pertinent sectors. Governmental decisions offer new chances for choices of goods and services in connection with different public policies (von Prittwitz *et al.*, 1994), which are illustrated sequectially, such as:

(a) to establish policy with public recognised framework and security,

(b) to stimulate policy for growth and development for subsistence, and

(c) to create policies for socio-economic production as well as socio-technological integration.

There are five stages of the policy cycle and their relationship to apply problem-solving, such as:

(i) Problem recognition.

(ii) Proposal of solution

(iii) Choice of solution

(iv) Putting solution into effect

(v) Monitoring results

2.7 Stakeholders' Perception and Evidence-Based Conservation

Stakeholders are an integral part of evidence-based conservation (Theobald and Hobbs, 2002), who provide four important functions, such as:

(i) Stakeholders establish conservation goals.

(ii) Stakeholders are able to frame and refine the spatial modelling process

(iii) Stakeholders help to assemble a list up to twelve alternative build-out scenarios.

(iv) Stakeholders filter the preliminary list of indicators.

Regulation makes some products more exclusive to enable consumers to buy the products at their higher prices (Portney, 1990). The regulations enhance to stakeholders, who are: (i) Development Sectors, (ii) Biodiversity experts, (iii) Forest manager, (iv) Ecologists, (v) Environmental Conservationists, (vi) Environmental education think-tank, (vii) Policy-makers, (viii) Park managers, (ix) Judges, (x) Environmental lawyers, (xi) Academics, (xii) Biodiversity information system managers, (xiii) Collaborative team leaders, and (xiv) Local villagers and indigenous people (Tyrrell and Alcorn, 2011). National Park's biological diversity is a landscape perception, although its preservation is some multidimensional problems (Elliott, 1994) connecting with various local and global stakeholders for natural resources management, sustainable use and security at a wide-range of rules and regulations. These regulations provide informative evidence (Sutherland *et al*., 2004) that supports for formulation, evaluation and decision-making towards evidence-based national park biodiversity management (Bennett, 2016).

Several research and reviews represent that the execution of biodiversity protection and security is no promise of conservation achievement (Edgar *et al*., 2014; Pfeifer *et al*., 2012; Ferraro *et al*., 2013; Mora and Sale, 2011), otherwise, of advantage towards individuals (Bennett and Dearden, 2014a; Coad *et al*., 2008; West *et al*., 2006); on the way to national park. Operative protection for resolutions from side to side co-management comprises a sequence of management planning outcomes (Hockings *et al*., 2006). Except co-management with local and indigenous peoples' involvement, the conservation scheduling including checking and evaluating (Bennett and Roth, 2015) are not guaranteed for suitability and backing for commendations (Chevalier and Buckles, 2013; Fortmann, 2008; Evans and Guariguata, 2008; Gujit, 1999). These local and indigenous communities support relevant models of caring species richness of national parks (McNeely, 1994) as well as biodiversity conservation perspectives (Bennett & Dearden, 2014a). The achievement of national park biodiversity management through local people's (MacKinnon *et al*., 1986) participation enhances in desired condition (Ali and Habib, 1998) as well as establishing co-management (Poffenberger, 2000). However, collaborative management is integrated with local people (MEA, 2005), indigenous people, elite leader, local government leader, decision-maker and administrative body for national park's biodiversity management.

2.8 Aichi Biodiversity Targets and National Conservation

Aichi Biodiversity Targets (ABT) included 20 targets for conservation of national biodiversity (UNEP-WCMC, 2015) within stipulated time 2020. The Article 17 of ABT indicated that every state government of CBD should improve and to approve a strategic policy instrument for effective conservation action plan within 2015 (ABT, 2010a), which

was shared to this government in 2010 through at Nagoya supplementary program (Leadley *et al*., 2014; CBD, 2010). Aichi Biodiversity Targets–ABT (2011-2020) are enhancing indicators for national biodiversity conservation (CBD 2016a), which indicates to the global networks. Aichi Biodiversity Targets contains five strategic goals including existing targets in connection with sustainable development goals (CBD-SDG, 2016; United Nations, 2015). The specific objectives of these targets are mentioned as sequentially, such as: (a) to achieve and utilize the all flora and fauna sustainably, legitimately, and implementing ecological-based (Rice, 2016) policies (CBD, 2010a), (b) to recognise species invasions for regulatory or eliminating as a prioritised basis of national park biodiversity conservation within stipulated time (CBD, 2010b), (c) to conserve 17% of landscapes and 10% of seascapes areas' biodiversity (CBD, 2014) associated with operative reserved area-based protection, (d) to progress and implement national conservation strategic plan of each state government within the period of 2015, (e) to develop and implement the science and technology management connecting to national park biodiversity status and its consequences through transferring, feedback sharing and recovery measures.

2.9 Biodiversity Strategic Plan— Evidence based Policy

National Biological diversity policy plan is an evidence-based policy instrument. There is relation between evidence base and policy coherence (Segan *et al*., 2011) for incorporating values into NBSAP (Chenery *et al*., 2015)., such as (a) Incorporating values into NBSAP (CBD Secretariat, 2010), (b) Integrated NBSAP's rationale, objectives and insights on values of nature, (c) Internalise and integrate biodiversity values and concerns, (d) Mainstream biodiversity, and (e) Behavioral changes (Schneider and Ingram, 1990), which demonstrate the value of revised NBSAP for national outcomes, improved human well-being and halt biodiversity loss (Adams and Sandbrook, 2013). Lack of effective and target-

oriented strategic plan, conservation of national park biodiversity tends to losses profoundly. Because, national biodiversity strategy and action plan connect with goals, targets and actions for effective conservation.

2.10 Biodiversity Clearing House Mechanisms

The word ‘clearing-house’ originates initially starting the arena of Investment, wherever it represents a central body that settles indebtedness between various financial institutions. In connection with the agreement, it was originally arranged to agree up a support providing evidence on biological diversity (CHM, 2010). Hereafter, moderately the existence massive data-set, the clearing house mechanism (CHM) is an evidence-based network (WCMC, 2010) completed up of automated and general electronic media (GIZ, 2001). Every contracting member of CBD committed to develop the CHM for scientific information exchange (Roberts, 2007) according to the Article 18.3 (CBD, 1992). It supports circumvent repetition of exertion, stimulates the sharing of network domain as well as facilitates communicated goals to be accomplished corresponding swiftly. In order to be able to implement the CBD, contracting states, non-governmental organizations, and all the other bodies supporting the convention need a great deal of information and knowledge. Much of these information and knowledge is already obtainable wherever in the earth including the system of biological diversity assessments, analysis outcomes, records on supportable practice, related legal status, statute, and controlling approaches for national park zones with specific strategies for structures, professional data-sets, national reports, conference and trained-up sequences. Without CHM support, it deals with time consuming, lack of transparency as well as lack of quick connections for operation. The CHM implies regionalized need-based structures which support policymaking and advances management with National Focal Point of contracting Government.

2.11 National Forest Policy and Conservation of Biodiversity in Bangladesh

The adoption of authorised laws and regulations through national park management tends to State rules for conserving of biodiversity and its protection (Alam, 2009) towards national parks. According to State Forest rules, the Government accelerated approximately 20% of forest cover through afforestation program within 2015 for maintaining ecological balance. This attempts represented with flora and fauna in the core areas of national parks, particularly in Sylhet division for increasing massive ecotourism, raising awareness on environmental conservation and mitigation of climate change (Bose and Muller-Ferch, 2008). However, the Bangladesh Forest Department could not fulfil the targets within the stipulated time. For this reasons, the Government of the People's Republic of Bangladesh takes initiative for update National Forest Policy (draft) 2016. This new policy will open the door for biodiversity conservation towards national parks to fulfil the Aichi Biodiversity Targets 2020 of CBD.

2.12 National Forest Act and Biodiversity Conservation

Government of Bangladesh amended the Forest Act 2000. It is the major legal instrument in national forestry sector. The Forest Act was modified in accord through the straightforward provisions of misuse and security, and took little reflection towards participating features of national park biodiversity protection. Overall, the amended forest law takes reticent several of the scarce Articles of the innovative law and administration. It silently affords area for the implementation of the traditional managing attitudes through the Forest Department (Muzaffar *et al*., 2011). These legal instruments have influenced towards national and international policy frameworks with diverse contexts of participatory forestry practices, particularly biodiversity conservation at

national parks, wildlife sanctuaries, and special conservation areas in Bangladesh. The existing engagements in the announcement of national parks and the outlines of collaborative administration in the reserve forest are closely connected to the primer and extension of shared forest options (MoEF, 2005).

2.13 National Conservation Strategy

Bangladesh is situated in the Indo-Burma Biodiversity hotspot (CI, 2012)). On the priority of hotspots, the country developed National Conservation Strategy (NCS) with innovation national conservation (Schulz, 2009) systems for the present and upcoming generations. The NCS is a crucial contribution that accomplishments to attain state conservational protection (MoEF, 2004) aims over assimilating varied rules on the environment in supporting procedures and the policymaking procedures (DeCosse *et al*., 2012). It is similarly settled on the salient features connection with Sustainable Development Goals (SDG) 2030. Through accepting the national conservation strategy, the administration of Forest Department repeated its state and collective obligations to confirm sustainable development through achieving conservation goals (Rahman, 1991). The national conservation strategy contained of relevant rules and regulations, administrations, organisational structures on starting supportable progress and performance over representing ecological protection beneath the comprehensive scale of the surroundings. Some restrictions and breaches try to minimize through the National Biodiversity Strategy and Action Plan (NBSAP) 2016-2021.

2.14 Strategic Plan for Biological Diversity of Bangladesh

Towards contributing to the global targets that is the Aichi Biodiversity Targets-2020 and implementation of NBSAP, the State Party (SCBD, 2011), Bangladesh has proposed 20

national targets to be taken into account during the final year 2015-2016 to 2020-2021. Some national targets, which relates to biodiversity (DoE, 2016) and as follows:

(i) By 2021, relevant stakeholders will be aware on the significance of biological diversity as well as play an active part in safeguarding sustainable use,

(ii) By 2021, Assessment of valuation of goods and services of major ecosystems will be furnished towards integration into national accounting system,

(iii) By 2021, Studies on the impacts of incentives or subsidies on biodiversity, as well as development of policy roadmaps for phasing obtainable of enticements or subsidies harmful to biodiversity will be completed towards mainstreaming the relevant ministry for implementation of the policy roadmap,

(iv) By 2021, studies on the rate of habitat loss will be furnished towards promoting implementation of land use policy and enforcement of relevant legislations on conservation of natural habitats,

(v) By 2021, study on the impact of Invasive Alien Species (IAS) will be furnished, regulations towards control of IAS will be developed and capacities at the port-of-entries will be enhanced to regulate IAS,

(vi) By 2021, Bangladesh's 5% area under terrestrial ecosystem (forests), 3% area under inland wetlands and coastal ecosystems and 5% of total marine area (SCBD, 2011) will come under protected areas or ECAs with development and implementation of management plan for these areas,

(vii) By 2021, capacity of *in-situ* and *ex-situ* conservation facilities will be strengthened to conserve the genetic diversity of cultivated plants, indigenous livestock and poultry resources,

(viii) By 2021, Agencies responsible for Biodiversity and Natural Resources Management will be adopting modern information technology like GIS and RS

and information on biodiversity will be shared through Clearing House Mechanism (CHM), and

(ix) By 2016, Bangladesh will develop, adopt and update NBSAP and commence implementation of the document in an effective and participatory manner including national conservation zones in Bangladesh (Nishat *et al*., 2002). The NBSAP, National reports (DoE, 2015) and biodioversity-clearing-house-mechanism are connected with state parties as well as CBD.

2.15 *In-situ* conservation with National Parks Declaration in Bangladesh

Government of Bangladesh declares in the Section 17 under Chapter 5 of the Wildlife Conservation and Security Act 2012 for declaration of i*n-situ* conservation, highlights on national park– as a research instrument. Till to date, Bangladesh declared 17 national parks according to IUCN management category and WDPA ID, as shown in Table 2.7. The specific objective of the stated Section to declare any state forest or part of such area as national park mentioning demarcation for conserving of biodiversity with their habitat or environmental development. This anoucement enhances with state rules and regulations, management plan, strategic plan and forestry master plan. But some national parks are lack demarcation area as well as lack of effective implementing legal status.

Table 2.7: National Parks of Bangladesh with WDPA ID.

Sl. No.	Name of National Parks	WDPA ID	District	Gazette Date
i.	Altadighi National Park	555576099	Naogaon	24-12-2011
ii.	Baroiyadhala National Park	555543042	Chittagong	06-04-2010
iii.	Bhawal National Park	4479	Gazipur	11-5-1982
iv.	Birganj National Park	555576100	Dinajpur	24-12-2011
v.	Himchari National Park	4480	Cox's Bazar	15-2-1980
vi.	Kadigarh National Park	555576101	Mymensingh	24-10-2010
vii.	Kaptai National Park	4474	Rangamati	9-9-1999
viii.	Khadimnagar National Park	555543260	Sylhet	13-04-2006
ix.	Kuakata National Park	555576102	Patuakhali	24-10-2010
x.	Lawachara National Park	142993	Moulvibazar	7-7-1996
xi.	Madhupur National Park	4481	Tangail -Mymensingh	24-2-1982
xii.	Medhakachhapia National Park	555543261	Cox's Bazar	8-8-2008
xiii.	Nababgonj National Park	555576103	Dinajpur	24-10-2010
xiv.	Nijhum Dweep National Park	317318	Noakhali	8-4-2001
xv.	Ramsagar National Park	7972	Dinajpur	30-4-2001
xvi.	Satchari National Park	555543040	Habigonj	15-10-2005
xvii.	Singra National Park	555576108	Dinajpur	24-10-2010

(Source: WDPA, 2017).

Some major problems were identified by different sources at Lawachara National Park (LNP) in Moulvibazar district of Bangladesh (IPAC, 2012). These are:

(i) Lack of demarcation for national park boundary,

(ii) Lack of national parks integrated online database, Biodiversity Clearing House Mechanism (BCHM) and digital conservation apps,

(iii) Lack of sectoral integration effectively,

(iv) Illegal logging, forest land encroachment and political nepotism in co-management team,

(v) Less involvement of local and indigenous communities towards ecotourism activities,

(vi) Lack of awareness on environmental education,

(vii) Lack of wildlife security and misuse modern technology (Kays *et al*., 2011)

(viii) Excessive invasions of alien species at LNP.

(ix) Associated food shortage for wildlife (Deshwara and Eagle, 2017; Bdnews24, 2016).

(x) Animal is susceptible to traffic accidents in Lawachara National Park (Deshwara and Eagle, 2017).

Lack of determined policies, national park biodiversity estimated to decline by a supplementary 10% of internationally within the period of 2050 (OECD, 2012). Previous research failed to reveal the strong points and faults evidently lingering to complications (Kaomuangnoi, 2014) on environmental policy instruments including National Biodiversity Strategy and Action Plan (NBSAP) evaluation towards national parks implementing policy domains with monitoring, formulation and analysis. Biodiversity technological research becomes more challenging due to lack of proper applications of information systems for digital conservation in Bangladesh. Developing state party lacks proper information and evaluation related to biodiversity conservation systems (Heywood, 1997) on national park.

2.16 Management Rules and Regulations for National Parks

Government of Bangladesh declares in the Section 16 under Chapter 4 of the Wildlife Conservation and Security Act 2012 for rules and regulations for National Park Management, which indicates in category II (IUCN, 1994). Plant, animals particularly gibbons at national park stay in threat (Ahsan, 2000; Brindle, 2009; Chowdhury *et al*., 2011; Geissmann, 2007; Molur *et al*., 2005 & 2003; Österberg, 2007; Walker *et al*., 2009). For saving this wildlife, the authority declares management rules and regulations. The declaration stated that "(1) The Government may, for each national park, prepare a management plan in accordance with the manner prescribed by rules, (2) The Chief Warden,

shall bear all responsibilities of implementation and management of management plan and may for this purpose, in limited scale, inside the national park —

(a) allow the operation of tourism shop for any commercial purpose, construction of road, bridge, building, boundary or controlled barrier entrance and demarcation or such other work, except construction of tourism shop, cottage or hotel, which is essential for the management of sanctuary;

(b) undertake necessary steps for ensuring the safety of wildlife and its habitat

(c) improve habitat, protect breeding ground, prevent disturbance during breeding for the protection of wildlife, and raise plantation suitable for wildlife in limited scale for ensuring food security;

(d) take necessary steps, in consultation with the co-management committee, for the protection of fresh water or salt water aquatic animals such as tortoise, crocodile, dolphin, whale, porpoise, etc. through control or prohibition of fishing activities or movement of watercrafts; or

(e) prohibit, after identifying the activities detrimental to environment within 2 (two) kilometres from the border of sanctuary area".

2.16.1 Legal Administration for Biodiversity Conservation

Legal administration for biodiversity conservation consists of five categories (WCS, 2012), such:

(i) Advisory board,

(ii) Scientific committee,

(iii) Authorised Officers,

(iv) Policy makers, and

(v) Co-management Team.

Government organises the Wildlife Advisory Board according to the Section 3 under Chapter 2 of the Wildlife Conservation and Security Act 2012 related to national biodiversity conservation including plant and animal species (Fitter, 1986)). The state government gazettes for appointment of chairperson and number of members, Scientific Committee and Authorised Officers. These appointees are experts in conservation of biodiversity, forests and wildlife, working in any institution, government or non-governmental organization and pertinent jurisdiction with constitutional overall duties of development of safety measures and management of biological diversity of Bangladesh (BFD, 2016a). The policy-makers are the top executive members of the country who are involved to make law, order, policy, ordinance and relevant legislations according to the national constitution, particularly Article 18A and 122 (TCPRB, 2012). Co-management team is the grass-root level team who are organised by the section 21 of the Chapter 5 of the Wildlife Conservation and Security Act 2012. Protection of biodiversity is essential for conserving the netting of lifespan that tolerates existing belongings at national park. In the Sections 6, 7, 8, 9 and 12 under Chapter 3 of the Wildlife Conservation and Security Act 2012 mentions effective prohibition related to wild animals and plants successively with prohibition, determination, removal, release and transfer.

The WCS Act restricts to for hunting any wild animal without a license or gaining a permit under this Act, or willfully pick, uproot, destroy or collect any plant, which mentioned in Schedule IV; (2) The Government may, by notification in the official Gazette, prohibit hunting of any specified or all wild animals in a specific forest area or throughout Bangladesh for a specific period. The Chief Warden shall determine which species or sub-species of wild animals mentioned in Schedule I, II and III and plants mentioned in Schedule IV, are vulnerable, endangered or critically endangered according to scientific data and

internationally acceptable provisions or customs in consultation with the scientific committee.

2.16.2 Biodiversity Protection related Legal Penalties

According to Chapter 9 of the Wildlife Conservation and Security Act, 2012 of Bangladesh illustrates the enforcement penalties in different sections (WCS, 2012); such as, the Section 34 and 37 of WCS, 2012 mentioned successively. The Section 34 of WCS, 2012 mentioned for consequences on behalf of certain violations. The punishment implies with minimum 1 (one) year or with a fine of fifty thousand BDT (Bangladesh Taka-currency) or with both of them, as well as maximum 3 (three) years or with a fine of 2 (two) lakh (1 million equals 10 lakh) BDT or with both of them ($US 1=BDT 80).

2.17 Biodiversity Legal Information and Technology in Bangladesh

Legal status biodiversity protection predisposes to its information and technology in modern era to data collection, analysis and decision-making. Government produced ICT Policy, which mentions the application of data and information in several sections (ICT Policy, 2009), such as:

(i) Legal perspective issues: Documents safety and suitability would be safeguarded over existing legal activities such as situation of encryptional values as well as worldwide treaties on environmentally requirements,

(ii) Environment perspective issue: Information Management Systems (IMS) for creating a wide-ranging catalogue of prevailing national parks' biodiversity of the State including surroundings as well aas its probable threatened populations.

Legal information systems can be used for national park biodiversity conservation and

relevant tasks (Bhardwaj and Margam, 2016), such as:

(i) Digital conservation,

(ii) Environmental Court Information,

(iii) Environmental Informatics,

(iv) Environmental legal research and Case law reports,

(v) Legal database,

(vi) Legal online dictionaries,

(vii) Legal online library information,

(viii) Legal citation and citators,

(ix) Legal treaties, convention and agreements,

(x) Global legal information network,

(xi) Online Legal periodicals,

(xii) Information of BAR Association,

(xiii) Juris Pedia,

(xiv) Institute of Advanced Legal Studies,

(xv) International Law Associations,

(xvi) Legal Online Conference,

(xvii) Legal Information Retrieval,

(xviii) Legal tools and media toolkits,

(xix) Legal informatics,

(xx) Legal Environmental Informatics,

(xxi) Online Mock Trial Video Conferencing,

(xxii) Online Court Session and Declaration,

(xxiii) Legal System connection with Global Navigation Satellite System,

(xxiv) National Court Interlinked with Space Research Remote Sensing Organization

(SPARRSO), and

(xxv) Environmental Court sharing with Supreme Court and District Branch Court for biodiversity governance.

2.18 Biodiversity Policy Information

Biodiversity policy information inclines to positions strata from operation level to management, then chief executive or decision-maker with information system sharing (IM, 2016) and feedback meeting, as shown in Figure 2.10.

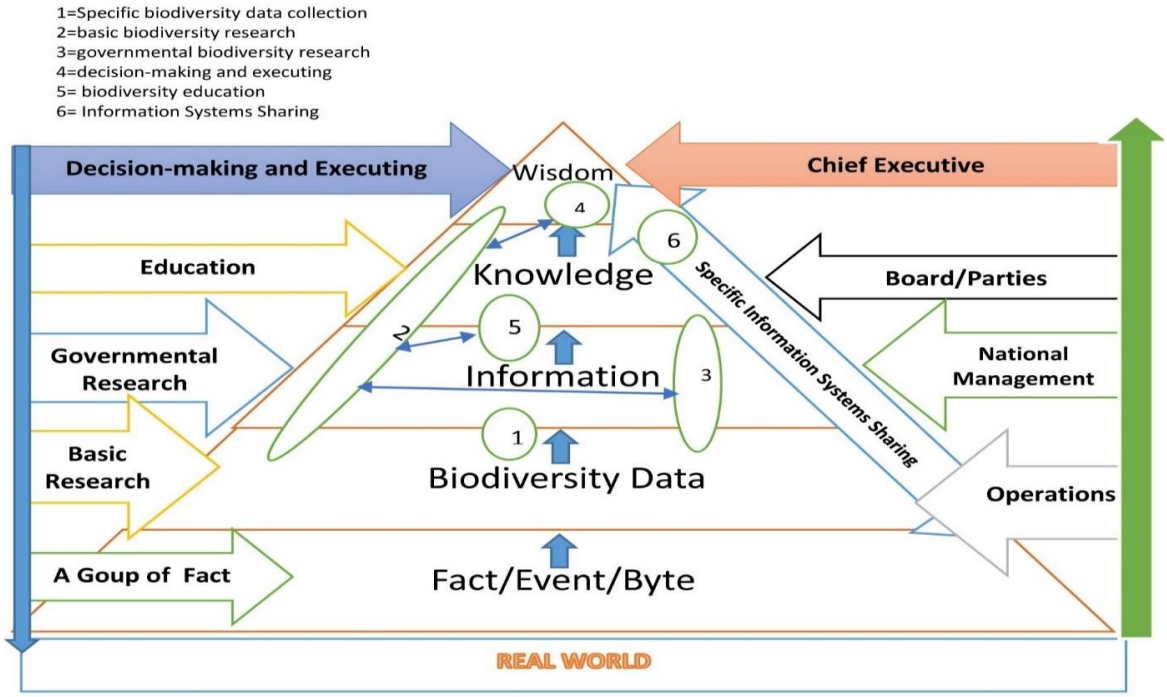


Figure 2.10: The Biodiversity Information Hierarchy (Modified Laihonen *et al*., 2003).

In general, the biodiversity related rules and regulations-makers required with professional education as well as contented with scientific performances to manage through alike progressively multipart and inter-connected conservational difficulties (Bierbaum, 2004). The effective decision-makers as well as administrators of national parks' biodiversity

leading to the present and upcoming generations should prerequisite to be talented with appreciating dialectal of various sectors and assimilate evidence through these policy-makers to innovate achievable, resourceful and publicly-suitable outcomes (Bierbaum, 2004). Furthermore, these resource persons need to be trained-up adequate to advance the give-and-take progress of education as well as rapport building – together with the requirements and opportunities of motivated and cultured stakeholders interlinked with knowledgeably policy-makers (Laihonen *et al*., 2003) related to national park biodiversity policy formulation and development.

The study tries to identify three environmental policy instruments connecting with biodiversity conservation at Lawachara National Park in Bangladesh, particularly on legal, in-situ and informational instruments for biodiversity conservation (Robinson *et al*., 2015) towards national parks. This research relates with Lawachara National Park in Moulvibazar district of Bangladesh with relevant methodology, which illustrated in Chapter 3.

CHAPTER 3

MATERIALS AND METHODS

3.0 Study Site

Bangladesh is a developing country in the north-eastern part of south-east Asia with augmented biodiversity earlier (DoE, 2016) and lies in the earth largest deltaic area between the coordinates of 20°34' and 26°38' north latitude; and 88°01' and 92°41' east longitude (DoE, 2016). A total of 38 protected areas cover an area of 439,798.18 ha (about 10.72% of total forest area), which was managed the percentage of sixteen (16) of the total area by the Forest Department (FD) of Bangladesh as well as below 2% of whole area of the country (Hossain, 2001; BFD, 2016). It includes 17 National Parks (Figure 3.1), 21Wildlife Sanctuaries and 12 other conservation sites (PAB, 2016).

In-situ instruments included national parks and wildlife sanctuaries in Bangladesh. The declared national parks are Himchari NP, Bhawal NP, Ramsagar NP, Lawachara NP, Kaptai NP, Nijhum Dweep, Medhakachhapia NP, Satchari NP, Khadimnagar NP, Baroiyadhala NP, Kuakata NP, Nababganj NP, Singra NP, Kadigarh NP, Altadighi NP, Birganj NP and Madhobpur NP. Lawachara National Park (LNP) is one of the 17 National Parks in Bangladesh. The 21 Wildlife Sanctuaries are Rema-Kalenga Wildlife Sanctuary (WS), Char Kukri Mukri WS, Sundarbans-East WS, Sundarbans-West WS, Sundarbans-South WS, Pablakhali WS, Chunati WS, Fashiakhali WS, Duppukuria-Dhopachari WS, Hajarikhil WS, Sangu WS, Teknaf WS, Tengragiri WS, Dudhmukhi WS, Chandpai WS, Dhangmari WS, Sonarchar WS, Nazirganj Dolphil WS, Shilanda-Nagdemra WS, Nagarbari-Mohanganj WS and Swatch-of-No-Ground Marine WS. *Ex-situ* Instruments included Botanical Garden, Eco-park and Safari Park, which were listed in Appendix O.

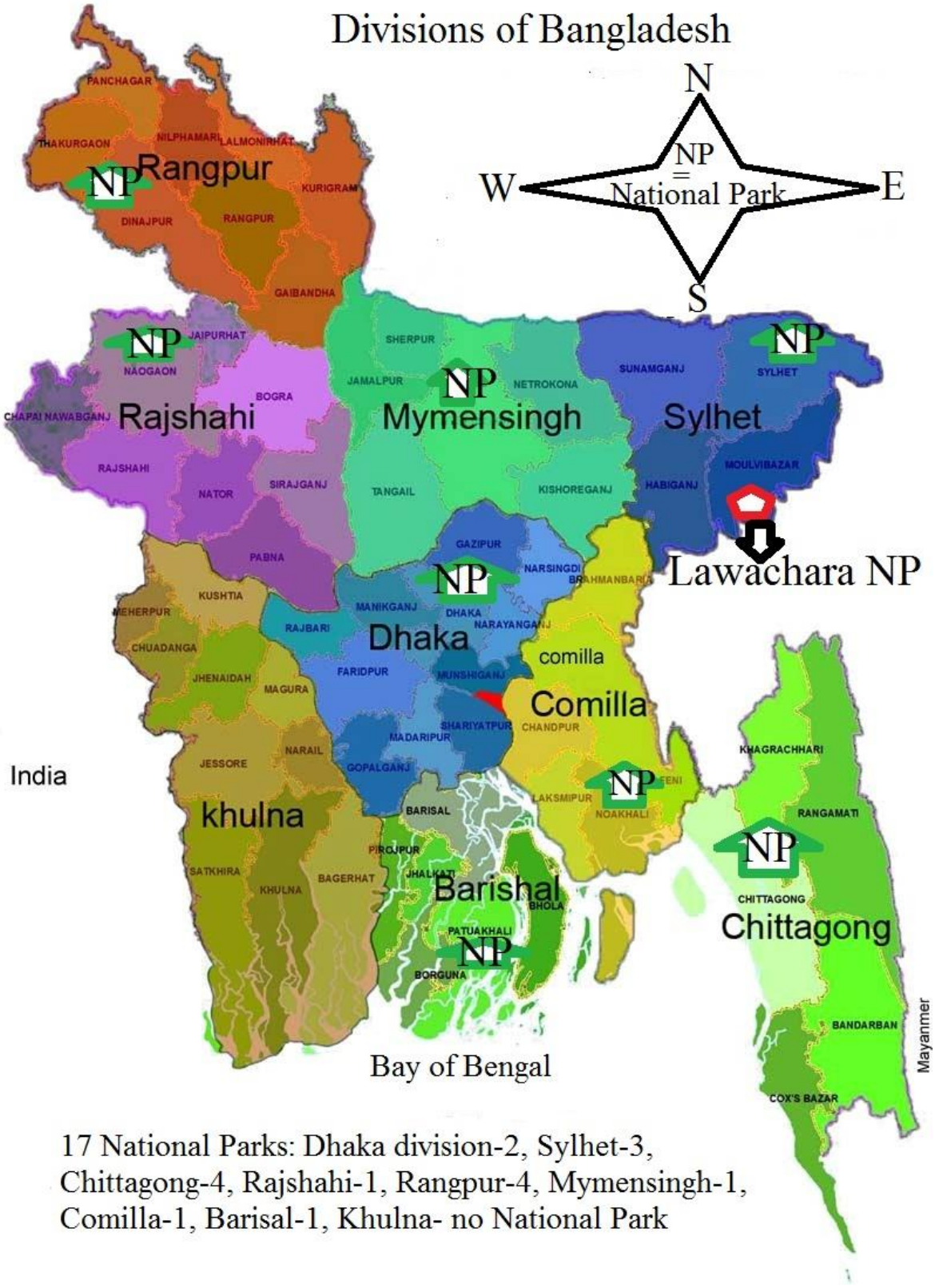


Figure 3.1: The declared National Parks of Bangladesh (RIMS, 2015)

3.1 Lawachara National Park: Case Study Area

The study was undertaken at Lawachara National Park (LNP) at Kamalganj sub-district in Moulvibazar of Sylhet division, Bangladesh coordinates with 24°32′12″N 91°47′03″E (NSP, 2005) as the forest conservation case study site. The LNP is situated in the Union and sub-district Kamalganj (Figure 3.2) in Moulvibazar district of Bangladesh (MP, 2006) with indicated parameters as shown in Table 3.1.

Table 3.1: Some basic parameters of Lawachara National Park.

Sl. No.	Parameters	Characteristics
i.	WDPA ID	142993 (WDPA, 2017)
ii.	IUCN Category	II (National Park category) (PAB, 2016)
iii.	Forest type of Park	Evergreen and semi-evergreen forests (IPAC, 2012)
iv.	Existing Law	The Wildlife Conservation and Security Act 2012
v.	Policy Management	Co-management System Active (CWS, 2012)
vi.	Physiography	Northern and Eastern Hills (IPAC, 2012)
vii.	Bio-ecological Zone	Sylhet Hills (IPAC, 2012)
viii.	Forest Range	Moulvibazar Wildlife Range, Srimangal (IPAC, 2012)
ix.	Forest Beat	Lawachara Beat (IPAC, 2012)

Besides, Lawachara National Park is uniqueness in Bangladesh for its scenic beauty, visitors attraction and other relevant parameters, which are illustrated in details as follows.

(i) Important Events in Lawachara National Park

(ii) Infrastructure Facilities.

(iii) Administration

(iv) Legal Status

(v) Biodiversity

(vi) Human Settlement

(vii) Soil and Topography, and

(viii) Climate.

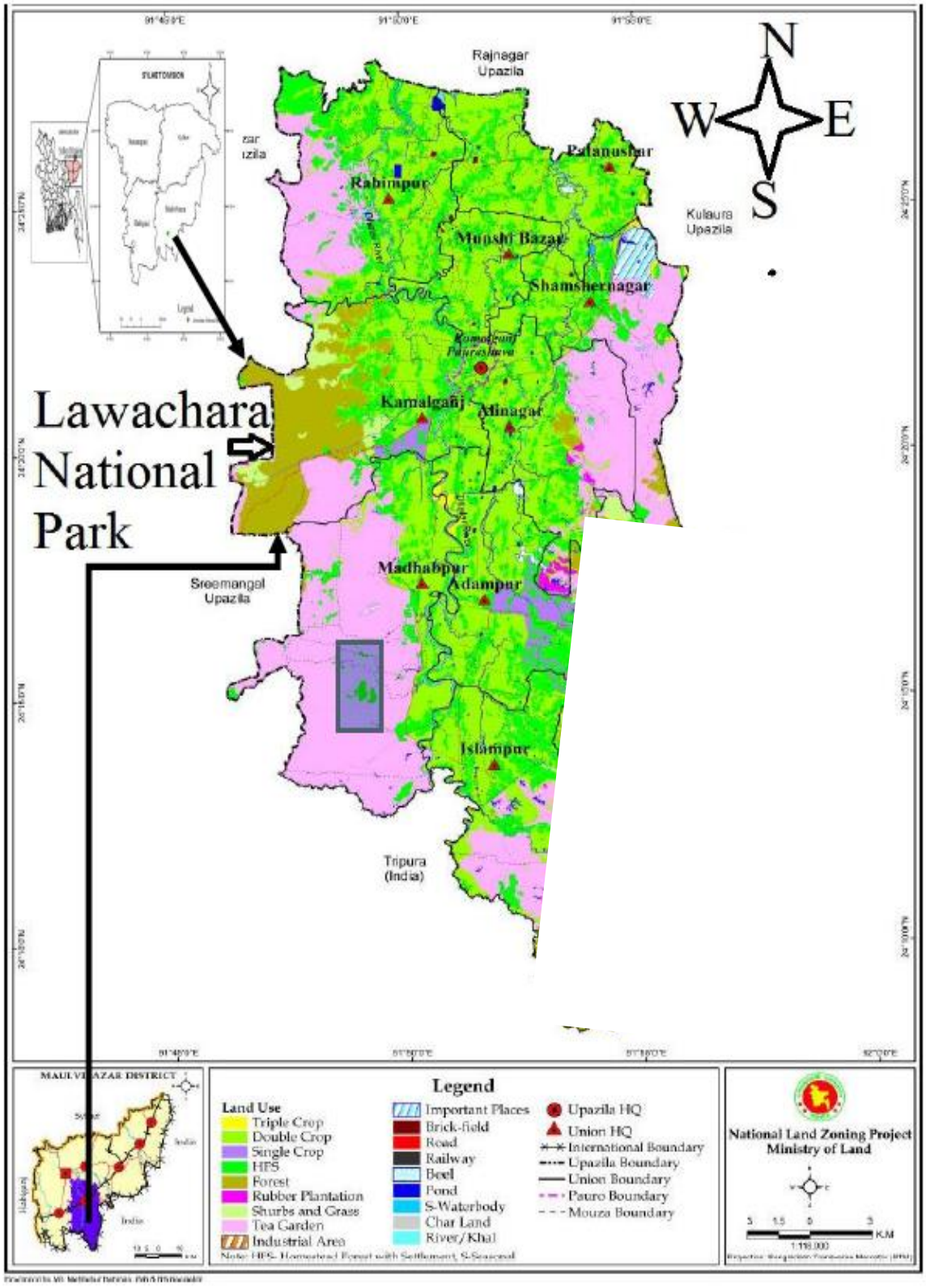


Figure 3.2: Lawachara National Park at Kamalaganj in Moulvibazar, Bangladesh (Source: NLZP, 2018)

3.1.1 Important Historical Events of Lawachara National Park

There are some important historical events of Lawachara National Park, which linked with its historical background (Table 3.2).

Table 3.2: Important historical Events in Lawachara National Park

Important Events	Period	Remarks
Historical Mixed Tropical Evergreen Forests.	Before 1848	British East India Company
Cleared the original forest for tea plantation.	1848	British Companies
Bamboo, Cane and other relevant species.	1923	Starting Afforestation
Lawachara Punji Established.	1940	For logging and plantation purpose
Magurchara Punji established.	1950	In connection with Lawachara
Declared Reserve Forest.	1973	By President's ordinance.
Declaration as Lawachara National Park.	1996	By Government
Launching Forestry Sector Project.	1996	Financed by Donor
Preparation of National Park Management Plan.	1996	Organised by BFD and Donor
Magurchara Fire Accident.	1997	Caused by Global Company
Launching Nishorgo Support Project.	2003	Implemented by International Resources Group (IRG)
Formulation of Forest Management Plan for Lawachara National Park.	2006	Organised by Bangladesh Forest Department
Closing of Forestry Sector Project.	2006	Declared by BFD-Donor
3D Seismic survey.	2008	By Chevron Multi-national Company
Closing of Nishoro Support Project	2008	Declared by BFD-Donor
Lauching of Integrated Protected Area Co-management Project.	2008	By BFD-IPAC
Established Co-management System at LNP.	2009	By BFD-IPAC
Established Article 18A in the National Constitution for National Park Biodiversity Protection for present and future citizens.	2012	By Bangladesh Government
Established Wildlife Conservation and Security Act 2012 for National Park Protection.	2012	By Bangladesh Government

Table 3.2 continued

Enlisted Lawachara National Park ID at World Database on Protected Areas (WDPA).	2014	By WCMC-IUCN
Established Public-Private Partnership Act 2015 for National ConservationProtection.	2015	By Bangladesh Government
Python swallode deer due to associated food shortage for wildlife.	2016	Observed by LNP Administration
LNP encroached land recover from local encroacher.	2017	By LNP Administration and Co-management Team

(Source: NSP, 2006; MP, 2006; WCS, 2012; TCPRB, 2012; IPAC, 2012; WDPA, 2017; ALNP, 2017).

These important events are historical witnesses in connection with National Park's Biodiversity Conservation, Protection, Management and present park conservation policy status to compare other National Park in Sylhet Division of Bangladesh.

3.1.2 Infrastructures Facilities

Lawachara National Park presently consists of different infrastructures facilities as shown in Table 3.3.

Table 3.3: Infrastructure Facilities of Lawachara National Park.

	Infrastructures Facilities	**Quantity**	**Remarks**
i.	National Park Office	1	Administrative control unit
ii.	LNP Range Office	1	connected with Field Office
iii.	NP Beat Office	1	Local field office
iv.	NP Camps	2	Operational purposes
v.	National Park Nursery	1	Adjacent LNP
vi.	Visitor Information Centre	1	Adjacent LNP
vii.	CMC Office	1	Adjacent LNP
viii.	Nature Trails	3	In connection with scenaries
ix.	Picnic Sites	2	For special occasions

Table 3.3 continued

x.	Ticket Counter	2	Adjacent middle point of LNP
xi.	ACF Quarter	1	For In-charge of LNP
xii.	Range Officers' Quarter	1	Family Quarter for Officer
xiii.	Beat Officer's Quarter	1	Family Quarter for Officer
xiv.	Research Student Dormatory	1	Rest house for researchers
xv.	Walking Trails	3	Walking distance scenaries

(Source: NSP, 2006; MP, 2006; IPAC, 2012)

3.1.3 Administration

The study site is situated in the civil administrative units of Kamalganj Police Station, Moulvibazar district under Forest Administration Unit (Halim *et al*., 2008). The Reserved Forest is divided into three Beats, viz. Lawachara Forest Beat, Chautali Forest Beat and Kalachara Forest Beat with a total area of 2610.31 ha (Anon, 1970). Earlier Lawachara National Park was a Lawachara Forest Beat of West Bhanugachh Reserved Forest under the jurisdiction of Sylhet Forest Division of the Bangladesh Forest Department (BFD). Forest Beat is the lowest administrative unit of BFD. According to National Requirements, the administration of the National Park has been transferred from territorial forest administration unit to Wildlife Management and Nature Conservation Division of BFD (Hossain, 2007; NACOM, 2003). The LNP is now under the Moulvibazar Wildlife Management and Nature Conservation Division, which is headed by the Divisional Forest Officer (DFO) of BFD administered by the Ministry of Environment and Forests (MoEF). In-charge of Lawachara National Park is an Assistant Conservator of Forests (ACF) assisted with field level staff and Co-Management Team to manage and protect the Park.

3.1.4 Legal Status

Lawachara National Park (LNP) was established through the President Order under the Bangladesh Forest Act 1927 (Amendment 2000). In 1996, the LNP was declared as a National Park under the provision of Article 23 (3) of the Wildlife (Preservation) (Amendment) 1974 (Hossain, 2007; NACOM, 2003). It was declared as a National Park in 1996 with 1,250 hectares (Gazette Notification-PBM (S-3)7/96/367 on 07 July 1996) (Halim *et al*., 2008) with highly diverse hilly evergreen forest under the conservation status of the Wildlife Preservation Act-1974 (this Act revealed). The current Wildlife Conservation and Security Act, 2012 is effective under the Article 18A of the National Constitution of Bangladesh.

3.1.5 Biodiversity Status

The LNP is one of three national parks in Sylhet region in the north eastern part of Bangladesh (RIMS, 2015). It is semi-evergreen and mixed deciduous forest (Champion *et al*., 1965). Total 460 species consist of floral 167 and 293 faunal species including amphibian 4, reptiles 6, birds 246, mammals 20, insect 17 (IPAC, 2012; Jalil, 2009). Major plant species are Chapalish, Gorjon, Jarul, Rokton, Segun and major wildlife species are Macaque, Barking deer, Capped Langur (NSP, 2006). The Lawachara is the most suitable to tourists to watch the stunning Hoolock Gibbon (*Bunipithecus hoolock* / *Hylobates hoolock*)), Capped Langur (*Trachypithecus pileatus*), Phayre's Langur (*Trachypithecus phayrei*), Pigtailed Macaque (*Macaca nemestrina*), Orange-bellied Himalayan Squirrel (*Dremomis lokriah*), Barking Deer (*Muntiacus muntjac*), Masked Civet (*Paguma larvata*) and rare Cobra and Python species (NACOM, 2003; Hossain, 2007). The LNP is an attractive ecotourism destination due to its aesthetic scenary and dense forest diversity (NSP,

2006). The Park was also a hotspot for biodiversity to find several species of a new and regional record for biodiversity conservation of Bangladesh (Hossain, 2001; Rufford, 2014).

3.1.6 Human Settlement

Lawachara National Park (LNP) is surrounded with human habitats and Tea Estate (NACOM, 2003). The LNP and surrounding forest areas consist of 30 villages (Haider and Kabir, 2014) and about 18 villages near LNP within 1 to 5 kilometers. Two Lawachara Punji and Magurchara Punji) of them are located within the boundary of the park and rest of villages lie on the boundary of the Park (Figure 3.3). Indigenous people in these areas are the Khasia people (Christian), the Tripuri people (Hindu), the Tipra people, and the Monipuri people. The rest of the population are mostly Muslims, they migrant from Noakhali and Comilla districts of Bangladesh, and Assam of India. These people have some rights within the reserve forest, such as wood collection for fuel and building materials, hunting, betel-leaf production, grazing of livestock, harvesting of other forest products, limited agriculture in allocated lands (NACOM, 2003). Temporary staff of Tea-Estate depends on LNP.

3.1.7 Soil and Topography

Lawachara National Park (LNP) is situated under bio-ecological zone of 9b-Sylhet Hills having physiographic characteristics of northern and eastern hills, northern-eastern piedmont plains (Nishat *et al*., 2002) with brown hilly soil, sandy clay loam to clay loam of Pliocene origin (NACOM, 2003). The LNP is an undulating topography having slopes and hillocks, locally known as ‘Tilla’ and are spinkled through the park area. Copious streams surge through the park area (Feeroz and Islam, 2000).

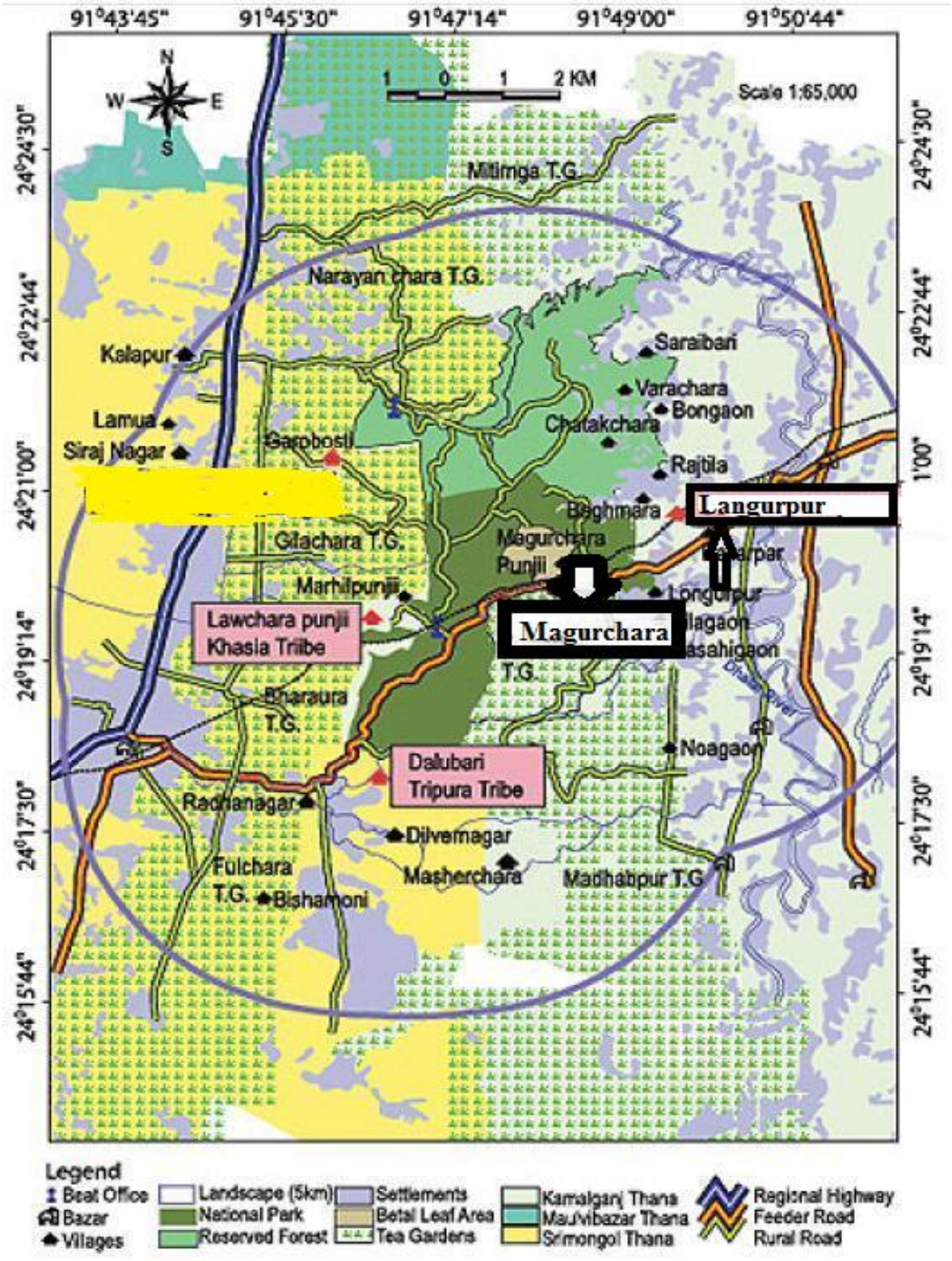


Figure 3.3: Lawachara National Park at Kamalaganj in Moulvibazar, Bangladesh (Source: Ferdous, 2015; NSP, 2007; MP, 2006)

3.1.8 Climate

Lawachara National Park (LNP) is a part of west Bhanugach Reserved Forest, which has diversities of geographically dense park sited in the maximum rainfall and a multi-tier vegetational stratification of rich biological diversity (MP, 2006). The park is crossed by several sandy-bedded seasonal streams; one of which is the name of Lawachara tributary, from which the park derived its name (Shewli, 2009). The climate of LNP is warm and humid. Maximum temperature is of 36.1ºc in June and minimum 10 ºc in February. The humidity is 74% in March and 89% in July of the year. The LNP is one of the wettest zones at the north-eastern part of the country. Average annual rainfall is 4200 mm with maximum fainfall falling during June to September from south-west monsoon (NSP, 2006).

3.2 Research Methods

The flowchart of research method was connected with different parameters to enhance data collection, compilation and interpretation, which as shown in Figure 3.4. This flowchart supports to data collection, data compilation, and analysis and model development related to national park biodiversity conservation, policy instruments and decision making processes. This research method was connected with the whole research procedure including primary and secondary data collection on the priority of qualitative and quantitative data (Kothari, 2004). The research method uses for primary and original data collection related to biodiversity conservation, park management, stakeholders' involvement, monitoring of LNP biodiversity status, identified ecological risk assessment and information on application of conservation technology towards Lawachara National Park's research. This research included with its philosophy, approach, strategy, time horizon with data collection period.

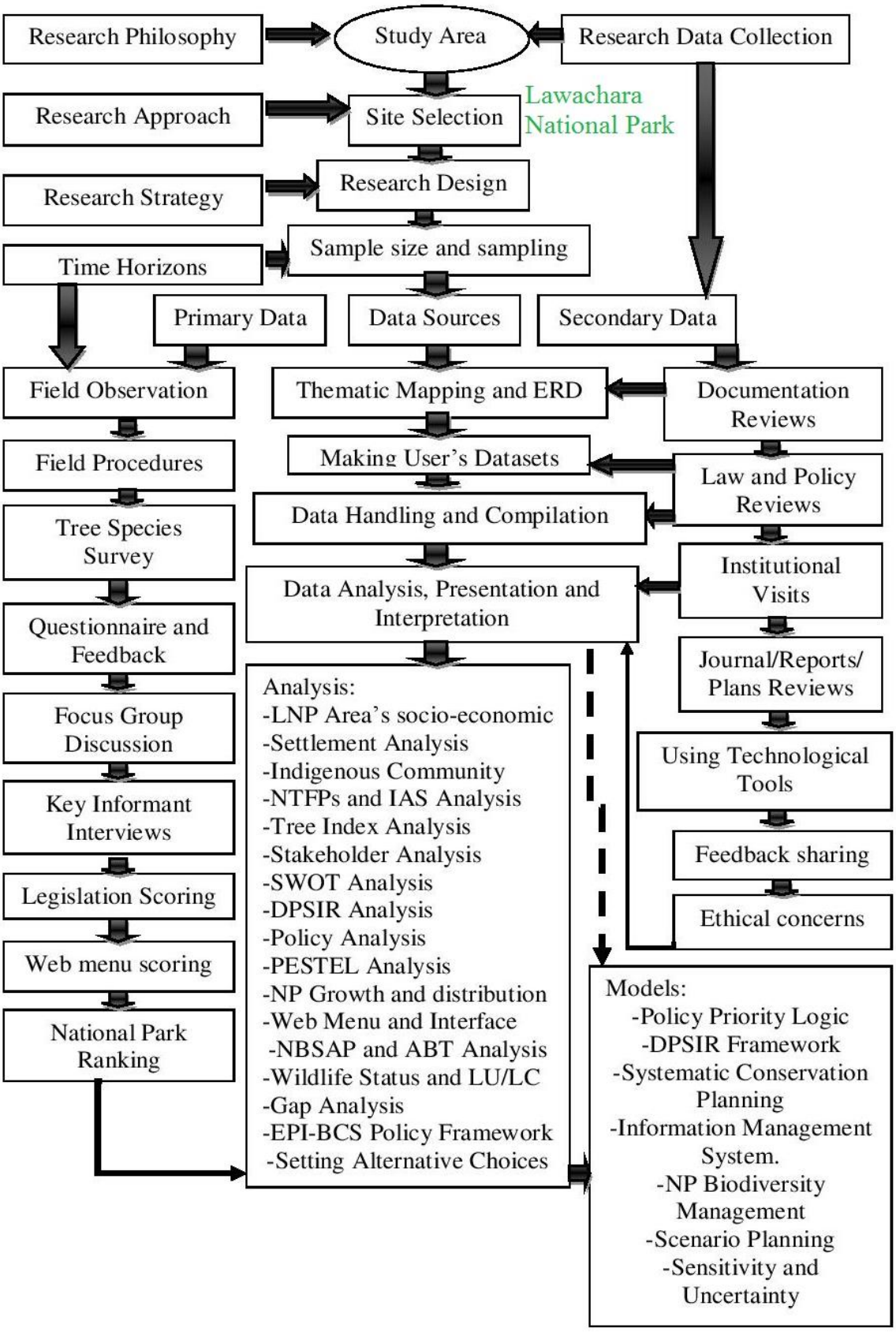


Figure 3.4: Flowchart of Research Method interlinked with National Park (Source: Author's Compiled Data, 2017).

3.3 Site Selection

Lawachara is about 160 km from the Capital city, Dhaka, and 60 km from Sylhet city and about 8 km from the sub-district town of Srimangal (MP, 2006). The study site was purposefully selected based on a set of conditions like location, suitability, flag species and visitors' attractions to permit for the analysis of cases. Lawachara National Park (LNP) is the study area at Kamalaganj sub-district in Moulvibazar district of Sylhet respective division, Bangladesh. This study envisaged the research that took in a useful enquiry element to consider issue hoisted in the study, first and foremost targeted at policy users across this national park area.

The district is chosen for research for ease transport and because of its rural nature and in all of others, the major profession is agriculture as a whole. The research took on Focus Group Discussions (FGDs) as well as expert opinion methods to obtain the relevant information in the study households. In the focus group discussions, the researcher involved in consultations with the leaders of the communities to organize the households into groups where the various issues concerning discussed. People with expert knowledge in biodiversity policy of the area are consulted for crucial information on the issues under discussions.

3.4 Research Design

The fundamental parts of the research design illustrated in the following points, such as: (i) Research Design, (ii) Research Instruments, (iii) Sample Population and Size, (iv) Pilot Study, (iv) Validation and Reliability, (v) Data Collection, (vi) Data sorting and assemblage, (vii) Data compilation, and (viii) Data Analysis. The survey on Lawachara biodiversity conservation system was undertaken in four (two inside and other two outside) of the 18 villages around Lawachara National Park, which as shown in Figure 3.5.

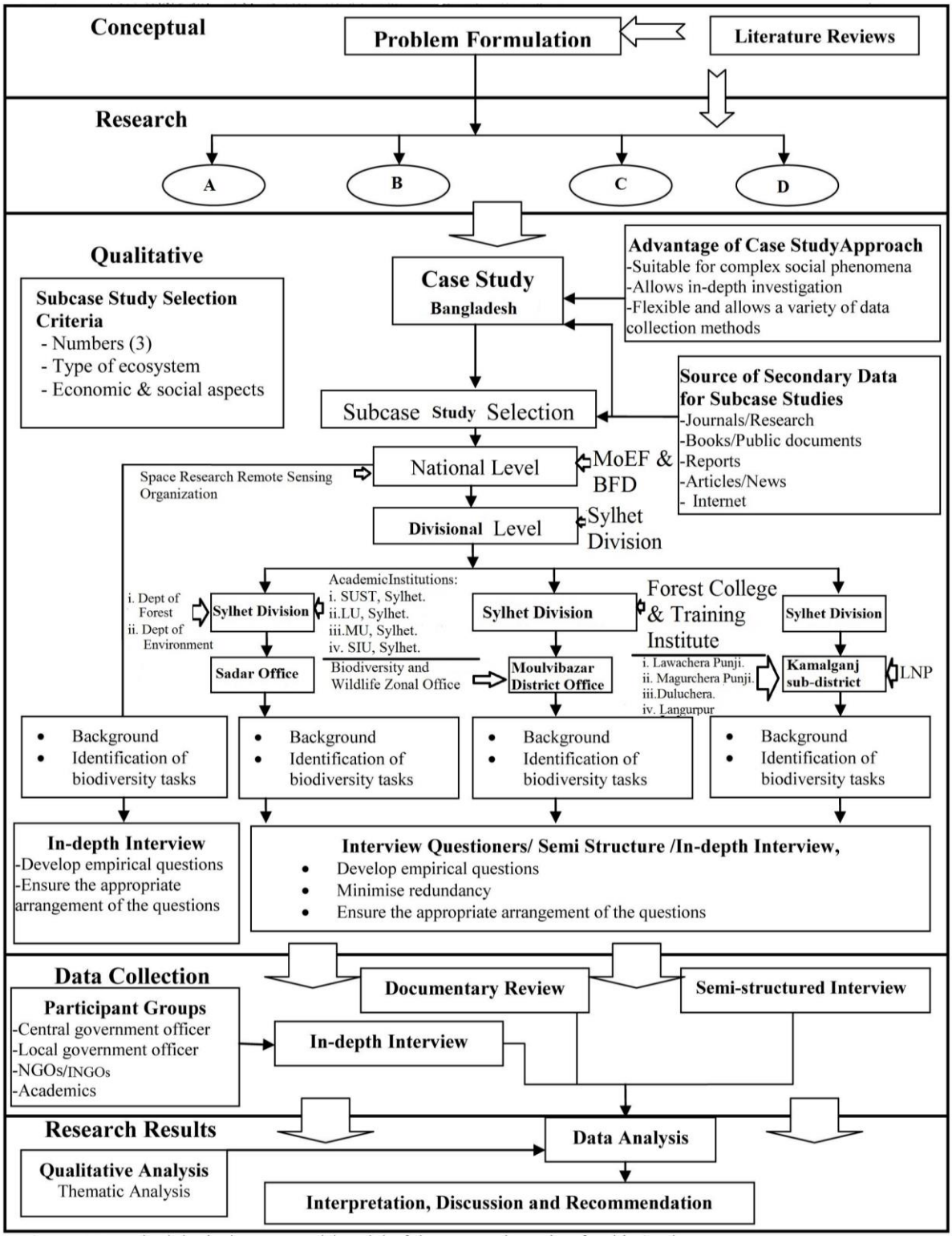


Figure 3.5: Research Design for the study Lawachara Area and adjacent areas (Source: Modified Kaomuangnoi, 2014).

Data related to conservation knowledge, usage of technology, biodiversity conservation policy and protected area management perspectives were collected from the

respondents(WFP, 2012). Indepth conducted interviews with respondents who were involved in Lawachara National Park such as Park Manager, Team Leader of Co-Management Committee, Indigenous Community Leader and relevant bodies. The research design is a viewpoint relating concepts of the study, records assemblage as well as approaches, consequences scrutiny, argument, and the ultimate outcomes circulated (Robson, 2002). This research design helped to primary and secondary data collection within the stipulated time frame, particularly household survey, stakeholders' interviews, key informant interviews, institutional survey, field procedure for tree species survey, existing laws and policies reviews, visitors' interviews and relevant other activities.

3.5 Sample Size and Sampling Techniques

The field survey related to villages, conservation knowledge, biodiversity policy, legal system, national park areas management perspectives and digital conservation. The average sample size is 30.36% with respondents' rate which as shown in Table 3.4.

Table 3.4: Status of Respondents in the studied area.

Name of village	**Existing Households** (NSP, 2006)	**Total Existing Member**	**Number of Respondents**	**Respondent's rate (%)**
Lawachera Punji	23	116	29	25%
Magurchera Punji	41	165	48	29%
Dolubari	84	255	46	18%
Langurpur	92	278	83	30%
Total	240	814	206	25.5%
Other Respondents		247	87	35.22%
Grant Total		1061	293	30.36%

Besides, the rest of respondents are 87 including visitors, biodiversity specialist, forest officer, biologist, agriculturalist, ecologist, conservationist, environmentalist, network specialist, software engineer, policy-maker, botanist, zoologist, wildlife manager, co-management team leader, judges, environmental lawyer, indigenous community leader,

academicians and NGO officers. Out of 4 villages, Lawachera and Magurchera are inside and Dolubari and Langurpur are outside villages from Lawachara National Park. First three villages are major stakeholders, while last one is minor stakeholder affected to LNP. The study undertook a survey on only four villages from LNP to determine the effectiveness of present biodiversity-related instruments on the ground by looking at data related to legal knowledge, biodiversity conservation policy and national park areas management perspectives of the stakeholders especially the locals including khasia, tripuri and monipuri (NACOM, 2003). Sampling methods used randomly through observations, semi-structured interviews and questionnaires, which selected based on the opinions related to the conceptual questions (Rufford, 2014).

3.6 Assessment Methods

The study focuses on the assessment method through the following formulae were applied at Lawachara National Park with the best contribution to the biodiversity policy analysis for improving national park areas management. Methods use are (i) Conservation policy assessment method, (ii) National Park Management Effectiveness Method, (iii) Tree Diversity Index Calculation, (iv) Stakeholder Analysis Method, (v) Legislation Scoring Method, (vi) Application method of information system for digital conservation, (vii) Clearing House Web Menu Scoring Method, (viii) PESTEL Analysis Method, (ix) SWOT Analysis Method, and (x) DPSIR Analysis method.

3.6.1 Conservation Policy Assessment Method

Assessment of conservation policy outputs should preserve decision-making in the political process by State Government and International Collaborative Institutions. It delivers information on to what level the environmental conservation and other relevant objectives

of an executed environmental policy have been completed at what costs, and with what effects on all-important themes concerned proposals for the next stage of the related policy cycle (Sauer *et al*., 2012). The assessment process was included into two main levels— (i) basic assessment and (ii) comprehensive assessment. The basic assessment is obtained all cases and is of a multipart character including the three "Pillars" of sustainable development: environmental, economy and institutional-social. The comprehensive assessment is also obtained only if essential by conclusion of the basic critical review. Therefore, Conservation Policy Assessment Method is someway related to a "small" and "prolonged" Regulatory Impact Assessment (RIA) (Sauer *et al*., 2012).

The policy assessment method (PAM) is anticipated to carry outputs that are understandable to policy-makers and experts in several parameters, as well as the public sectors. In opinion, PAM practises organised and easy-to-survey tables, which are to be accomplished systematically. This system consents for the asseesment to integrate regular arrangement and procedures simplifying the assessment. Moreover, all the policy assessment steps are also perceptibly documented. The PAM legalizes the definite purpose of competency in the assessment process: clear definition of the roles of the national park managers, executor of the assessment, subjects concerned (stakeholders) and expert reviewers with critical review of the assessed documentation. As regards the methods used for the actual assessment of the policy implementation effectiveness, both qualitative and quantitative methods are applied. The qualitative methods include, for example, document analysis, and identification of relevant factors for multicriterial analysis, consultations, and comprehensive interviews with experts and subject concerned, etc. The quantitative methods include, in particular, conversions to comparable units used in assessment tables, and also multicriterial analysis techniques. In preparing the assessment, the quality of the data is observed and evaluated.

The assessment scale runs from 1 to 4 points (Sauer *et al*., 2012) : (a) 4= suitable, (b) 3= in general, (c) 2=undesirable, and (d) 1= no comment. The assessment method designates the rules for assigning points to each of the parameters in much more detail, including quantifying relevant values if appropriate. The basic assessment consists of four phases: (a) Preparatory phase, (b) Data collection and assessment in the particular modules, (c) Overall assessment of the policy and elaboration of a policy rating, (d) Critical review and final assessment of the policy (Sauer *et al*., 2012).

The preparatory phase begins with making a requirement to assess the effectiveness of a policy implementation. Such a requirement may arise from the policy itself or it may be forwarded to the Ministry of Environment and Forests from another organization at the government level like ministries, parliament. It may also arise from non-governmental organizations, political parties, industrial associations, community-based organization and collaborative management committee, etc. The requirement is then reviewed from the viewpoint of the necessity to perform an actual assessment of the relevant policy implementation effectiveness. Reasons for rejection of the requirement may be, for example, the fact that the required assessment already is proceeding as part of reporting to the CBD, that the policy concerned does not fall within the powers of the Ministry of Environment and Forests, that the requirement aims at public resource management rather than an assessment of the effectiveness of the policy implementation, etc.

3.6.2 National Park Management Effectiveness Method

Management Effectiveness Tracking Tool (METT) is the approach based on the WWF/World Bank Tracking Tool to assess with questionnaire form. The assessment form contains 31 tools covering with the World Commission on Protected Areas (WCPA)

Framework including contextual, planning, inputs, process, outputs and outcomes. The WCPA framework aims to provide overall guidance in the development of assessment systems and to encourage standards for assessment and reporting. The tracking tool aims to report progress on management effectiveness and should not replace more thorough methods of assessment for the purposes of adaptive management. The tracking tool has been developed to provide a quick overview (Ahsan *et al*., 2016). The assessment includes a corresponding score from 3, 2, 1, and 0. Final score is calculated as percentage of total score from related questions. It starts with the understanding of the context of existing values and threats, progresses through planning and allocation of resources (inputs), and as a consequence of management actions (processes), eventually produces products and services (outputs, that result in impacts or outcomes (Stolton *et al*., 2007).

The METT is one of a series of management effectiveness assessment tools built around the WCPA Framework, which range from the WWF Rapid Assessment and Prioritization Methodology used to identify key national park areas at threat within a protected area system to detailed monitoring systems (Coad *et al*., (2013) such as that developed by the Enhancing UNESCO Heritage sites. Having this range of tools in place will aid the CBD State Signatory Parties. As part of the Programme Nations have committed to develop assessment systems and report on the effectiveness of 60% of protected areas by 2015 (CBD, 2010b).

3.6.3 **Tree Diversity Index Calculation**: Shannon Index, H'

Shannon Index, H' $= - \sum_{i=1}^{n} p_i \ln p$ ----------(i)

Where, pi = the quantity of tree species (particularly, *Artocarpus chaplasha*) belonging to the *i*th tree species in the dataset of importance (Shannon, 1948).

Simpson Index, λ $= \sum_{i=1} p_i^2$ ----------(ii)

Where, pi = the number of *i*th tree species in the dataset of importance (Simpson, 1949).

The Species Plot size 30 m X 30 m at top, slope and plain forest lands, the n=12 sampling plots was taken from the studied areas including three forest land status, like plain, up and slope land. These areas are north-south and east-west zone, central and railway route areas. Each area took three sample plots. For this purpose, the study used Global Positioning System (GPS) to check coordinates. From the diversity survey, the study identified the number of tree species individual and family. For unknown species, the study being used harberium related manual (Das and Alam, 2001). The research was used to compare the diversity index between Shannon Biodiversity Index–ShaBI (Shannon, 1948) and Simpson Biodiversity Index–SiBI (Simpson, 1949). Small value in datasets of SiBI indicates in high diversity and a large value indicates low diversity in National Park and vice versa in ShaBI. The study identified tree diversity towards National Park from SiBI and ShaBI, which was connected with national forest policy 1994 for augmentation of afforestation and reforestation programmes. These indices used for identification of Lawachara National Park' tree diversity.

3.6.4 Stakeholder Analysis Method

This analysis was applied on X^2-test: The value of the test-statistic was connected with stakeholders' performance.

Chi-square, $$\chi^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i} \quad \text{----------(iii)}$$

(Source: Pearson, 1900)

Where,

χ^2 = Pearson's cumulative test statistic to analyze the stakeholders' engagement, O_i = an observed value of stakeholders; E_i = an expected value of stakeholders; n = number of frequencies of stakeholders. Categories evaluation of Stakeholders viz.

Scientist, Academia, Policy-maker, NGO, Citizen, Manager, Student, Private Sector, Facilitator and Media exposures.

3.6.5 Legislation Scoring Method: Legislation scoring was calculated for development of update law, policy, order and related schedule for biodiversity protection effectively with the certain period in Bangladesh.

Legislation Scoring, $$P_i = \sum_{i=1}^{n=23} W_i S_i \quad \text{----------(iv)}$$

Where, n= number of legislations, Pi= weighted average score of national park, Wi= weight for policy i, and Si= Score Assigned for policy I (Rahman and Barua, 2016).

3.6.6 Application Method of Information Systems for Digital Conservation

In this study, we seek to identify and analyse the application of information systems for digital conservation in connection with Biodiversity Clearing House Mechanism (BCHM) and Online Integrated Information Systems (OIIS). To undertaken this analysis, it has been required to extend and search beyond peerreviewed publications, documentations, books and other scholarly works. Systematic review methodology tends to avoid these in their emphasis on data quality (Pullin and Stewart, 2004). We identified six key dimensions (Arts *et al*., 2015) (Figure 3.6), which has a substantial impact on biodiversity conservation. This approach related to horizon scanning exercises, which aims to identify relatively unknown phenomena at the earliest possible stages (Pettoreli *et al*.,2014; Waddle *et al*., 2003; Wagtendonk and De Jeu, 2007; Van der Wal *et al*., 2015). The study tried to assess different biodiversity related databases, such as: (i) National Plant Species Database, (ii) Wildlife Database, (iii) National and Global Biodiversity Experts Databases, (iv) Online National Report of Bangladesh to CBD, Digital Monitoring Conservation System of LNP, (v) Visitors

Database with revisit information system to LNP, (vi) HRIS and Infrastructure Facilities of LNP, and (vi) Co-management system and list of Co-Management Council (CMC).

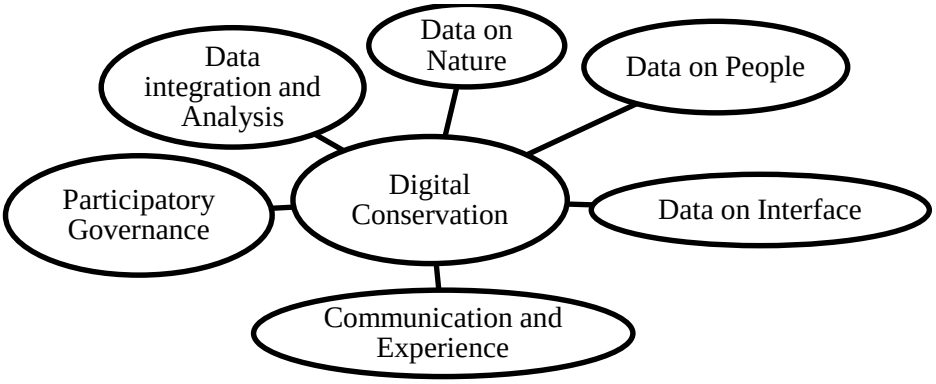


Figure 3.6: Data Collection Approach for Digital conservation (Source: Arts *et al*., 2015).

3.6.7 CHM Web Menu Scoring Method

Till to date, Bangladesh has not developed clearinghouse mechanism as a State Party. Randomly selected 10 State Parties of CBD in Asia compared analysis of CHM web menu performance among them. These State Parties are Bahrain, Cambodia, China, India, Indonesia, Japan, Malaysia, Myanmar, Republic Korea, and Yemen. The Selected State Parties of CBD, n=10, Specific Parameters of State Party's webpage performance (CHM, 2010; FWI, 2012), such as: (a) Image/map scrolling, (b) National biodiversity menu, (c) National Protected Area menu, (d) Policy and NBSAP menu, (e) National Experts menu, (f) Link with other sectors, (g) Display Language status, (h) Link with CBD, (i) Link with Social Media, and (j) Search menu. The average Scoring indicates the grading and ranking of each Party's Clearing House Mechanism as shown in Table 3.5.

Table 3.5: Scoring and Ranking of State Party's Biodiversity Clearing House Mechanism's Performance (Satty, 1987).

Scoring	Ranking	State Party's Grading
0-10	As Usual display	Achieved scoring
11-20	Approximately	Achieved scoring
21-30	Good	Achieved scoring
31-40	Better/Very good	Achieved scoring
41-50	Excellent	Achieved scoring

The study also identified web interface display time of selected State Parties. Each parameter contains 5 score.

3.6.8 PESTEL Analysis Method

PESTEL Analysis approach is used to analyse the National Park Biodiversity Conservation in connection with ecotourism service as well as National Government's conservation commitment to the Convention on Biological Diversity (CBD). This approach helps to assess the conservation demand on the priority of Access Benefit Sharing (ABS) and Biodiversity Clearing House Mechanism (BCHM). The analysis includes the external factors related on Political, Ecological, Socio-cultural, Technological, Economic and Legal status (Johnson and Scholes, 2002; Gregoric, 2014) for the conservation of National Park Biodiversity. This approach also used the respondents' opinion from Focus Group Discussion (FGD) on the study areas.

3.6.9 SWOT Analysis Method

This method implies as an organised development technique for evaluation the internal factors (strengths and weaknesses) as well as external factors (opportunities and threats) towards Lawachara National Park (LNP) biodiversity conservation. It involves the specifying the objectives of LNP management and identifying the internal and external

factors (Rezazadeh *et al*., 2017); (Yuksel and Dagdeviren, 2007); (Saaty, 1987) that are favourable to achieving that objectives. The scoring of internal and external factors 5 scoring individually (strength 4, weakness 1 and opportunity 3, threat 2). This method benefits in analysing the gains and drawbacks of the park management planning and approaching out through planned propositions for conserving of biodiversity. In addition, it supports in comprehensive decision of conservation policy instruments, its essentials, procedure and applications related to LNP administration in order to govern suitable involvements.

3.6.10 Method for DPSIR Framework

The DPSIR framework is able to demonstrate the intricacies of the system interaction (Erma *et al*., 2010) in sustainable conservation and national park management. The framework can be summerized as follows:

(a) The Driving Forces are processes and anthropogenic activities that able to cause pressures during the conservation of biodiversity at National Park, in other words, they are the reasons that cause the changes in the conservation process.

(b) The Pressures are the direct stresses, deriving from the anthropogenic activities and affecting the environment, economic and community.

(c) The State reflects the actual conditions of National Park areas.

(d) The Impact is the measure of the environmental effects due to loss of biodiversity of National Park.

(e) The Response refers to specific actions oriented to reduce the pressure and promote conservation in terms of economic or administrative measures.

The selected indicators were assessed under a variety of management scenarios using Analytical Network Process (ANP) scoring, with equal weight given to social,

environmental and economic concerns (Saaty, 2008). The decision indicators included loss of biodiversity, land use, demographic changes, implementation of policies, land owners, wildlife status, hydrological balance, presence of a riparian buffer (Benini *et al*., 2010), application of conservation technology and community involvement. The various indicators were combined using additive weighting to give a score for each possible management action.

3.7 Conceptual Policy Analysis Approach

The study analyzed on conservation policy management using a model, which enhances the cost effectiveness protecting biodiversity policies and improving national park area management administered by Government. A simple "input-output" evaluation framework deployed to organize data about the impacts of policy and governance instruments, as shown in Figure 3.7.

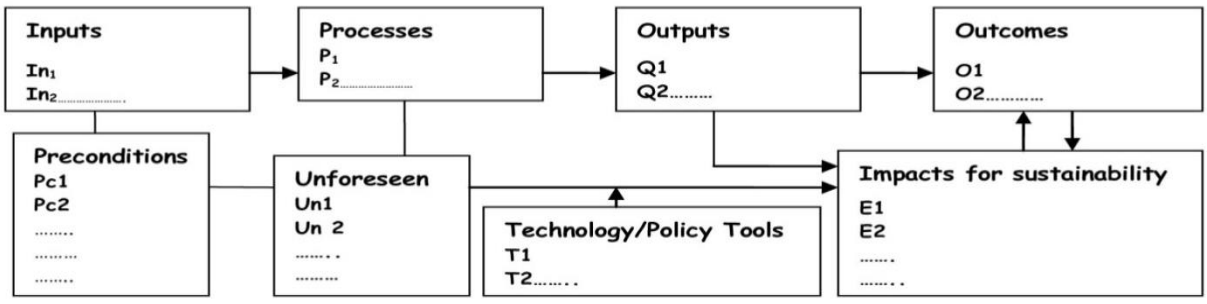


Figure 3.7: Biodiversity Policy Evaluation Framework (Mickwitz, 2003; ECC, 2012)

This framework continues into account-anticipated laws, policies, actions, related aspects, and unanticipated measures in the study of the causations of organizations and pertinent policies. Biodiversity Policy and Priorities Logic Model developed by various parameters; viz. Activities, Outputs, Target Audiences and Outcomes in presence of its impact interlinked with mentioning research plan, as shown in Figure 3.8.

Activities	Outputs	Target Audiences	Outcomes		
			Direct Outcomes	Intermediate Outcomes	Final Outcomes
A1	OP1	TA1	D1	O1	F1
A2	OP2	TA2	D2	O2	F2
A3	OP3	TA3	D3	O3	F3



Impact

Figure 3.8: Policy and Priorities Logic Model (Modified Mickwitz, 2003 and ECC, 2012)

3.8 Making Users Dataset for Biodiversity Information Systems

The user database for biodiversity information systems prepared using MS Office 2013 including database table, data query, data form and reports. It also showed the relationship among datasets of Lawachara National Park including documenter analysis for decision-making of the existing database (Appendix H).

3.8.1 Impact of Sensor Network on Animals (ISNA) Experiment

ISNA Experiment implies the experiment on the Impact of Sensor Network on Animals (ISNA). Digital technology is helpful to the National Park Biodiversity Conservation, particularly digital conservation. However, cyber tracker misuses this technology to enhance loss of biodiversity conservation and negative impact through tracking on wildlife conservation (Kays *et al*., 2011). The study examined into two specimens, one dog and another one cat for identification of this misuse application. These animals are available in the study area and suitable for experiment. The study selected sound health two species with Feline Body Mass Index (FBMI) and other following parameters (Waltham, 2017) as shown in Table 3.6. The experiment took at dark and light conditions. From the field observation, the Automated Radio Telemetry System is more effective in dark than light environment.

For this purpose, the study was examined the system with on-cell phone, iron cage (size: 3.5′x 2′x2.5′) and individual species separately (Appendix P).

Table 3.6: Two selected animals' specimens with Feline Body Mass Index (FBMI).

Species	Body Temperature (^{0}C)	Breathing rate (bpm)	Respiration (per minute)	Blood Pressure (mmHg)	FBMI
Cat	36.4	210	23	121-175	24.2
Dog	36.7	192	25	122-180	24.7

(Source: Author's compiled data, 2017).

During this experiment, the study aws used the following parameters, these are : (i) Windows based Laptop connected by WiFi, (ii) Desktop computer with double window, (iii) Malwarebyte and Kaspersky utility update versions, (iv) GUI (Windows 10) operating system, (v) CUI (Ubuntu 16.3) operating systems, (vi) Ubuntu based Laptop connected by broadband internet, (vii) Desktops connected by broadband and WiFi, (viii) Mobile Phone (DiGi and HotLink) with GPRS, GIS and GPS supports, (ix) Mobile Phone without SIM Card but connected with WiFi, (x) Google Chrome with Add-in and Add-Block, (xi) Dark and Light temporal environment, and (xii) Iron Cage. The dog and cat put into the iron cage with cell phones separately. The experiment continued at five locations, viz.

(i) Location A with light environments but no WiFi

(ii) Location B with dark and light environments including WiFi

(iii) Location C with dark and light environments including WiFi

(iv) Location D with light environments but no WiFi

(v) Location E dark and light environments including WiFi

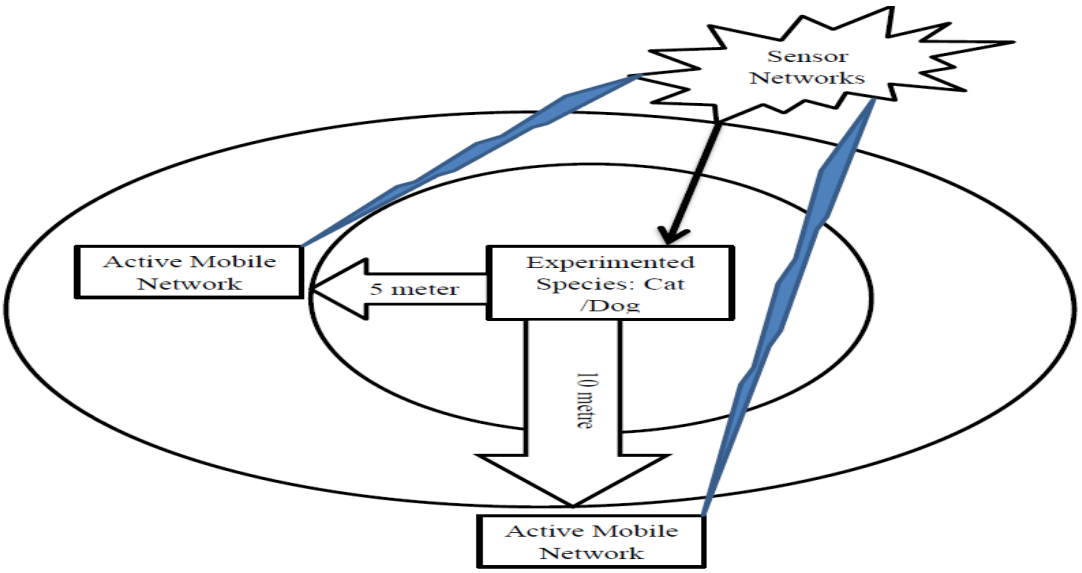


Figure 3.9: ISNA Experiment with Sensor and Mobile Active Networks

These experiments continued to identify the reflection of Automated Radio Telemetry System from Telematics device via cell phone towards animals at 09:00 p.m. to 6:00 a.m. from 1 January 2017 to 28 January 2017 (Figure 3.9). The location of experiment settled the species with the temporal conditions through global positioning system. Although many important moments in animal's life are difficult to study because they are rare, cryptic or occur over large spatial or temporal scales (Kays *et al*., 2011). For the study of FBMI calculation, the study was used web calculator through using rib case circumference and length of the lower back leg from the knee to the ankle. The study was observed the physical condition of animals like respiration affected by the telematics device.

3.9 Field Work

The study necessitates an integration of methods used in social sciences and knowledge of decision-making. This envisaged the research taking in matter-of-fact research elements to investigate issue hoisted in the study, primarily targeted at policy users across Lawachara National Park. The fieldwork conducted in the studied national park within January 2015 to

July, 2015. The Field data collected based on field observation, interviews, questionnaire, key informant interviews, feedback meeting and relevant networking, negotiation, communication and interpersonal communication.

3.9.1 Observation

The researcher observed relevant website, Library, Institution, Forest Areas and relevant places. In order to determine the extent of the biodiversity web portal and get location of this according to the proposed plant diversity, species diversity, and genetic diversity. During the observations about landscape, agriculture and forest were made and questions for using in the geo-data gathering generated.

3.9.2 Questionnaire Preparation and Techniques Setting

Different types of questionnaires preparation follow the research objectives as a whole. These questionnaires categorized on structured, semi-structure and unstructured according to respondents and key informant status based on biodiversity, mechanism tools, taxonomic classification, and so on of the priority of setting techniques viz. digital and non-digital data including flora and others.

3.9.3 Focus Group Discussion

The study made two Focus Group Discussions (FGDs) from four surveyed villages. The FGD were held with five to seven participants from the studied four villages, such as (i) FGD-1: Lawachara Punji, and Magurchera Punji, (iii) FGD-2: Duluchera, and Langurpur. In addition, there was a meeting and discussion with Park Management Authory, Experts, and Representatives of Divisional Forest Office. After discussion, the study also checked with them for feedback meeting with relevant queries on cause's loss of biodiversity, NTFPs,

co-management system, wildlife and national park management, systematic conservation planning, framework and models.

3.9.4 Informal Discussion

Informal discussion is connected with individual of respondents and stakeholders. Some field data were collected through informal discussions with respondent to have insight views of the Lawachara National Park. This discussion method was also used to be familiar and friendly relationship with the potential interviewees. This discussion method was helped the study towards triangulation data collection of National Park' biodiversity. The discussion was recorded in the field note and analysed by the help of text explanation.

3.9.5 Institutional Visit and Feedback Sharing

The data and information obtained were analysed. The researcher visited academic Institutions-Centre for Academic Information Systems (CAIS), UNIMAS, Forestry Department of Shahjalal University of Science and Technology, Forest School at Sylhet, Forest divisional office at Sylhet, Forest Department at Dhaka, REDD+ Cell, MoEF. Lawachara National Park Forest Office, Department of Environment and Forest Office, Bangladesh Environmental Lawyer Association (BELA) Office, Sylhet Environmental Court, Biodiversity Research Group of Bangladesh (BRGB), IUCN-Bangladesh, FAO-Bangladesh, WWF-Sarawak Office, NGO Office-NACOM, RDRS, BRAC, CNRS (Centre for Natural Resource Studies), Local NGO Office, community-based organizations and relevant others offices. The researcher also collected stakeholders' feedback and sharing for developing the proposed framework of the research.

3.9.6 Interviews and Key Informant Interviews

Interviews were conducted with four of the ten Key Informants that responded positively on the questionnaire. Each interview consists of an approximately 20-minute interview with an open-ended format. The study selected from each Head of Institution used as respondents with local language/standard language for the questionnaires including government, autonomous and private respondents. Besides, External Key Informant Interviews also involved such as Co-management team leader, Foresters, Assistant Conservators, Park Manager, Academics, Policy-makers, bureaucrats and an NGO official based in the area, staff of Climate Resilient Ecosystems and Livelihoods (CREL) Project.

3.9.7 Feedback Meeting and Data Quality Information

Feedback meeting information collected in order to develop the study outcomes with the informants to acquire their feedbacks–propositions, remarks and observations of biodiversity, environmental policy and relevant mechanisms related phenomena during the organized interview through questionnaire for quality data assurance. The findings of the biodiversity, instruments and relevant studies, questionnaire and interviews analyses presented including the problems identified and how they ranked by the interviewed respondents.

3.10 Secondary Data /Information

Information pertaining to biodiversity conservation and protection worldwide especially within Asian region were obtained from various sources such as the internet and library at Universiti Malaysia Sarawak (UNIMAS) on related journals, reports and books of the countries that are parties to the Convention on Biological Diversity (CBD), as well as International/National-NGOs. Also referred was the national park related global database

e.g. WDPA, developed by UNEC-IUCN (2013) which contains the wide-ranging records and update world national parks' dataset supporting both landscapes as well as seascapes ecological zones with above 200,000 records currently. Information obtained is being used to understand updates and trends in biodiversity conservation. Then two areas within Asian region were chosen i.e. Bangladesh and Malaysia as examples to determine how these two countries fair in relation to the CBD requirements by looking at their respective national biodiversity policy, ordinances, and national biodiversity-related reports, and National Biodiversity Strategy and Action Plans (NBSAPs) as well as Economic Annual Review, Sarawak Forestry Annual Reports, Bangladesh Bureau of Statistics (BBS), RIMS and NPD of Bangladesh Forest Departments (BFD) and Sarawak Forestry of Sarawak, Malaysia; before undertaking fieldwork data collection. Also based on the information from WDPA, the selected parameters of protected areas between Bangladesh and Malaysia were compared. The existing policies and laws reviewed to identify indications which develop the cost effective conservation policy model for the present and upcoming generations.

3.11 Applications of Emergence Technological Tools

For primary and secondary data/information collection, the study used new emergence technology tools, viz. teleconferencing, mobile conferencing, e-mail exchange, encyclopedia, file transfer protocol, web browsing and hosting, social networking, viz. chatting through facebook, google+, twitter, messenger, Skyping, Whatsapp and other relevant customized technological tools.

3.12 Data Handling and Compilation

At first, all the general information regarding the occurrence of biodiversity and informatics including biodiversity conservation systems in the Lawachara National Park and their

diversity, status, and distribution are collected and tabulated in an organized manner. After the data had been collected, they were checked properly for accuracy, by using the crosschecking method for data compilation.

3.13 Data Analysis, Presentation and Interpretation

All general information regarding the occurrence of biodiversity and national parks including legal systems in the protected area and their diversity, status and distribution were checked for accuracy from the different sources and sources of information were also verified. Information regarding the initiatives of the authority towards the conservation of biodiversity was collected through relevant secondary information and field survey. Then the information were included in the preparation of data master sheet and incorporated into convenient forms used in the result and discussion section. The data were compiled and analyzed for presentation and interpretation using standard data analysis software like MS Office Suite 2013, and R programming version 3.4.

3.14 Simplification of the Study

Simplification is the appearances of study that mark the appropriate significance of results athwart actions, approaches, individuals, backgrounds, and time frame. It is based upon how the study is conducted. As this study goals investigate all perspectives of the development and implementation of environmental policy instrument using information systems for conserving biodiversity based on national park management. The stage of implementation and the effectiveness of mentioned instruments were considered to novelty simplifications and limitations of the study.

3.15 Validity of the Study

Data validity and reliability represented jointly to evaluate the means of methods. This study employed both qualitative and quantative research approach (Golefshani, 2003) to evaluate and understand the actual effects of environmental policy instruments development and implementation on Lawachara National Park from key informant matched information, plant and wildlife species information and natural resource uses with documentation, which illustrated in Chapter 4.

3.16 Ethical Concerns of the Study

Ethical matters are important to take into account of biodiversity policy research towards national park's exposure. It relates with anonymity and confidentially according to research norms and values, ethics and informed consent associated with national park data collection, interviews and presentation of findings for exposure. In addition, the fieldwork notes kept safe with the researcher and destroyed later in suitable time. Limitation time allotted as well as the validity and reliability in real-world ways in order to potential issue associated with relevant kind of bias, all respondents were guaranteed anonymously, which are applicable to this study.

CHAPTER 4

RESULTS

4. 0 Overview

The main findings from field descriptions showed that inhabitants of four villages (Lawachera punji, Magurchera punji, Dolubari and Langurpur) were highly dependent on natural resources of Lawachara National Park (LNP). Due to this high dependency on the national park resources, most of the respondents in four villages admitted to undertake illegal as well as unwanted activities inside the park. For example: illegal logging, poaching, hunting, illicit-felling, encroaching (Reuters, 2007). However, the response patterns from interviews and key informant interviews in four villages indicated that more than 50% of the respondents believed in conservation of LNP's biodiversity. Most of them wished to see the LNP and and conserved well according to update Conservation Policy and Conservation Technology. The positive attitude of them could be related to the benefits earned from the LNP, which include incomes from the ecotourism services, employment opportunities, and enjoyment of viewing wildlife and pertinent values for present and upcoming generations.

Moreover, Environmental Conservation Policy research findings are about developed models to evaluate the contribution of environmental policy instruments along with information systems for biodiversity conservation towards National Parks in Bangladesh. The management of biodiversity by security representative and well-connected habitat network in managed national parks. The park requires a wise combination of protection, maintenance, and restoration of plants, animals and habitat at sustaining goals (Angelstam *et al*., 2003). The ultimate goal of this research is to evaluate the existing laws, policies, assessment of biodiversity information systems with clearing house mechanism and

stakeholders' engagement, control measures of invasive alien species and conservation strategies, which illustrates in different section of this chapter successively.

4.1 General Outcomes of Lawachara National Park

Lawachara National Park is a famous state park at Kamalganj sub-district in Moulvibazar district of Bangladesh. The park is surrounded by local and indigenous communities including two inside villages, which stated following.

4.1.1 Assessment of Socio-economic Data

The socio-economic data on positive attitude towards National Park Biodiversity Conservation 63% (average) illustrated with individual village respondent's opinion (Table 4.1). With detail to earlier survey assumed in the National Park /environmental area, this mentioned outcome is reasonably acceptable for a field assessment.

Table 4.1: Different studied villages with households and response rate

Village name	Total households	Distance from LNP (km)	Positive Attitude towards Biodiversity Conservation
Lawachara Punji	23	Inside, less than 1km	70%
Magurchera Punji	41	Inside, less than 1km	68%
Duluchera	84	within 1km	55%
Langurpur	92	Within 5 km	59%
Total/average	240	Overall, 2 km	63%

Table 4.2: Societal and economic features of Stakeholders in the Study area (n=293) (Field Data).

Parameters	Socio-economic and demographic indicators	Frequency	(%)
Gender	Male	180	61.43
	Female	113	38.57
Age Class	< 15	52	17.75
	15 to 30	115	39.25
	31 to 45	85	29.01
	45 to 60	31	10.58
	>60	10	3.41
Education	Illiterate	83	28.33
	Primary	48	16.38
	Secondary	58	19.80
	Higher Secondary	44	15.02
	Graduation	60	20.48
Primary occupation	Betel leaf and betel-nut farming	80	27.30
	others	213	72.70
Secondary occupation	Service	77	26.28
	Business	51	17.41
	Agriculture	97	33.11
	others	43	14.68
	None	25	8.53
Average Annual Income (US$)	Total	US$ 2060	-
	Primary	US$ 1558	-
	Secondary	US$ 502	-

Some socio-economic features of stakeholders are illustrated in Table 4.2 with mentioned indicators and frequencies including gender, education, occupation and annual income of the local people. The study was taken a field survey for the purpose of socio-economic status adjacent villages of Lawachara National Park. From Table 4.2, the study observed that the ratio of male and female was 61: 39 including local and foreigner stakeholders. Out of them, the maximum aged class range 15 to 30 years and secondary occupation is agriculture (33.11%), whose average annual income US$ 2060. Some respondents depend on Lawachara National Park for the collection of Non-Timber Forest Products (NTFPs).

4.1.2 Conservation Awareness among Stakeholders

Socio-economic features enhance to identify the different parameters of stakholders for co-operation and management of National Park biodiversity, as shown in Figure 4.1. The graph represents different types of stakeholders who responded in the research activities.

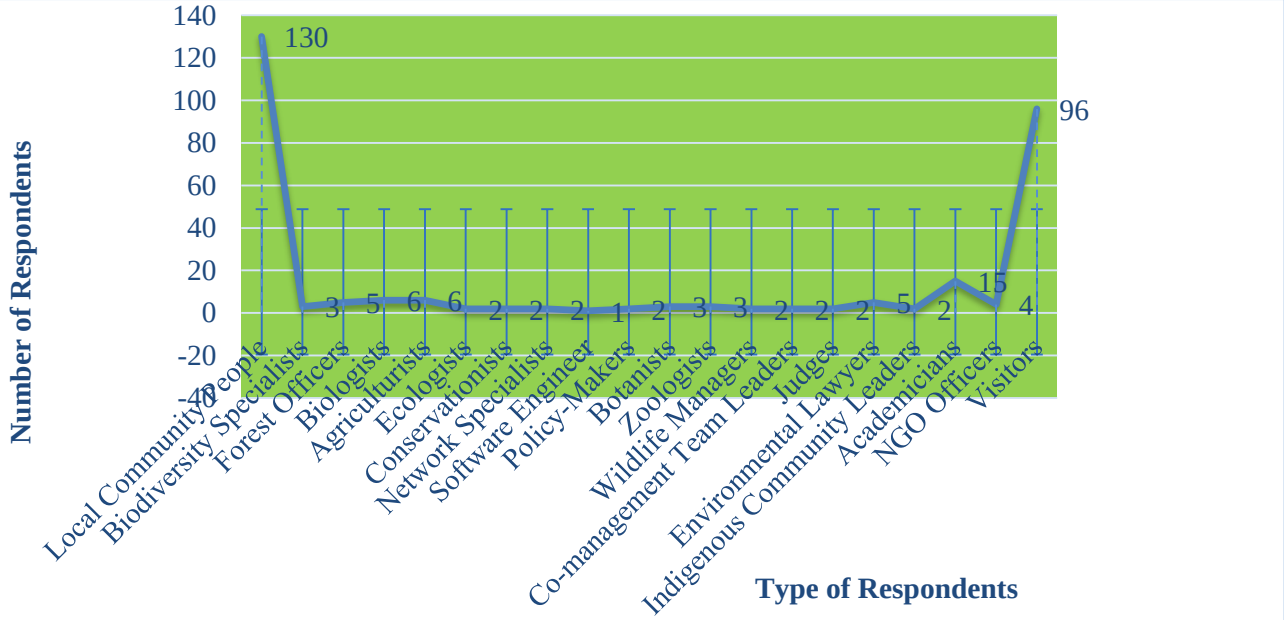


Figure 4.1: Quantity of Respondents

Most of stakeholders (110) are responded as local people, visitors (96) and minimum (1) respondent is national policy-maker. From the study, it found that the educationist and researcher are statistically significant. These stakeholders are aware on biodiversity conservation at Lawachara National Park, which as shown in Figure 4.2.

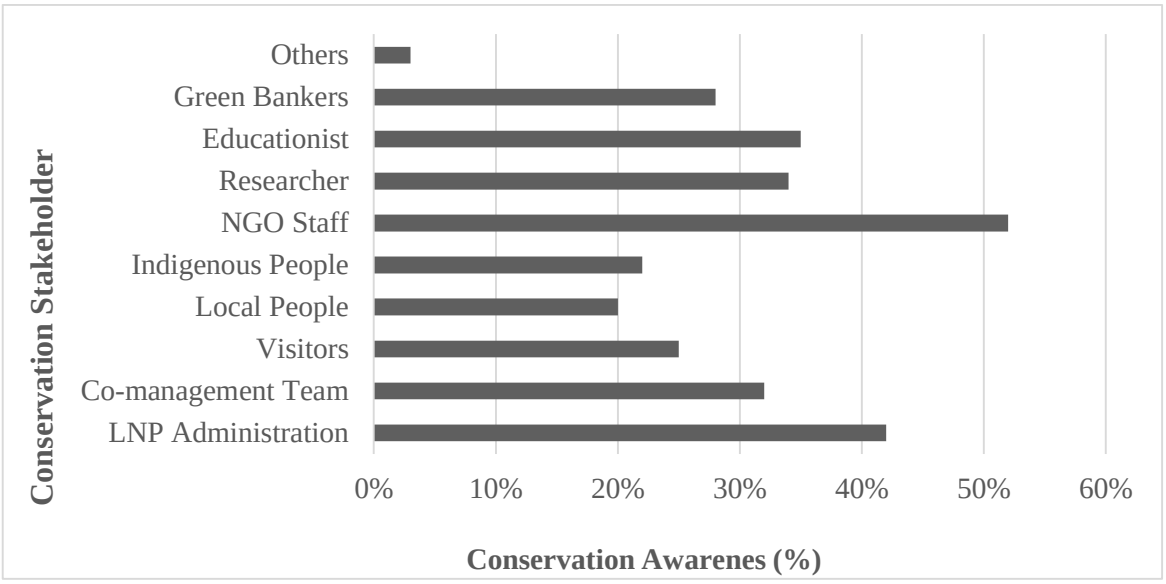


Figure 4.2: Stakeholders' Conservation Awareness

The study found that NGOs and development organizers are more aware (52%) but local villagers (20%) are less motivated than others. It depends upon the participation of all the stakeholders for proposing activities of administration, private sector, Non-governmental Organizations, local and indigenous community leaders.

4.1.3 Impact of Settlements on Lawachara National Park

Settlement has been one of the main footprints of humanity on earth's terrestrial ecosystems (Massada *et al*., 2014). Lawachara National Park (LNP) surrounded by 18 villages, tea-estate, agricultural land and baren land (Figure 4.3). In this LNP, there are numerous interactions between human and natural resources as a bio-ecologically region in Bangladesh.

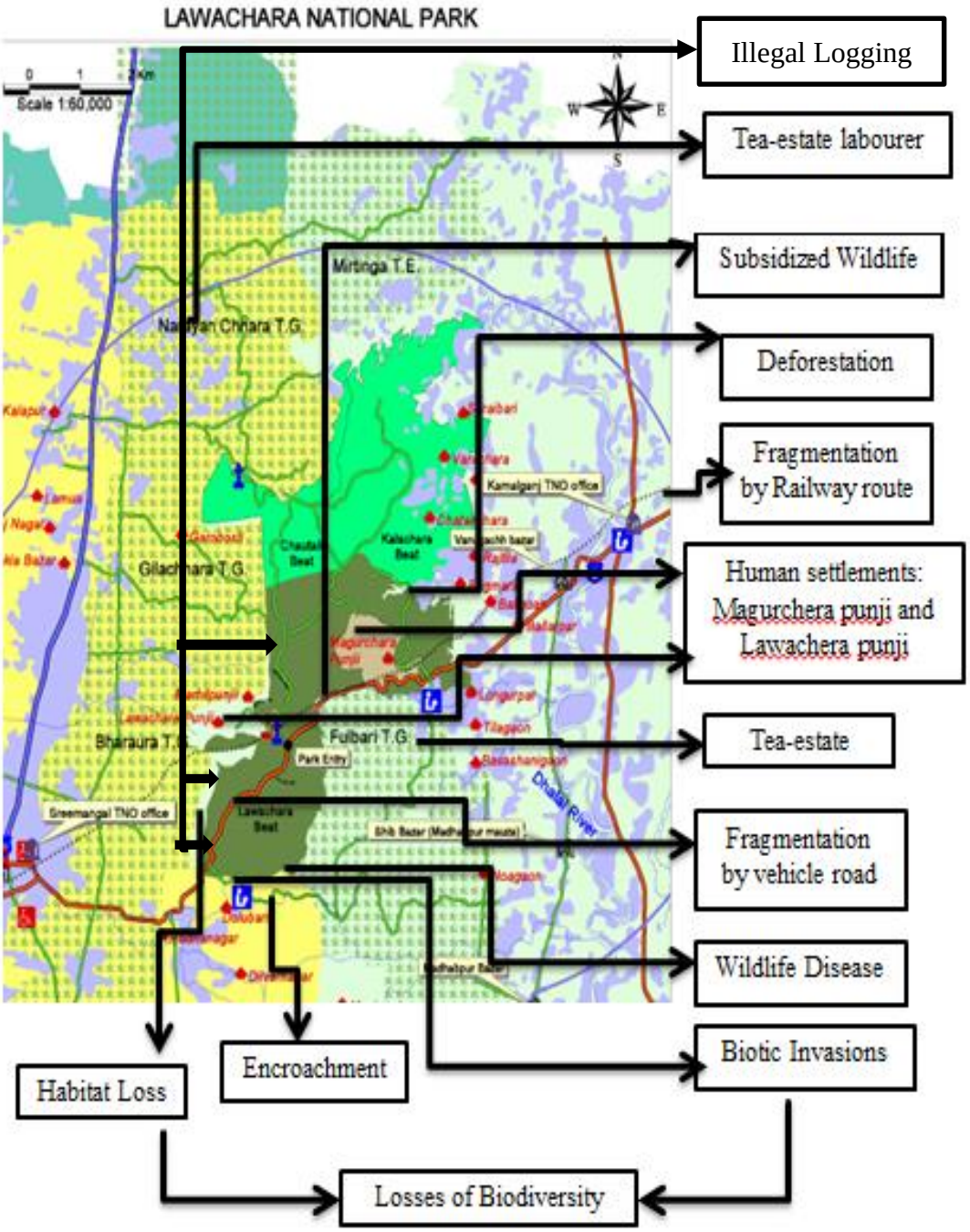


Figure 4.3: Biotic and abiotic parameters occurred with settlements in Lawachara National Park interface.

Lawachara National Park is the park area in which human settlements adjoin or intermix of local and indigenous communities with bio-ecosystems. These human settlements affect neighbouring ecosystems through biotic processes including introduction of exotic species,

wildlife subsidization, land encroachment, disease transfer, land cover conversion, fragmentation, and habitat losses. The effects of LNP settlements on biodiversity conservation are two tiered– starting with national park modification and fragmentation by railway route and vehicle road, and progressing on different processes in which direct and indirects effects of anthropogenic activities spread into neighbouring ecosystems at varying fluctuate scales. The people of these villages are dependence on LNP including major, moderate and minor primary stakeholders according to involvement and distance, which as shown in Figure 4.4. The study identified the following outputs:

(a) Major dependency villages: Bagmara, Magurchera, Lawachera, Baligaon, Dolubari and Biranpur. These villages are situated within 1 km surrounding LNP.

(b) Moderate dependency villages: Rashtila, Botertol Slum, Saraibari, Veenachera, Radhanagar and Garobosti;

(c) Minor dependency villages: Langurpur, Ballarpur, Noagaon, Tilagaon, Bhashaniganj and Bongaon.

Inhabitants of Lawachera, Magurchera, Dolubari and Biranpur are involved in fuel wood collection from Lawachara National Park, while the people of Bagmara, Radhanagar, Rashtila, Baligaon, Verachera and Chatakchera villages are involved in illicit tree felling at the park. Out of six Tea-estates, Noorjahan and Bharaura are neighbouring tea-estate and the rest of tea-estates are country bordering. The employed tea-estate workers and their families are involved in illegal logging (NSP, 2006) from within LNP. The study suggested that need environmental education programmes for awareness building among the communities of two inside and four outside villages. New scientific management and conservation policy tools needed in order to better consciousness the LNP as a unique social-ecological zone and to mitigate negative consequences of its sustainable management.

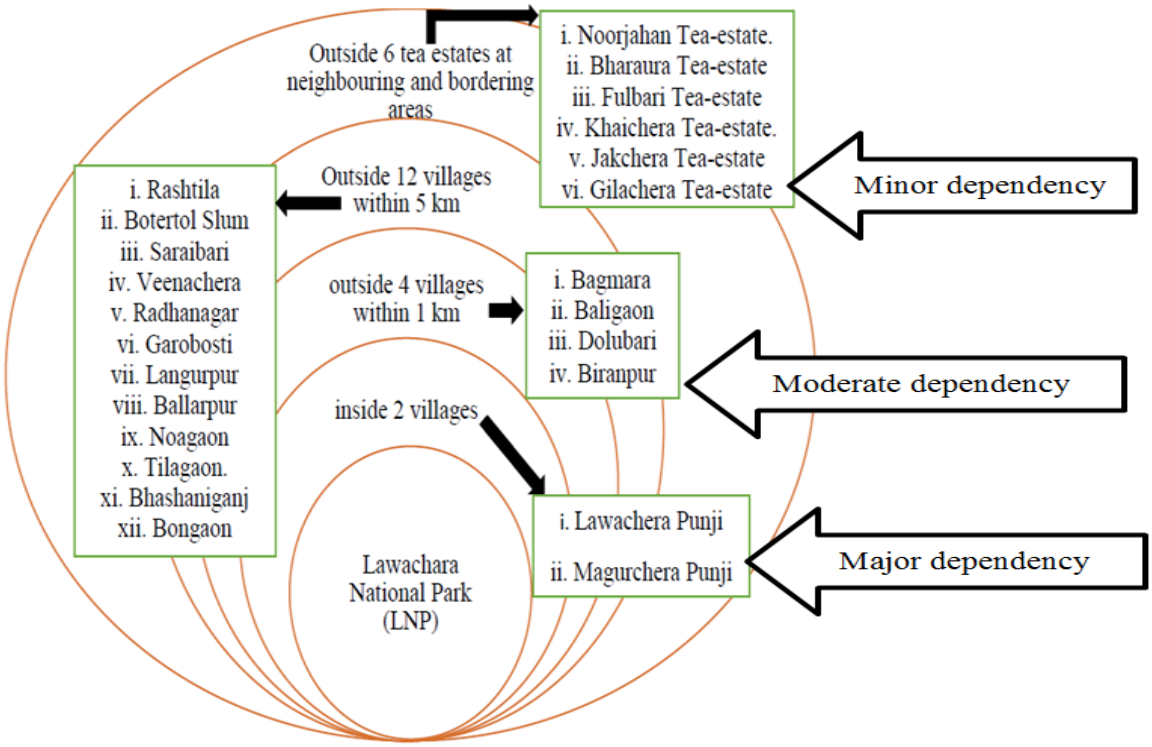


Figure 4.4: Lawachara National Park and adjacent villages

4.1.4 SWOT Analysis of Lawachara National Park

Lawachara National Park consists of multi-species including flora, fauna and genetic diversity in Sylhet division. However, this Park's diversity loss due to several reasons, such as: (i) weakness: lack of clarity/ information on how co-management committee and alternative income strategies benefit LNP biodiversity long-term, and (ii) threat: lack of government commitment to conserve biodiversity to enforce environmental laws. For this purpose, the study identified some strength, weaknesses, opportunities and threats which as shown in Figure 4.5. From the study of SWOT analysis, the scoring value for strength 4, weaknesses 1, opportunity 3 and threat 2, then the calculated value summerised accordingly, as shown in Table 4.3.

Table 4.3: Factors scoring of Lawachara National Park through SWOT Analysis

Internal Factors	**Strengths**	**Weaknesses**	**Total**
	32	9	41
External Factors	Opportunities	Threats	Total
	30	28	58

The study identified internal factors 41 and external factors 58 of Lawachara National Park from SWOT analysis. SWOT analysis has shown that the well-established tourism destination with a variety of natural attraction and unique culture of indigenous people having traditional culture are the strengths of LNP while lack of effective visitors' database and fundamental facilities are the major weaknesses. Appropriate ecotourism package development involving co-management team in decision-making are found to be few of the key opportunities whereas tensions, anxiety and insecurity in peripheral areas are the core threats. The study suggested that it is required more efforts on conservation and ecosystem services for Lawachara National Park biodiversity management, because policy instruments, like legal, social, political, institutional, and informational, connected with co-management team and eco-guide for the conservation perspectives and grant financing.

Internal Factors	
Strengths	**Weaknesses**
• Attractive Wildlife in Lawachara National Park (LNP), like gibbon, capped langur. • Higher ecosystem services flows. • Presence of very good-looking flag plant and animal species. • Introduce co-management systems. • The highlighted historical and cultural heritage. • Co-operation with LNP authority and co-management team. • State status and special protection of LNP. • Broader work on local governance and community based development can support LNP biodiversity.	• A reduced amount of land use change within the LNP. • Poor infrastructure and its complete absence in accessible areas. • In-sufficient level of services. • Low level of competence. • Low efficiency of marketing and sales of the tourism product. • Less natural watershed management during winter and summer seasons. • Narrow the scope of its tourist routes. • Lack of clarity/ information on how co-management committee and alternative income strategies benefit LNP biodiversity long-term. • LNP biodiversity work is not linked to broader development assistance or engagement with government of Bangladesh on removal of invasive alien species, deforestation, land degradation, and wildlife crime etc.
Favourable for Achieving the Objectives	**SWOT** / Unfavourable for Achieving the Objectives
Opportunities	**Threats**
• More potential connectivity with LNP. • Ecosystem services provision in the surrounding. • Great potential tourism attraction. • Increase media exposure and information. • Save competitive prices for tourism products. • Improving the quality of services. • Creating a new attractive tourists route. • Increasing public awareness and priority for environmental protection and conservation of LNP. • New technologies and systems for LNP management, wildlife protection and biodiversity monitoring. • Biodiversity research funding various sources expected to increase.	• Urbanization augmenting in the surrounding of LNP. • Intensification of Agricultural land and encroachment of park land. • Loss ecosystem services delivery from surroundings. • The instability of the political and socio-economic situations. • Natural water scarcity during winter and summer seasons. • Lack of government support for ecotourism. • Lack of foreign investment. • Environmental degradation through vehicles communication. • Lack of own funds and resources of LNP. • Reducing level of services and security risks of tourists. • Illegal logging, illicit-felling, hunting and poaching. • Lack of government commitment to conserve biodiversity to enforce environmental laws. • Natural disasters and internal displacement of indigenous communities in LNP. • Lack of baseline information on biodiversity and national park network.
External Factors	

Figure 4.5: SWOT Analysis of Lawachara National Park

4.1.5 PESTEL Analysis

PESTEL analysis used to analyse the National Park Management as well as Biodiversity Conservation those related to environmental policy instrument. This analysis helps to assessing the National Biodiversity Conservation Policy on Lawachara National Park Management of Bangladesh in connection with Aich Biodiversity Targets 2020. The PESTEL analysis included the following factors: Polictical, Economic, Socio-cultural, Technological, Ecological/Environmental and Legal in terms of LNP's Biodiversity Conservation which as shown in Figure 4.6.

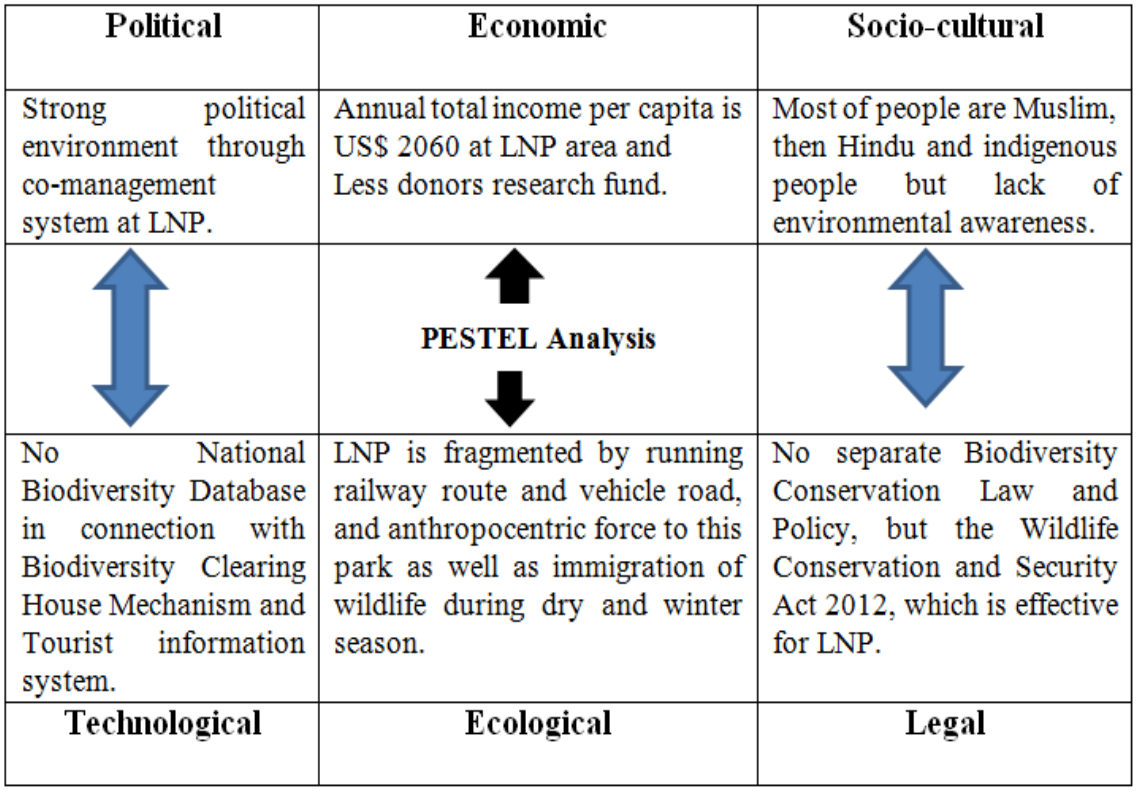


Figure 4.6: PESTEL Analysis on Lawachara National Park

The study suggested for development National Biodiversity Conservation Policy and National Biodiversity Database in connection with Aichi Biodiversity Targets 2020.

4.1.6 DPSIR Analysis

The DPSIR analysis has done to understand the major cause and effect relationships of socio-economic and environmental factors. In this context, the Driving Forces (D)-Pressures (P)-State (S)-Impacts (I)-Responses (R) approach used to provide and communicate knowledge on the state and change of causal factors regarding environmental issues for national park biodiversity conservation. 53 indicators were arranged according to the DPSIR analysis, where as D=8, P=13, S=8, I=14 and R=10, which showed in Table 4.4 with relevant parameters.

Table 4.4: The description of indicators, their category and performance for two periods.

Indicators	**Description**	**Category ***	**Period**		**Remarks**
			1971-2000	2001-2015	
Local Population	Number of community people	D	low	High	
Less bio-religious related person for taking decision-making	Number of religious leader	D	low	Moderately	
Nepotism in co-management	Political biasness	D	No	Medium (in general)	
BCHM expert	Number of conservation technologists	D	No	Low	
Biodiversity research specialists	Number of researchers	D	low	Medium	
Negative impact on tourism	Effect of eco-tourism	D	low	Moderately	
Increase migration of outsider inhabitants	Number of migrants	D	low	High	
Agriculture and Tea-estate expansion	Land conversion	D	low	Slightly increase	
Over exploitation of Park resources	Natural resources	P	low	High	
Park land encroachment	Illegal habitat	P	High	Slightly recover	
Excessive Invasive Alien Species	Species invasion	P	High	Very high	

Table 4.4 continued

Landscape conversion	Land diversification	P	low	Slightly increase	
Illegal logging	Illicit-felling	P	low	High	
Unseasonal NTFPs collection	Reduction of growth and development	P	low	High	
Deforestation	Cleared park area	P	low	High	
Shifting cultivation	Frequency of occurance	P	low	High	
Illegal hunting	Status of wildlife	P	low	High	
Running Railway route and vehicle road	Habitat disturbance and fragmentation by road/route	P	low	Very high	
Noise disturbance	Increase of noise disturbance on wildlife habitat	P	low	High	
Wildlife disease	Disease occurance	P	low	High	
Domestic grazing	Illegal grazing	P	low	High	
Healthy biodiversity	Plant and animal status	S	High	Low	
Mother tree species	Impact on growth and development	S	High	Very low	
Immigration of wildlife during dry and winter season	Scarcity of water and associated food	S	low	High	
Land degradation	Baren park area	S	low	High	
Threatened species	Ecological status and pyramid	S	low	High	
Endemic species	Status of macaque and capped langur	S	low	Very high	
Regeneration potential of plants	Failure of establishment of seedling and tending	S	low	High	

Table 4.4 continued

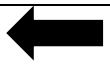
Deterioration of vegetation cover	Vegetation status	S	Low	High	
Park Biodiversity	Losses of biodiversity	I	low	High	
Habitat loss	Loss of ecological niche	I	low	High	
Negative impact on healthy environment	Change of park status	I	low	High	
Local socio-economic impacts	Income status of local community	I	low	High	
Landscape fragmentation	Isolated area	I	low	High	
Social unrest	Unstability in the society	I	low	High	
Application of conservation technology	Arena of digital conservation	I	No	Low	
Ecotourism services	Status of tourist towards park	I	No	Low	
Bio-environmental education awareness	Consciousness of conservation education	I	No	Low	
Species diversity reduces	Anthropogenic status	I	low	High	
External and internal factors	Status of SWOT approach	I	low	External high and internal low	
Co-management grant financing is higher	Collaborative activities	I	low	High	
Human wildlife conflict	Extend of conflict between local people and Macaque	I	low	High	
Genetic disorder from vehicles' whistles	Status of growth and development	I	low	High	
Biodiversity conservation law and policy	Legal status	R	No	Integrated but no separate	
Research and Policy gaps	Gap status	R	low	Moderate	

Table 4.4 continued	takeholder's nvolvement	R	low	High	
Sectoral integration	Institutional status	R	low	Low	
Biodiversity database administration	Number of Expert	R	No	Low	
Biodiversity Management Institution	Institutional stability	R	No	Need separate	
NBSAP	Biodiversity related action and targets	R	No	Update	
Political commitment	Government ratified with CBD	R	low	High	
Policy scoring higher	Integrated policy status	R	Less	High	
Connection with Global Database	LNP in WDPA	R	No	Medium	

* D represent Driving Forces for the park, P – Pressures on the park, S – Changes in the State of the park, I– Impacts on the park, and R – Responses to park threats.

From Table 4.4, it calculated for identification of reflection and response from DPSIR analysis. The DPSIR implies categories with different values, for example, Reflections, D=4, P=3, S=2, I=1, and Response, R=10. The study analysed that the Reflection Value is 101 and Response Value is 100, i.e.

Reflection Value > Response Value. The study identified that less response to Lawachara National Park for decision-making.

4.1.7 Stakeholder Analysis

Stakeholders are the focusing involvement indicators for national park biodiversity management, which as shown in Table 4.5 with their responsibilities and actions required towards Lawachara National Park, for example: Co-management team leader comes from local community to hold the position to interpret the eco-tourists, for this purpose, the

accountable person needs more idea for raising awareness among them. It is a dynamic to occupy primary and secondary stakeholders who eventually influence and /or are inspired by the national park. The stakeholder consists of the government agencies, corporate bodies, villagers and relevant others having direct and indirect interests towards Lawachara National Park. The research suggests integrating policy options for enhancing sustainable use and conservation of the park through involvement, education, livelihood, disposal income and integrity with knowledge management and administration of Lawachara National Park.

Table 4.5: Stakeholders with respect to their responsibilities and actions essential towards LNP

Stakeholders	**Specific roles**	**Area of accountability**	**Action Essential**
Local Community And Indigenous community	(i) Community team leaders. (ii) Lawachara NP co-management team leader. (iii) Cultural association leader. (iv) tourist guide association leader	(i) Within the suitable position to interpret the LNP to Eco-tourists. (ii) Need cash income through eco-guide services. (iii) Able to share LNP information to the grassroots levels. (iv) Their response meeting can enhance the new project development of the existing environment.	(i) Need more exchange of ideas with them to raise consciousness of LNP and to build rapport with them to make sense of their carelessness of the existing park's views. (ii) Need to generate more prospects that will associate the community benefits to them directly in socio-economic means. (iii) Need to develop and improve their managing capacity to facilitate the park can be achieved successfully.
Co-management council and committee	(i) Authorized role by the regulations. (ii) Participation	(i) Participation on park development activities and provided relevant support services.	(i) Need to improve their capabilities so that they can be active participants in the eco-tourism industry.

Table 4.5 continued

	and involvement on respective park programmes.	(ii) Collaborate in controlling on illegal hunting and logging as well as encroaching activities	(ii) Need to reflect open-handed enticements for their assistances.
Sawmill licensees and contractors	Operating timber business in the Kamalganj catchment	(i) Comply with timber licensing terms and conditions including EIA actions which could disturb the national park. (ii) Collaborate to avert illegitimate logging, felling, hunting and poaching in national park	(i) Need to avoid issuing new logging licenses on steep slopes within Kamalganj catchment. (ii) Need to displace present sawmilling log pond once license terminates.
Brick manufacturer	Operating brick preparing business in the Kamalganj catchment.	(i) Comply with brick burning (control) Act 2013, which could disturb the national park. (ii) Collaborate to avert illegal wood burning at brick field according to relevant policy.	(i) Need to avoid burning wood products at the brick field within catchment. (ii) Avoid issuing new license on brick field growth.
State own Agency: Bangladesh Forest Department	Operating national park as a public institution.	(i) Liable for management of national park biodiversity conservation goals. (ii) Accountable tourists' services at Lawachara National Park catchment. (iii) Make Leading efforts to conserve park resources with various sectors.	(i) Need to develop detailed implementation plan for park conservation targets. (ii) Need to review park staffing requirements. (iiii) Need to allocate priority train-up staff.
Visitors and Eco tourists	Communicating visitors and relevant services.	(i) Ensure diversity tourists attraction resources in good conditions. (ii) Bio-recreational opportunities. (iii) Promote park conservation issues.	(i) Need to avoid damage of park flora and fauna. (ii) Need to restrict to visitors for disturbing wildlife. (iii) Need to prohibit to access to dense diversity zone of national park.

Table 4.5 continued

Academic researchers	(i) Biodiversity related research. (ii) Evidence based research.	(i) The national park is an educational domain and research tank. (ii) Offer professional attitude on concerns interrelated to decision-making on national park protection. (iii) Make a pool of systematic expertise and practical provision.	(i) Need to communicate with park management on prospective research themes. (ii) Need to potential agree the national park as focal point for research in biological diversity. (iii) Need to ensure sufficient research fund and its proper utilization.
NGOs	Local, national and international NGOs.	(i) Contribute in natural resource investigations and execution of particular projects. (ii) Support improving consciousness and informative databases.	(i) Need to communicate with park management on potential projects on Lawachara National Park. (ii) Need to inspire further local and global NGOs to establish biodiversity related actions inside the national park.
Ministry of Environment and Forests (MoEF)	National Focal Point on NP Biodiversity Conservation.	(i) Provides technical support to National Forest Department. (ii) Ensures the implementation of sustainable national park biodiversity conservation.	(i) Need to ensure industries licensing comply with legal specification. (ii) Need to continue intensive monitoring for sustainable national park management.

4.1.8 Stakeholders' opinion on causes of biodiversity loss

The opinions of the villagers, visitors and others on different causes of loss of biodiversity are shown in Table 4.6. The conservation policy affected the following indicators, such as: (i) poverty/low income, (ii) over inhabitants, (iii) illegal logging/illicit-felling, (iv) hunting

and capturing, (v) political reasons, (vi) lack of legal action, (vii) natural calamities, (viii) ecological disturbance, (ix) land conversion, (x) invasive alien species.

Table 4.6: Stakeholders' Perception for threatening to Biodiversity

Different parameters regarding loss of biodiversity	Stakeholders' Opinion			
	Villagers	Visitors	Others*	Average
Habitat Fragmentation and Loss	94%	85%	91%	90%
Unsustainable Use/Overexploitation	90%	88%	92%	90%
Negative Impact of Invasive Alien Species	87%	94%	95%	92%
Climate Change driving Biodiversity Loss	88%	93%	95%	92%
Pollution/Nitrogen Posing threat to biodiversity	75%	87%	93%	85%
Limited Capacity including Financial, human and Technical Issues for Biodiversity Loss	88%	82%	94%	88%
Complications in Retrieving Systematic Evidence	86%	94%	96%	92%
Inadequate Consciousness on Conserving of Biodiversity Issue	64%	86%	90%	80%
Constrained National Park's Biodiversity Mainstreaming,	68%	85%	72%	75%
Scrappy Decision-making	62%	76%	90%	76%
Imperfect communications among various department/divisions	54%	88%	92%	78%

* Others are LNP Manager, Co-management Team Leader, Tea-Estate Manager, Eco-guide, Academicians, Researchers, Bio-network specialist, Conservation Educationists, Policy-maker, Environmental Lawyers and Judges.

Stakeholders' Perception enhances on Environmental Policy Instruments for Conserving Biodiversity and threats to Biodiversity. For example, stakeholders' average opinion on habitat fragmentation and loss is 90%, where maximum between villagers (94%) and minimum in visitors (85%). The study suggested for afforestation /reforestation programme with engagement of stakeholders.

4.1.9 Improvement of the visitors's Access for Ecotourism Development

Visitors' access to National Park is the connection of ecotourism and park management, which indicates the existing park is well-known with scenic view of nature, easy communication, and so on, which mentioned in Figure 4.7 with respondents' opinions as a whole. The study showed that the scenic view of nature has a scoring maximum (90%) while minimum scoring (40%) in personal interest. The study suggested that the facilities of visitors enhanced repeat visits for ecotourism supports particularly visitors' database development towards Lawachara National Park.

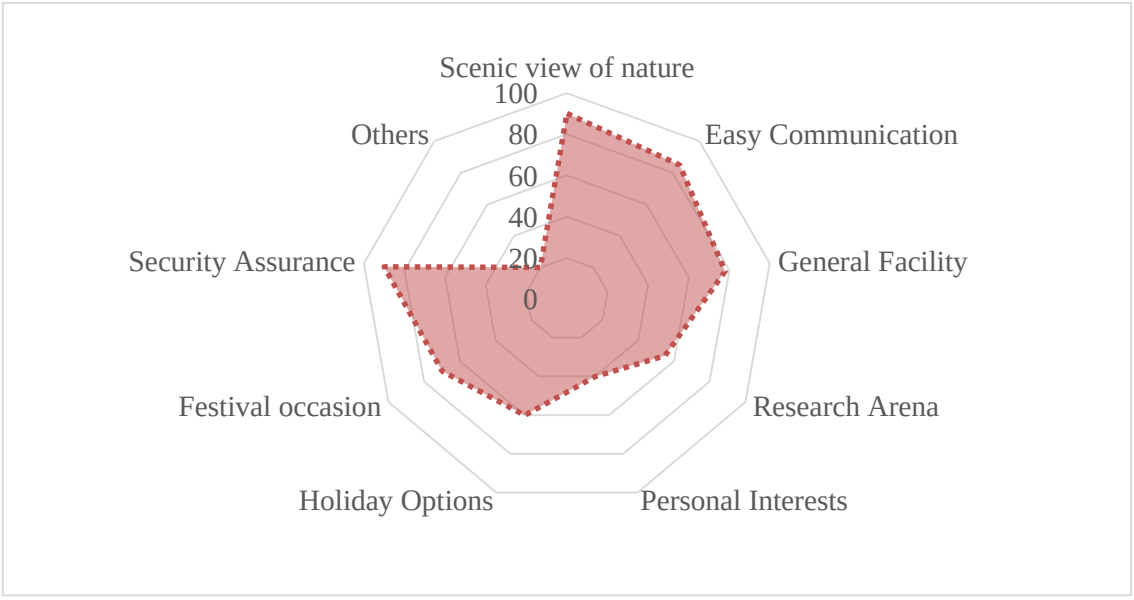


Figure 4.7: Respondents' response on ecotourism development

4.1.10 Awareness on Co-Management Approach

Co-management approach is the new system for National Park biodiversity management through community involvement, as shown in Figure 4.8 with trendlines graphs. Awareness on co-management approach at studied national park area of Bangladesh in the scheduled period can be estimated using the equation developed through regression analysis. Here, the study expressed the approach through the following equation,

y= 3.9818x……..(1)

And R^2=-0.324

Where, y is awareness (%) and x is the satisfaction approach with suitable, good, biasness and so on.

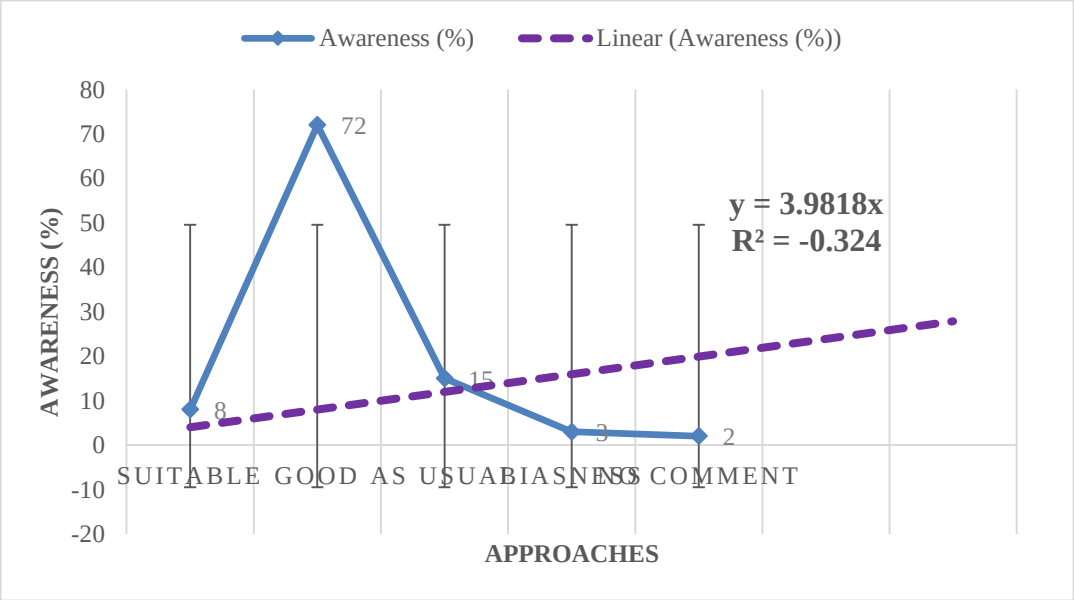


Figure 4.8: Awareness on Co-Management Approach.

Equation (1) has an adjusted R^2 (co-efficient of multiple determination of 0.0.324 with a standard error of estimate on observed mean. The value of R^2 is below 0.5, which indicated downward portion and neglected. So, the stated equation is rejected. The developed equation was then employed to simulate human consciousness changes in LNP area for co-management system, if the R^2 value is within 0.5 to 1.0. Differences in changes through co-management approaches between observed and simulated values are estimated effects on LNP in Bangladesh. For this reason, the stated linear equation is rejected. The existing co-management approach will be accepted, if the value of "suitable" options must be reached on 40 or above for more awareness criteria adopted in the listed approaches. However, the policy on co-management is needed update.

4.1.11 Community Environmental Awareness

From the field survey, the community environmental awareness seems to decrease on the priority of respondents' reflection, acceptance and need basis, as shown in Figure 4.9. The most 65% respondents' expressed their opinion on augmenting environmental education programs, like systematic curriculum development, scientific action-oriented programs, empirical education, enthusiastic to digital conservation, ecological field exoposures, sectoral integration and academia trainings and institutional green activities.

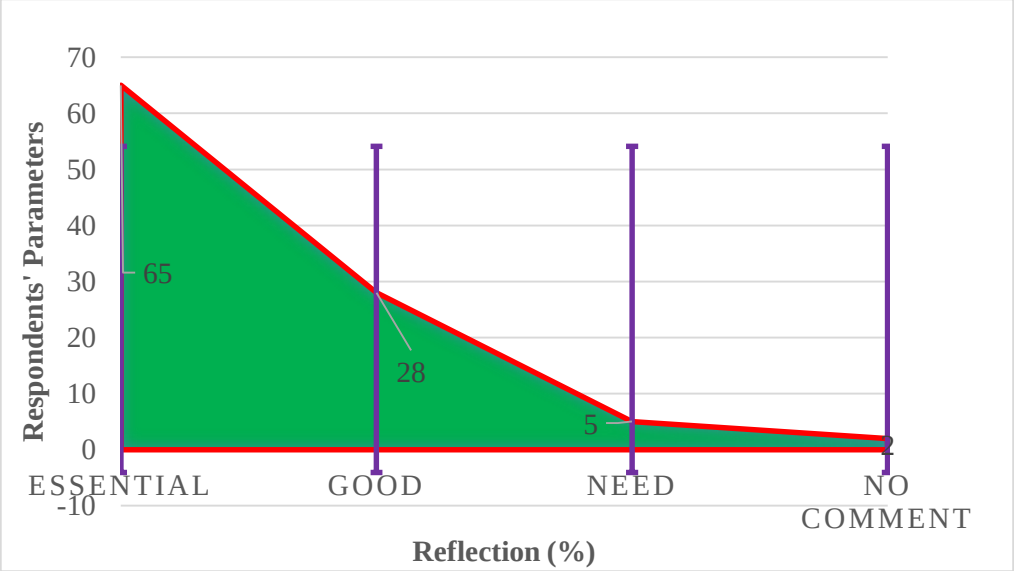


Figure 4.9: Augmenting Environmental Education adjacent National Park areas.

Knowledge of Respondents in Green Banking System (GBS) is imperative, because, with the knowledge on GBS, they need to know the worth of relevant policy and technology that deals with input, processing and output with the technology and green banking systems. There are 100 respondents who are involved with Green Banking Activities either directly or indirectly in the community as well as adjacent villages to response on environmental awareness in study areas, as shown in Figure 4.10. About the 53% of the respondents opined their opinions as very essential and 44% as essential with 2% 'Approximately' and only 1% 'No Comment'. These respondents were different categories, such as Government Officials,

Bank Managers, Clients, Customers, Environmentalists, Policy-makers, Environmental Lawyers, Co-management Team Leaders, Local people, NGOs Officers, Forest Officers and network specialists.

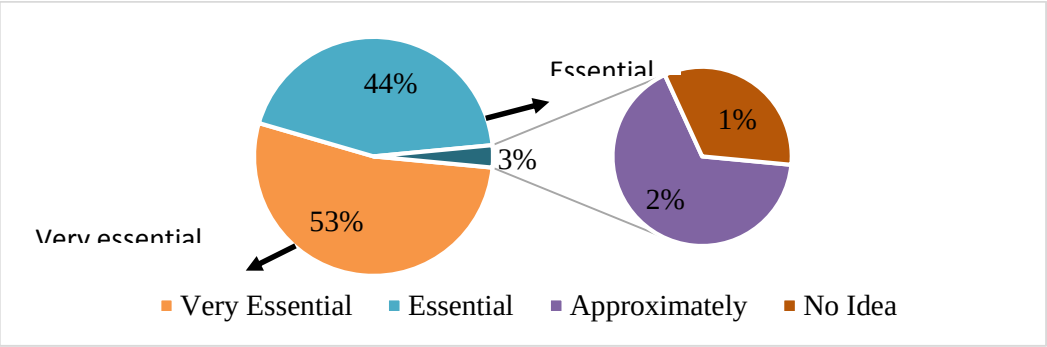


Figure 4.10: **P**erception on Green Banking Activities with Environmental Awareness.

4.1.12 Indigenous Communities' Perception on National Parks

Local people and indigenous communities contributed to conserving of biological diversity towards national park in Bangladesh (Lawachara). Khasia is contributed as indigenous community (25%) in Bangladesh than other indigenous communities. The research explored the perception of indigenous community on biodiversity conservation at Lawachara National Park as shown in Figure 4.11.

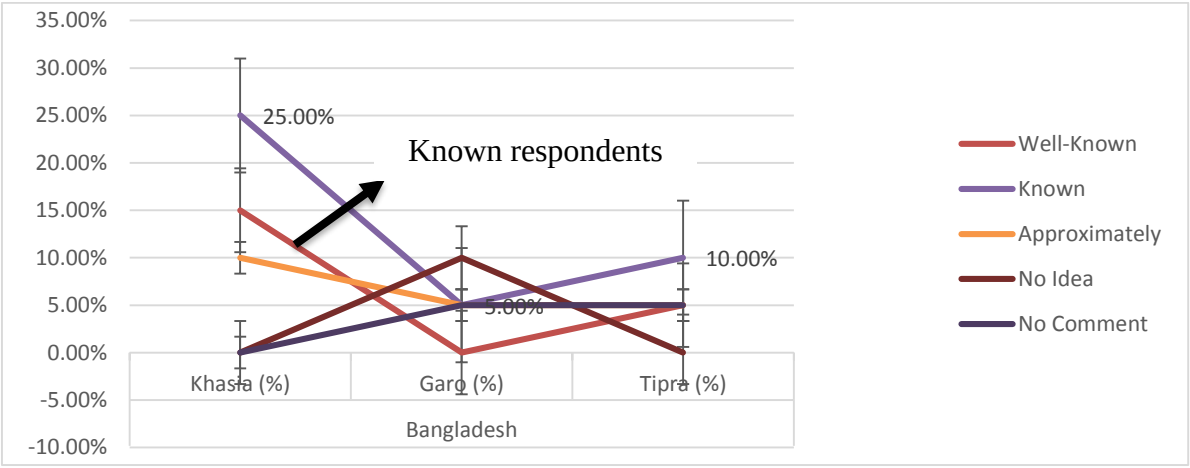


Figure 4.11: **N**ature conservation of indigenous communities' perceptions.

The study suggested that indigenous communities should involve in the conservation activities according to CBD regulations. Local communities were involved in the planning process before the parks were established and agreed to limit their activities illegally.

4.1.13 Rain Water Harvesting for Conservation of Biodiversity

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. During winter and summer season water scarcity indicated to highly ecosystem services at LNP. Most of respondents 58% (academic scholar) opined their opinion for rainwater harvesting with indigenous knowledge technology, where lower researcher scope only 2% (postdoc), as shown in Figure 4.12. This scarcity assessment supports policy and decision-makers in assessing options to modify existing policies, which develops initial long-term strategic plans for rainwater harvesting, and implement effective policies for sustainable biodiversity conservation.

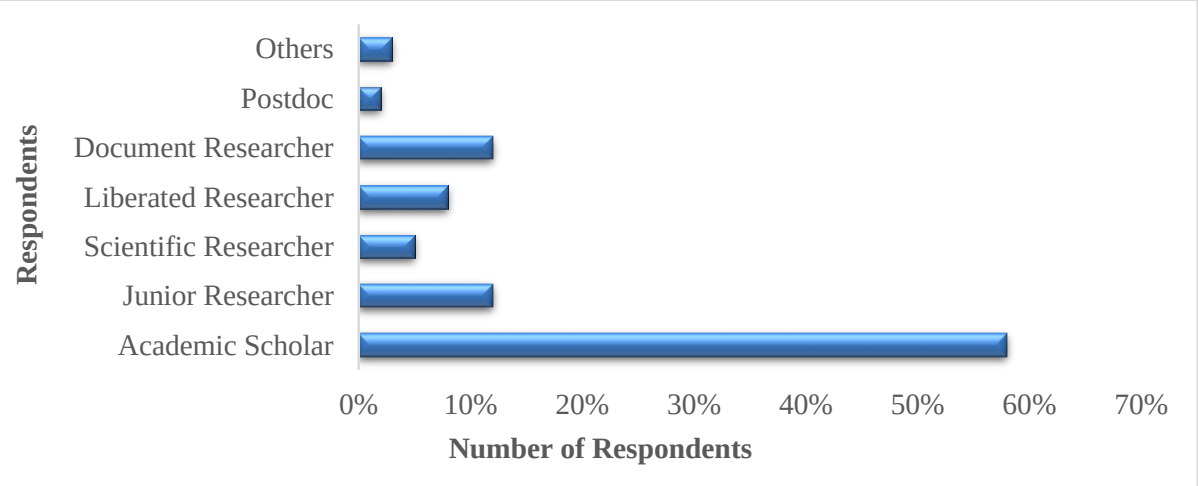


Figure 4.12: Number of Respondents on Rain Water Harvesting for Biodiversity

The study also highlights on the steps, initiatives, benefits and future of rainwater 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. Figure 4.13 showed the respondents' response on this regards. The study observed that 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.

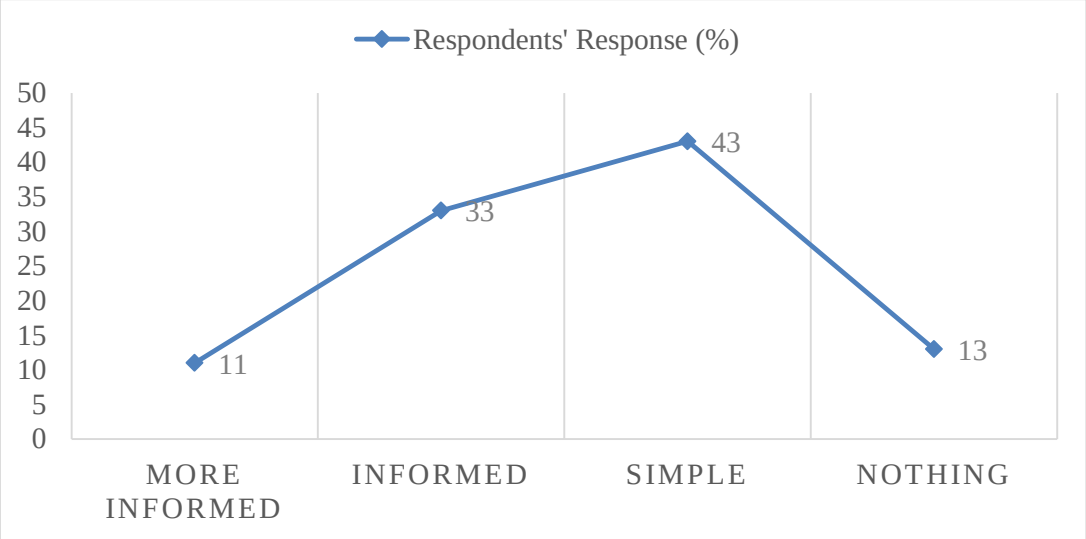


Figure 4.13: Respondents' Response on Rain Water Harvesting for Biodiversity.

The findings revealed that about 43% of respondents have simple knowledge for more informed research knowledge to maintain essentially for sustainable Lawachara National Park management as compared with the 11% of respondents who claimed that they are 'more informed' of the rain water harvesting (RWH).

4.1.14 Non-Timber Forest Products Collection

The field surveys found that local community and indigenous people were dependent on Lawachara National Park (LNP) through Non-timber Forest Products (NTFPs) collection.

These are fuelwood, vegetables, raw materials, grass, roots, bark, and honey and so on. The local and indigenous peoples, particularly female and children collect the NTFPs. The highest collection period is October to December (37.5%) and the lowest on January to March (18.5%) (Figure 4.14). Out of the collectors, indigenous people are more involved in NTFPs collection.

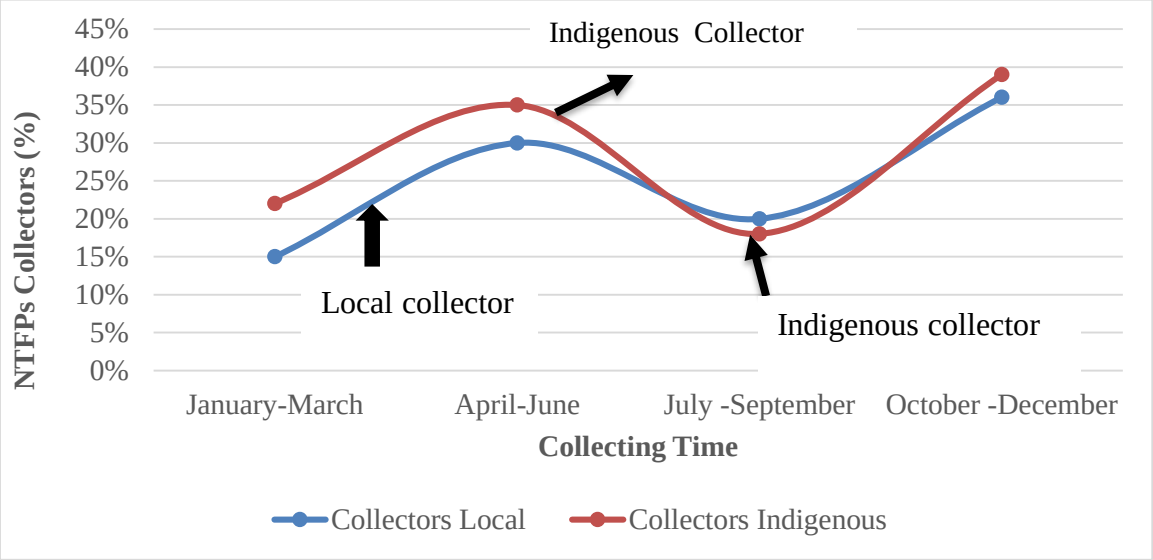


Figure 4.14: NTFPs Collection period from Lawachara National Park

The study suggests that policy formulation is essential on NTFPs collection on the priority of conservation of biodiversity.

4.1.15 Status of Invasive Alien Species

Alien species invasions are often detrimental to local flora, fauna, habitat and weather. According to Article 8(h) of the Constitution of CBD, every state party must take strategy plan for removal these species. There are some recognized invasive alien plant species during survey at Lawachara National Park and categorized according to their levels of harmfulness are presented in (Appendix K). A total of 15 plant species were identified in

LNP, among of them, top ten harmful species (Table 4.7) are *Lantana camara* and *Clerodendrum viscosum.*

Table 4.7: Invasive Alien Plant Species at Lawachara National Park

Scientific Name	**Invasiveness**	**Impacts**	**Distribution Potentials**
Lantana camara	High	High	High
Clerodendrum viscosum	High	High	High
Cassia tora	High	medium	Medium
Mikania micrantha	High	High	Medium
Sida cordifolia	High	Low	Medium
Eupatorium odoratum	High	Medium	Low
Leucaena leucocephala Lamb de wit	High	Low	Low
Acacia auricoliformis Cunn Ex Benth	High	High	Medium
Acacia mangium Wild	High	High	Medium
Eucalyptus camaldulensis Dehnh	High	High	Low

These ranking identified on the priority of the integrated opinion of Focus Group Discussion (FGD). So, it is urgent necessary for removal IAS from National Parks, as shown in Figure 4.15. Human activity has introduced a high number of invasive species into park ecosystems (Evans, 2011). Reflection on Invasive Alien Species for removal from National Park depends on strategic plan, financial support, and experts for identification and dedicated manpower, who are enthusiastic to perform these tasks. Different indicators on IAS for removal from National Park are (i) species rare, (ii) species too wide-spread, (iii) public resistence, (iv) collaboration, (v) management method, (vi) expensive, and (vii) mechanical support.

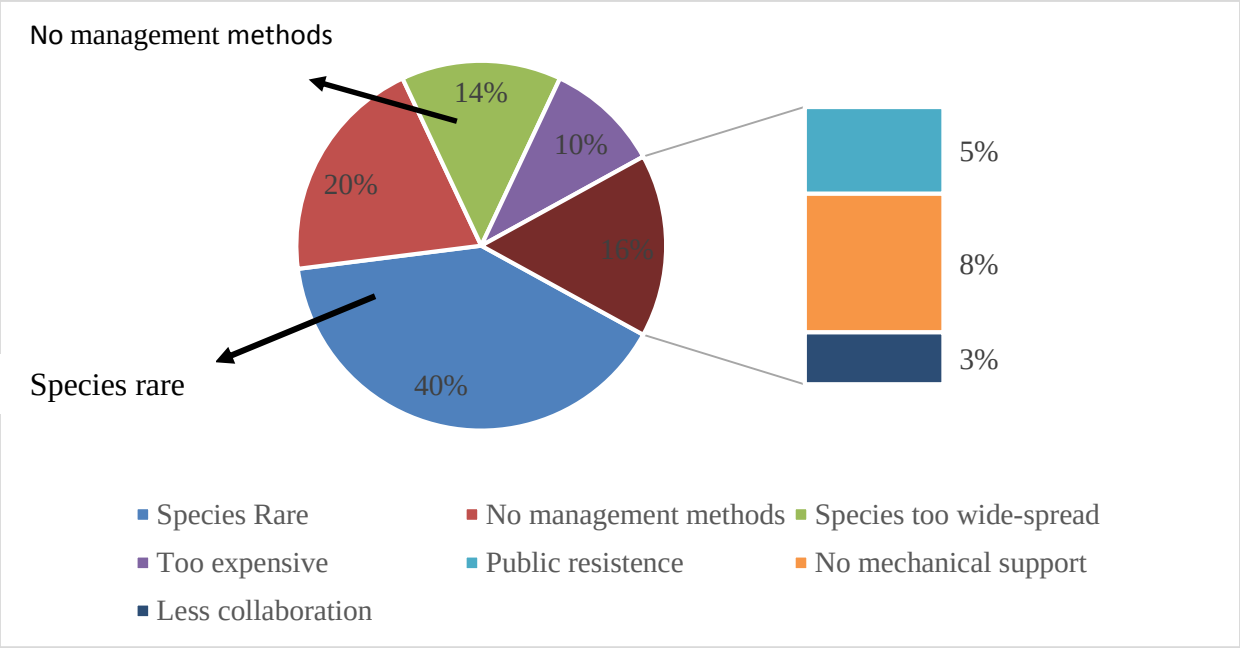


Figure 4.15: Reflection on Invasive Alien Species removal from Lawachara National Park

From the field observation, the present status of controlling of IAS stated, which showed in Table 4.8.

Table 4.8: Present status for controlling of IAS on behalf of BD Government

Invasive Alien Species (IAS) related parameters/questions	**Measuring scale**
In Bangladesh, controlling measure of IAS from National Park?	Low
In Bangladesh, IAS identified at National Park?	No
Does national policies develop for IAS?	No
Does Risk Assessment measure for IAS?	No
Does undertaken the prevention against IAS?	No
Does continue development project of IAS?	Little/No
Does include the issue of IAS in revised NBSAP?	No appropriately

Effective parameters for control of IAS illustrated with respondents' opinion in Figure 4.16 including eradication status and relevant parameters. Invasive Alien Species are aggressively a mediator of change and threaten native biodiversity in Bangladesh (Afrin *et al*., 2010). The authority of Bangladesh Forest Department took initiative regarding to control of invasive alien species. According to Section 14, prohibitions related to National Parks in sub-section 1(m) that no person shall introduce any alien and invasive species in a National Park. The

section 35 of the Wildlife Conservation and Security Act-2012 stated on penalties for contravention of the provisions of section 14 (WCS, 2012).

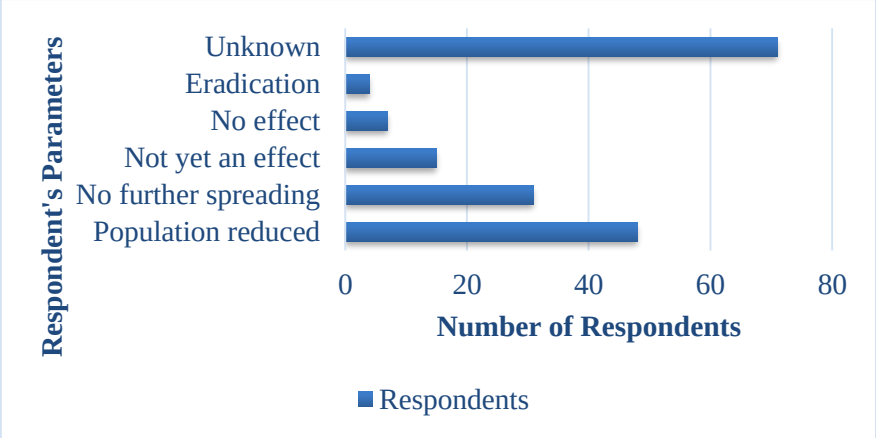


Figure 4.16: Effective different parameters regarding control of Invasive Alien Species

4.1.16 Co-management and Sustainable Environmental Conservation

Co-management system establishes in Lawachara National Park (LNP), which is situated in Moulvibazar of Bangladesh. This Park is being affected by the neighbouring human interference and other causes. Maximum people of the adjacent villages are not aware on park's biodiversity conservation and environmental protection. Lawachara National Park is importance ecological and socio-economic perspectives (Table 4.9).

Table 4.9: National Parks value on ecological and socio-economic perspectives

Category	Example	Remarks
National Parks are with comparatively higher ecological and socio-economic values.	Lawachara National Park	Uniqueness and attractiveness but reduce continuousnly. Need collaborative efforts.
National Parks are with less ecological values but high economic importance.	Khadimnagar National Park	Need collaborative efforts
National Parks are with comparatively lower ecological and socio-economic values.	Nijumdweep National Park	Need collaborative efforts

The study identified higher-pressure leads to lower ecological value on Lawachara National Park. Immediate management focus and innovative actions with update technological

options with regard to restoration and protection are thus necessary for LNP (IPAC, 2012). Therefore, the LNP is a tourist place where a lot of people visit everyday, which is an earning source of national income as shown in Figure 4.17**.**

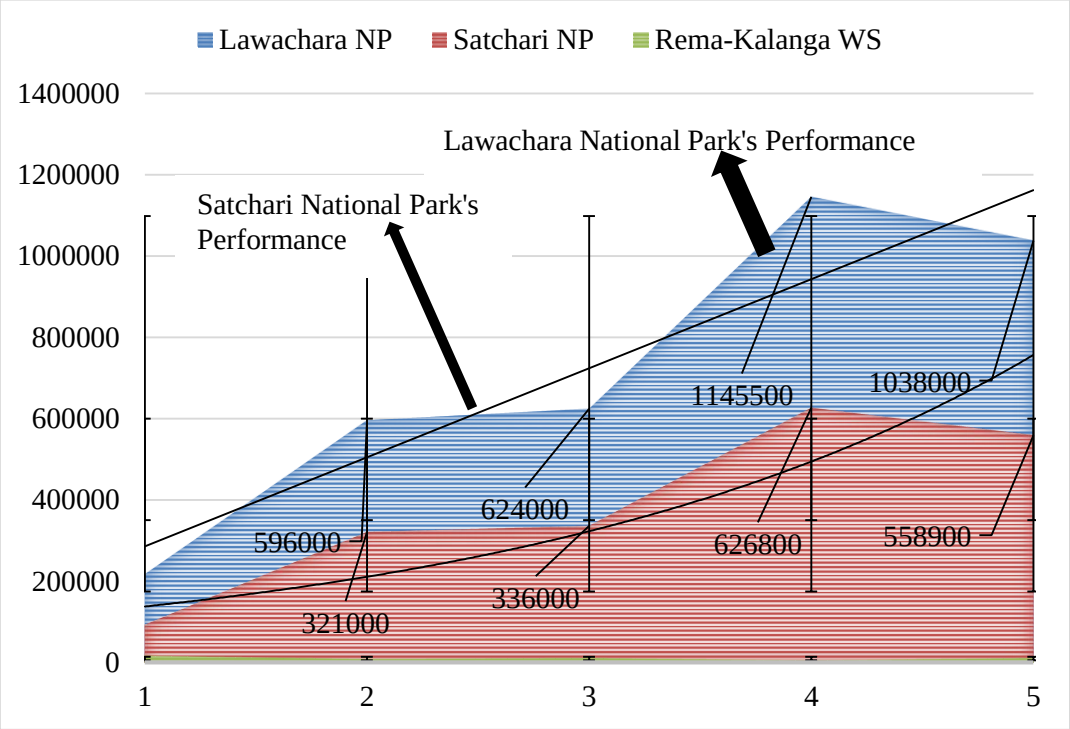


Figure 4.17: National Parks' Grant Financing in Sylhet division of Bangladesh.

The study suggests that the establishment of horticulture centre and relevant institutions are necessary alternative income generating activities (AIGA) and green income generating activities (GIGA). On the other hand, Lawachara National Park has the maximum grant financing system, the amount of BDT 3620500 (1 US$ equals to BDT80 equals to RM4) than that of the other National Parks namely Satchari National Park and Rema-Kalanga Wildlife Sanctuary from the period of 2009 to 2014 (Islam, 2014). The visitors are mainly Bankers, service holders, researchers, academicians, students, foreigners, environmentalist, and others. Bangladesh Forest Department introduced with Co-Management Team at

Lawachara National Park according to Wildlife Conservation and Security Act, 2012 (Co-management, 2012).

4.1.17 Tree Diversity of Lawachara National Park

From the field surveys, the study recorded 1,318 tree individuals from 82 species and 37 families from 36 subplots at Lawachara National Park, which as shown in Table 4.10. Tree diversity index enhances to the establishment of afforestation and reforestation programme inside at Lawachara National Park.

Table 4.10: Number of species and family from studied sites

Plot Sites	Number of Species	Number of Family
Central Site A	10	4
Central Site B	8	3
Railway Routev Site A	3	2
Railway Route Site B	3	2
Western Site A	7	3
Western Site B	8	3
Eastern Site A	7	4
Eastern Site B	6	3
Southern Site A	7	3
Southern Site B	9	4
Northern Site A	6	3
Northern Site B	8	3
Total	82	37

Central Site indicated maximum species (*Artocarpus chaplasha*) and families (Leguminosae and Moraceae) but railway route site showed less both of them. The research identified that the LNP increased monoculture species than that of mixed species. The study suggested for afforestation reforestation programmes with multi-purpose species for gap filling in the stated sites. The tree diversity index graph of Shanon fluctuates on the movement as well as same condition to the diversity index of Simpson. But there is a diversity gap at the site of

inside railway route, where maximum fluctuations indicate in the both indeces, as shown in Figure 4.18.

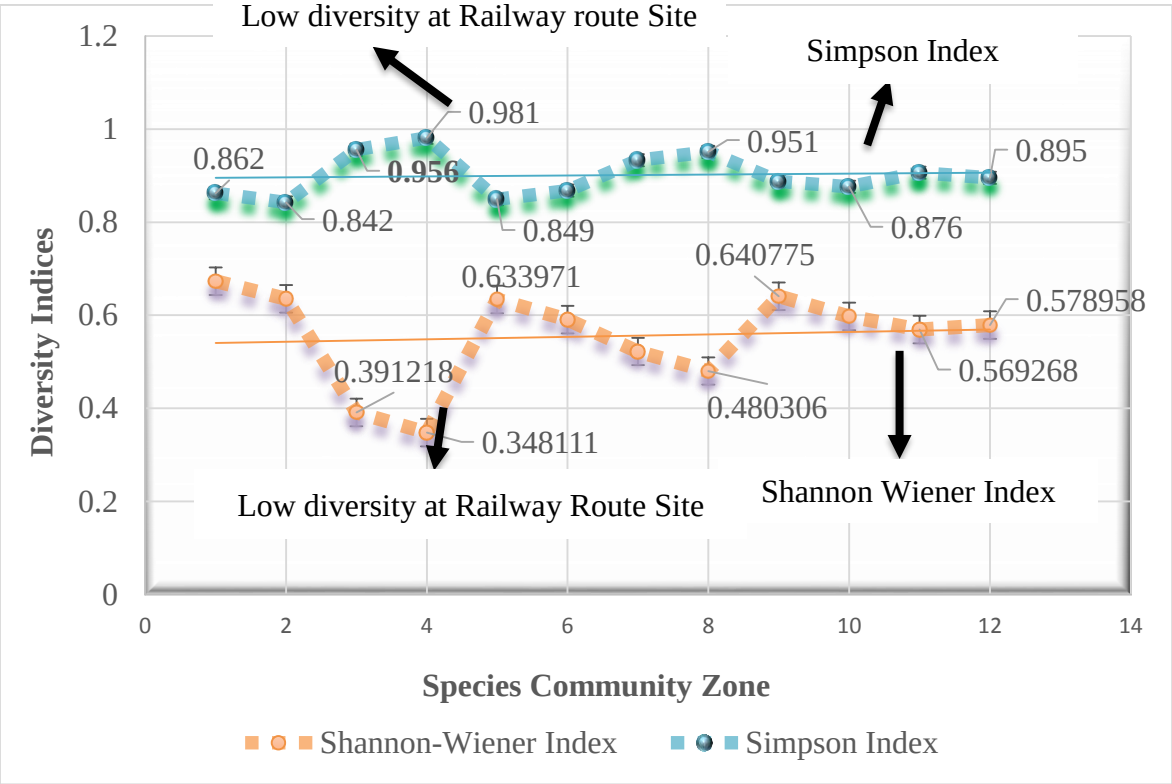


Figure 4.18: Tree Diversity index of Lawachara National Park.

The study identified that the running railway route site less plant diversity (Shannon Winner Index 0.981 and Simpson Index 0.348). Pavel *et al*. (2016) reported on the Shannon winner Index 2.18 at conservation area of north-east Bangladesh. Malaker *et al*. (2010) identified 60 families at Lawachara National Park. Meanwhile, the study observed some tree species were endangered at Lawachara National Park during species survey. For example, Ironwood (*Xylia dolabriformis*) is in endangered (Appendix-K). The research suggested that need afforestation and reforestation programmes at the route sites as soon as possible. From the findings, need effective afforestation and reforestation program inside the Lawachara National Park.

From the field survey, the study represented maximum tree individuals at central area A (195 individual) and minimum at railway route A (19 individual), as shown in Figure 4.19. The study suggests the establishment of reforestation and afforestation programme inside the Lawachara National Park on the priority of National Forest Policy 1994.

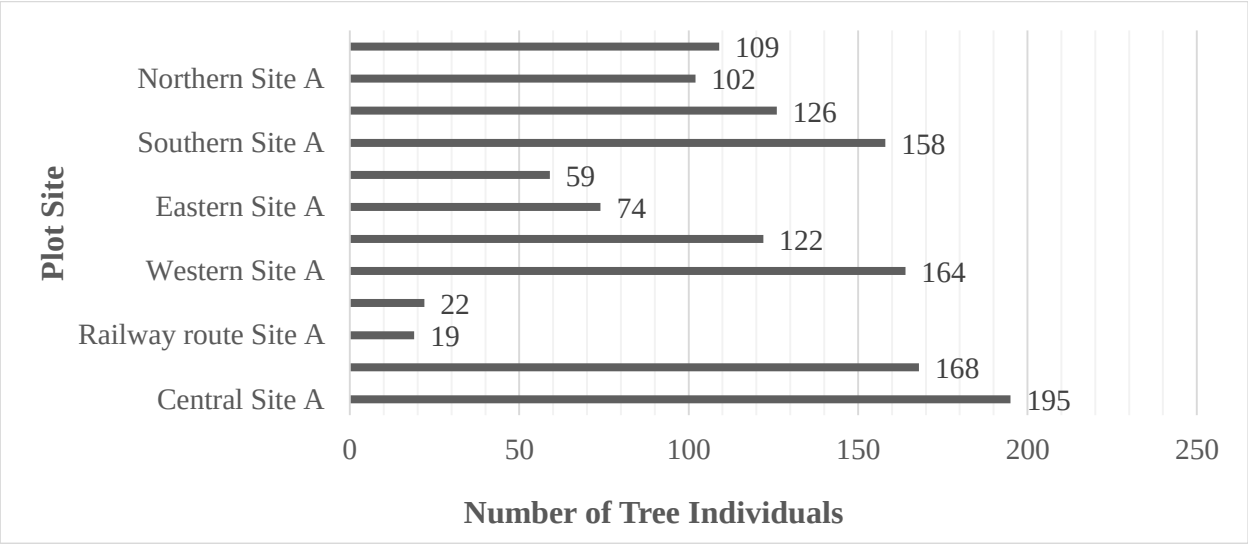


Figure 4.19: Tree species Individuals in different Plots

4.1.18 Wildlife Critical Condition of Lawachara National Park

From the field observation, sheltered wildlife status of Lawachara National Park (LNP) is captured by threats. These Threats to wildlife and their habitations are multifarious and pervasive in the Lawachara National Park. According to IUCN (2017) these are 39 mammalian wildlife consisted in LNP, out of them, almost 23% of the known species are threatened, 18% are vulnerable as well as 5% endangered, which as shown in Figure 4.20. The study showed the status of vulnerable and endangered of wildlife conservation in the LNP with risk assessment. Some wildlife of LNP were killed by Railway and vehicles during movement the road / route (SOD, 2016).

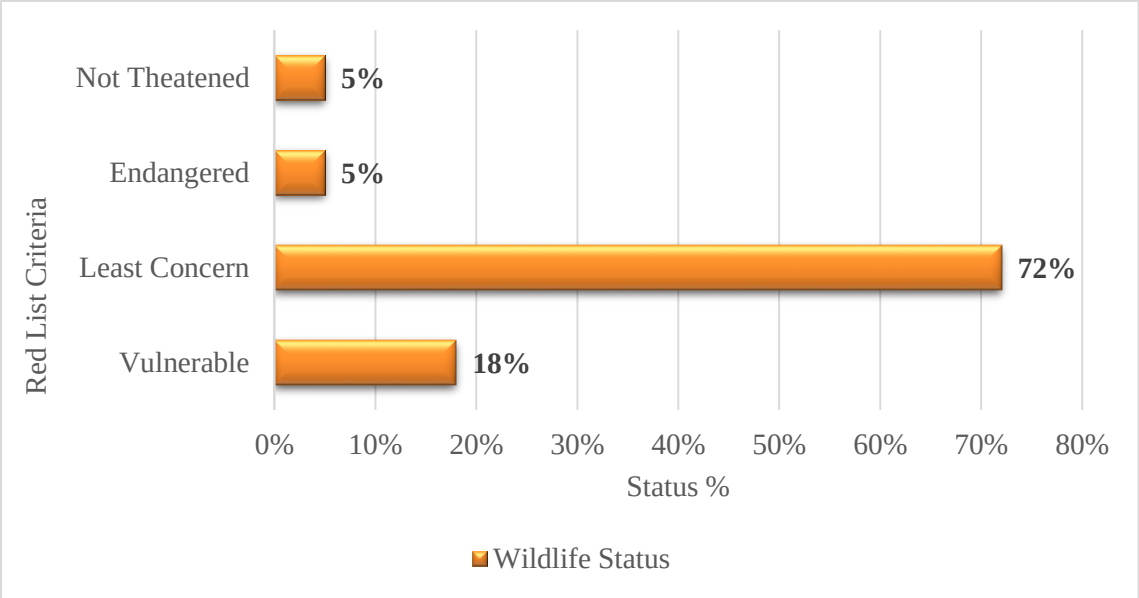


Figure 4.20: Wildlife Criteria of Lawachara National Park

These death wild animals are: Fox, Fishing cat, wild cat, monkey, deer, frog and snakes. These are often run over and killed by vehicles on the road. The study suggested for update wildlife conservation policy formulation in connection with national and global stakeholders' opinions on the priority of Aichi Targets.

Lawachara National Park (LNP) Service Management is challenged to stability tourists and researchers' access with the environmental, social and ecosystem service consequences of motor vehicle use and running railway. Wildlife populations in LNP are in danger to road and route collision. The study of the survey identifies the existing circumstances and wildlife-vehicles conflicts. The accessible transportation systems at LNP were professed to be beyond capacity, with passageway volumes presently high or very high traffic anticipated escalating in the majority means of entrance. LNP unit used some form of mitigation method to reduce the impacts on wildlife. Approximately 55% of the respondents indicated the impacts would merely exacerbate in the next ten years (Table 4.11).

Table 4.11: Severity of road and route impacts on wildlife at LNP

Parameters	**More Severe**	**Severe**	**Less severe**	**No comment**
Road and Route Mortality	55%	37%	5%	3%
Habitat loss	45%	35%	15%	5%
Habitat disturbance	30%	33%	22%	15%
Habitat fragmentation	42%	35%	21%	2%

From the Field observation and opinions of Focus Group Discussion, different wildlifes of Lawachara National Park were killed by railway and vehicles, which as shown in Figure 4.21. The study suggested that the existing route and road need to shift from inside of LNP.



Figure 4.21: Snake and monkey attacked by vehicles at Lawachara National Park road (Babu, 2013)

Analysis of Impact Appraisal on National Park Communication

Impact appraisal (IA) is the integrated part with various parameters, such project nature, importance, disturbance, occurrence, reversibility, extension, duration and innovation (Table 4.12). This IA is connected with Lawachara National Park' communication including inside railway route and vehicle road affected towards biodiversity.

Impact Appraisal (IA) = Project Nature (Pn) + Disturbance (Di)+ Importance (Im) + Occurrence (Oc) + Extension (Ex) +Duration (Du)+ Reversibility (Re) + Innovation (In)

Or, IA = Pn+Di+Im+Oc+Ex+Du+Re+In

Where, Ranking value 1–5, indicating,

Low=1, Moderate=2, Medium=3, High=4, Maximum=5. These ranking values settled the opinions of the respondents of Focus Group Discussion (FGD).

Table 4.12: Impact Appraisal on Lawachara National Park Communication

Parameters	**Appraisal**		**Score Balance**	**Overall Assessment**
	Positive	**Negative**		
Project Nature (Pn)	High (4)	Medium (3)	1	Positive
Importance (Im)	High (5)	Medium (-3)	2	Positive
Disturbance (Di)	Regular (2)	Regular (-1)	1	Positive
Duration (Du)	Permanent (3)	Average (-2)	1	Positive
Occurrence (Oc)	Very Probable (3)	Probable (-1)	2	Positive
Reversibility (Re)	Reversible (3)	Reversible (-2)	1	Positive
Extension (Ex)	Regional (3)	Local (-1)	2	Positive
Innovation (In)	Application (4)	Misuse (-2)	2	Positive
Total=40	(+27)	(-15)	12	Positive

Therefore, IA= 12.

Hence, Positive impacts outweigh negative by the ration of 27:15. The Environmental Conservation Impact Assessment project at LNP is highly positive on reflection of biodiversity conservation.

4.1.19 Status on Afforestation, Forestation and Reforestation

From the field observation, deforestations increase in the Lawachara National Park. Bangladesh Government takes initiatives for afforestation and reforestation program according to forest policy 1994. Most of respondents' expressed their opinion for these programs on the priority of Aichi Biodiversity Targets 2020, as shown in Figure 4.22 . The

study found observed that about 12% of the respondents were informed on afforestation (series 1),

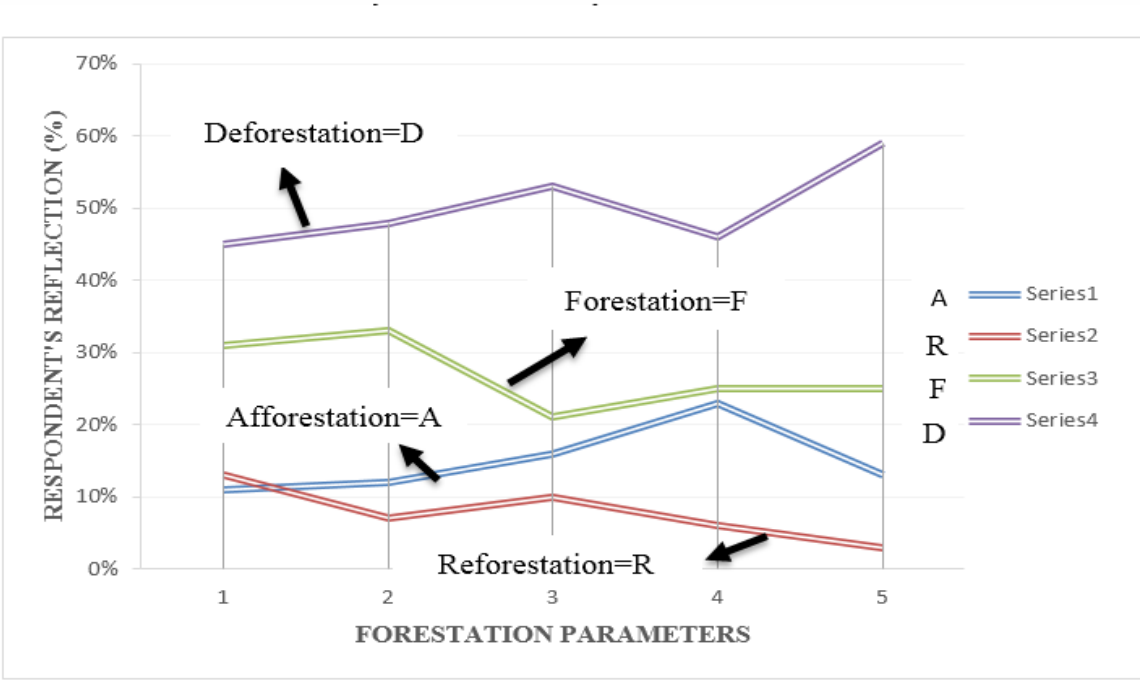


Figure 4.22: Respondents' opinion on Afforestation, Reforestation and Deforestation.

The study found observed that about 12% of the respondents were informed on afforestation (series 1), while reforestation 7% (series 2), forestation 31% (series 3) and deforestation 45% (series 4). The study suggests that afforestation and reforestation programmes augment the dense diversity with selected plant species towards national parks, which mentioned earlier in Forest Policy 1994. The study also advocated that afforestation and reforestation programmes need to augment with multi-species plantation through inspection for and monitoring of unlawful clear-cutting and further conservation events.

4.1.20 Lawachara National Park Conservation Evidence

Lawachara National Park (LNP) is famous earlier for its flora and faunal diversity in the north-eastern part of Bangladesh, particularly hoolock gibbon at Kamalganj sub-district

(Islam *et al*., 2011). But day by day, habitat loss and land conversion are the utmost issues liable for the fading of hooluck populations and other biodiversity from LNP. Some conservation related published articles of LNP illustrated its evidence from 2006 to 2016, as shown in Figure 4.23.



Figure 4.23: Conservation Evidence of Lawachara National Park

The study represented maximum evidence on wildlife conservation and minimum on Invasive Alien Species. Conservation policy research is as usual. The study suggests for policy formulation related on conserving of biodiversity towards national park management. The study also focused on the update research on conserving of biological diversity towards mentioned national park, particularly conservation policy and technology. This research field is rare in Bangladesh due to lack of effective efforts.

4.1.21. Impact of illegal logging at Lawachara National Park

Illegal logging is one of the major drivers of deforestation (Schloenhardt, 2008) in Bangladesh. Deforestation is a particular concern in Lawachara National park (NP) because this LNP is home to much of the State's biodiversity (WWF, 2015). Illegal logging is the

harvesting of wood that is in violation of National regulations (GFA, 2017) in the country. In addition, it is the cutting down of trees, transporting them are using their products such as timber for economic or benefiting gains against the prohibition by law. It involves the use of corrupt ways to reach the Lawachara National Park area, the cutting down or illicit felling of trees without approval and selling them adjacent town area in black markets as timber (UNODC, 2010). Therefore, there are some causes for illegal logging at LNP, which as shown in Figure 4.24. The maximum 40% of respondents expressed their opinion on "rural poverty", the root cause for illegal logging at LNP.

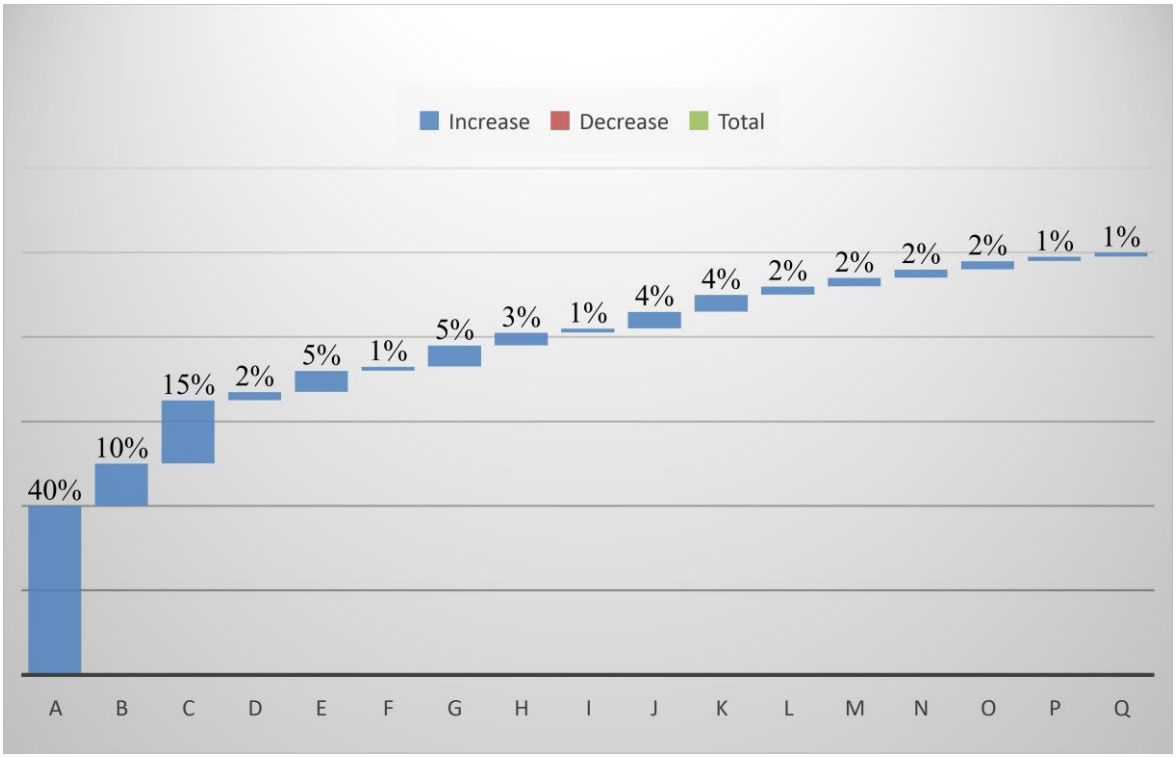


Figure 4.24: Causes of Illegal Logging at Lawachara National Park

The figure symbols imply as follows: A= Rural Poverty, B=Poor Governance, C=Poor Law Enforcement Capacity, D=Economic losses, E=Losses of biodiversity, F= Global warming and climate change, G=Cheaper products in black markets, H=Illegal charcoal, furniture and timber trade, I=Poor living standards for Indigenous population, J=Corruption at local level,

K=Umemployment, L=Firewood shortage, M=No source of income, N=Inadequate manpower, O=Lack of logistics, P=Unscrululous dealings, and Q= Lack of conservation knowledge.

The impacts of illegal logging are varied, ranging from unchecked deforestation to the deprivation of sustainable livelihood opportunities for local communities of Lawachara National Park areas. Besides, there are some areas; those are risk for illegal logging and poaching, as shown in Figure 4.25.

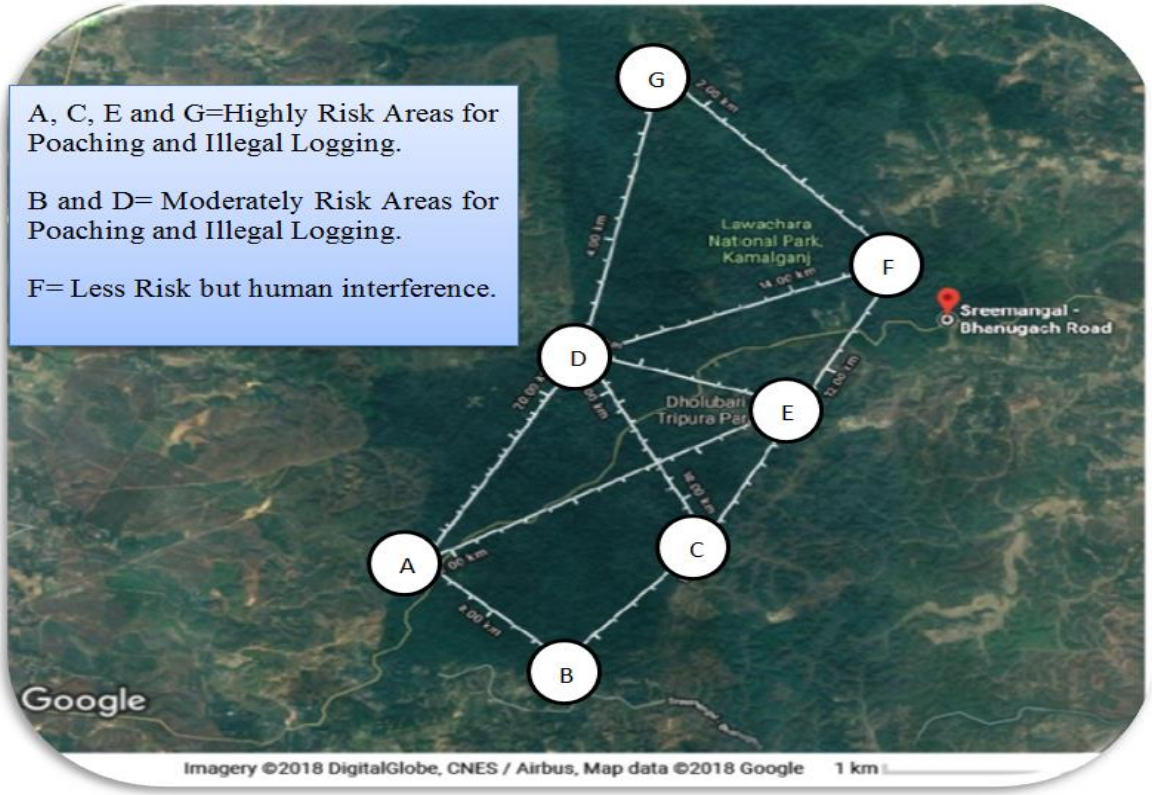


Figure 4.25: Risk areas in Lawachara National Park for poaching and illegal logging (Source: Google Map, 2018)

Here the symbols expressed as: A= Adjacent Bharaura, B= Adjacent Fulbari Tea Garden, C= Adjacent Magurchera, D= Adjacent Gilachara Tea Garden, E= Adjacent Langurpur, F= Adjacent Bagmara, and G= Adjacent Garobosti areas. Out of these areas, adjacent area of Bharaura is the most highly risk area for poaching and illegal logging— according to the

opinions of Focus Group Discussion and Informal survey. Moreover, Illegal logging tends to deforestation, which creates loss of LNP's biodiversity. According to World Bank (2012) estimates, illegal logging is the results in a loss of approximately USD 5 billion in tax revenue for government annually. Bangladesh Forest Department (BFD) maintained its efforts to tackle illegal logging since the establishment of co-management system at LNP. The staff of LNP Administration had argued on illegal logging that:

"We work honestly and sincerely, but have no provision a backing for good work, otherwise take punishment for corruption or no promotion. We are continually having under pressure on strong political elite and illicit-feller those are involved in illegal logging, poaching and encroaching. As a result, some of our colleagues assist them and take undesirable benefit from them."

On the other hand, one local person who is a member of co-management committee expressed that: *We caught some illegal loggers, encroachers and poachers during duty time and transferred them to the forest guards; they removed them by taking illegal money and received cell phone call. We informed senior officials of BFD and recovered some encroached forest land".* External political supporter and powerful gangs of illegal loggers are severe wildlife criminals at LNP, who operated emerging technology like Telematics. The study suggested for comprehensible and transparent integrated policy framework that is effectively and reliably enforced is a pre-requisite for challenging illegal logging and the trade in illegal timber.

4.1.22 Hypothesis Analysis

Hypothesis analysis depends on stakeholders' participation and response positive, negative or neutral towards Lawachara National Park. The study observed the analysis from Table 4.13, which used the online calculator for chi-square test calculation (Silico, 2017). The study represented on the opinions of stakeholders, which contributed on the national park ecotourism activities, particularly on the local and foreigner visitors at existing national park.

Table 4.13: Stakeholders' opinion analysis including national and foreigner

Observation	Local			Foreigner			Marginal row totals (MOV)
	Detected value (DV)	Estimated value (EV)	Chi-square statistic for each cell	Detected value (DV)	Estimated value (EV)	Chi-square statistic for each cell	
Male	145	129.01	1.98	35	50.99	5.01	180
Female	65	80.99	3.16	48	32.01	7.99	113
Marginal column totals	210	-	-	83	-	-	293

The Chi-square calculated value is 18.14., where 0.000021 is *p*-value.

This outcome is highly accepted at $P < 0.05$, the critical value of the study at 95% confidence level is 3.84, where degree of freedom (df) is 1. Table 4.11 shows that the null hypothesis is rejected for all the co-efficients,. i.e. the outcomes of the stakeholder participation is significant. Therefore, the necessary effort is required for environmental conservation instruments towards Lawachara National Park Biodiversity.

Inference: There is attraction of visitors towards Lawachara National Park for visiting purpose in connection with ecotourism activities. So, it is needed update policy instrument for biodiversity conservation and ecotourism activities. From Global Forest Watch report, Lawachara loses 34 ha in the period 2001-2014 and gain 0.18 ha area on the period 2001-2012 (GFW, 2016). From the study, the expected research hypothesis is significant

difference in conservation policy instruments towards Lawachara National Park through the improvement of existing biodiversity conservation, ecotourism and ecosystem services.

4.2 Assessment of National Parks related Instruments in Bangladesh

National Park is the instrument of *In–Situ* conservation. Here the study showed different analysises on National Parks and relevant ones.

4.2.1 Degree of Threats to National Parks

Protected areas consists of national parks, wildlife sanctuaries, nature reserves and relevant other areas. The total number of protected area records in the December 2016 release of the World Database on Protected Areas (WDPA) is 232,128 comprising of 213,328 polygons and 18,800 points (UNEP-WCMC, 2016).

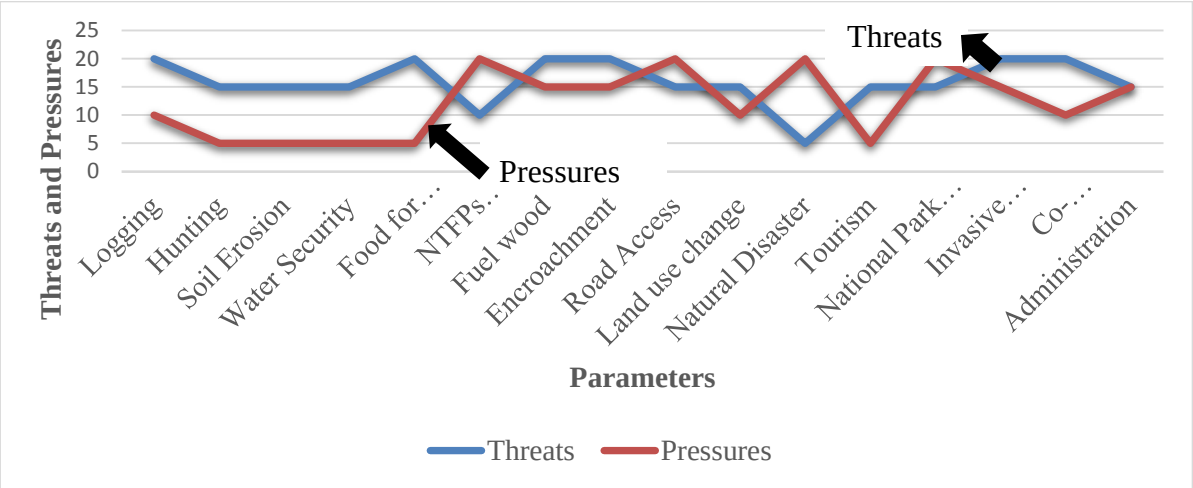


Figure 4.26: Degree of Pressures and threats on Lawachara National Park.

Degree of pressures and threats increase day by day on Lawachara National Park (IPAC, 2012), as shown in Figure 4.26, with compared different parameters towards protected areas in Bangladesh, such as, hunting, illegal logging, access road use inside the park with road transport and railway route.

4.2.2 Distribution of National Parks in Bangladesh

Bangladesh has gazetted 17 national parks according to legal systems and IUCN management categories (BFD, 2016). These National Parks are distributed in 13 administrative districts out of 64 among 7 administrative divisions in Bangladesh as shown in Table 4.14.

Table 4.14: Distribution of National Parks among Districts with Divisions in Bangladesh.

Sl. No.	Administrative Districts	Administrative Divisions	National Parks	Sl. No.	Administrative Districts	Administrative Divisions	National Parks
a	b	c	d	e	f	g	h
1	Barguna	Barisal	0*	33	Jessore	Khulna	0
2	Barisal	Barisal	0	34	Jhenaidah	Khulna	0
3	Bhola	Barisal	0	35	Khulna	Khulna	0
4	Jhalokati	Barisal	0	36	Kushtia	Khulna	0
5	Patuakhali	Barisal	+	37	Magura	Khulna	0
6	Pirojpur	Barisal	0	38	Meherpur	Khulna	0
7	Bandarban	Chittagong	0	39	Narail	Khulna	0
8	Brahmanbaria	Chittagong	0	40	Satkhira	Khulna	0
9	Chandpur	Chittagong	0	41	Jamalpur	Mymensingh	0
10	Chittagong	Chittagong	+	42	Mymensingh	Mymensingh	+
11	Comilla	Chittagong	0	43	Netrakona	Mymensingh	0
12	Cox's Bazar	Chittagong	++	44	Sherpur	Mymensingh	0
13	Feni	Chittagong	0	45	Bogra	Rajshahi	0
14	Khagrachhari	Chittagong	0	46	Joypurhat	Rajshahi	0
15	Lakshmipur	Chittagong	0	47	Naogaon	Rajshahi	+
16	Noakhali	Chittagong	+	48	Natore	Rajshahi	0
17	Rangamati	Chittagong	+	49	Chapainawabganj	Rajshahi	0
18	Dhaka	Dhaka	0	50	Pabna	Rajshahi	0
19	Faridpur	Dhaka	0	51	Rajshahi	Rajshahi	0
20	Gazipur	Dhaka	+	52	Sirajgonj	Rajshahi	0
21	Gopalganj	Dhaka	0	53	Dinajpur	Rangpur	++++
22	Kishoreganj	Dhaka	0	54	Gaibandha	Rangpur	0
23	Madaripur	Dhaka	0	55	Kurigram	Rangpur	0
24	Manikganj	Dhaka	0	56	Lalmonirhat	Rangpur	0
25	Munshiganj	Dhaka	0	57	Nilphamari	Rangpur	0
26	Narayanganj	Dhaka	0	58	Panchagarh	Rangpur	0
27	Narshingdi	Dhaka	0	59	Rangpur	Rangpur	0
28	Rajbari	Dhaka	0	60	Thakurgaon	Rangpur	0
29	Shariatpur	Dhaka	0	61	Habiganj	Sylhet	+
30	Tangail	Dhaka	+	62	Moulvibazar	Sylhet	+
31	Bagerhat	Khulna	0	63	Sunamganj	Sylhet	0
32	Chuadanga	Khulna	0	64	Sylhet	Sylhet	+
Total National Parks in Bangladesh			8				9

* +=Present of National Parks, and 0= Absent of National Park at Administrative Districts of the Existing Administrative Divisions in Bangladesh, showing the coloured and white boxes with district locations and empty respectively.

These administrative districts are Patuakhali at Barisal division; Chittagong, Cox's Bazar, Noakhali, Rangamati at Chittagong division; Gazipur, Tangail at Dhaka division; Mymensingh at same division, Naogaon at Rajshahi division, Dinajpur at Rangpur division, Habiganj, Moulvibazar and Sylhet at Sylhet division. No exists National Parks in 51 districts and not a single National Park in Khulna division consisting of 10 administrative districts of

Bangladesh. The World Database on Protected Areas (WDPA), which is a good information dataset to know easily the present status of protected areas of the CBD members. Every National Parks, wildlife sanctuaries and other types of protected areas consists of WDPA ID of all National Parks in Bangladesh.

4.2.3 Growth of National Parks

From the statement of the National Constitution (Article 18A), it can be assumed that the bio-environmental policy is essential for the upcoming generations (TCPRB, 2012). It also mentioned the Citizens Contribution on Environmental Conservation in the Article 102 of the Constitution. From the above article, the number of NPs had grown from 1980 to 2014 which is shown in Figure 4.27.

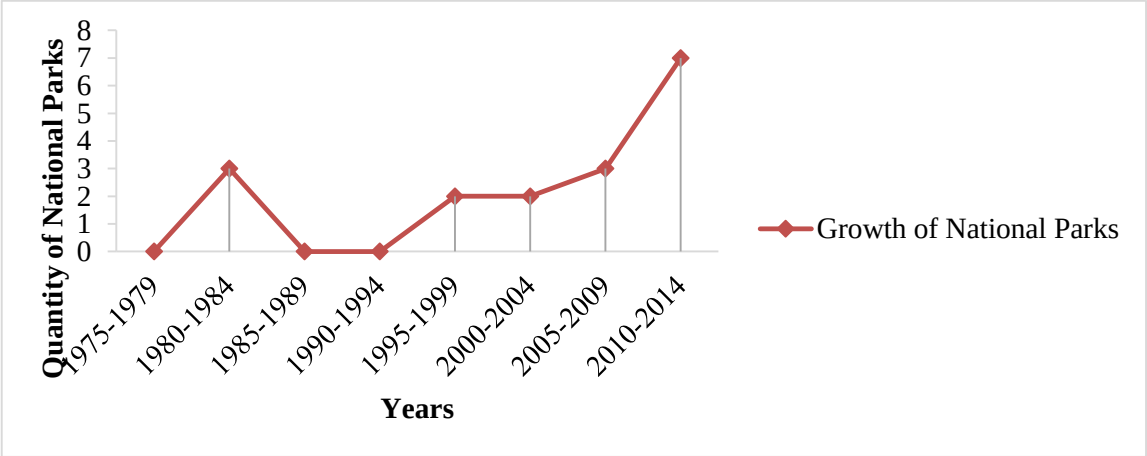


Figure 4.27: Year-wise Growth of National Parks in Bangladesh

The mentioned figure showed in the way of 5 years interval for declaration and gazette notification which is analyzed successively. In the year 1980-1984, there are three National Parks declared but in 1990-1994, there is no a single notification for protected areas establishment. On the other hand, 7 National Parks declared within 2010-2014. Because,

within this period, the relevant laws and policies are updated in Bangladesh, like article 18A in the National Constitution and Wildlife Conservation and Security Act 2012.

4.2.4 Information Status on National Parks Distributions

In Bangladesh, there are 64 districts with only 27.13% covered by National Parks in Figure 4.28. Thus 72.87% the districts are without National Parks, which is considered alarming in future for these areas in terms of conservation. The study suggested that the rest of proposed national park will be declared by the Government of Bangladesh within the stipulated time of CBD. Bangladesh consists of 8 administrative divisions. These are Dhaka (Capital of Bangladesh), Khulna, Sylhet, Barisal, Rangpur, Mymensingh, Rajshahi and Chittagong.

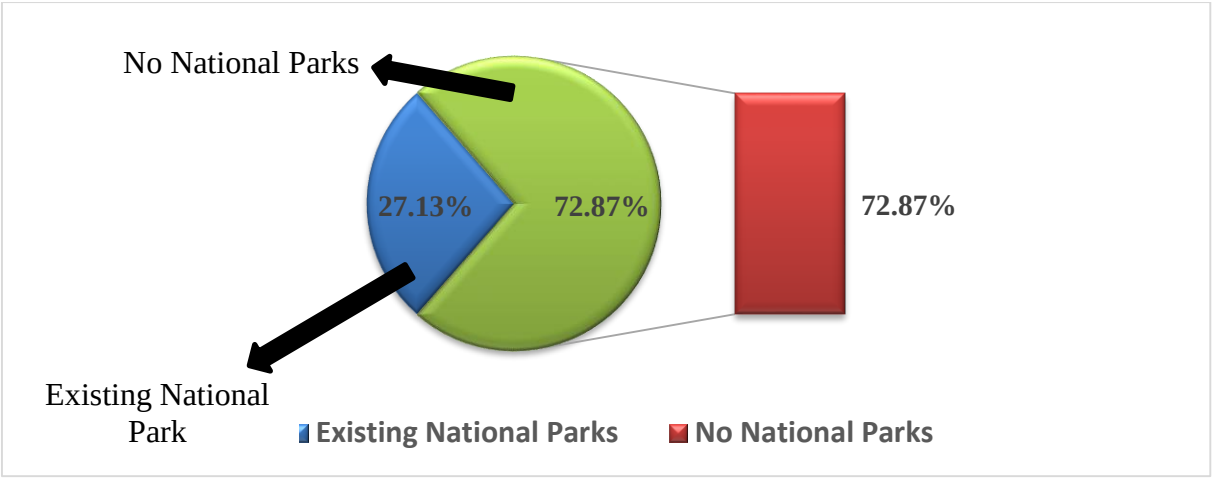


Figure 4.28: Status of existing National Parks at different administrative districts.

Most National Parks are covered by four districts in Chittagong and Rangpur division with the least in Barisal and Rajshahi divisions as shown in Figure 4.29. The increase in surrounding population, the fragmented habitats and aggressive agriculture extension had adversely impacted these National Parks areas.

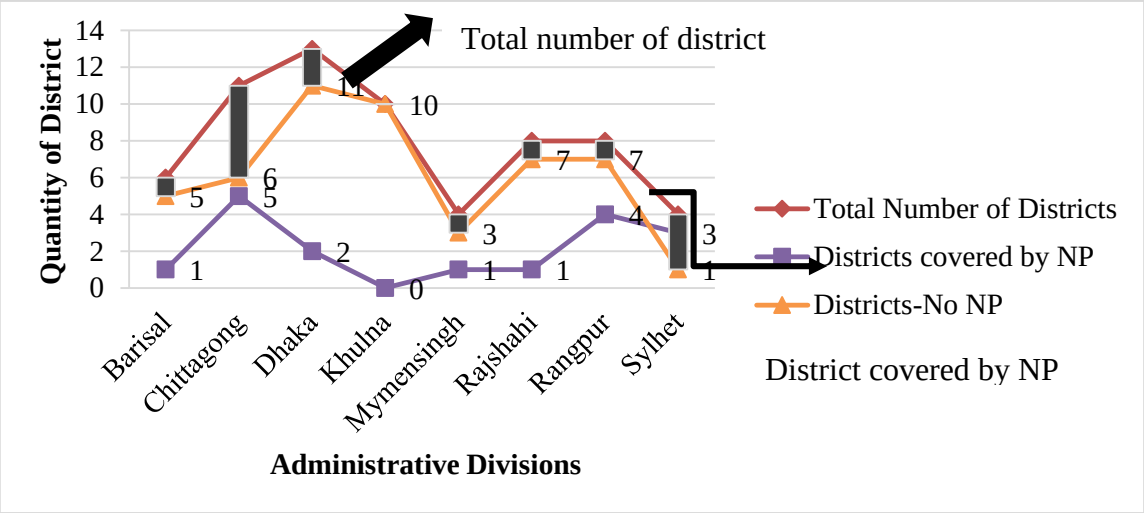


Figure 4.29: Status of National Parks distributed and non-distributed in Bangladesh.

Besides, these National Parks are less than ideal management due to lack of updated information for policy formulation.

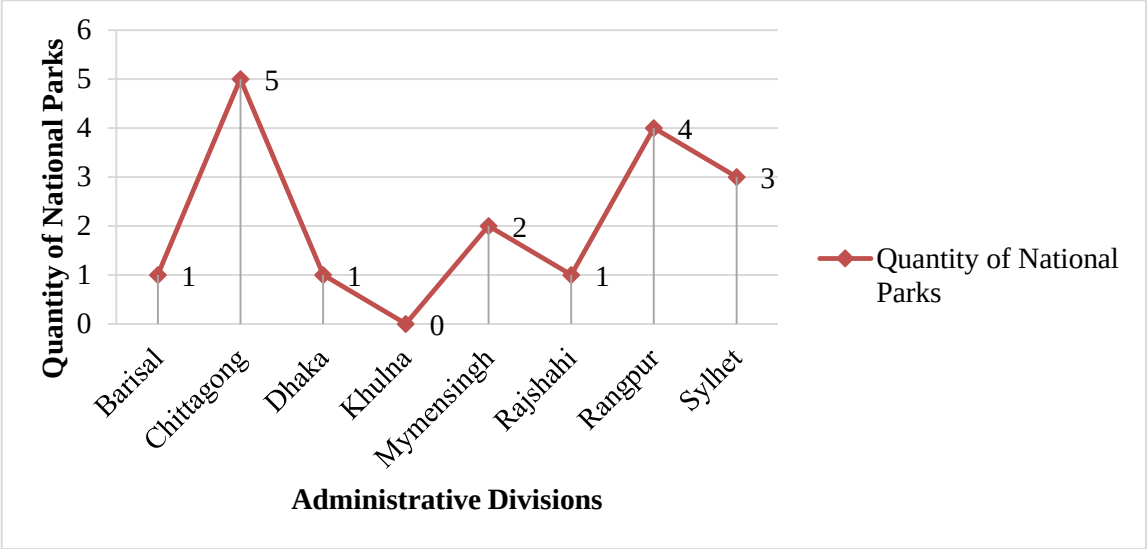


Figure 4.30: **N**umber of National Parks distributed at different divisions.

On the other hand, these National Parks distributed among seven administrative divisions out of eight in the whole country. No National Park exists in Khulna division. On the other hand, maximum National Parks 5 in Chittagong division. Others are Rangpur 4, Sylhet 3, Dhaka 2 (1 National Park situated between Dhaka and Mymensingh division), although

another 1 National Park in Mymensingh division, and Barisal and Rajshahi- each division contains 1 National Park as shown in Figure 4.30.

4.2.5 Area wise distribution of National Parks in Bangladesh

According to area wise, maximum area, 26874.76 hac National Parks (NP) distributed in Chittagong division where minimum 264.12 hac in Rajshahi division of Bangladesh (BD). Other NPs are distributed with 344.13 hac in Mymensingh, 1019.61 hac in Rangpur, 1613 hac in Barisal, 2171.71 hac in Sylhet and 13458 hac in Dhaka divisions of BD. Previously, it is mentioned that not a single area of NP till to date in Khulna division as shown in Figure 4.31.

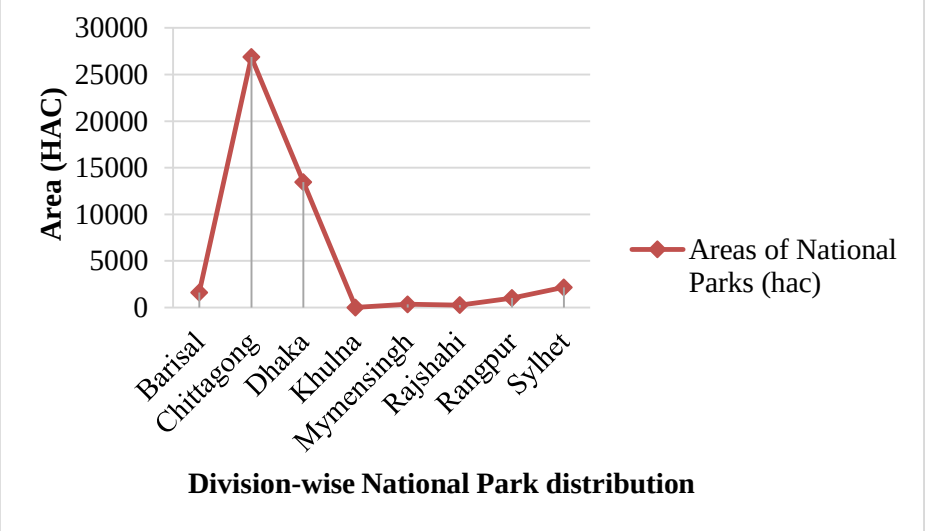


Figure 4.31: Area wise National Parks distributed at divisions in Bangladesh.

4.2.6 Comparative analysis on National Parks

National Park (NP) is a good instrument for biodiversity conservation in State Parties of CBD. Several factors that affected biodiversity conservation at National Parks in these countries were recognized. Bangladesh consists of 17 NPs (BFD, 2016) and 36 NPs in

Sarawak (FDS, 2016), Malaysia. The number of NPs had grown from 1975 to 2014 as shown in Figure 4.32. The mentioned figure showed in the way of 5 years interval for declaration and gazette notification which is analyzed successively. In the year 1980-1984, there are three National Parks declared but in 1990-1994, there is no a single notification for protected areas establishment which compares with that of Sarawak. On the other hand, 7 National Parks declared within 2010-2014. Within this period, the relevant laws and policies are updated in Bangladesh and Malaysia from the facilitation of CBD, like Wildlife Conservation Acts.

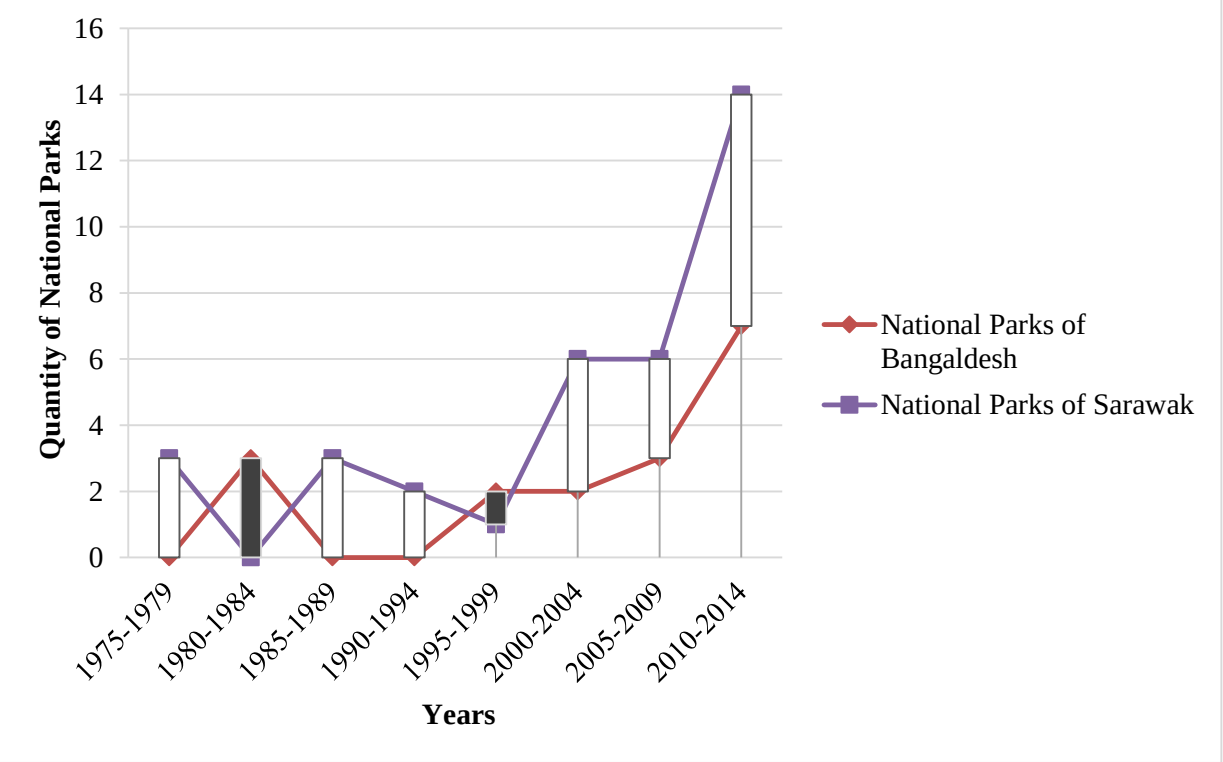


Figure 4.32: Growth of National Parks year wise in Bangladesh and Sarawak, Malaysia

4.2.7 Analysis on National Parks and Wildlife Sanctuaries

Bangladesh (BD) was independent in 1971. From 1971 to 2014, government of Bangladesh declared seventeen national parks for conserving of biological diversity, as shown in Figure 4.33. After 44 years, the BD has 835952 ha protected areas including 60932.33 ha National

Parks and 270143.82 ha wildlife sanctuaries. The study suggested that new national parks need to declare through the government of State Party according to ABT 2020 of CBD.

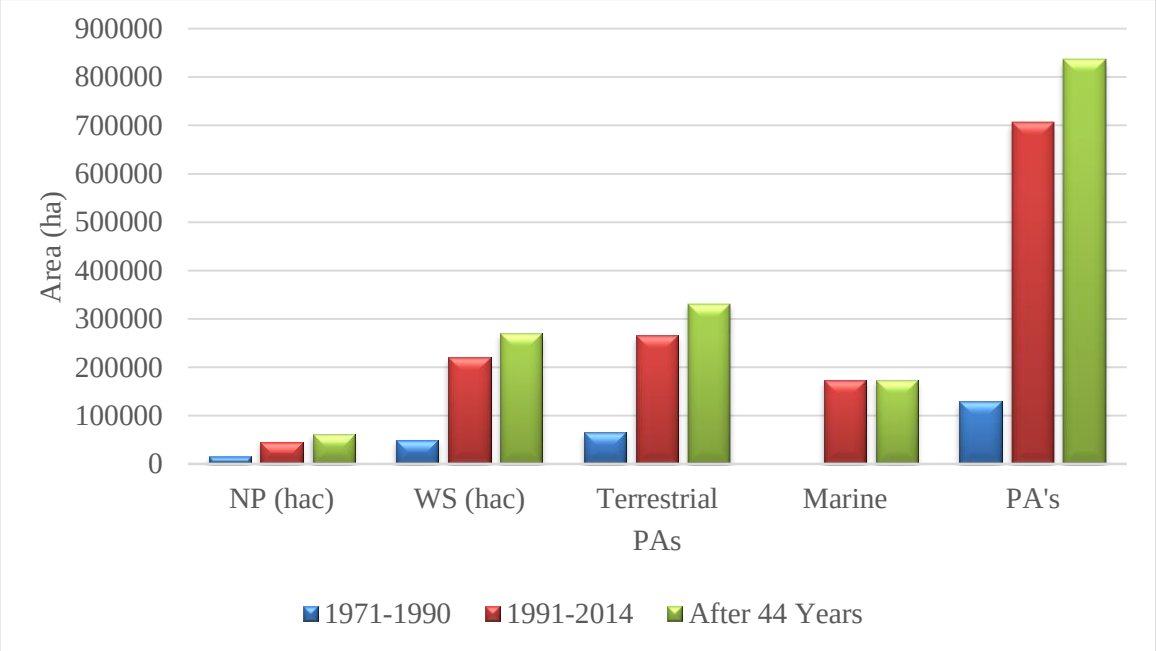


Figure 4.33: A comparative analysis on different types of protected areas in Bangladesh.

4.2.8 Analysis of National Park Management Effectiveness

Management Effectiveness scores of Lawachara National Park (LNP) was identified through Focus Group Discussion (FGD). The 31 parameters were used on the basis on Park's priority and FGD's opinions for the scoring of Management Effectiveness (Appendix N). The calculated value of the LNP's score was 54.88% to compare with Bangladesh Forest Department value 56% (Ahsan *et al*., 2016). The study suggested for effective policy with dynamic administration for national park biodiversity conservation.

4.3 Assessment of Biodiversity related National Policy Instruments

The existing biodiversity related national policies mentioned as below:

4.3.1 Biodiversity-related National Legislation Scoring

The legislation scoring categories and their grading definitions constructed based on discussions with biodiversity and legal experts including both professionals and academicians in Bangladesh context, as shown in Figure 4.34. The graph observed maximum weight (%) in Lawachara National Park (LNP) and minimum in Khadimnagar National Park (KNP), where compare with linear, and polynomial trend line for dissemination of present status on legislation scoring. The score of National Park increased gradually. The findings suggest that the Government of Bangladesh targets of fully implementing the biodiversity related policies/laws/ legislations till to date remains substantially unattained. From the study, biodiversity related law, policy, and administrative order etc. produced more or less in several years, but no legislation produced from the period of 1980 to 1989 in Bangladesh.

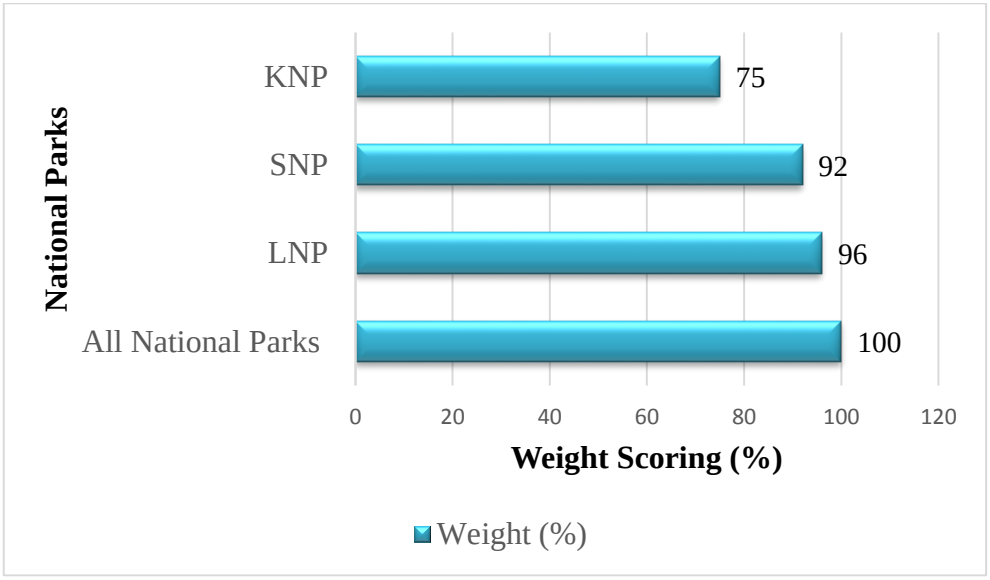


Figure 4.34: Biodiversity conservation related existing national legislations scoring

The result suggests that the existing legislations need to modify for sustainable development of national biodiversity in connection with regional and global perspectives, particularly CBD' requirements.

4.3.2 Existing Law and Policies related to Biodiversity Conservation

Existing legislations related to biodiversity conservation, as shown in Table 4.15, with relevant parameters. The study relates to biodiversity conservation with different articles at the Constitution of Convention on Biological Diversity, such as in-situ, national policy, strategic plan and relevant technology. Every state party develops National Park, national biodiversity related policy and strategic plan through national biodiversity database and clearing house mechanism according to CBD requirements. These requirements enhanced to legislation analysis for conservation of biodiversity towards National Parks in Bangladesh on the priority of regulation, control alien species, regular monitoring through effective research and training, environmental education awareness and sustainable use.

Table 4.15: Policy related characteristics of State Party's National Parks

Parameters	Characteristics	CBD
In-situ	National Park system for special measures need.	Article 8 of the Convention
Strategic Plan	National strategic plans and programmes for conservation.	Article 6 (a)
National policy	Development and implementation of national policies for promoting.	Article 18
Technology	State Parties technologies enhance access for transfer and sustainable use of biodiversity.	Article 16 of the Convention
Exchange of Information	The exchange of information facilitated to the conservation.	Article 17
Control Alien Species	Preventing measure of Invasive Alien Species, which threaten to ecosystems.	Article 8(h)
Resources utlisation	Regulating natural assets confirm their protection and justifiable practice.	Article 8 of the Convention
knowledge	gislations enhance the traditional knowledge for biodiversity conservation.	Article 8 (j) of the Convention
Monitoring	Monitoring with sampling techniques enhance biodiversity protection.	Article 7 (b) of the Convention
Incentives	Biodiversity conservation measures encentives with economically and socially sound.	Article 11
Research and Training	Technical education and training established biodiversity conservation.	Article 12 of the Convention
Education and Awareness	Global education and public awareness programmes for collaboration and conservation.	Article 13 of the Convention

Table 4.15 continued

The conserving parameters of biodiversity laws and policies indicates on the following, such as: (i) *In-situ*, (ii) Strategic Plan, (iii) National policy, (iv) Technology for Clearing House Mechanism, (v) Exchange of Information, (vi) Control measures of Invasive Alien Species, (vii) Resources utilisation, (viii) Traditional knowledge, (ix) Monitoring, (x) Incentives, (xi) Research and training, and (xii) Education and awareness.

4.3.3 Legislation relevance to Biodiversity conservation in Bangladesh

New legislation relevance to biodiversity conservation initiatives require human resources, institutional capacity, and funding for successful development and implementation to identify the people and organization with the interest and expertise to ensure progress on new legislation development related to biodiversity in Bangladesh (Table4.16).

Table 4.16: Laws and policies to protect biodiversity towards National Park areas in Bangladesh.

Law/Policy	Year	Perspectives
The National Constitution	2011	Article 18A, 102, 152
The Bangladesh Biodiversity Act, 2017	2017	Chapter 3,4,6,8 and 9.
The Wildlife (Conservation and Security) Act	2012	Section 2(15, 43), 11, 12, 13, 14, 15, 16, 17, 18, 21, 22, 23, 24, 27, 28, 29, 30, 34, and 42.
Bangladesh Environmental Conservation Act 2010 (amendment)	2010	Section 5, 6, 7, 12, and 15
Bangladesh Forest Act (amended)	2000	Section 28, 29, 30, 32, 33, 41, 42, 43, 52, 53, 54, 55, 56, 63, 64, 65, 66, 67, 68
Table 4.16 continued	1992	Section 5
	1994	Section 1.1 (a, b, c, and d)
Environmental Court Act	2010	Section 4, 9, 11, 14, 15, 18, 19, 20, 21, and 22
National Biodiversity Strategic Action Plan	2016	Chapter 1, 2, 3, 4, 5, 6, 7, 8.
Compensation Policy for Casualties caused by Wildlife	2010	Section 5, 6, and 7.
Saw-Mill (License) Rule	2012	Section 7, 8, and 9
Forest Products Transit (Control) Rule	2011	Section 3, 4, and 5
Social Forestry Rule (amendment)	2011	Section 4, 5, and 6

Brick Prepared and Kiln Establishment (Control) Act	2013	Section 5, 6, and 8.
The Prime Minister Award Giving Rules 2013 on Plantation	2013	Section A, B, C and D
ICT Act 2013	2013	Section 54, 55, 56, 57
ICT Policy	2009	Section D (9), E (4, 9)
Ecologically Crical Areas Rules	2016	Section 3, 18, 19, 20, 22, 26, 27, 28.
Tea Act 2016	2016	Section 7, 17, 29
National education Policy 2010	2010	Chapter 11, 12, 14, and 15
Water Act 2013	2013	Section 3, 4, 8, 15, 17, 18, and 29.
Protected Area Management Rules 2017	2017	Section 2, 4, 15, 18, 19, 20,21, 24, 29
Plant Quarantine Act 2011	2011	Section 6, 7, 26, 31
The Bangladesh Public Private Partnership Act 2015	2015	Chapter 2, 4,5,6

From Table 4.14, the study identified 26 tools for biodiversity conservation on national parks. These are: (i) Constitutional Rights, (ii) Forest, Wildlife and Biodiversity, (iii) Agroforestry, (iv) Industrial ecology, (v) Forest health and environment, (vi) Food energy, (vii) Water development and harvesting, (viii) Forest land, (ix) Fisheries and Livelihood, (x) Associated for wildlife, (xi) Terrestrial Environment, (xii) Transport and communication, (xiii) Green Banking, (xiv) Settlement and community, (xv) Sectoral policy intregration, (xvi) Bio-culture and religious, (xvii) Population/ stakeholder, (xviii) Collaborative Management, (xix) Removal of Invasive Alien Species (IAS), (xx) Education and public awareness, (xxi) Dynamic administration, (xxii) Science and Technology, (xxiii) Research and innovation, (xxiv) National, regional and global commitment/agreement, (xxv) Public-private partnership, and (xxvi) Protected Areas Management rules (PAMR, 2017), for example- Lawachara National Park Management Rules. From the study, National Constitution, Wildlife Conservation and Security Act, Forest Act and Policy, Environmental Conservation Act and Policy, ICT Act and related policies, Biological diversity Strategic Conservation Plan, Compensation Policy on behalf of Causulties caused by Wildlife, Environmental Court Act, and Brick Burning (Control) Act are the major instruments for conservation of biodiversity at National Parks.

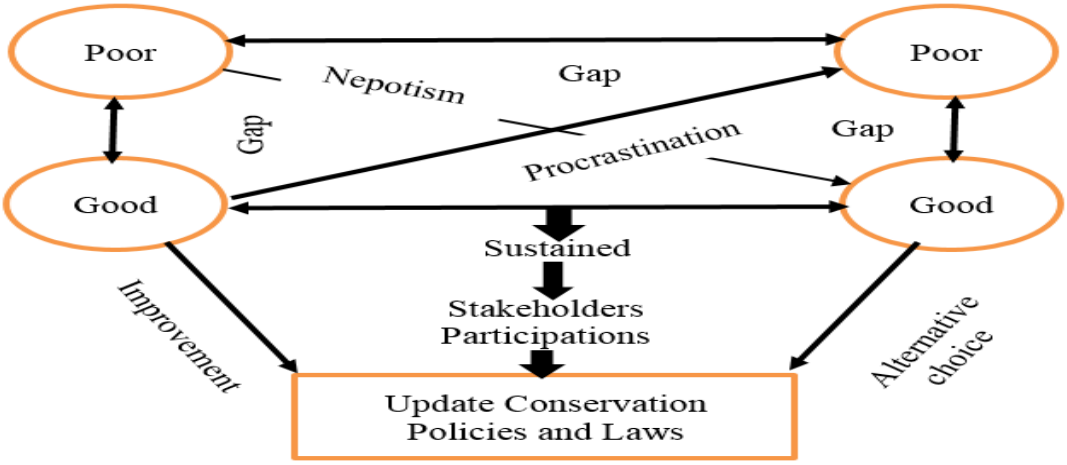


Figure 4.35: Criteria Conservation Policy Improvement

These laws and policies enhanced for update for National Park biodiversity management and protection as well as taking initiative for alternative choice (Figure 4.35). The study suggested that the existing conservation policy needs improvement including alternative choices on the priority of constitutional rights as well as it will be stakeholders' participation without nepotism and procrastination.

4.3.4 Produced Quantity of National Legislations

National legislation develops for enhancement of national biodiversity towards National Parks.Biodiversity related national legislation produced maximumwithin the period of 2010-2016, as shown in Figure 4.36. The study found that most of legislations related to biodiversity conservation formed after COP-10, in this period, CBD provided circulations to the state parties for update the national legislation for conserving of biological diversity. The Government of Bangladesh produced the Biodiversity Conservation and Security Act 2012 within this period. The study suggested that the government takes initiatives for separate law and policy for national biodiversity conservation towards national parks in Bangladesh.

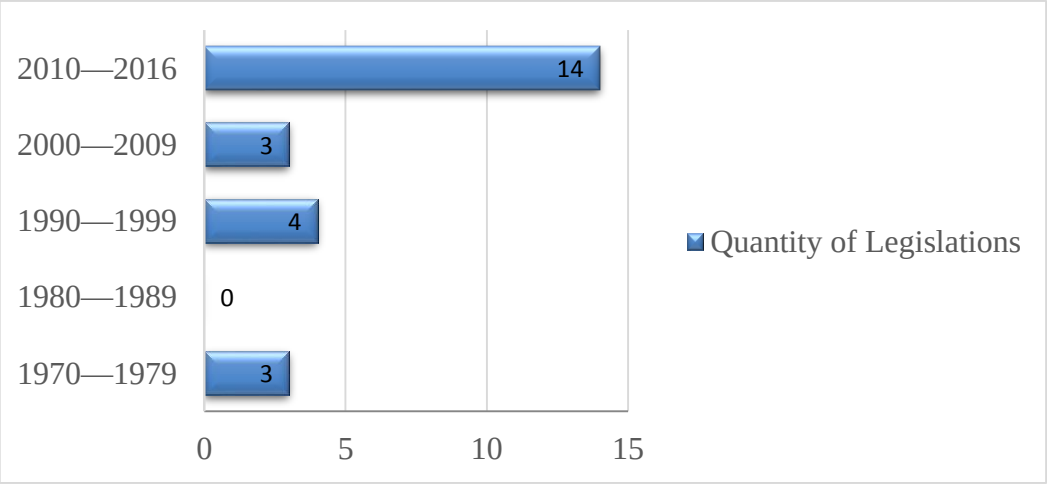


Figure 4.36: Produced number of biodiversity related legislation in Bangladesh

4.3.5 Analysis of Wildlife Conservation Act and Order

National biodiversity conservation opens the door through the Wildlife Conservation and Security (WCS) Act 2012. This Act updates in Bangladesh for biodiversity conservation and protection, particularly wildlife protection. The WCS compares with previous Preservation Order 1973, as shown in Table 4.17. The main parameters highlight on National Constitutional Status, Legal Integration, and National Park declaration, Co-management System, Penalties, Biodiversity Advisory Board and Scientific Committee. But no Section of relevant Law and policy mentions for digital conservation through National Park database and clearing house mechanism. From the respondent's opinion on WCS Act 2012 at FGD is as 11% 'adequate', 33% 'good', 56% 'inadequate' and 2% 'no comment'. The findings suggest for modification with new Sections related on digital conservation, particularly biodiversity information systems and clearing house mechanism for the purpose of global network connection and digital conservation. The study also represented the legal status of co-management system in Section 21 of the Wildlife Conservation and Security Act 2012

creating new opportunities for national park biodiversity conservation in connection with national and global perspectives.

Table 4.17: Comparison between Wildlife Conservation Act and Order

Parameters	Wildlife Conservation and Security (WCS) Act, 2012	The Bangladesh Wildlife (Preservation) Order, 1973
Constitutional Status	The provision on behalf of the conserving and safety of biodiversity including wildlife by the state has been inserted Article 18A of the National Constitutionh. And indirectly Article 102.	In enactment of the Fourth Schedule to the National Constitution, the President is satisfied to create this Order.
Providing Status	This Act is to offer for conserving and safety of national biodiversity.	This Order is convenient to offer for the protection, safeguarding and managing of national wildlife.
Act/Order No.	Act No. XXX of 2012, 10 July, 2012/26 Ashar,1419.	President's Order No. 23, dated March 28, 1973.
Chapters and Sections	10 Chapters and 54 Sections	No chapter and 48 Sections
Schedules	Contains I, II, III and IV Schedules.	Contains I,II,III Schedules.
Highlights	Advisory Board, Scientific Committee and Authorized Officers	The Bangladesh Wild Life Advisory Board, Officers and Honorary Officers
Legal Integration	(i) Code of Criminal Procedure (CrPC) 1898, (ii) Brick-Burning (control) Act 2013, (iii) ICT Act 2006, (iv)Penal Code (PC), (v) Environmental Conservation Act, (vi) Environmental Court Act 2010, (vii) Forest Act (FA).	(i) Code of Criminal Procedure (CrPC) 1898, (ii) Arms Act (AA) 1878, (iii) Penal Code (PC), (iv) Forest Act (FA)
Global Participation	CBD, CITES, IUCN, UNCLOS and other related organizations	This order included the CITES as the global partnership
Co-management	Section 21: Introduction of Co-management Systems	No Section on co-management
Special Declaration	Section 22: Declaration on special biodiversity conservation area	No Section for special declaration
Community	Declaration of community conservation n the Section 18	No Section for Community Conservation Area

Table 4.17 continued

Declaration of Parks and breeding centre	Declaration of safari park, ecopark, botanical garden and wild animal breeding center.	No declaration of safari park, eco-park, botanical garden and breeding centre.
Offences	(a) Cognizibility and non-cognizibility, (b) bailability, non-bailability, and (c) compoundability of offences	Offence identified by not classify.

Minimum Penalties	Minimum custody 1 year with BDT fifty thousand or with both.	Minimum custody ½ year with BDT two hundred fifty or with both.
Maximum Penalties	Maximum custody 12 years with BDT fifteen Lac (1.5 milion) or with both.	Maximum custody 2 years with BDT two thousand or with both.
Application of Technology	No proper legal section but indirect linking with ICT Act 2006.	No section on this Act.
Miscellaneous	Annual Reports, Scientific Research, Prohibition relating to airgun, Powers to amend schedules and making rules, Publication of translation, Repeal & savings.	Powers to amend schedules and making rules, Publication of translation, Repeal & savings.

4.3.6 Comparative Study on National Parks related Legislations

National Park related legislation enhances park biodiversity conservation and protection according to the existing rules and regulations, particularly Bangladesh and Malaysia have some legislation for protection of National Parks' biodiversity separately. There is a comparative study in Table 4.18 between Bangladesh and Malaysia (BFD, 2016; FDS, 2016; FRIM, 2016). From the study suggests that both countries need policy formulation according to CBD requirements on the priority of Aichi Biodiversity Targets 2020. For example, maximum imprisonment for destroying biodiversity in Bangladesh is 12 years (BFD, 2016), but in Malaysia 20 years (FRIM, 2016) and in Malawi 30 years imprisonment (IELP, 2016). According to Kana (2016), the Forest Ordinance 2015 could to improve for effective conservation towards national parks in Sarawak. Overall, Biodiversity related policies need to improve both Bangladesh and Malaysia, which stated in the Aichi Biodiversity Targets 2020, as every state party of Convention on Biological diversity (CBD).

Table 4.18: Biodiversity related legislations with enforcements in Bangladesh

Parameters	**Bangladesh**		**Malaysia**			
			Peninsular	**Sabah**	**Sarawak**	
Legislation➔	Forest Act 1927	Wildlife Conservation and Security Act 2012	National Forestry Act 1984	Forest Enactment 1968	Wildlife Protection Ordinance 1998	Forest Ordinance, 2015

Number of Schedules	4	4	6	1	2	4
Number of Sections	86	54	121	61	56	114
Number of Part/Chapters	13	10	10	5	6	8
Maximum Fine (RM**)	RM** 2,500.00	RM 75,000.00	RM 500,000.00	RM 500,000.00	RM 50,000.00	RM 10,000 ,000
Minimum Fine (RM)	RM 100.00	RM 2,500.00	RM 10,000.00	RM 10,000.00	RM 10,00.00	RM 100.00
Maximum Imprisonment	7 yrs	12 yrs	20 yrs	20 yrs	5 yrs	10 yrs
Minimum Imprisonment	Not less than 1 Month	1 yr	1 yr	1 yr	3 Months	Less than 1 yr
**RM 1= 20 BD Taka; and US $ 1=80 BD Taka=4 RM						

4.3.7 Biodiversity related Law and Policy on National Parks

National Parks are declared by notification officially gazette under Section 17 of the WCS Act 2012. In Bangladesh and Malaysia, there are some laws and policies related on biodiversity conservation through protected areas declaration and management, as shown in Table 4.19. The study suggests that both countries need to develop new Act / Policy for biodiversity conservation, for example, Bangladesh and Malaysia need separate "Biodiversity Law" and individually Bangladesh needs also separate biodiversity conservation policy.

Table 4.19: Laws and Policies on the priorities of Biodiversity Conservation

Sl. No.	Country/State	Law/Policy/Ordinance
i.	Bangladesh	Wildlife Conservation and Security (WCS) Act, 2012
ii.		Forest Act, 2000 (amended),
iii.		The Bangladesh Environment Conservation Act, 2010 (amended)
iv.		National Forest Policy, 2016 (Draft)
v.		Environmental Policy, 1992
vi.		Plant Quarantine Act, 2011
vii.		Environmental Court Act, 2010

Table 4.15 continued

viii.			Ecologically Critical Area Rules 2016
ix.			Co-management Rules
x.			Forest Products Transit Rules 2011
xi.			Forestry Master Plan
i.	Malaysia	Peninsular	Wildlife Conservation Act, 2010
ii.			National Forestry Act 1984
iii.			National Forest Policy 1992
iv.			National Environment Policy 2002
v.			National Biodiversity Policy 1998
vi.			National Wetland Policy 2004
vii.			National Biotechnology Policy 2005
viii.			Environmental Quality 1974
ix.			Pesticide Act 1974
x.			Fisheries Act 1985
xi.			National Biosafety (NBS) Act 2007
xii.			Interna. Trade in Endangered Species (ITES) Act 2008
xiii.			National Land Conservation (NLC) Act 1960
xiv.			National Land (NL) Code 1965
xv.			National Park (NP) Act 1984
xvi.			Central Forest Spine Master Plan (CFSMP)
xvii.			Heart of Borneo Initiative (HBI)
xviii.			Plant Quarantine Act
xix.		Sarawak	Wildlife Protection Ordinance 1998
xx.			Forest Ordinance, 2015
xxi.			National Forest Rules (NFR) 1962
xxii.			The National Forest (Planted Forest) Rules 1997
xxiii.			The National Parks and Nature Reserves (NPNR) Ordinance 1998
xxiv.			National Park and Nature Reserve Regulations 1999
xxv.			Sarawak Timber Industry Corporation Development Ordinance 1995
xxvi.			Sarawak Forestry Corporation Ordinance1995
xxvii.			Natural Resource and Environmental Ordinance 1993
xxviii.			Wildlife Protection Ordinance (WPO)1998
xxix			Wildlife Protection Rules (WPR) 1998
xxx.			Sarawak Biodiversity Centre Ordinance
xxxi.			Wildlife (Edible Birds' Nests) Rules 1998
xxxii.			Sarawak Biodiversity (Access, Collection and Research- ACR) Regulation 1998
xxxiii.		Sabah	Sabah Forest Enactment (SFE) 1968
xxxiv.			Sabah Biodiversity Enactment (SBE) 2000
xxxv.			Sabah Parks Enactment (SPE)1984

These laws and policies are enacted with the hope to change the way how to think about the law as a system of power and control. These relate 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 policies and technologies. Attempts are made here to determine if the mentioned laws and policies can be utilised in the integrated online clearing house mechanisms in Bangladesh, and that the information flow and decision-making could enhance biodiversity conservation which can be better than traditional system.

4.3.8 Essential Law and Policy Adoptions for National Park

National Park is an essential *In-situ* instrumentsns for biodiversity conservation. Every State Party committed to CBD to increase the National Parks with the stipulated times. For this purpose, each State Party tries to adopt relevant law and policy. Most (62%) respondents 'strongly agreed' for essential law and policy adoption for National Park management, on the priority of Aichi Biodiversity Targets 2020, as shown in Figure 4.37. The findings suggest that Government should adopt the priority of stakeholders' opinions for development of new essential law and policy for National Park management.

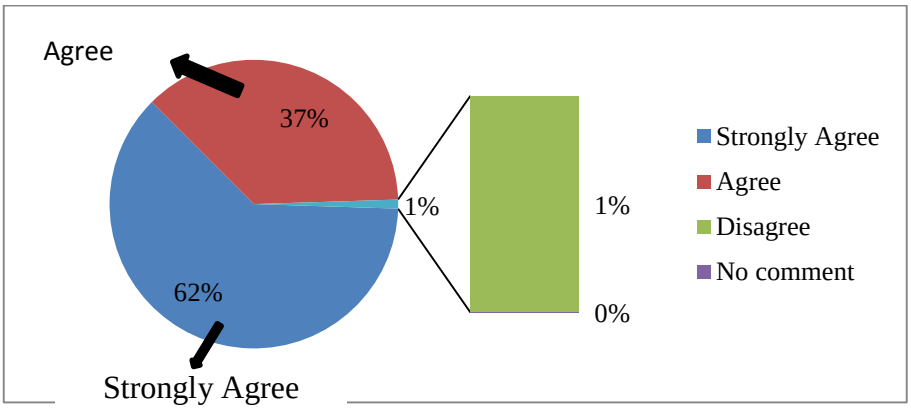


Figure 4.37: Stakeholders' opinion on essential law and policy adoption for national park

4.3.9 Oral Interview Responses

National Focal Point (NFP) involved in conserving, developing, regulating and monitoring of the National Park biodiversity protection and management, NBSAP development, mapping and biodiversity geodatabase, CHM and nature conservation related activities in general. The responses with relevant questionnaires from the relevant Ministry mentioned as below:

Question 1:

What are the main purposes of this department/organization in relation to environmental policy instruments for conservation of biodiversity towards National Park in Bangladesh?

The main purposes of the BFD in relation to National Park biodiversity are to conserve, sustain, manage and improve the park environment consistent with the functions of the Wildlife Conservation Act 2012, Forest Act 2000 (amended), and Environmental Conservation Act 2010 (amended); and their relevant policies, orders and schedules, as shown in Figure 4.38**.**

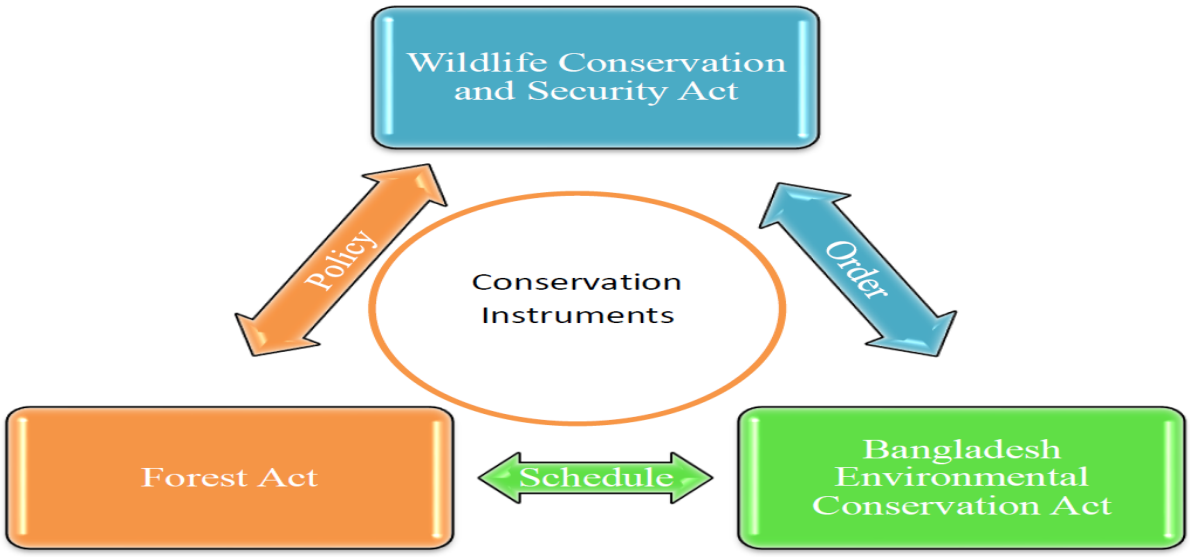


Figure 4.38: Biodiversity Conservation Instruments– Law, Policy and Order

The regulations under GoB are also liable for the execution of the resolutions decided by the CBD, as it related to Aichi Biodiversity Targets 2020, Nagoya Protocol, Bio-safety and pertinent regional and global agreements. The Departments are also responsible for the success of conservation programmes of bilateral and multilateral cooperations between regional and global treaties.

Question 2:

How frequent does the MoEF visit National Park for inspection and monitoring?

The MoEF embarked on inspection and monitoring of National Park according to need based in a year, as well as undertakes inspection and enforcement when there is a reported case of illegal activitity at any of the 17 National Parks. For Lawachara National Park, co-management team engages with park improvement activities to cooperate with administrative body. Clearly, the existing monitoring and inspection by this department is not sufficient to achieve Aich Biodiversity Targets 2020 provided by CBD to its State Party.

Question 3: What does the MoEF aim to achieve in inspection and monitoring of National Park biodiversity?

Government of Bangladesh takes initiatives for inspection and monitoring of National Park biodiversity according to the requirements of CBD as well as national demand. The main aims of inspection and monitoring to achieve National Park biodiversity by the department are:

(i) To confirm acquiescence through the regulatory necessities of the Wildlife Conservation and Security Act, Forest and Environmental Legislations.

(ii) To observe the conditions of local community and indigenous people, and to assess the potential for their participations and engagements.

(iii) To identify the potential National Park areas for improved biodiversity conservation through afforestation and reforestation programmes and removal of Invasive Alien Species.

(iv) To determine sources of public complaints including illegal logging, over-exploiting, hunting, poaching and encroaching.

(v) To enable the management to focus on potential National Park areas for ensuring sustainable biodiversity conservation.

(vi) To demonstrate the departments' commitment to enhance and protect the biodiversity, and ensure fulfilment of the Aichi Biodiversity Targets 2020.

These objectives and aspects of inspection by MoEF are adequate for the purpose of monitoring, to achieve compliance of biodiversity related regulations by the Government of Bangladesh. However, the successes of monitoring largely depend on number of indicators, such as:

(a) Technical competence of BFD and DoE officers

(b) Sufficient manpower to cover all the National Parks.

(c) Regular inspection of the National Park by the effective officers of MoEF.

(d) Proper prosecution and appropriate punishment of offenders.

Question 4: How many National Parks are declared in Bangladesh according to IUCN category?

At present, Government of Bangladesh declares 17 National Parks according to IUCN categories. These National Parks distributed in all administrative divisions except Khulna division. There is no National Park in Khulna division till to-date while a few National Parks were still waiting for Government Declaration and necessary initiatives.

Question5: Is the Wildlife Conservation and Security Act 2012 adequate for biodiversity conservation towards national park in Bangladesh?

The Wildlife Conservation and Security Act 2012 is a recent conservation and security Act in Bangladesh. It provides the national park management, Conserving of Biodiversity and wildlife protection. The State has been inserted in the Article 18A of the Constitution of the People's Republic of Bangladesh. The Act consists of 10 Chapters including 54 Sections. It includes Biodiversity Advisory Board, Authorized Officers and Scientific Committee. The Act also provides the protection of wild animals and plants with determination of vulnerable, endangered and critically endangered species according to Schedule I, II, III and IV. The Act contains the declaration of National Park, Wildlife Sanctuary, and other special conservation areas for biodiversity conservation. The Act integrates with other Acts of institution, company, industrial factory and brick burning (control) Act. The stated on management of Protected Areas with specific provisions of relevant Sections, particularly Section 14, 15, 16 and 17 for National Park Management. It includes co-management system in Section 21 to ensure active participation of all stakeholders. The Act also provides minimum penalty 1 year with a fine 50 thousand BDT or with both, and maximum penalty 12 years with a fine of 15 lac (1.5 million) BDT for biodiversity offences. Overall, this Act enhances more protection of national biodiversity to compare with previous Wildlife Preservation Order.

Question 6: *Does the Government of Bangladesh take initiative for development of national park biodiversity database on the basis of clearing house mechanism?*

Yes, the Government of Bangladesh (GoB) have taken necessary initiatives for the development of national park biodiversity database based on clearing house mechanism

(CHM). For this purposes, it is required more time for effective development of CHM due to lack of trained up staff, instrumental supports and financial availability. The GoB believes that the idea of CHM is a milestone to share biodiversity information in a tangible platform between Bangladesh and CBD. It enhances gaining information as systematic and administrative manners. It relates with biodiversity decision-making to compare the successive levels of policy, strategic, technical and operational choices. At each level, the information content is anticipated to augment in amount and in accuracy. It is stimulating task of building national biodiversity information systems with multiple development stages. It indicates more attention to be paid to biodiversity web site architecture and human computer interactions to establish a network with effective information sharing capabilities. The CHM opens the door to make state biodiversity data including habitats, species and ecosystems sharing through the modern information technological method. It also encourages, coordinates and supports the development of worldwide capacity to access biodiversity data through WDPA, museums, libraries and databanks. Intellectual property rights including repatriation of biodiversity information have become a vital issue at a common political level in the relations between various state parties of CBD. Effects on biodiversity information exchange depend entirely on the political will of the government.

Question 7: Are there any biodiversity related international laws, regulations, conventions or treaties targeted towards National Parks that is being used or adopted by Bangladesh?

Bangladesh is a ratified state party to intercontinental laws, regulations, agreements and conventions, like CBD, Ramsar Convention, UNCLOS, CITES, and so on, as shown in Figure 5.29 (Chapter 5) including regional and international treaties and agreements. These treaties, international action plans and other relevant instruments play a significant role in

regulation use, conservation, protection, management and trade of biological diversity at the regional, national and global levels.

4.3.9.1 Lawachara National Park Management

Lawachara National Park exists to provision of country laws and policies. The execution of those laws and policies into park objectives can only be achieved if park management has the capacity to execute its responsibilities. The park management decisions flow according to national top-down approach, which as shown in Figure 4.39. The study represented the Lawachara National Park Management body for creation of new decision making in connection with stakeholders, relevant institutional linkage and policy-makers. This decision flows according to bottom-up approach. The study indicated that decision-making flow of Lawachara National Park interlinked with Government's decisions and research on biodiversity.

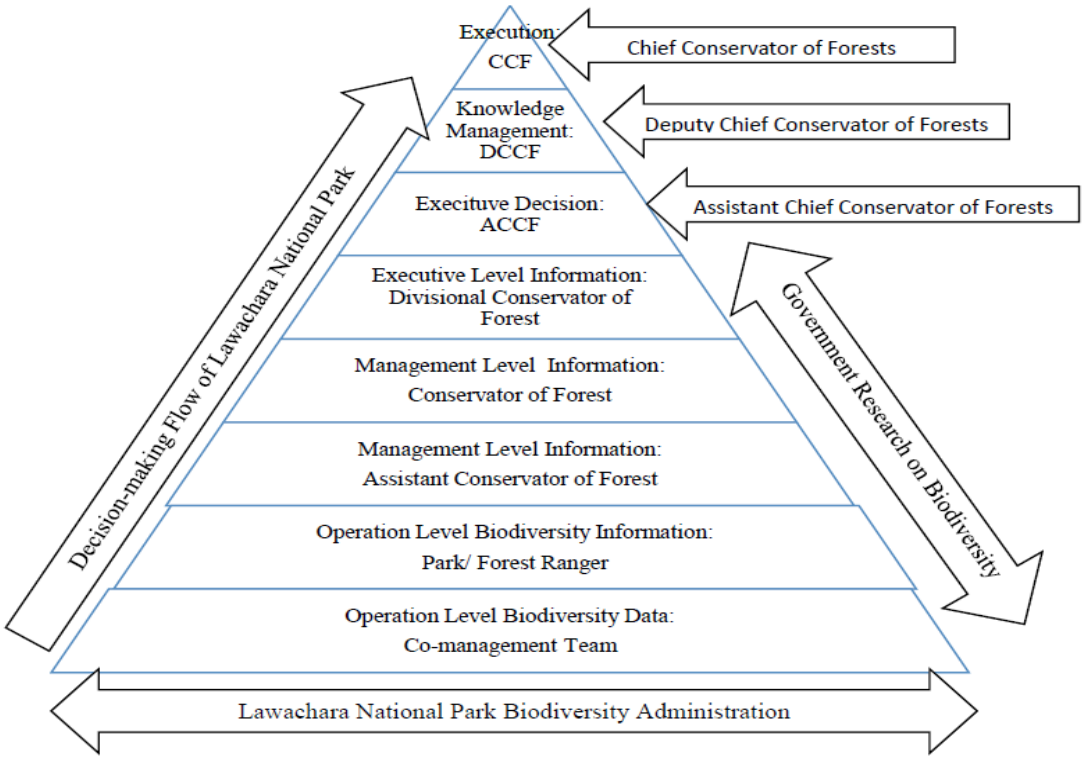


Figure 4.39: Lawachara National Park Management

4.3.10 Biodiversity Networks with Treaties/Agreements

Bangladesh is a ratified as well as signatory state party to selected regional and global conventions. These conventions provided environmental conservation policy instrument for the protection of National Parks biodiversity. These conventions are (a) CBD, (b) CITES. (c) World Cultural and Natural Heritage (MoEF, 2015); (BRC, 2016); (CITES, 2016); (APAP, 2016), as shown in Table 4.20. These treaties and conventions create new collaboration with national, regional and global agreement with organisations for biodiversity conservation and protection.

Table 4.20: National and International Agreements and Treaties.

Sl.	Agreement/Treaties	Bangladesh	Malaysia
i.	CBD (Convention on Biological Diversity)	State Party	State Party
ii.	Asia Protected Area Partnership (APAP)	Joined 2014	Non-member
iii.	World Cultural and Natural Heritage (WCNH)	Member	Member
iv.	South Asia Wildlife Enforcement Network (SAWEN)	Member	Non-member
v.	Ramsar Convention (RC) Treaties	Signatory Member	Signatory Member
vi.	United Nations Conventions to Combat Desertification (UNCCD)	Member	Member
vii.	CITES	Ratification 1981	Accession 1977
viii.	Mangrove for Future (MFF)	State member	Non-member
ix.	ITPGRFA	Signature Member-2002 And Ratified 2003	Accession Member 2003
x.	EAAFP (East Asian Australasian Flyway Partnership)	Joined 2010	Joined 2012
xii.	GTI (Global Tiger Initiative)	Member country	Member country
xiii.	International Plant Protection Convention (IPPC)	Registration on 13 September, 2016	Registration on 11 September, 2014
xiv.	EAAFP (East Asian Australasian Flyway Partnership)	Partner country	Partner country
xv.	APFNet (Asia Pacific Network for Sustainable Forest Management)	Member	Non-member
xvi.	GTF (Global Tiger Forum)	State member	State member

From the study, Bangladesh is a state party of CBD and other relevant international organizations for improving of biodiversity in connection with global parties. Bangladesh ratified or signed with 15 biodiversity conservation related regional and international associations for the period of 1971 to 2016. Out of them, Bangladesh ratified with Convention on Biologiocal Diversity (CBD) as a State Party in 1994. In the year 1970 to 1989, Bangladesh signed with only 2 International treaties, such as–WCNH and CITES. But 2010 to 2016, the country ratified/signed 5 associations, which is maximum in the whole periods. The country also signed 4 international and regional treaties separately for the 1990 to 1999 and 2000 to 2009, as shown in Figure 4.40.

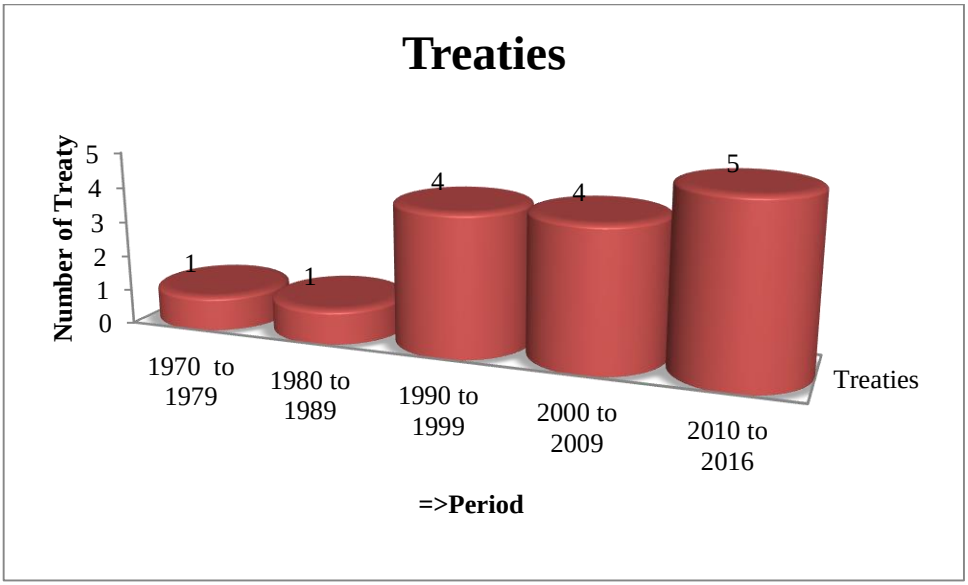


Figure 4.40: Biodiversity related regional and international treaties ratified by Bangladesh

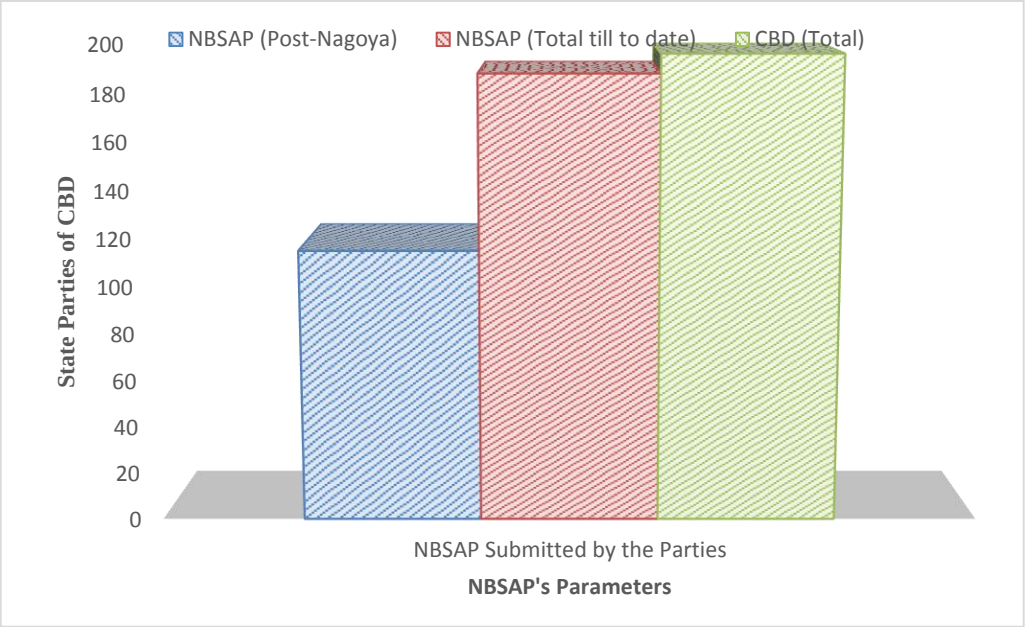


Figure 4.41: NBSAP submisstion status by State Parties to CBD

The NBSAP is the essential tool for executing the Aichi Targets 2020 at countrywide. It has been updated in order to fulfill the commitment of Bangladesh towards implementing the three objectives of CBD. The NBSAP is a state strategic plan possessed by national citizen of the country. This plan has been developed on a participating procedure connecting several stakeholders. Post–Nagoya NBSAP submission increases the present submission to CBD, as shown in Figure 4.41. Bangladesh submitted NBSAP revised version 2 in 2016, but the submission date to CBD was 2015 according to ABT 2010.

4.3.11 Conservation-related Policy and Gap Analysis

Conservation related policies contain some gaps on biodiversity protection, effective management, cooperation, coordination and integration among various sectors/departments. The MoEF in Bangladesh leads the position for integration and development of NBSAP, CHM and National Park management and forestation programmes, as shown in Table 4.21

successively including relevant policy, ministry or department and conservation related gaps. As a State Party, Bangladesh has little research on biodiversity policy and technology, where there are a lot of research gaps. In this regard, gaps are observed between update policy and application of biodiversity technology. The research finds suitable methods on the priority of observing gaps. The study suggests enhancing the revised edition of NBSAP towards National Park's biodiversity conservation. Nature conservation related policy and gap analysis discussed in Chapter 5 in details including policy options, policy integration, policy improvement and combination of conservation policy and technology for Lawachara National Park Biodiversity Management. The study also suggests that the integration of natural and social sciences in the form of two-dimensional (horizontal and vertical) gap analysis is an efficient tool (Angelstam *et al*., 2003) for the implementation of biodiversity policy.

Table 4.21: Different policies of ministries for conservation gap analysis

Policy	Conservation and Gap Analysis	Ministry/ Department
Environment Policy 1992	Biodiversity conservation is a cross-cutting issue stated in the Section 3 and 4. For this purpose, it is required to connect with global communities, like CBD.	Ministry of Environment and Forests (MoEF)
Forest Policy1994	Biodiversity policy is a sketchy manner. For this purpose, it is required incorporation with policy-makers and world-wide stakeholders.	Ministry of Environment and Forests (MoEF)
National Agriculture Policy 2013	Conserving of biodiversity enhances sustainable use of natural and genetic resources, which emphasis towards integration among sectors, department and institutions.	Ministry of Agriculture (MoA)
Landuse Policy 2001	National Park biodiversity connected with land zoning and promulgation including agricultural land and wetland. For this purposes, it is required boundary demarcation with land data bank and certificate of land ownership.	Ministry of Land (MoL)

ICT Policy 2013	National biodiversity is connected with global network for exposure of digital conservation and environmental informatics. For these reasons, it is required national park database with clearing house mechanism.	Ministry of Post and Tele-communication, and Information Communication & Technology

4.3.12 Structure of National Biodiversity Strategy and Action Plan

Every State Party must develop the NBSAP according to CBD requirements within 2015. For this purpose, Bangladesh developed NBSAP with some following charateristics showed in Table 4.22. The study showed that no proper parameters on biodiversity conservation policy, national biodiversity database, clearing house mechanism (CHM) and control measures of Invasive Alien Species (IAS). The study suggests that Bangladesh need separate biodiversity policy, CHM, and effective plan for IAS control measure according to CBD constitution and Aichi Biodiversity Targets 2020.

Table 4.22: Structure of NBSAP of Bangladesh with main chapters

Sl. No.	Chapters	Parameters	Characteristics
i.	Chapter one	Introduction	General background regarding the problems.
ii.	Chapter two	Description in brief Status of Biodiversity in Bangladesh	National biodiversity details features.
iii.	Chapter three	Status of existing country's biodiversity with the associated threats and trends	Highlights the current threats and face problems in future
iv.	Chapter four	Discuss the major issues including cross-cutting, analysing gap and overcome processes	Illustrates the principal issues on cross-edge cutting, sectoral integration and recovery status
v.	Chapter five	Proposed national biodiversity policy	State Party's biodiversity related policy
vi.	Chapter six	Key strategies and relevant actions	State Party's national Targets and Action according to CBD's requirement.

vii.	Chapter seven	NBSAP Implementation mechanisms with institutional set-up and strategies.	In details implementation with supervision, monitoring and feedback sharing
viii.	Chapter eight	Financing Strategy	Financial perspectives

4.3.12.1 NBSAP Submission during pre-COP10 and post-COP10

Convention on Biological Diversity including various parameters, such as, A= Parties that have revised NBSAPs; B=Parties with NBSAPs with under revision; C=Other Parties with completed NBSAPs; D= Parties with first NBSAPs under development; E= Parties for which there is no recent Bangladesh developed update NBSAP with new information, criteria, activities and action for development and conservation of National Park biodiversity, as shown in Figure 4.42. On the other hand, 3 State Parties did not submit NBSAP till to date. The study suggests that need more revised edition of NBSAP with targets oriented actions and implementation including intensive monitoring, reporting and evaluation with feedback sharing.

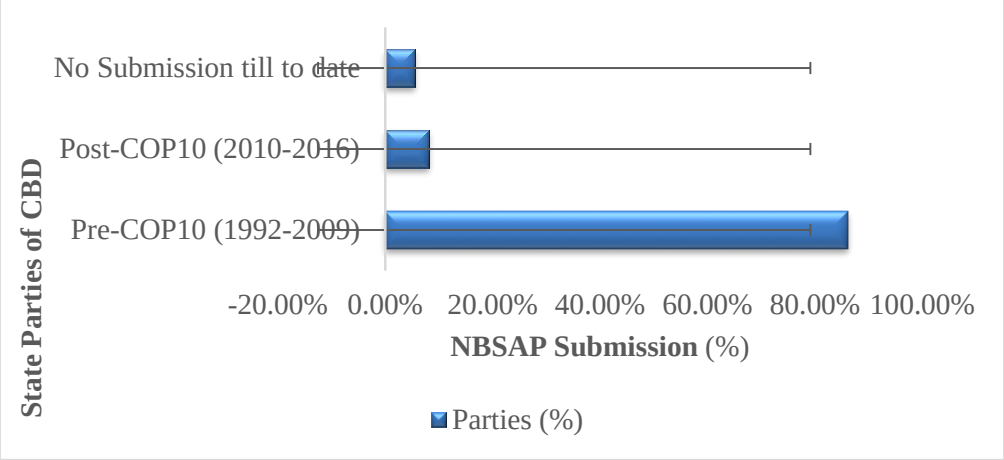


Figure 4.42: NBSAP submission during pre-COP10 and post-COP10

The study showed information about status of NBSAPs, where, PR-NBSAP-A= Parties that have revised NBSAPs, PUR-NBSAP-B= Parties with BSAPs with under Revision, POC-

NBSAP-C= Other Parties with completed NBSAPs, PUD-NBSAP-D= Parties with first NBSAP under development, PNI-NBSAP-E= Parties for which there is no recent information about status of NBSAP. There is a comparative analysis between pre-COP10 and post-COP10 in Figure 4.43.

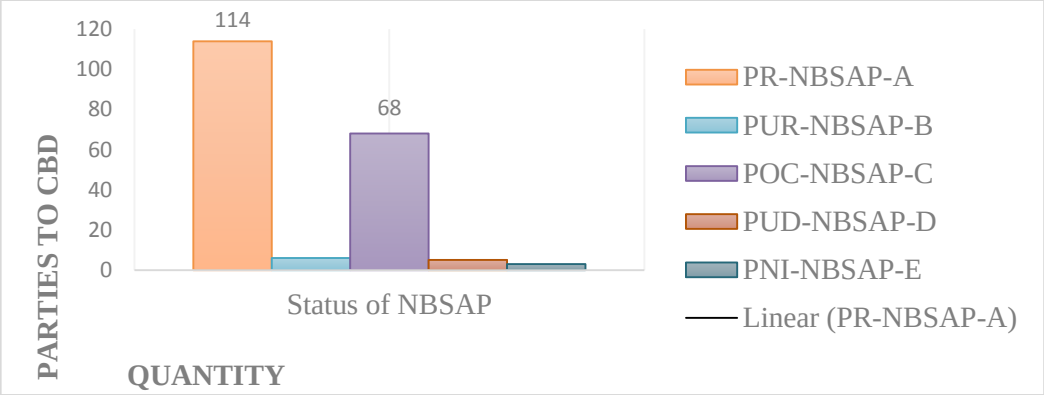


Figure 4.43: Status of NBSAP according to CBD

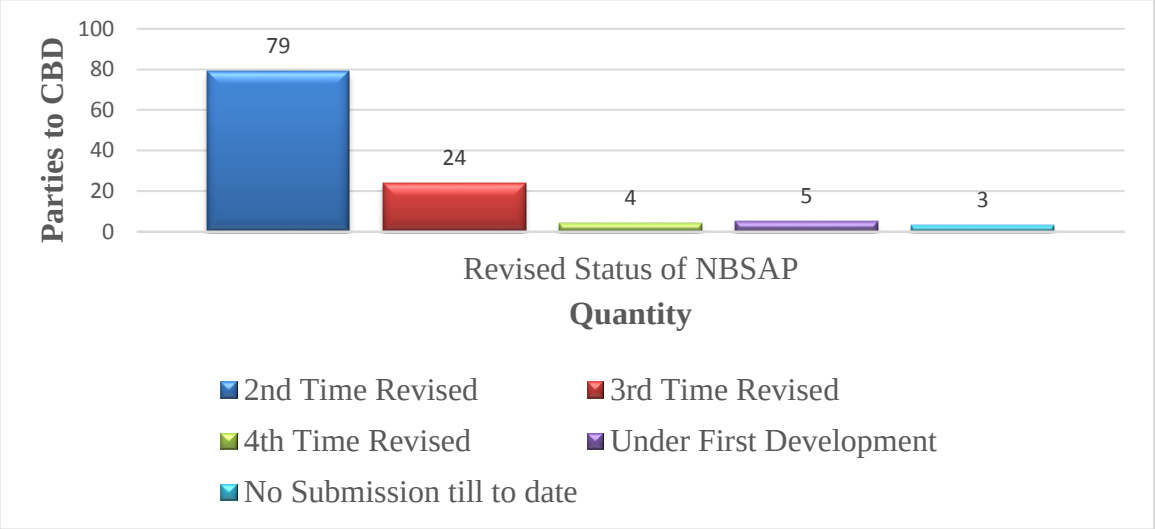


Figure 4.44: Quadrate wise NBSAP Revised Status and Submission to CBD

State parties' NBSAP status fluctuate on the category of (A), (B), (C), (D) and (E) in Figure 4.44 stated some parties submitted NBSAP maximum 4 times but some state didn't submit

in the stipulated time, which indicates to need more efforts particularly policy, education, training and financial supports.

Other state parties of CBD also revised NBSAP, showed in Figure 4.44 with mentioning additional revise edition for improvement according to Aichi Biodiversity Targets 2020. Some countries revised NBSAP until 4 cycle quadrates times. The study suggested revising the NBSAP within the stipulated time in connection with Aichi Biodiversity Targets 2020.

4.3.12.2 Party's Performance with Revised status of NBSAP

Revised status of NBSAP of the existing State Parties according to quadrate wise revised within the stipulated time and requirements of CBD, as shown in Figure 4.42. This performance enhances on the advanced priority of individual state party for conservation planning.

4.3.12.3 Role Players for NBSAP Process in Bangladesh

NBSAP plays a great role for biodiversity and planning in Bangladesh. There are some role players for NBSAP processes in Bangladesh, as shown in Table 4.9 with different activities and remarks. National focal point is the main communication channel of individual state party to deliver information sharing, transferring, feedback meeting and biodiversity related other pertinent tasks, as shown in Table 4.23. There are some differences between role players according to activities.

Table 4.23: Role Players for National Biodiversity Strategy and Action Plan.

Sl.No.	Name of Role Players	Activities	Remarks
i.	State Ministry of which work impacts on the Environment.	National Focal Person with uniqueness communication	National Focal Point (NFP) of Bangladesh to CBD.
ii.	National Pertinent Departments	For management decision disseminating and technical supports	Forest Department (FD), Department of Environment (DoE), MoEF, Bangladesh
iii.	Divisional and District Environmental and Forest Departments	For operation and technical supports	Sylhet Forest Divisional Office.
iv.	Non-governmental Organizations	For development work with partnership and cooperation	RDRS, NACOM, CNRS, USAID
v.	Community-based Organizations	Community participation and awareness	Youth Club, Community Association
vi.	Local Governments	Government connection with local administration, like district, sub-district and union council.	Local Government and Engineers Department (LGED)
vii.	Scientists	Knowledge management with innovation	National, regional and international knowledgeable people with inventions
viii.	Academia	Teaching-learning and sharing	University and Research Institutions
ix.	Industries	New idea research preservation with intellectual property rights.	Patent, design and copyright
x.	Conservation Agencies	Friendly working agencies nature loving and environmental conservation.	Conservation related research Agencies.
xi.	Research Institutions	Research, publications and dissemination	Bangladesh Forest Research Institute
xii.	Funding Agencies	Global Funding for project research	USAID, DFID, UNDP, GIZ
xiii.	Co-management Team	Collaborative management with bottom-up approach from Government decision-maker to community leader.	Lawachara co-management Team

4.3.12.4 Comparative Study on State Parties' NBSAP

The comparative study of NBSAP stated among different countries of CBD in Table 4.24.

Table 4.24: Comparative Study of NBSAP among different State Parties

Parameters	Bangladesh	Malaysia	Nepal	Sri Lanka
Name of NBSAP	National Biodiversity Strategy and Action Plan of Bangladesh (NBSAP-BD)	National Policy on Biological Diversity	Nepal National Biodiversity Strategy and Action Plan	National Biodiversity Strategic Action Plan
Strategic Year	2016-2021	2016-2025	2014-2020	2016–2022
NBSAP version	Revised version2	Revised version2	Revised version2	Revised version2
Revision date	October, 2016	2015	July2014	May 2016
Chapters/Sections	9 Chapters	3 Sections	7 Chapters	5 Chapters
Targets/Themes	20 Targets	17 Targets	6 themes	12 Targets
Actions/Activities	50 Activities	60 Actions	226 Actions	87 Actions
Short Term Plan	6 years	2.5 years	7 years	7 year
Monitoring Actor	Ministry of Environment and Forests (MoEF)	Ministry of Natural Resources and Environment (MNRE)	Ministry of Forests and Soil Conservation (MoFSC)	Ministry of Mahaweli Development and Environment
Linking with Clearing House Mechanism	Not developed CHM till to date.	Developed CHM	Not developed CHM till to date.	Not developed CHM till to date.
Linkage with SDG	SDG 13, 14 and 15 Linkages with NBSAP	No mentioned	SDG linkage with relevant goals	SDG linkage with relevant goals
Sectoral Policies Integration	Mentioned the integration with different sectoral policies.	Indirectly mentioned for sectoral policies integration.	Mentioned the different sectoral policies integration	Mentioned the different sectoral policies integration

The study illustrates that Bangladesh developed NBSAP with 9 chapters but others contain less chapter than that of Bangladesh. Nepal contains maximum actions (226) than that of other countries. The study suggests that Bangladesh needs to revise the forest policy and environmental conservation policy, which relates to National Park biodiversity conservation, particularly Aichi Biodiversity Targets.

4.3.12.5 NBSAP Policy Integration

NBSAP is the main instrument for development of state party's National Park biodiversity. For this purpose, policy integration is mandate among different sectors/ department for cooperation, information exchange, sharing, feedback monitoring and update reviewing with some ministries integration for NBSAP policy development (MoEF, 2004), as shown in Table 4.25. The study enhances the policy integration for effective roles on Lawachara National Park biodiversity management, like Forest Department and Ministry of Environment and Forests (MoEF).

Table 4.25: NBSAP Policy Integration among different Ministries

General Policy Role	Key Roles	Effective Ministry
Policy leadership on national biodiversity conservation.	Assessment of planning, programming and taking necessary action towards biodiversity conservation. Sectoral and departmental integration for conserving of national park biodiversity. Besides, update NBSAP, Networking, Monitor ing, Implementing, Enforcement, Initiatives, Coordinating and Reporting to CBD.	Ministry of Environment and Forests (MoEF), Bangladesh (BD).
Policy advancement, formulation and regulatory leadership	Development of dynamic mechanisms for agri-biodiversity conservation, implementation, coordination, exploration, documentation and legal instrumentations in the agriculture sector.	Ministry of Agriculture (MoA), BD.
Policy improvement, origination and monitoring leadership	Enlargement of vigorous instruments for in-situ and ex-situ conservation, enactment, harmonisation, investigation, documentation and authorised controls in the Fisheries and Livestock sectors.	Ministry of Fisheries and Livestock (MoFL), BD
Policy and technology Encouraging, systematic research on national digital conservation	Establishment systematic capacity building. Directing and implementating of biodiversity related digital technology in connection with MoEF and SPARRSO.	Ministry of Science and Information & Communicatio

Table 4.25 continued

		n Technology (MoSICT)
Using Biodiversity Registers at local community and indigenous people.	Connecting local administration, co-management team and other stakeholders for conserving of biodiversity. Assimilating, local level planning and institutional capacity building for national park biodiversity conservation.	Ministry of LGRD & Cooperatives (MoLGRDC)
Law and Policy upgrading, instigation and observing leadership with suitable network setting.	Improvement of active mechanisms for fresh and marine water biodiversity conservation, operation, management, assessment, documentation and preservation, legal tools in the water sector.	Ministry of Water Resources (MoWR)
Policy-mixing of nature conservation views through Land and sustainable resources use policy.	Familiarising nature conservation associated commitments for protection and development.	Ministry of Land (MoL)
Generating countrywide consciousness through media exposure.	Responsibility on media capacity building actions programmes for producing mass alertness on information and digital communication.	Ministry of Information (MoI)
Sponsoring green banking based goods and services through market promotion.	Developing, Employing and monitoring green-banking related policies, laws, other Sections in connection with bilateral and multilateral agreements.	Ministry of Commerce (MoC)
Incorporating bio-environmental conservational education through formal and informal curricula development	Environmental Education Awareness, Institutional supports, capacity building towards teachers and facilitators. Organising scientific and ecological field trips, and country-wide conservation campaign.	Ministry of Education (MoE), BD
Evaluation, Formulation and modification of existing bio-environmental laws and policies.	Formation as a 'Sunshade Act' for wide-ranging biodiversity conservation related law and policies.	Ministry of Law, Justice & Parliamentary Affairs (MoLJPA)

4.4 Assessment of Biodiversity Information Systems

Biodiversity Information Systems (BIS) is a part of Clearing House Mechanism (CHM) with Integrated Online Database, which discussed successively.

4.4.1. Building Biodiversity Information Systems

Biodiversity Information Systems (BIS) is a database which consists of biodiversity related all informations for collecting, processing, disseminating, storing, exporting data for evaluation and decision-making. BIS connected with World Database on Protected Areas (WDPA), Biodiversity Clearing House Mechanism (BCHM) and Integrated Online National Database (IONDB). The researcher can develop biodiversity information system using MS Access 2013 to prepare with design views of Table, Query, Form and Report on multi-relationships among each other, as shown in Figure 4.45 to develop the biodiversity information systems with multi-relationships.

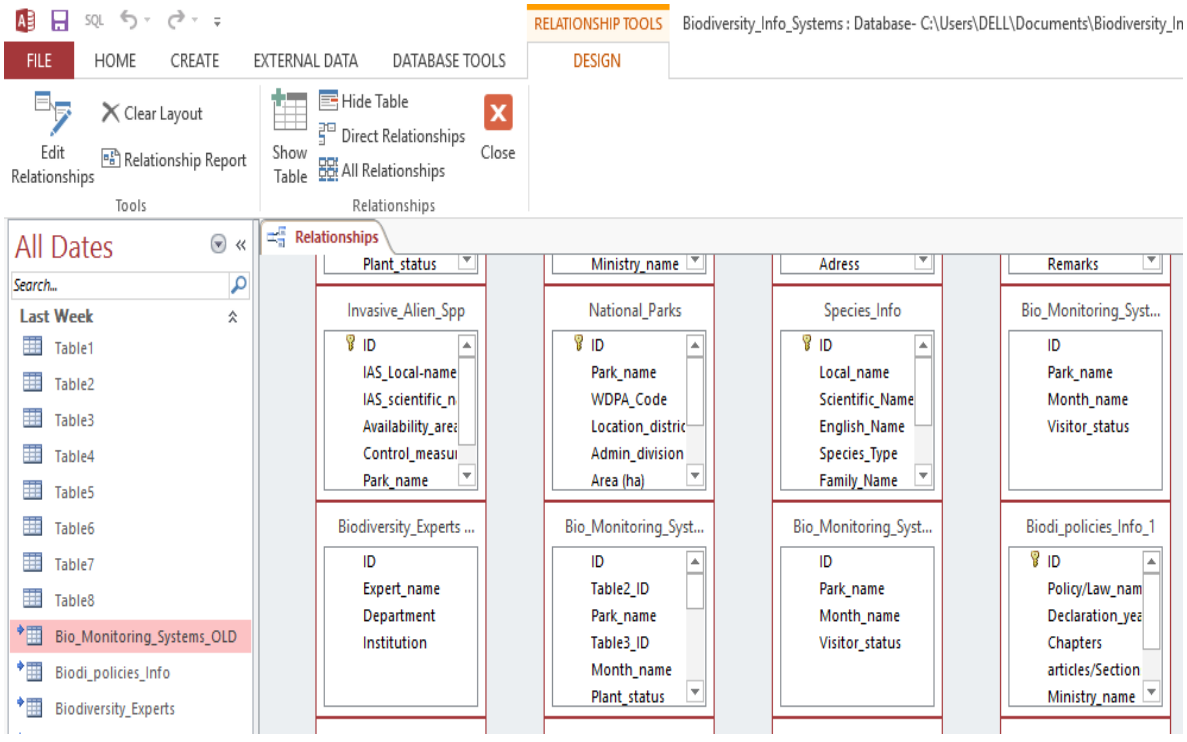


Figure 4.45: Multi-relationships for Biodiversity Information Systems.

Relationships for Biodiversity Information System (BDIS/BIS) with one to one, one to many, many to many and many to one relation. It mentioned that one research paper published at Malaysian Journal of Medical and Biological Research. These relations are: (i) National Parks Database, (ii) Species Information Systems, (iii) Taxonomic Information Systems, (iv) Biodiversity Monitoring Systems, (v) Biodiversity Policy Info, (vi) Biodiversity Experts, (vii) Biodiversity Networks, (viii) Invasive Alien Species Information Systems, and (ix) Query files. The sample BIS can be used by the relevant users according to demandful information of national parks as well as other protected areas of Bangladesh and other state parties in the world. Any application programming can be used for BIS report wizard as shown in Figure 4.46, like: MS Access 2013, Visual Basic, Oracle 11g and so on. Here, MS Access 2013 is being used as for example.

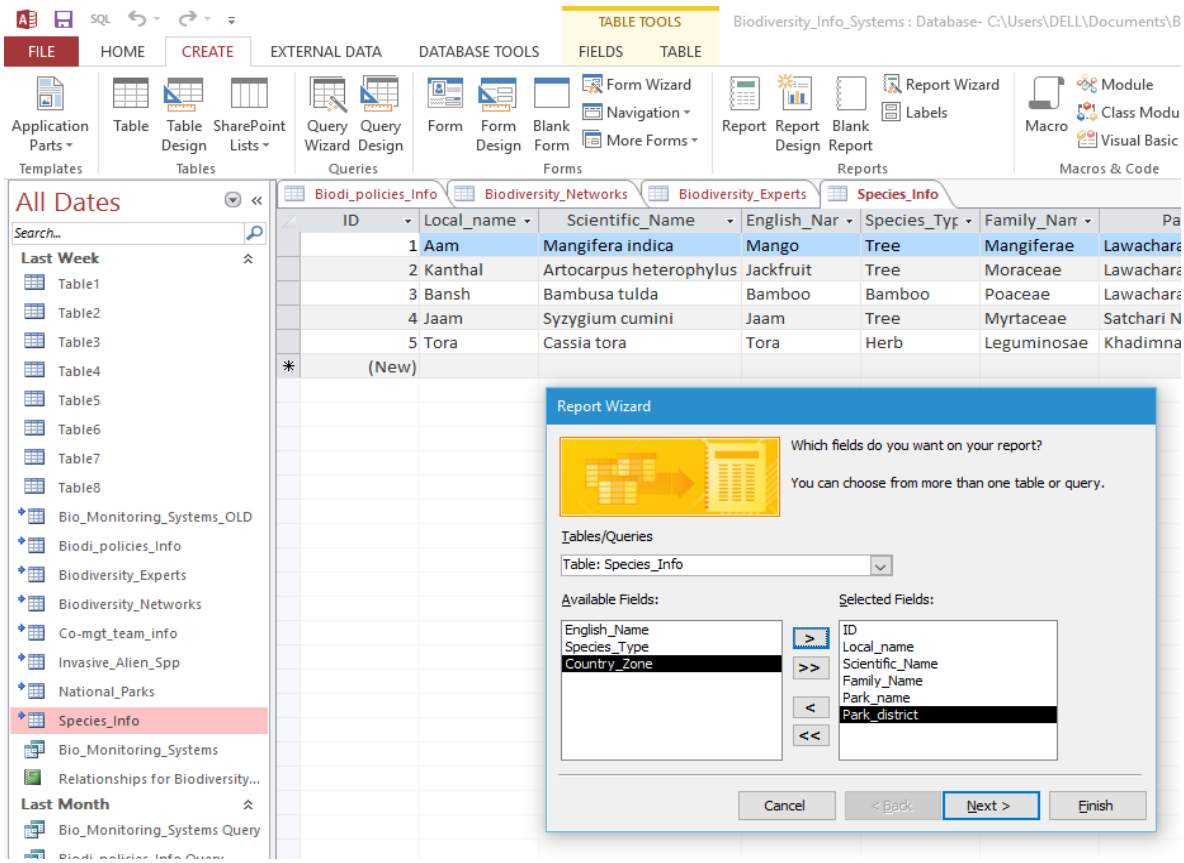


Figure 4.46: Database tools used for report wizard of Biodiversity Information system.

4.4.2 BIS Database Report

For database report, the researcher used here report wizard options, as shown in Figure 4.46 on database tools indicating wizard interface and print report of Lawachara National Park biodiversity within a short time to make decisions. Biodiversity Information System Database report system can augment for sending national reports to convention on Biological Diversity (CBD) within the stipulated time. For this purposes, the database users can develop entity relationship diagram (ERD), then report wizard through application software, like MS Access 2013, Visual Basic, or Oracle programming. Here the study used MS Access 2013.

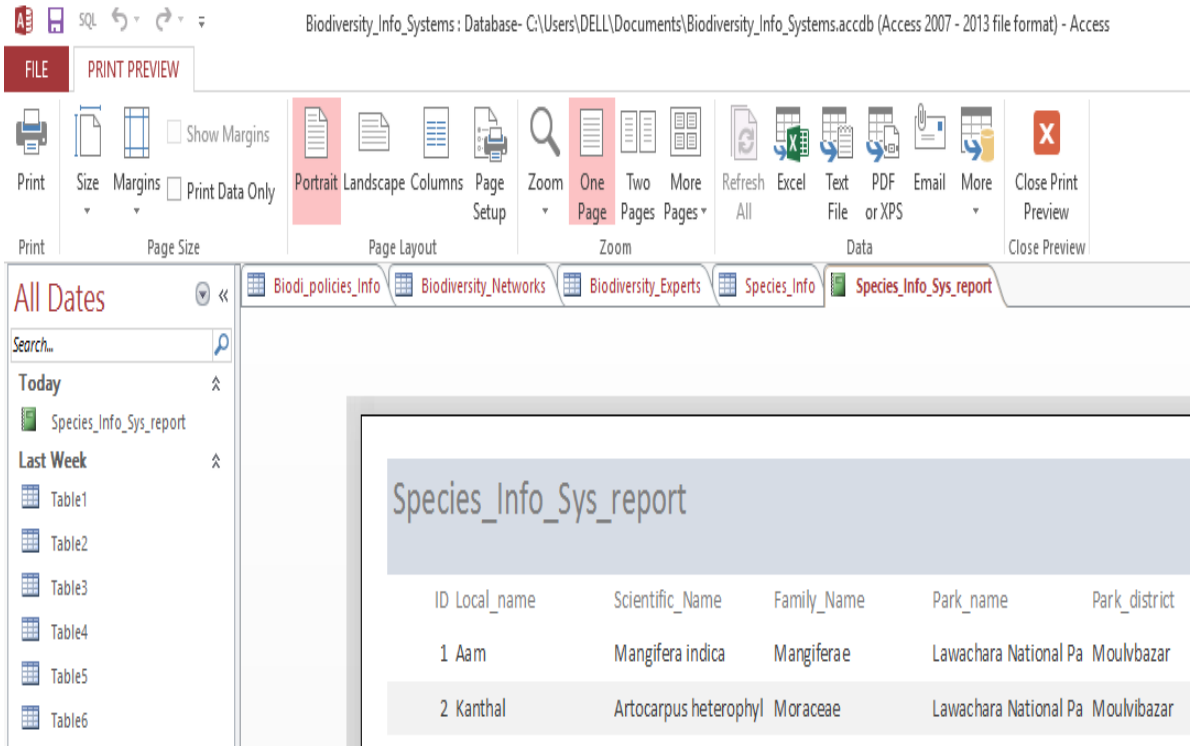


Figure 4.47: Database Report on Species Information Systems (SIS).

4.4.3 Using Integrated Online Biodiversity Conservation Database

Biodiversity conservation databases created to expect where study determinations may be directed, to be reprocessed as alternates for complete assessments of species in a study of biological diversity at a county scale, and to envisage conceivable effects of conservational

vicissitudes (CBD, 2016; Aspinall, 1995). The BIS consists of some essential components for integrated database as shown in Figure 4.48. Integrated Biological Diversity Information Systems (IBDIS) is a central database which interlinked with MoEF including BFD and DoE. It is the application of information systems that helps to improve management, operation, monitoring, sharing, detection, assessment and enquiry of the biodiversity. It forms on the basis of species taxonomic, systematic and biological evidence warehoused in digital conservation manner. The database stores information on visitor's catalog, vegetation mapping with the connection of Regional Navigation Satellite System (RNSS) interlinked with Space Research Remote Sensing Organization (SPARRSO). Therefore, other stakeholders can utilize the IBDIS according to their requirements as indicated in BIS database. A specific value of IBDIS is to identify species status, site quality, mapping segment and geographic location, that could be utilised as bio-catalysts of ecological based management and provide early cautionary of changes in National Park areas.

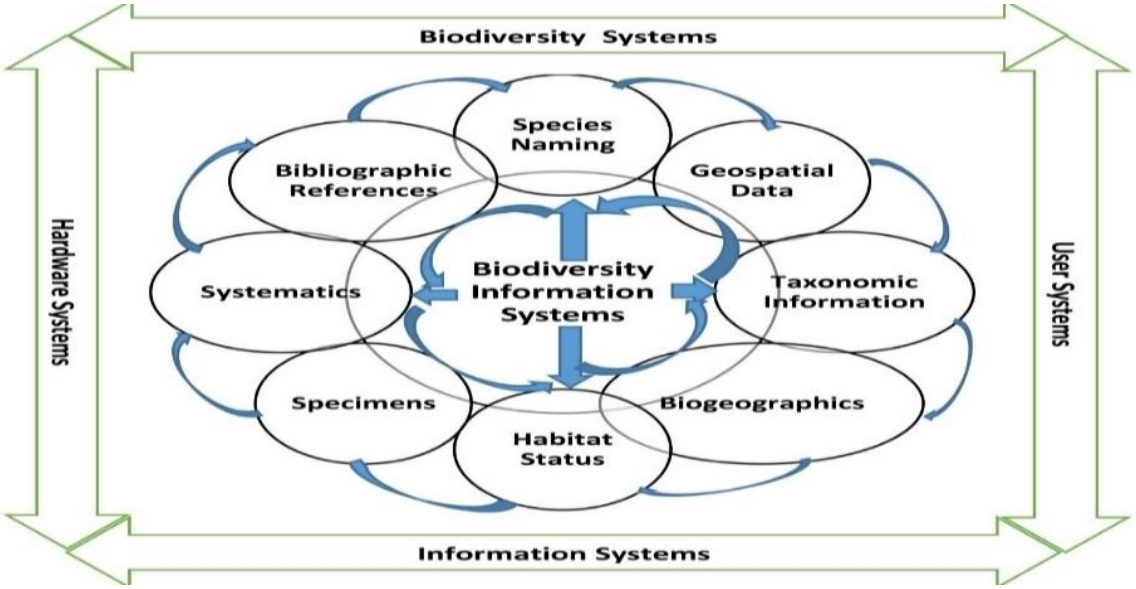


Figure 4.48: Components of Integrated Online Biodiversity Database (ITIS, 2017).

Biodiversity database is a national as well as global connected database. This database contains defferent types of users including students and research assistants, researchers and

specialists, national scientists and technologists, and educators and policy-makers, as shown in Figure 4.49. The Biodiversity database users are two types on the priority of online and offline databases. On the other hand, for security purposes, these integrated databases are used to general user and administrative user. This biodiversity database enhances to digital conservation, which is the requirements of CBD forwarded to the State Party. Government of Bangladesh takes initiative for development of National Biodiversity Database.

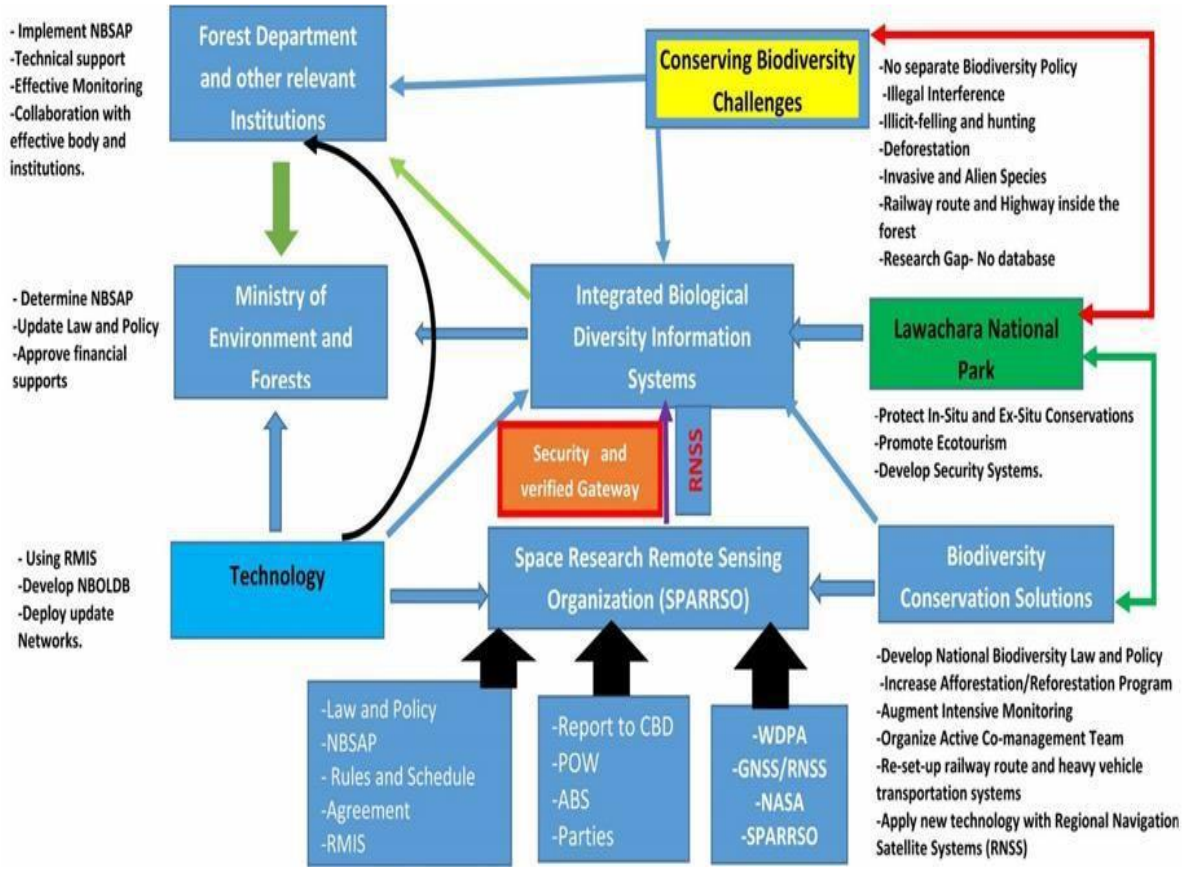


Figure 4.49: Biological Diversity Information Systems at Lawachara National Park.

4.4.4 Biodiversity Databse Users

Administrative users are mainly top management executive staff, decision-maker, and network security manager, monitoring officer and Chief Parton / Adviser. This database interlinked with World Database on Protected Areas (WDPA), Red List Database, Species Information Systems Database, and Taxonomic Information Systems Database, Global

Invasive Alien Species Database, Biodiversity–Clearing House Mechanism Database, CBD– State Parties Database, Biodiversity related National and Global Experts Database, Global Navigation Geospatial Database, Global *Ex–situ* Database including Global User Geographic Positioning Systems, as shown in Figure 4.50.

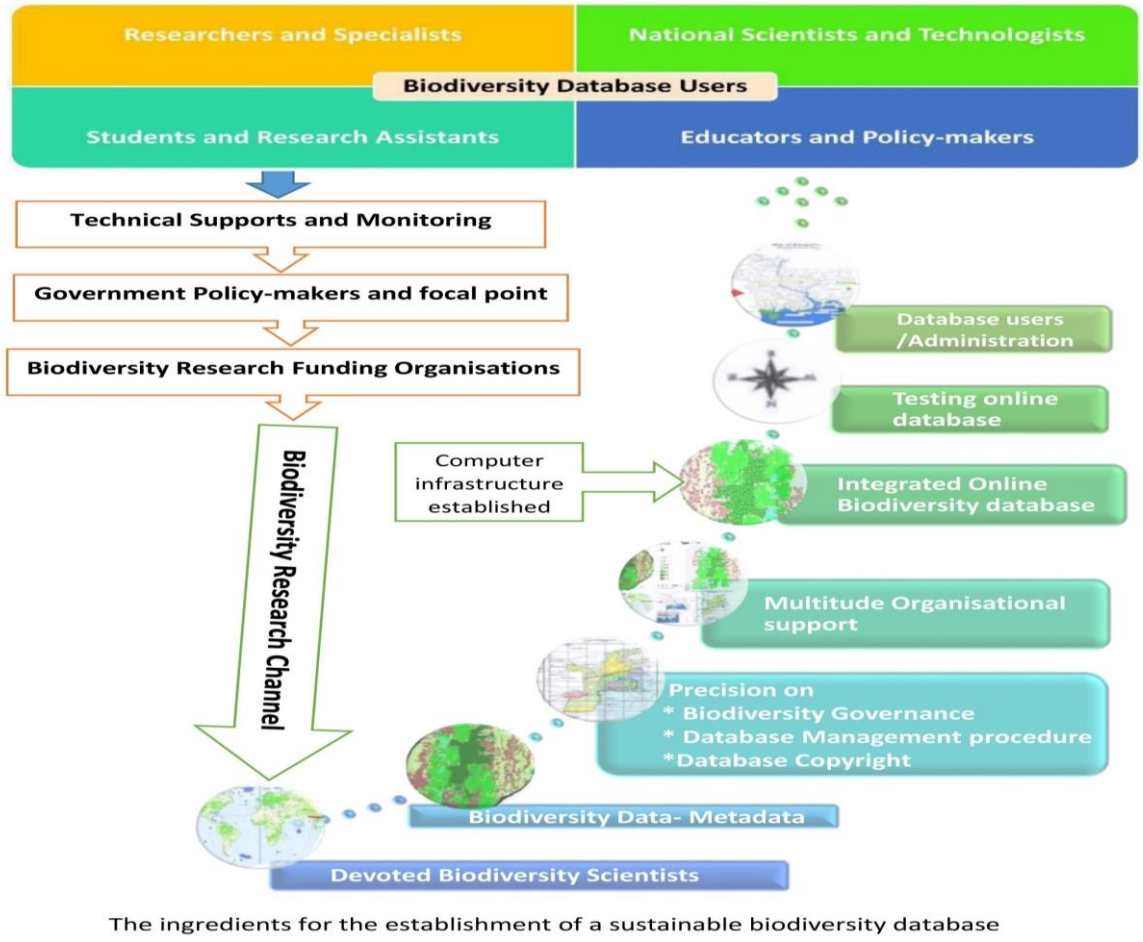


Figure 4.50: Different users of national biodiversity database

This database also contains biodiversity research funding organisation including research Grants, scholarship, fellowship, and other relevant funding opportunities. The WDPA includes different ingredients for the establishment of sustainable biodiversity management and digital conservation through online exchange information on national parks, wildlife sanctuaries and relevant other reserved conservation areas. The establishment of suitable

biodiversity database enhances technical supports with monitoring, decision-making and research networking.

4.4.5 Security of BDIS Database

All data base need proper safety for its effective and efficient operations. But in Bangladesh about 53% respondents were of the opinion that less secure as a whole that deals virus, spam, cookie, malware and so on with the obsolete technology and information systems, compared to only 7% who were of the opinion that BIS database more secure as shown in Figure 4.51.

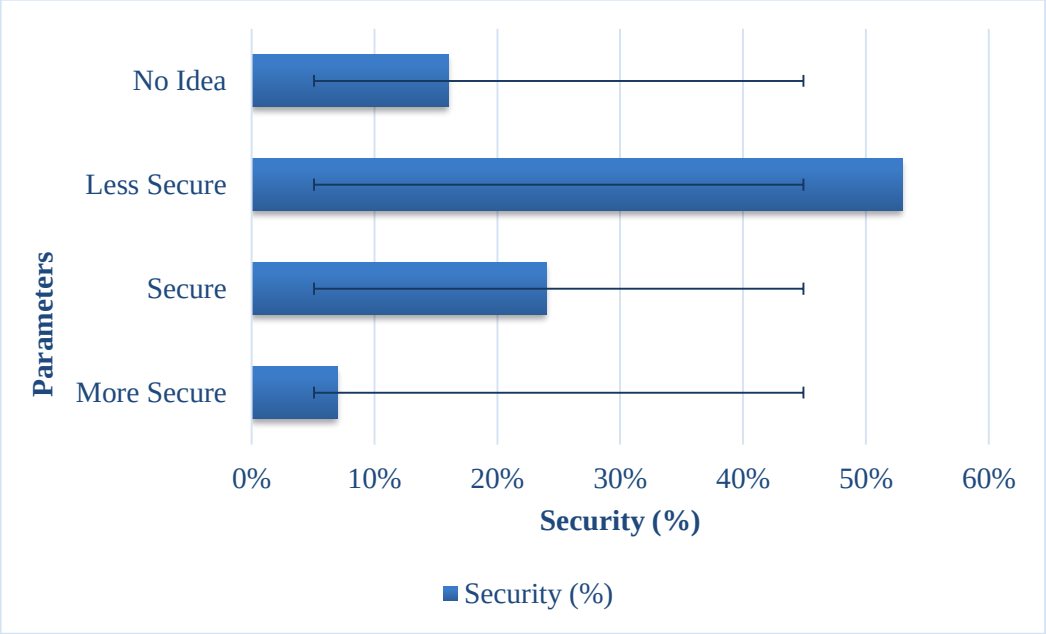


Figure 4.51: Security Status of National Biodiversity Database

This research also wish to explore the BDIS awareness and status linkages with lawyers, policy makers, government officials, academics, researchers, visitors, decision-makers and relevant stakeholders with tools connecting to update technological arena with the cooperation of computer-based Resources Information Management System (RIMS) unit in Forest Department for promoting and harmonizing the existing nature conservation policies in Bangladesh. The study also investigates the actual indicators/instruments and regulatory

framework of the available conservation operations and policies related to biodiversity safeguarding at Lawachara National Park in Sylhet division of Bangladesh. This biodiversity database system can be operated smoothly by the National Park Manager, Academia, Biodiversity Specialist, Scientist, Network Technologist and relevant researchers.

4.4.5.1 Stakeholders' Perception for Biodiversity Information

Biodiversity is important in our life. However, we cannot perform a single task without its information. The importance of biodiversity information is essential to the respondents in the study areas are shown in Figure 4.52**.**

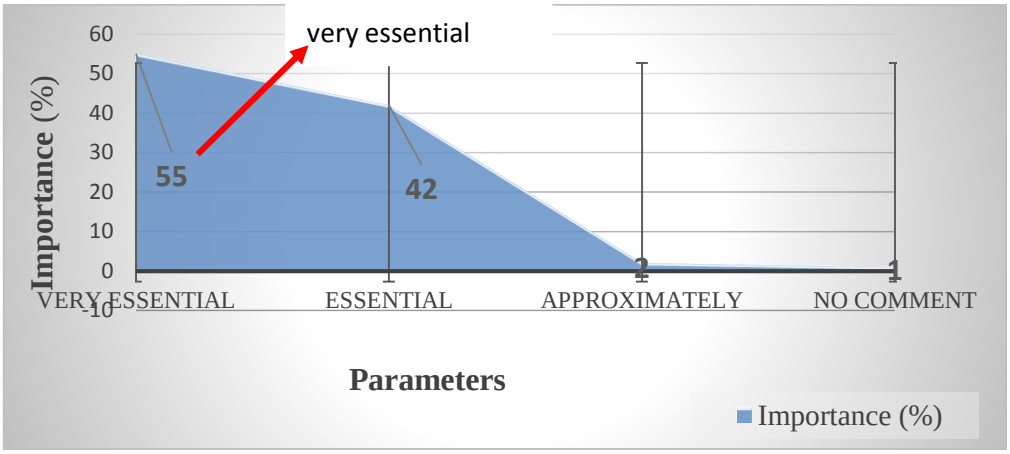


Figure 4.52: Importance of Biodiversity Information

About the 55% of the respondents opined their opinions as very essential and 42% as essential and only 1% 'no comment'. While much biodiversity and ecosystem information presently exist and much more is composed on a periodic basis. For this purpose, biodiversity information system incorporates with different formats, conventions and update technologies for ensuring digital conservation. A significant concern is formative how to practise this evidence to paramount envisage prevailing conservation of biodiversity towards Lawachara National Park.

4.4.5.2 Perception on Biodiversity Information Systems

BDIS shows a vital part in researches on national park biodiversity protection particularly in the arena of natural resources and digital technology that deals with the impact of activities on eco-systems. In Figure 4.53, it can be seen that about 58 respondents who are academic staff performed utilizing BDIS for their research activities sturdily for sustainable protected area management, compared 2 Postgraduate/Post Doctorate for their research.

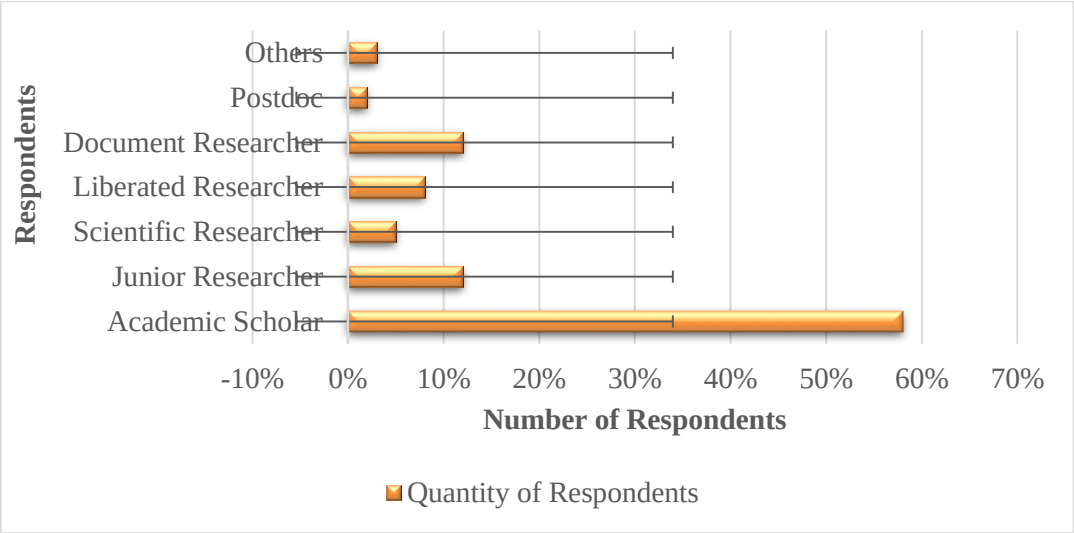


Figure 4.53: Research Role Play among Stakeholders on Biodiversity Information Systems

The study found that indigenous community members have specific information of threatened wildlife at Lawachara National Park (LNP) that can improve the step of consciousness of conservationists, scientists and researchers. It is, consequently, required to disseminate perception of the crucial to indulgence natural capitals and participate, therefore, to avert their reduction (Salem, 2003; CBD, 2016) at Lawachara National Park. This perception enhances for the biodiversity database security with sustainable natural resources uses towards Lawachara National Park, Bangladesh.

4.4.5.3 Biodiversity Knowledge Management Systems

Knowledge of Respondents in Biodiversity Information Systems is imperative, because, with the knowledge on BDIS, they need to know the worth of relevant database that deals with the input, processing, and output with the technology and information systems. In Figure 4.54, 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 are 'more informed' of the BDIS.

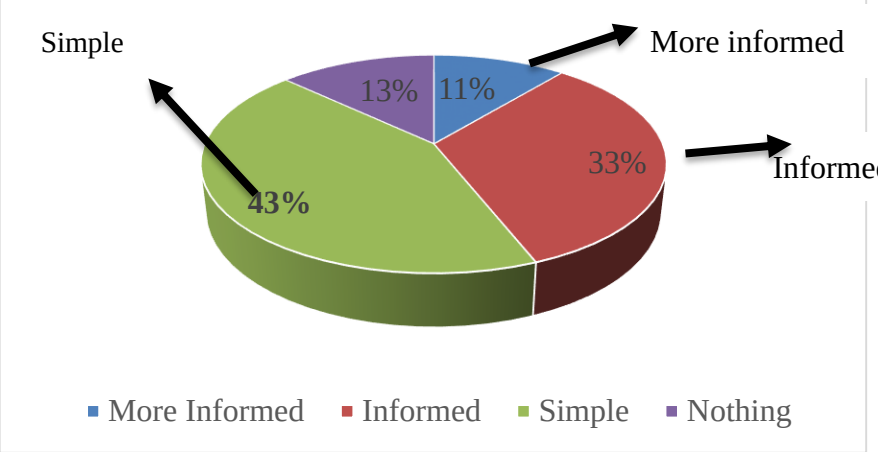


Figure 4.54: Knowledge of Respondents in Biological Diversity Information Systems (BDIS)

The results revealed that BDIS implementation performed surrounding encounters which were mostly unease managing, direction, and publics convoluted in BDIS application processes. Moreover, it can be decided that the main concerns which the BIS execution task should extant with largely fixated on the relevant system and their system tasks. The previous research outcome is focussed on special parameters and significances, and it stated (Burger *et al*., 2009; Arino, *et* al., 2011; Kornkaew, 2012) that application of BIS primarily marks the mentioned procedure which indicates to modification, for case situation, sequences, recent advancements in information technology application, national biodiversity and

protected area databases, related system database design, research evaluation, ecological monitoring, public rendezvous, data security and so forth at LNP in the north-eastern part of Bangladesh.

4.4.6 Assessment of Geospatial Technology for Biodiversity Conservation

There are several applications of geospatial technology for biodiversity conservation, which illustrated successively. This geospatial technology enhances the LNP with digital conservation with dissemination of biodiversity information towards national as well as global perspectives.

4.4.6.1 Geodata Centric Conservation Mode

Geospatial database technology can apply for digital conservation. NASA's multi-platform Earth Observation System generates over one terabyte of geospatially referenced raster data per day (Shekhar and Chawla, 2003). Geodata is the spatial dataset collected with geodata centric mode. The Goedata centric mode consists of (i) Geodata Sensor centre, (ii) Geodata receiving station, (iii) Geodata processing centre, (iv) Geodata distribution centre, and (v) Geodata application centre, as shown in Figure 4.55. The study collected the geodata with active application of such datasets towards Lawachara National Park to inform the existing biodiversity status. The study illustrated geodata including existing agricultural lands, encroached agricultural lands, encroached fallow lands, normal fallow lands, and forested areas, and Rubber gardens, community settlements, Tea estate, and water bodies (CEGIS-WARPO, 2012). Geospatial systems determined to solve common problems in spatial computing have been tailored with a great deal of achievement to geospatial computing.

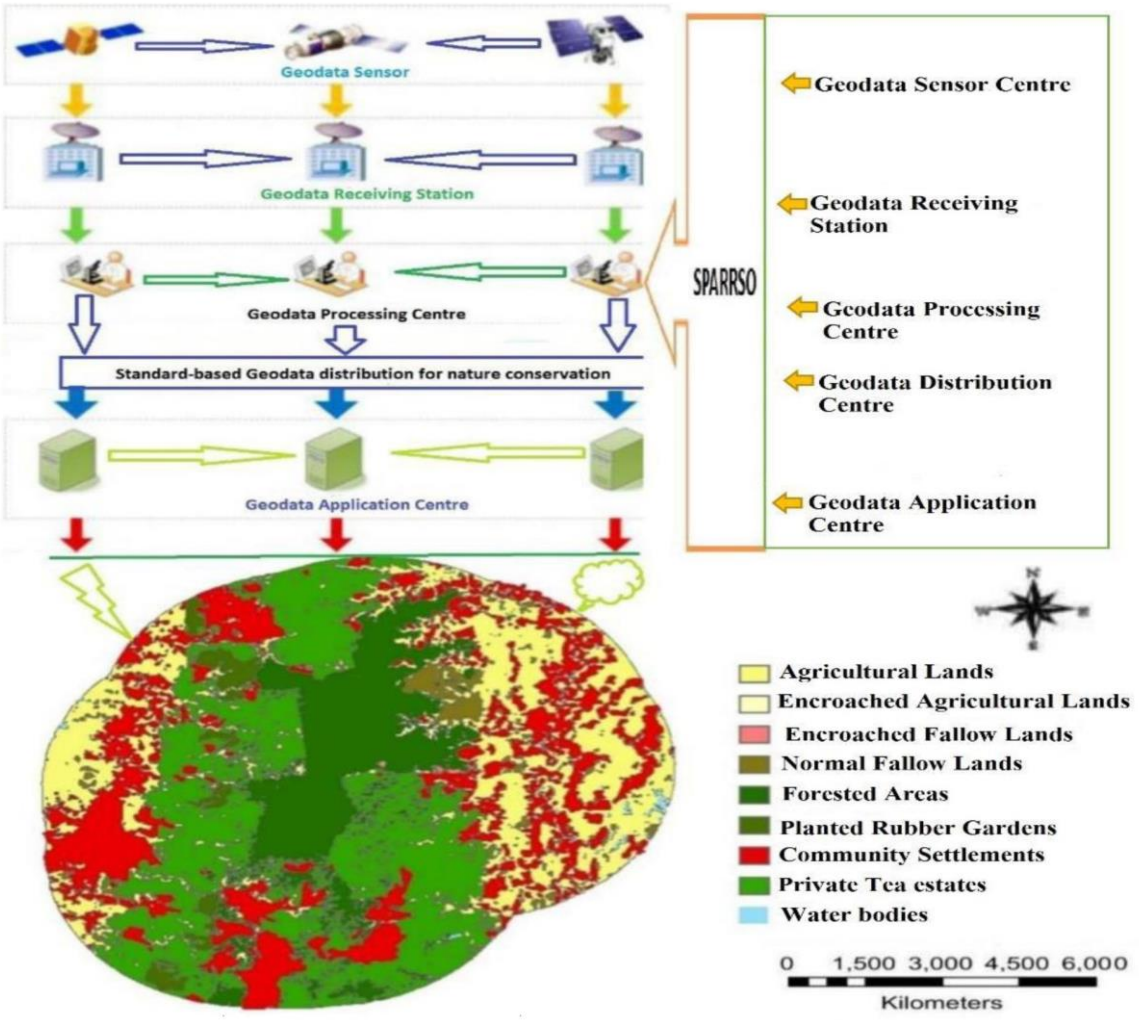


Figure 4.55: Geodata centric biodiversity conservation mode at Lawachara National Park

4.4.6.2 Geospatial Application on ecological integrity

Throughout the country, the wetlands are decreasing, due mainly to anthropogenic activities like unplanned expansion of housing and settlements, industrial installations and construction of road networks with relevant parameters, as shown in Figure 4.56. The study represented on agriculture, vegetation and fallow land with ecological integrity components, particularly Lawachara National Park Biodiversity Conservation. The study suggested requiring monitoring with geospatial application towards Lawachara National Park diversity status.

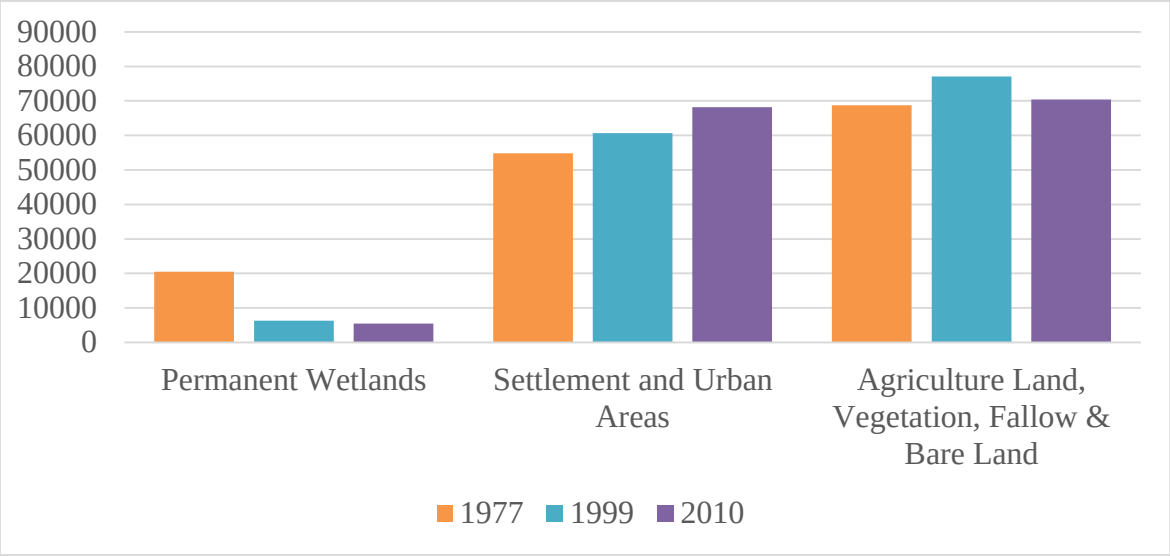


Figure 4.56: Changes in Land classes during the period 1977 to 2010 in Bangladesh

The changes in land classes showed in percentage in the same year of 1977-2010 in Figure 4.55. Degradation status of wetlands could be realized from an analysis of CEGIS taking Landsat2 MSS Satellite images of 3 January 1977, Landsat5 TM Satellite images of 1999 and Landsat5 TM Satellite images of 2010 for the three landcover classes (CEGIS-WARPO, 2012). The study found that the area of landcover of perennial wetlands was 20,503 ha in 1977; the same has been reduced to 5,520 ha in 2010. It denotes a reduction of 73% of wetlands occurred within the period of 1977 to 2010 **(**Figure 4.57). The landcover class of settlement and urban developed area was 5,4864 ha in 1977 which has been increased to 68,144 ha in 2010 that denotes an increase of 24% of settlement and urban developed area within the period of 1977 to 2010 (CEGIS-WARPO, 2012). The landcover class of agriculture land, vegetation, fallow and baren land was 68,708 ha in 1977 which has been increased to 70,417 ha in 2010 which denotes an increase of 2.48% of agriculture land from 1977 to 2010 (CEGIS, 2012). The study clearly that indicates that pressure on wetlands ecosystems is dramatically increasing (CEGIS-WARPO, 2012).

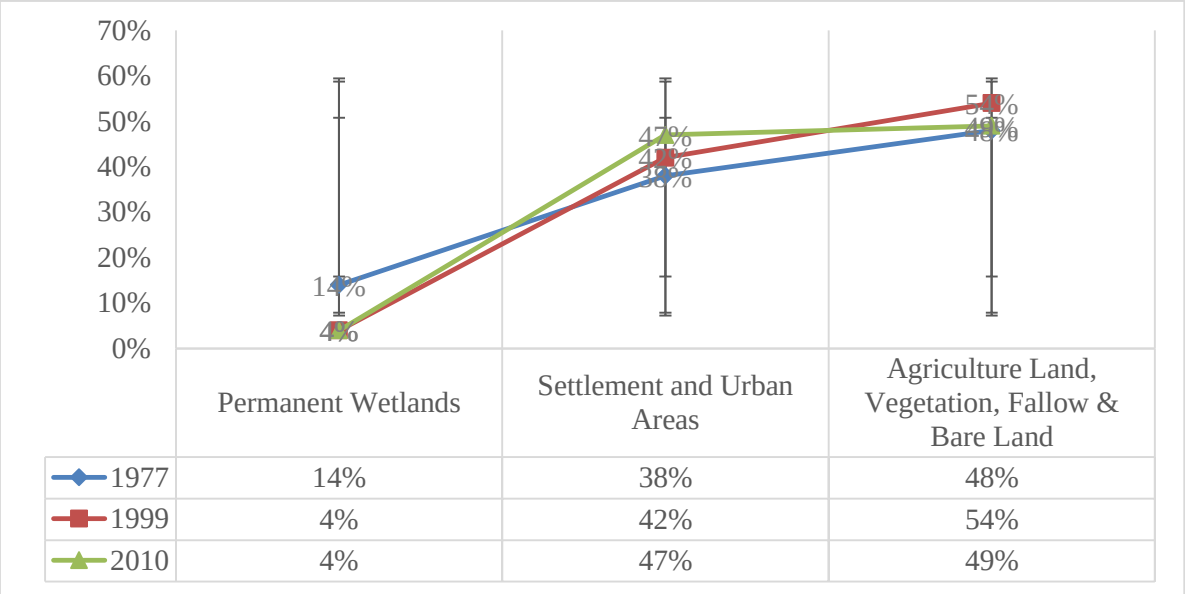


Figure 4.57: Changes in Land classes (%) during the period 1977 to 2010 in Bangladesh

Spatial ecological integrity on biodiversity is less, where mother tree reduced continuously at Lawachara National Park in Bangladesh, as shown in Figure 4.58. Mother enhances on species growth and development with other species association, for example, vulture species stay at big and tall mother tree, due to shortage of these mother trees, they left their habitation. The study suggests increasing afforestation and reforestation programmes regularly with intensive monitoring.

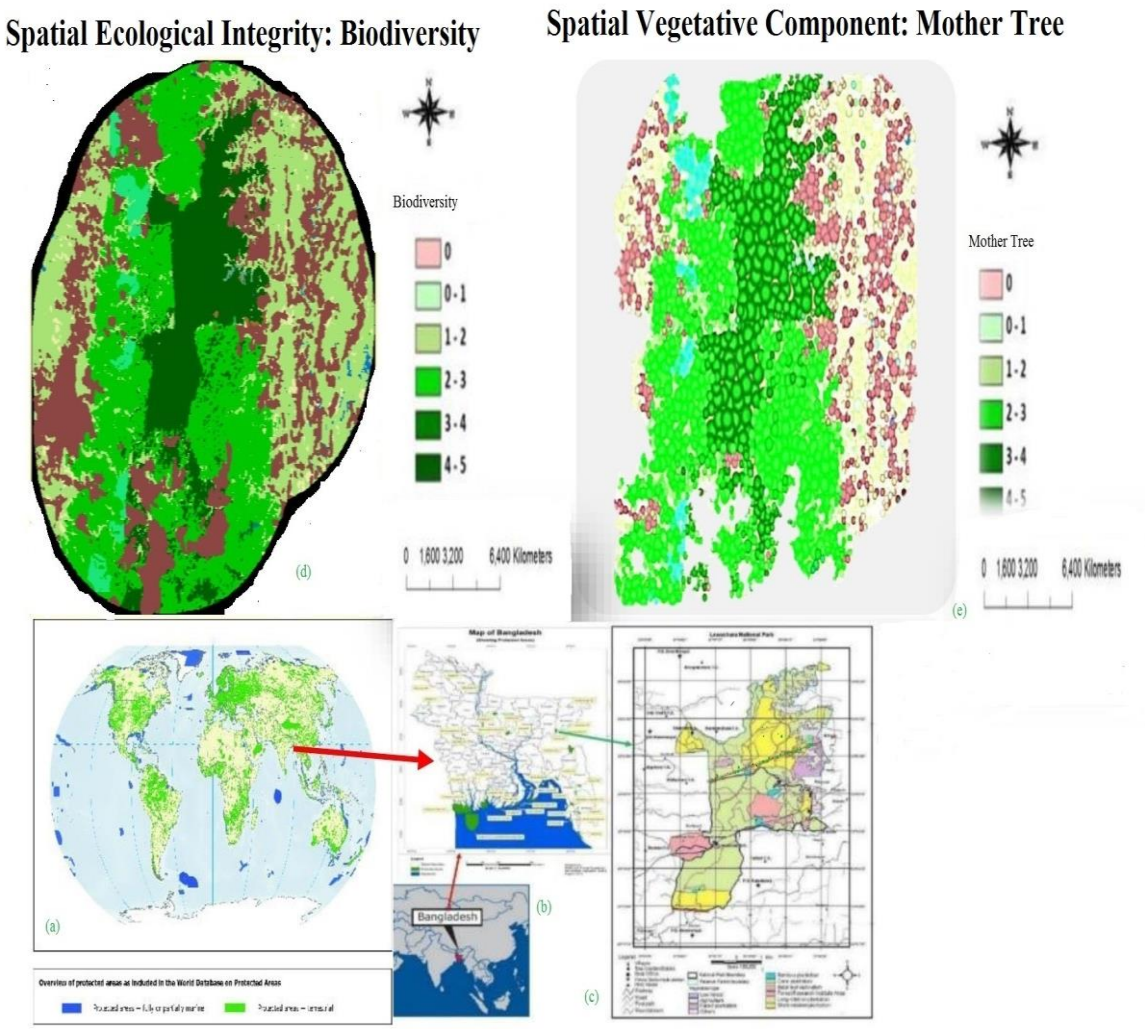


Figure 4.58: Spatial Ecological Integrity on biodiversity and spatial vegetative component.

4.4.6.3 Land use/ Land cover (LULC) Status

Land degradation and land use change are the major barriers at Lawachara National Park for loss of biodiversity. The research illustrates the different types of land cover surrounding the Lawachara National Park showed in Table 4.26 including using percentage, major purposes and remarks. The study observed that 16.61% only forested area for conservation purposes by government, but the rest of area, 83.39% used by other purposes, which will affect on ecological pressure towards Lawachara National Park.

Table 4.26: The existing land cover of Lawachara and adjacent covering area

Land cover	Percent (%)	Major purpose	Remarks
Forest Area	16.61	Conservation	Govt. property
Agricultural Land	24.04	Cultivation	Private property
Encroached Agricultural Land	0.15	Cultivation	Private property
Settlements	23.90	Habitation	Private property
Fallow Land	3.27	Normal	Barren land
Rubber Plantation	2.23	cultivation	Private property
Waterbodies	0.38	Fishing	Private proprerty
Tea estate	29.34	Cultivation	Private property
Encroached Settlement	0.09	Habitation	Private property

The study also represented on spectral signature of different land use/ land covers for Lawachara and adjacent areas, showing in Figure 4.59.

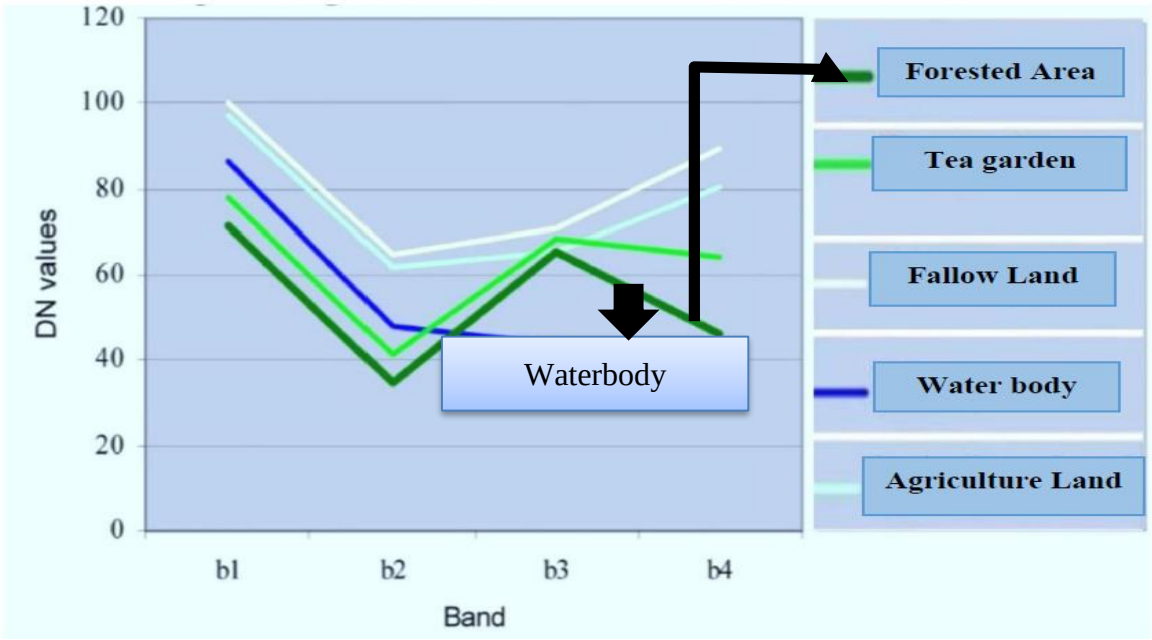


Figure 4.59: Spectral signature of different land use/Land covers at LNP

From this graph, the study found forest area and water bodies decrease day by day at Lawachara National Park, which will affect on loss of biodiversity in future. According to previous research of CEGIS-WARPO (2012) illustrated this opinion. From Figure 4.60, the study compared among forested land, agricultural land, encroached agriculture land, settlement areas, fallow land, rubber plantation, water bodies, tea-estate and encroached settlements adjacent area of Lawachara National Park in Moulvibazar district of Bangladesh (CEGIS-WARPO, 2012).

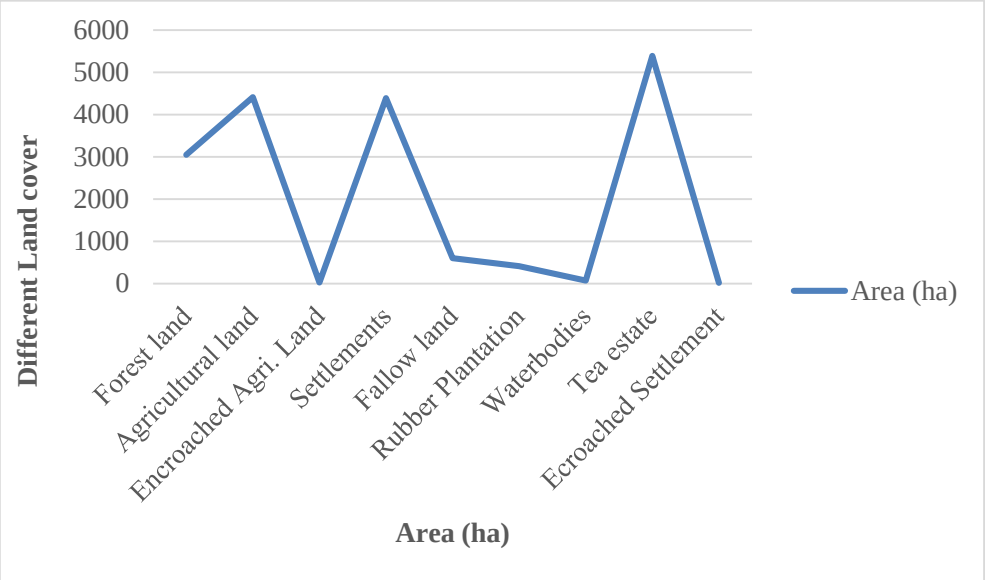


Figure 4.60: Land use/ Land cover adjacent area of Lawachara National Park

4.4.7 Biodiversity Information- Clearing House Mechanism

Biodiversity Information– Clearing House Mechanism is the newly formed online global as well as national database, connected with State Parties and CBD. This database is a bigdata portal with different parameters related to biodiversity.

4.4.7.1 Different Parameters for developing CHM Database

Biodiversity Information-Clearing House Mechanism interlinks with Integrated Online Biodiversity Information Systems (IOBIS). National biodiversity information—clearing house mechanism is the update information system for digital conservation, information sharing, update, collaboration, online monitoring and technology transfer among State parties and relevant organisations. Meanwhile the policy-makers take initiative for update law, policy and strategic plan on sustainable conservation of biodiversity. This IOBIS database will open the global gateway for digital conservation among state parties and relevant national, regional and global organizations. This clearing house mechanism is helpful to sending national report to Convention on Biological Diversity (CBD), which creates evaluation status and decision-makingThe IOBIS constitutes with different parameters and particulars as shown in Table 4.27.

Table 4.27: Different parameters of IOBIS with its particulars

Keys	Particulars	Remarks
PAIS	NPIS: National Parks Information Systems.	Lawachara National Park Database.
	WSIS: Wildlife Sanctuaries Information Systems.	Rema-Kelanga Wildlife Sancuary Database.
	NRIS: Nature Reserves Information Systems.	Borshijora Eco-park Database
NBIS	SIS: Species Information Systems	All plant species of Bangladesh.
	TIS: Taxonomic Information Systems	Taxonomic characteristics of National Species.
	ISIS: Invasive Species Information Systems	Acacia sp database
CBD	National Reports: Every State Party submits national report to Convention on Biological Diversity (CBD).	Fifth national report of Bangladesh to CBD
	NBSAPs: National Biodiversity Strategies and Action Plans.	Revised NBSAP of Bangladesh to CBD
GBIS	State Parties: There are 198 State Parties of CBD	Bangladesh is a State Party of CBD

Table 4.27 continued

WDPA	PA's: All protected areas of State Parties include in World Database on Protected Areas.	Information status of State Party's PA.
BD	MoEF: Ministry of Environment and Forests	Contact person to CBD
	SPARSSO: Space Research Remote Sensing Organization.	Public instituition for spatial research
	ICTD: Information and Communication Technology Division.	Public instituition for technological research
	Other Ministries and Sectors: Ministry of Agriculture, Ministry of Posts, Telecommunication and Information Technology, Ministry of Parliamentary and Law Affairs, Ministry of Education and others.	Need integration and collaboration
Social Media	Facebook: Facebook is one type of social media. Besides, Google+, twitter and so on.	Local Stakeholder's reflection through social media.

The IOBIS enhances the State Party to develop national databases including National Park database, taxonomic database, species database, monitoring database and so on which indicates in Figure 4.61.

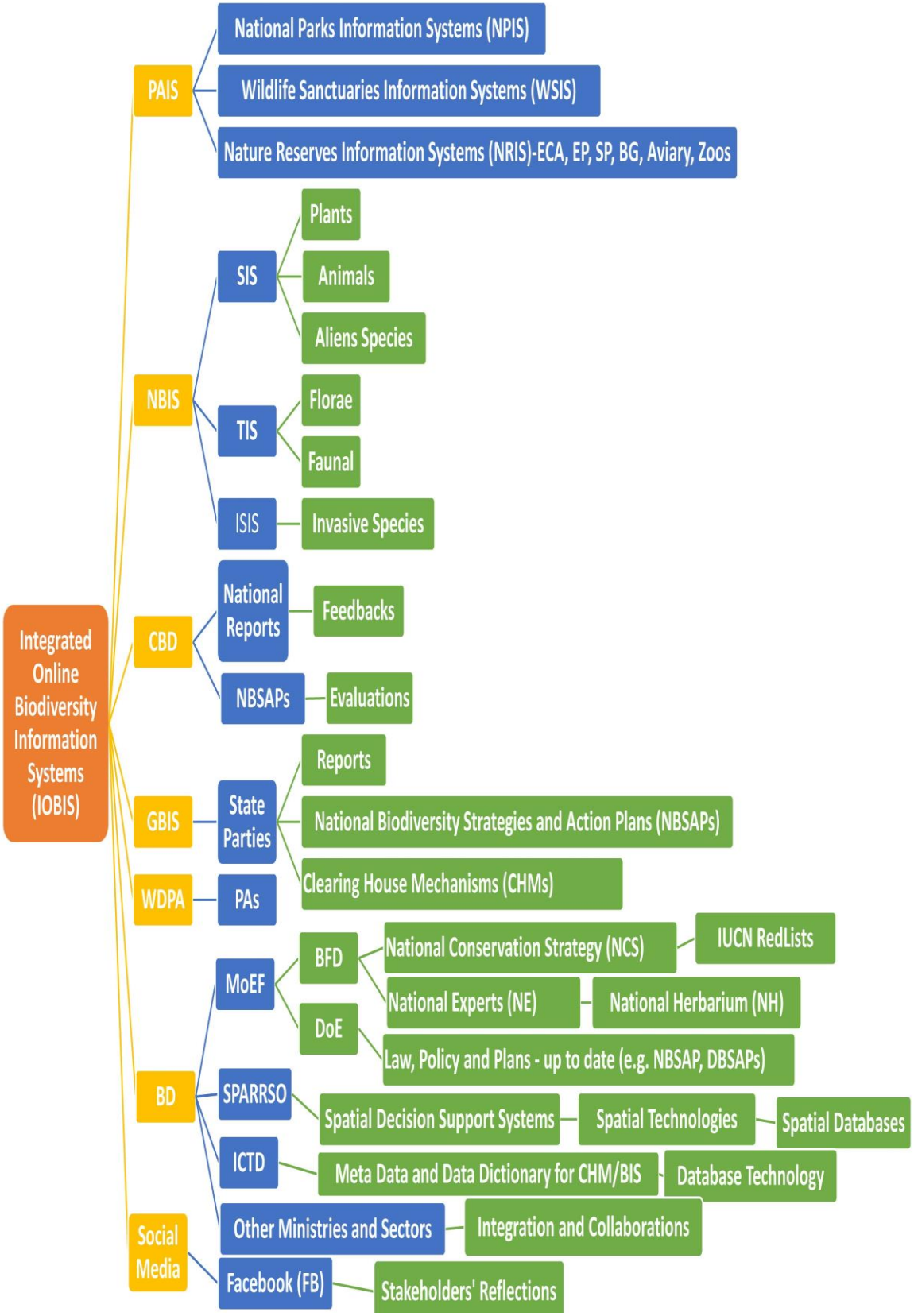


Figure 4.61: Structure of Integrated Online Biodiversity Information Systems.

4.4.7.2 Assessment of State Parties Biodiversity Clearing House Websites

From the study, it is identified that Bangladesh has not developed Biodiversity Clearing House Mechanism (BCHM) till to date, among the 196 CBD's state parties. However, all state parties did not develop their national clearing house mechanism websites. Here, the research mentioned few CHM websites to compare with CBD and State Parties through Figure 4.62 with relevant parameters. There are 57 state party of CBD in Asia and the Pacific but only 19 States developed CHM websites. The study suggests that Government of Bangladesh need to develop CHM website within the stipulated time.

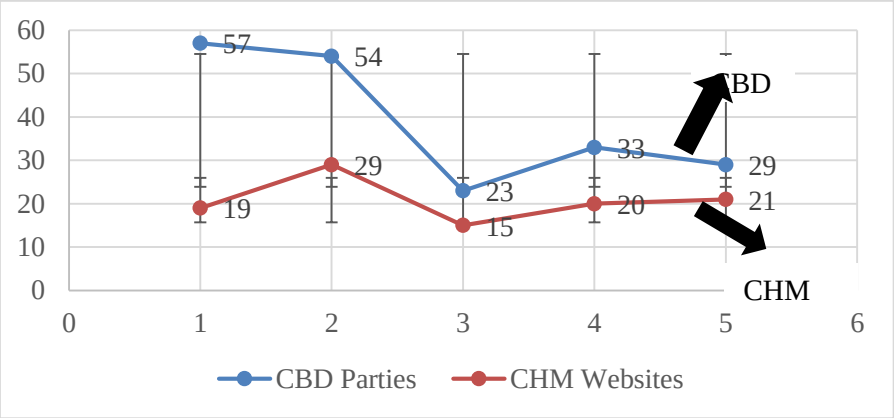


Figure 4.62: Clearing House Mechanism websites developed by some State Parties

4.4.7.3 Status of Clearing House National Focal Point

National Focal Points (NFP) are the most important contact purpose between CBD and State Party. However, some State Parties have no national focal point till to date, as shown in Figure 4.63 including Asia and the Pacific National Focul Point Status and each other. The study represented the 57 CBD State party in Asia and the Pacific but CHM NFP is only 45. The Study suggests that the CHM-NFP is essential for secured communication between

CBD and other State parties. NFP of Bangladesh needs to use secured communication with CBD and relevant other state parties.

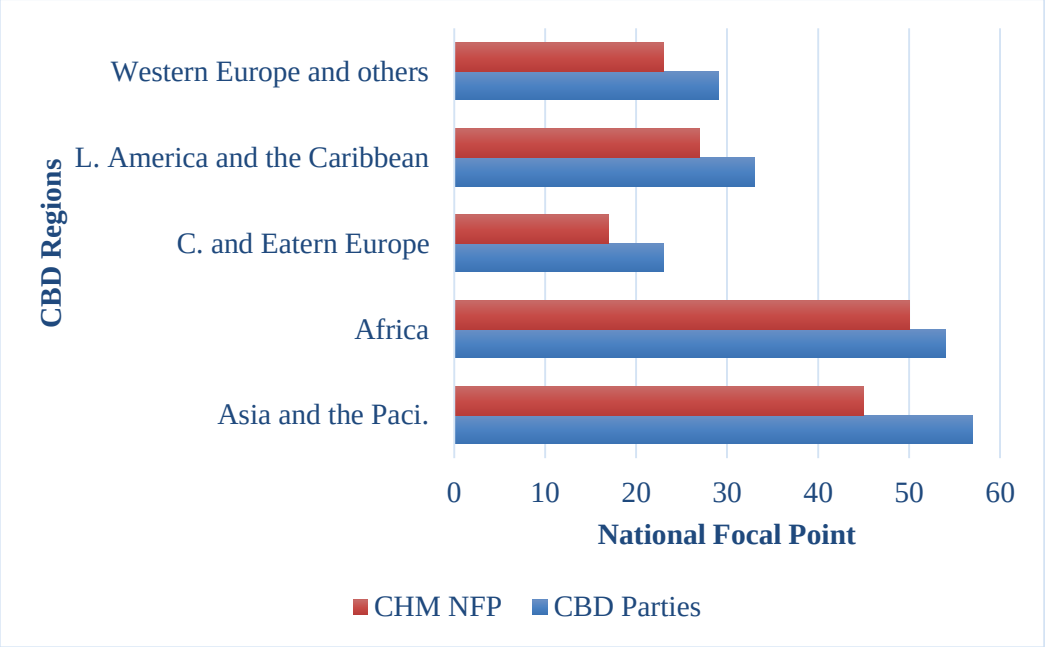


Figure 4.63: Status of CHM National Focal Points

4.4.7.4 Status of CBD State Parties Clearing House Mailboxes

In modern era, communication is the quick connection among each other. CBD and State Parties are the connector partners through mailboxes. But some countries have no CHM mailboxes till to date as shown in Figure 4.64 including different regions representing the informational instruments in connection with Lawachara National Park Digital Biodiversity Condervation in Bangladesh.

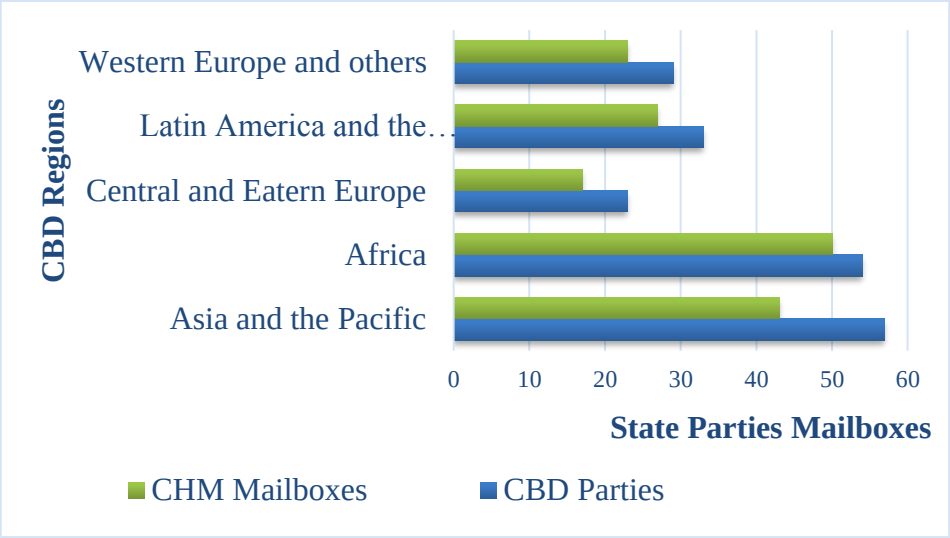


Figure 4.64: Status of CBD State Parties Clearing House Mailboxes

4.4.7.5 Observation on State Parties' Clearing House Websites Menus

State Parties CHM websites' menu enhance quick display and follow up the visitors' reflections on the policy, documents, present status of national biodiversity, as shown in Figure 4.65 including update NBSAP, national report to CBD, link with other sectors, CBD and social media, and so on. However, some webpages are not attractive to visitors as a whole. The average scoring is 34.5 out of 50. The highest scoring is 45 in the parameters of national biodiversity menu, policy and search menu, but lowest 20 linking with social media. The study suggests that quick display webpage attracts to the visitors and users. Government of Bangladesh needs to develop the quick display webpage with high scoring requirements of CBD.

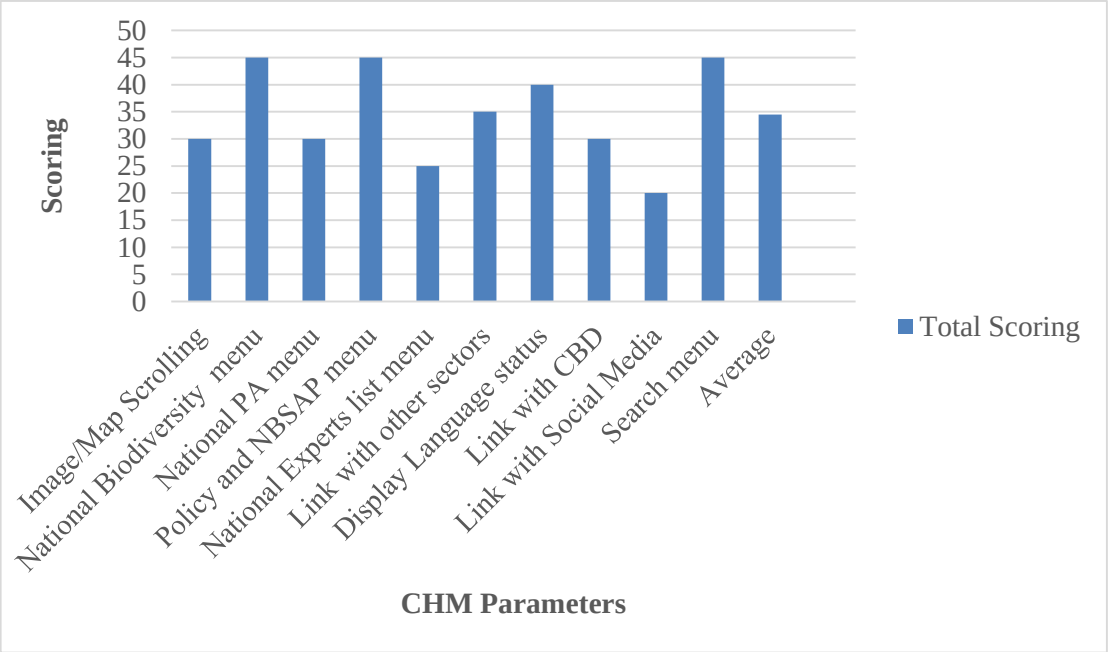


Figure 4.65: Status of CBD State Parties Clearing House Websites (Source: Field Data)

4.4.7.6 State Parties' Clearing House Web Interface Display Time

Webpage display time enhance to attractive to the others to compare mind satisfaction. The interfaces of State Parties CHM webpages display their features overall good. But some webpages are not attractive to others, as shown in Figure 4.66.

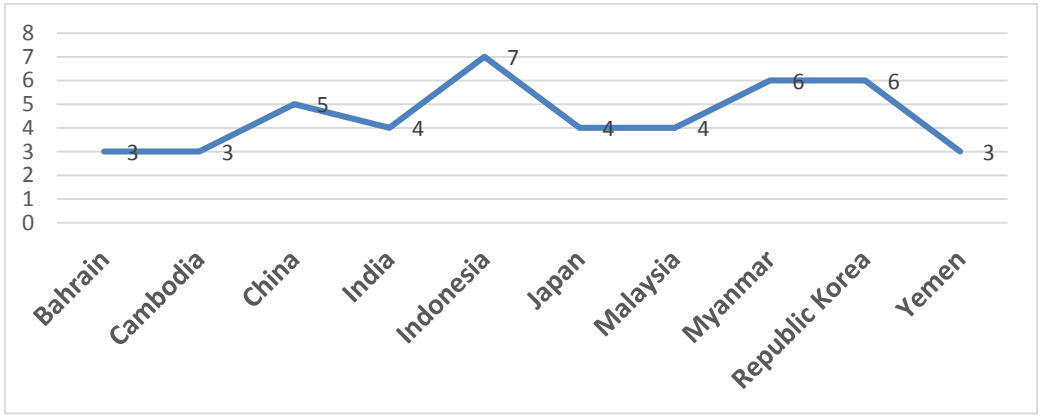


Figure 4.66: Status of CBD State Parties CHM webpages display time.

The study represented that the webpage display took less time in Bahrain, Combodia and Yemen (3 second), but took more time in Indonesia (7 second). The study suggested for the

webpage development of Bangladesh to maintain display time quickly for attractive to the visitors as well as information dissemination.

4.4.7.7 State Parties Biodiversity CHM Websites Scoring

From the research, the study observed that the maximum scoring of CHM website is Malaysia and minimum of it is in India as shown in Figure 4.67, with comparing other state parties of CBD. From the graph, the study assumed for update websites for biodiversity CHMs. The highest scoring is 47.5 out of 50 of Malaysia, while lowest scoring 7.5 in India.

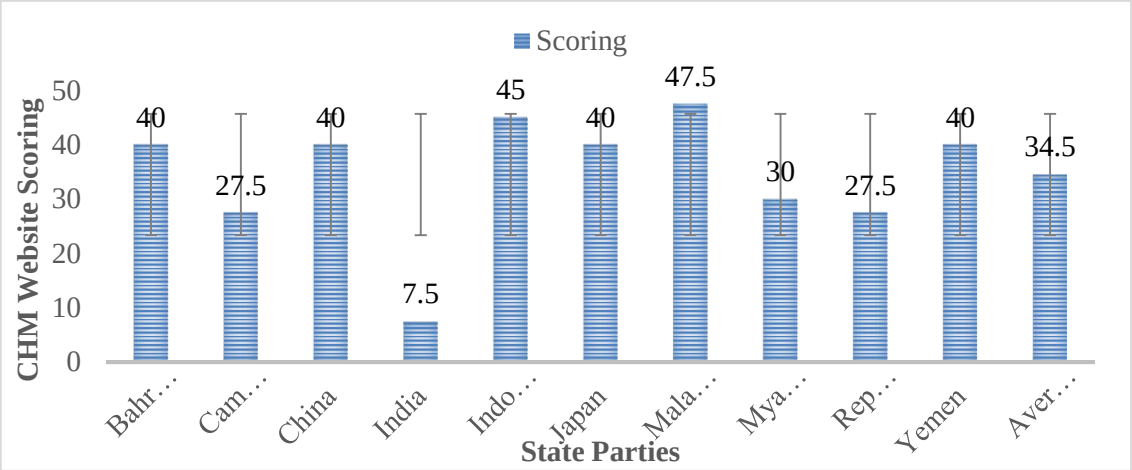


Figure 4.67: Status of CBD State Parties Biodiversity CHM websites scoring.

Bangladesh is a State Party of CBD. Till to date Bangladesh has no separate biodiversity CHM websites for online display the NBSAP, national report, national policies and network with others. The study suggested that Bangladesh should follow the webscoring of Malaysia.

4.4.7.8 Analysis of Technological Contribution on Conservation

Lawachara National Park (LNP) is connected with World Databse on Protected Areas (WDPA) with specific code. However, LNP connects with digital conservations enhancing on the Biodiversity Clearing House Mechanism (BCHM), which is the requirements of

Convention on Biological Diversity (CBD). From the field study, some positive and negative contributions are identified on digital conservation towards Lawachara National Park biodiversity through sharing information, such as:

Positive Contributions:

(i) Biodiversity Clearing House Mechanism

(ii) Digital Conservation and National Park Network Connectivity

(iii) Connected with State Parties and WDPA.

(iv) Interlink with IUCN Green lists and Biodiversity Related Conventions (BRC).

(v) Digital integrated Monitoring

(vi) Harberium Technology

(vii) Information sharing and management

(viii) Removing of Invasive Alien Species through applying technology

(ix) Develop Scientific Research Domain

(x) Reporting

(xi) Biodiversity Group Decision Support Systems

(xii) Computer Aided Species Taxonomy

(xiii) Transferable electronic image and files in lieu of heavy book.

(xiv) Time Series Management and Just-in-Time feedback on biodiversity information.

Negative Contributions

(i) Cybercrime on digital conservation

(ii) Misuse digital biodiversity information

(iii) False web interface display

(iv) Malware and cookies effects

(v) Misuse of Telematics for destroying wildlife and plant species through tracking.

(vi) Information on Conservation Policy gaps, bouncing, phishing, pharming and blocking.

4.4.7.9 Impact of Misusing Modern Technology

From the study of misuse of telematics, it observed that the examined species- cat and dog were felt sleepy and after few moments, they could not breath properly, as a whole, they were about to die. Immediately cell phone removed and disconnected from the study area. During medication time, the study also observed that both animals felt pain at their throats separately. The study identified that the animals were suffered from cough-cold and fluctuated body temperature. The telematics device also affects on tracking effective time to animals, which as shown in Table 4.28.

Table 4.28: Tracking effective time to animals

Type of animals	**Environment**		**Impact**
	Light	**Dark**	
Less weighted	More time (25 minutes)	Less time (15 minutes)	Sleepy and weakness
Heavy weighted	Average (12 minutes)	Less time (7 minutes)	About to die

These animals were affected pain at tracheas by sensor networks, which were transmitted from the telematics technology as shown in Figure 4.68. During the experiment, it was also identified that the tracker tracked the animal through scanning temporal landscape including longitude, latitude and elevation using global navigation satellite system, which was connected with GPS and GPRS, cell phone and Wi-Fi networks. It is mentioned that the Automated Radio Telematics System includes black box, sensor network and integrated Smartphone Telematics. However, the study illustrated that loss of biodiversity at Lawachara

National Park (LNP) occurs through the misapplication of modern technology, particularly macaque monkey declining (Example at Appendix M).

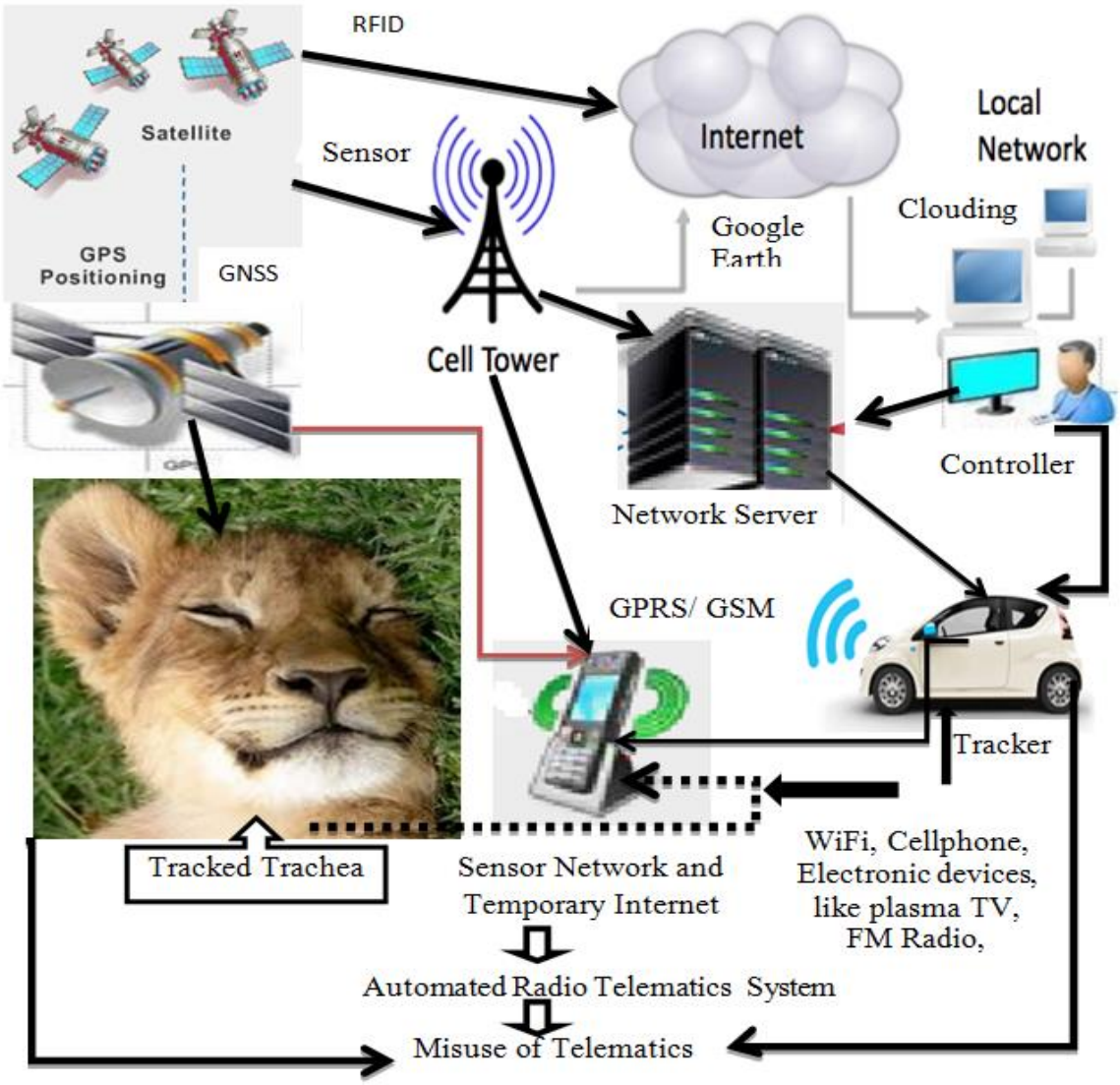


Figure 4.68: Impact of Misusing Technology towards Wildlife

The study also suggested for improvement of biodiversity conservation policy in connection with modern technology, BCHM and further trajectory research. The way of information is processed through the telematics technologies that the study was examined, along with the digitalization and abstraction of observation analysis, reconfigures space and time in

National Park Area. Further investigation is required into how telematics track on wildlife through transmitting server data from satellite to captured location within the stipulated distance for conserving of biodiversity require even more attention in misuse technology.

4.4.7.10 The Idea of Biodiversity Clearing House Mechanism

Biodiversity Clearing House Mechanism (BCHM) is the priority of biodiversity information dissemination to aware digital conservation for the rationalised generations. It connects the whole National Park databases, WDPA and displays the update news for sharing, augmenting, digitalizing, updating and reporting in connection with State Party's National Biodiversity status. Till to date Bangladesh has not developed the national biodiversity clearing house mechanism. Government of Bangladesh takes initiatives on this task, because it is essential for digital conservation and information exchange according to State Party of CBD. About most of 66% respondents expressed their opinions on biodiversity clearing house mechanism for national biodiversity database, as shown in Figure 4.69. The study suggests that this idea will reflect to the Government of Bangladesh towards development of national CHM.

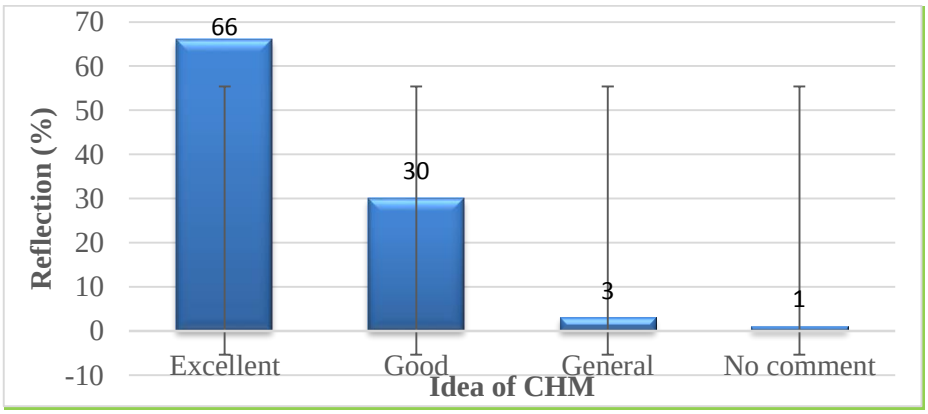


Figure 4.69: The Idea of Biodiversity CHM for national database

4.4.8 Evidence of Aichi Biodiversity Targets

The Aichi Biodiversity Targets (ABT) 2020 of CBD have six strategic goals including 20 Targets. These goals are A, B, C, D and E, which mentioned in details at chapter 2 of this thesis. The strategic goal A contains 4 in number Targets, 6 Targets in B, 3 Targets in C and D individually; and 6 Targets in E strategic goals successively. The highest Targets is 6 (30%) in the strategic goal B and lowest Targets 3 (15%) in the C and D separately, as shown in Figure 4.70.

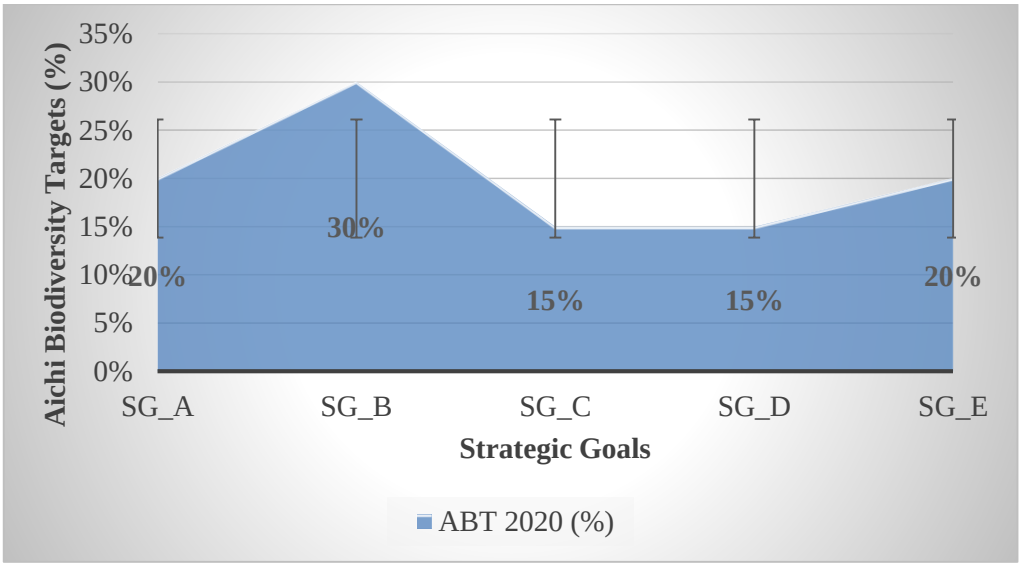


Figure 4.70: Different percentages of ABT 2020 Strategic Goals.

The study suggests that Government of Bangladesh needs to commit the fulfilment the target oriented strategic goals stated in the ABT 2020. The rest of A and E consist of 4 Targets (20%) of each other. This quantity enhances the biodiversity conservation for State Party with Target-oriented goals. This required percentage of Aichi Biodiversity Targets 2020 enhances the NBSAP of Bangladesh with Strategic Goals of CBD.

4.4.8.1 Aichi Biodiversity Targets Categorized Functional Analysis

Aichi Biodiversity Targets (ABT) 2020 is the focus indicators for biodiversity conservation at National Parks and other reserve areas among countries into the following categories

functions like (i) Land use and its changes, (ii) Protected Areas Management, (iii) Species distributions, and (iv)Systematic Conservation Planning, as shown in Figure 4.71. The study represented on different targets related conservation policy instruments towards protected areas, particularly Lawachara National Park in Bangladesh. Every ratified state party should follow the ABT 2020 to the requirement of the Convention on Biological Diversity within the stipulated time. Government of Bangladesh sets ABT actions to revised NBSAP in 2016 in lieu of 2015 and submitted to CBD on October 2016. The revised submission was being late starting earlier Actions and Targets of ABT. The study suggested that Government of Bangladesh needs to take initiative for implementation of conservation systematic planning.

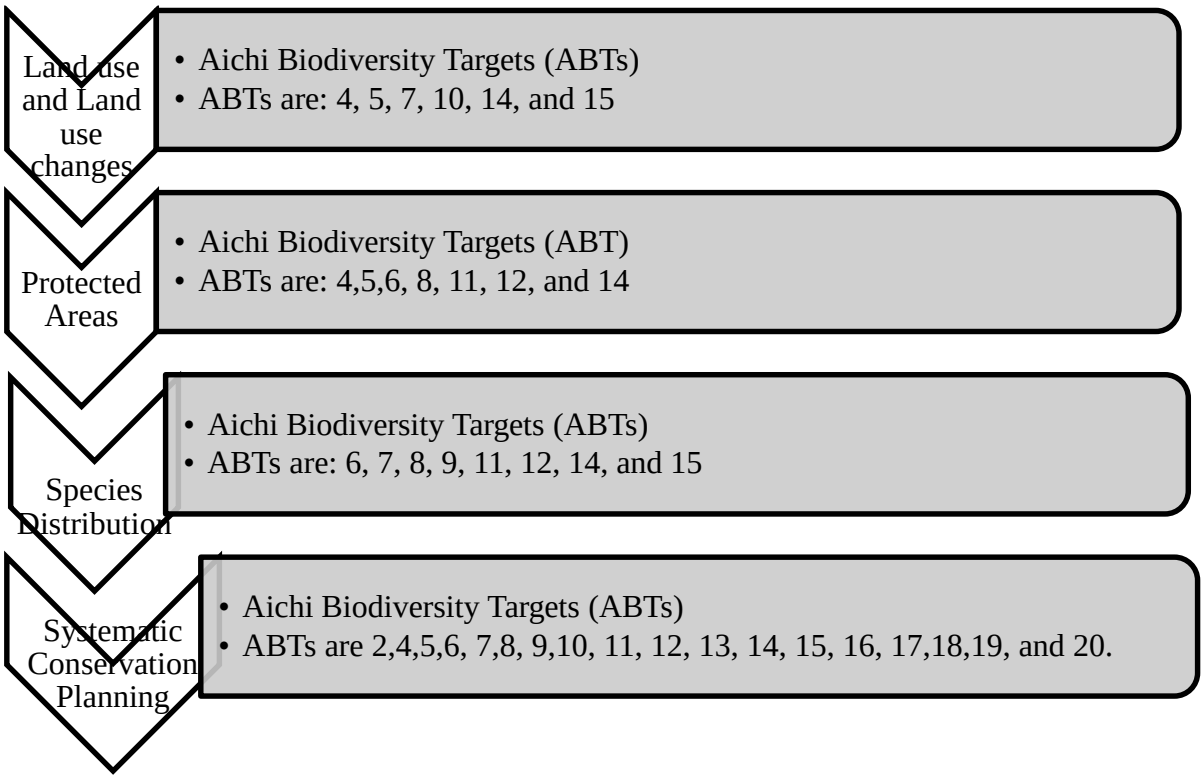


Figure 4.71: Aichi Biodiversity Targets Categorised Functions

4.4.8.2 Mapping of the National Biodiversity Indicators aligned with the Aichi Targets

National biodiversity indicators imply with direct and indirects indicators for mapping with the priority categories of Aichi Biodiversity Targets 2020. From Table 4.29 illustrates the

mapping of national biodiversity indicators with Aichi biodiversity Targets 2020. The study suggested that Bangladesh should follow the Aichi Biodiversity Target (ABT) 11, as a State Party of CBD. This ABT 11 enhances to augment the growth of National Park. Government of Bangladesh needs to declare new national park with conservation status towards terrestrial (landscape) and marine (seascape) according to the Targets of CBD.

Table 4.29: Mapping of national biodiversity indicators with Aichi Biodiversity Targets

Aichi Targets	Direct Biodiversity Indicators	Indirect Biodiversity Indicators
Aichi Biodiversity Targets 1.	(i) Consciousness, accepting, and provision for conserving of biodiversity. (ii) Intriguing activities for national park and co-management participation in in conserving perspectives.	(i)Integration of national park's biodiversity considferations through business activity. (ii) Area of land in agri-environment schemes. (iii) Area of forestry land certified as sustainably managed.
Aichi Biodiversity Targets 2.	Value of biodiversity integrated into decision making of Bangladesh (BD).	(i) Consciousness, accepting, and provision for conserving of biodiversity.. (ii) Intriguing activities for national park and co-management participation in in conserving perspectives. (iii) Integration of national park's biodiversity considferations through business activity.
Aichi Biodiversity Targets 3	(i) Area of national park in environmental conservation schemes. (ii) Forested zone certified as sustainably managed.	(i) Value of biodiversity integrated into decision making. (ii) Integration of biodiversity considferations into business activity. (iii) Sustainable Fisheries. (iv) Expenditure on BD and international biodiversity
Aichi Biodiversity Targets 4	(i) Worth of biological diversity incorporated through policy-making.	(i) Consciousness, accepting, and provision for conserving of biodiversity.

Table 4.29 continued

	(ii) Integration of biological diversity considerations into business activity.	(ii) Intriguing activities for national park and co-management participation in in conserving perspectives.
Aichi Biodiversity Targets 5	(i)Habitat connectivity (ii) Status of national habitats of Bangladesh	(i)Area of land in agri-environment schemes. (ii) Area of forestry land certified as sustainably managed. (iii) Surface water status (iv) Protected areas: Condition of Areas or Sites of Special Scientific Interest. (v) Status of national species of Asian importance. (vi) Status of national priority species: relative abundance. (vii) Status of national priority Species: Occurence
Aichi Biodiversity Targets 6	(i)Sustainable conservation for fisheries.	(i) National Park areas towards marine. But LNP is lack of sufficient body.
Aichi Biodiversity Targets 7.	(i) Area of land in agri-environment schemes. (ii) Area of forestry land certified as susatinably managed. (iii) Birds of the wider countryside and at marine: Firmland birds and Woodland birds. (iv) Insects of the wider countryside: Semi-natural habitat specialists.	(i) Sustainable Fisheries. (ii) Habitat connectivity. (iii) Plants of the wider countryside. (iv) Biodiversity and ecosystem services: Removal of greenhouse gases by Bangladesh forests. (v) Biodiversity and ecosystem services: status of pollinating insects.
Aichi Biodiversity Targets 8.	(i) Pressure from pollunation: Air pollution. (ii) Pressure from pollution: Marine pollution. (iii) Surface water status.	(i) Protected areas: Condition of Areas or Sites of Special Scientific Interests. (ii) Status of Bangladesh Habitat of South Asian importance.

Table 4.29 continued

Aichi Biodiversity Targets 9.	(i) Pressure from invasive species.	(i) Invasive alien species- concept idea
Aichi Biodiversity Targets 10.	(i) Climate change adaptation (ii) Pressure from climate change.	(i) Pressure from pollution: Air pollution. (ii) Pressure from pollution: Marine pollution. (iii) Surface water status. (iv) Habitat connectivity.
Aichi Biodiversity Targets 11.	(i) National Parks and wildlife sanctuaries. (ii) Status of Bangladesh Habitats of south Asian importance.	(i) Habitat connectivity. (ii) Status of BD species of south Asian importance. (iii) Status of BD priority species: relative abundance. (iv) Status of Bangladesh Priority Species: Occurence.
Aichi Biodiversity Targets 12.	(i) Status of BD species of south-east Asian importance (ii) Status of BD priority species: relative abundance. (iii) Stutas of BD priority species: Occurence.	(i) Protected areas. (ii) Habitat connectivity. (iii) Status of BD habitats of south-east Asian importance.
Aichi Biodiversity Targets 13.	(i) Natural assets for sustenance.	(i) Biotechnology aimed at biodiversity resources.
Aichi Biodiversity Targets 14.	(i) Biodiversity and ecosystem services: Removal of greenhouse gases by BD forests. (ii) Biodiversity and ecosystem services: status of pollinating insects.	(i) Surface water status.
Aichi Biodiversity Targets 15.	(i) Climate change adaptation. (ii) Biodiversity and ecosystem services: Removal of greenhouse gases by BD forests.	(i) Pressure from climate change. (ii) Habitat connectivity. (iii) Biodiversity and ecosystem services: Fish size classes in the Bay of Bengal.

		(iv) Biodiversity and ecosystem services.

4.4.8.3 Relationship Analysis on Conservation Policy Targets

Conservation Policy Instrument includes several policy targets for Lawachara National Park Biodiversity Conservation in Bangladesh. These policy targets are related with Aichi Biodiversity Targets 2020 (ABT 2020), Sustainable Development Goals 2030 (SDGs 2030) and National Biodiversity Strategy and Action Plan 2021 (NBSAP 2021). There is a relationship analysis for national park biodiversity conservation as shown in Table 4.30.

Table 4.30: Relationships on Conservation Policy Targets

Sustainable Development Targets	Aichi Biodiversity Targets	Remarks
15.1 To ensure the conservation, restoration and sustainable use of national park ecosystems and their services with obligations under international agreements.	ABT4: Sustainable production and consumption, ABT5: Habitat loss halved or reduced, ABT11: National Park Areas.	Conservation, restoration and sustainable use.
15.2 To promote the implementation of sustainable management of NPs and substantially increase afforestation and reforestation programmes.	ABT7: Sustainable forestry, ABT14: Ecosystem services, ABT15: Ecosystem restoration and resilience,	Conservation, restoration and sustainable use.
15.5 To take urgent and significant action to halt the loss of biodiversity for preventing the extinction species.	ABT12:Reducing risk of extinction,	Protection and Conservation.
15.6 To promote fair and equitable sharing of the benefits arising from the utilization of genetic resources.	ABT16: Access to and sharing benefits from genetic resources	Resources equity and services
15.7 To take urgent action to end poaching and trafficking of protected species of flora and fauna.	ABT12: Reducing risk of extinction	Protection and Conservation.
15.8 To introduce measures to prevent the introduction and significantly reduce invasive alien species.	ABT9: Pressure from Invasive species	Conservation with control measures.

15.9 To integrate ecosystem and biodiversity values into national and local planning with strategies.	ABT2: Biodiversity values integrated	Conservation targets to achieve the Goal.
16.7 To ensure responsive, inclusive, participatory and representative decision-making at all levels	ABT17: National Biodiversity Strategy and Action Plan (NBSAP)	Conservation targets to achieve the Goal.

4.5 Framework on Biodiversity Conservation related Policy Analysis

Environmental policy analysis framework is a set of actions to develop the task with relevant indiocators to help the National Park management – as a case study teams in evaluating the performance of existing policy instruments, instituitional and governance arrangements for ensuring the sustainability of National Park's flora and faunal protection systems as well as the establishment of ecosystem services. Generally, environmental related tools for conserving of biodiversity did not exist innovative isolation from earlier legislative and instituitional environment that surrounds them, but are part of a wider 'National Park policy integration.

Environmental Policy Instruments for Biodiversity Conservation Systems (EPI-BCS) is a case study site at Lawachara National Park: A biodiversity policy integration is a combination of environmental policy, biodiversity policy and agriculture policy instruments, which has an influence on the resources efficiency and sustainability of biodiversity conservation including clearing house mechanisms, with a particular focus on co-management inputs and rain water harvesting. An innovative approach assesses policy instruments in different fields, like– wildlife protection and security, revised NBSAP, Policymix Nishorgo Support Project, Clearing House Mechanism. Overall, this assessment indicated to the problems identification of existing instrument, then includes effective policy operations for integration with feedbacks and performance, then evaluation for effectiveness

and potential sustainability, and lastly the innovative instrument disseminates for sustainable conservation towards National Parks according to the provision of ecosystem services. The study illustrated the main steps of the EPI-BCS policy analysis framework includes 5 procedural steps operating in a sequential and iterative mode. These Phases are, (i) Phase 1: Problems Identification, (ii) Phase 2: Select instrument and its operation, (iii) Phase 3: Policy Integration, (iv) Phase 4: Policy Evaluation, and (v) Phase 5: Enhanced Innovative Instruments for sustainable environmental conservation, as shown in Figure 4.72.

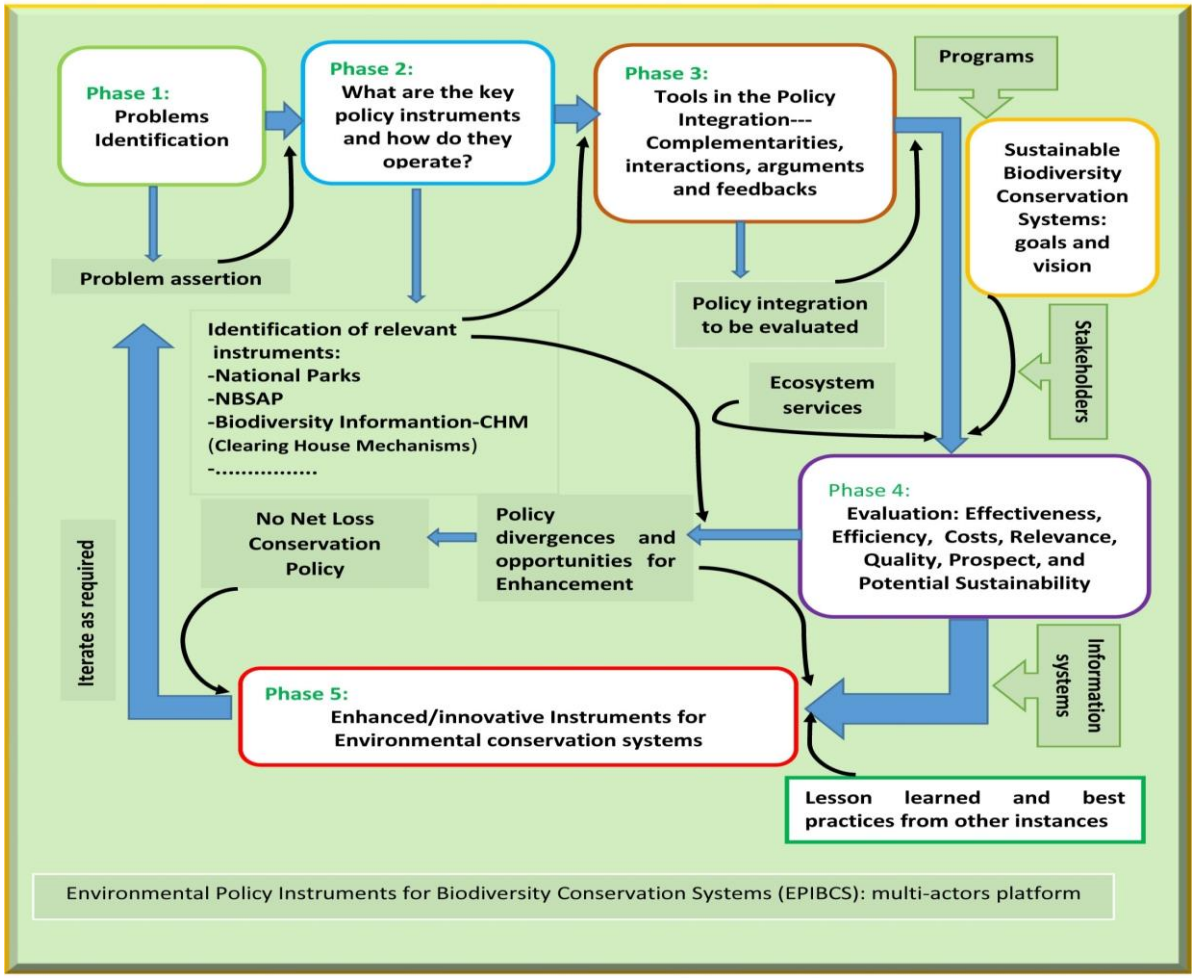


Figure 4.72: Phases and outcomes of the EPI-BCS policy analysis framework.

The primary phase is to select a policy issue (or two main issues) that links directly with EPI-BCS and that will be addressed in the Lawachara National Park. These are (a) scarcity of water for wildlife during dry and winter season, (b) excessive invasive alien species. The main goal is to arrive at a formulation (problem identification) that is agreed by the main stakeholder groups (for example: National Park administration and co-management team) in the LNP area. The final objective of the research is to identify potential enhancements on policies and governance mechanisms related to rain water harvesting and controlling of Invasive Alien Species with these problems that will contribute to develop an enabling policy for biodiversity conservation with update EPI-BCS products and services. These include some stakeholders like local experts, indigenous people, co-management team member, relevant field specialist, as shown in Table 4.31.

Table 4.31: Stakeholders Activities and Actions towards Policy Instruments

Stakeholders	Activities	Action
Co-management team, Local stakeholders and Park Administration	(i) Identification of perception of different stakeholders on the reasons for rain water harvesting. (ii) Removal of Invasive Alien Species. from Lawachara National Park, (iii) Possible solutions to reach reduce these issue in the long-term, integration of a wide stakeholder field as there are opinions on who is expert in these field.	(i) Effective time frame (ii) Facilitation, Integration and Initiatives by Team leader. (iii) Supporting parameters.

The research tries to identify the main biodiversity conservation issues/ questions in my case study that the study would like to explore based on the priorities of public bodies (National Park manager, environmental agencies, forestry sector public bodies, nature conservation agencies). It is assumed that these stakeholders take the concerns of public policy and agree for the reflection of the main issues from a broader societal point of view. The documentation

of main externalities associated with demanding forest should also be used to inform this discussion, being a relevant link to the work that will be developed in this research. For examples: Externalities are considered in EPI-BCS as the often unintended side effects of biodiversity conservation activities related to the environment and civil society. Positive externalities: (i) Provision of important (valuable) Lawachara National Park elements and its biodiversity enhancement, (ii) Maintaining adjacent community's coherence, tradition and cultural identity, (iii) Indirect effects on marketing channels/ chains. The policy analysis covers the most relevant policy instruments that shape the forest users (or other relevant stakeholders) decisions in my study area. The policy will not always originate from forestry or environmental rules and regulations merely, but could interlink through miscellaneous sectoral actions (energy or trade policies), as shown in Table 4.32. The absence of some policies / instruments can also be very relevant to shape the forest users' decisions (rain water harvesting technology provides with low cost) and it is important to identify these gaps to justify the need to adjust/ improve policies in place or design new instruments/ governance mechanisms. Examples of relevant policy instruments identified in LNP area, such as: (i) Empowerment of co-management team leader,

Table 4.32: Some Examples for Policy Instruments Identification

Sl no.	Some examples
i.	Taxes on access to National Park
ii.	Payments for environmental/ecosystem services/ green tea
iii.	Tarrifs/taxes on video conferencing/ digital technology at National Park areas.
iv.	Other forest sectors subsidies and voluntary funding schemes.
v.	Climate policies / carbon taxes.
vi.	Brick fields tarrifs/taxes.
vii.	National agri-environmental payments.

(ii) Ensure alternative income generating activities like betel leaf plantation, (iii) Environmental Education Awareness. As a priority phase to the analysis of the impact of the different instruments on the sustainability of biodiversity conservation and co-management

team, a brief description of each of the instruments identified in the previous section is required. The following aspects are considered in this characterization in Table 4.33.

The results of the different phases should be used to arrive at a definition of the policy mix that will be studied in the National Parks areas. The related biodiversity policy instrument(s) can be characterized with less detail, including only the relevant elements to understand the links and to allow the development of phase3. Figure 4.73 presents some examples of potential policy instruments for biodiversity conservation sustainability, illustrating the case of a hypothetical policy mix for biodiversity conservation.

Table 4.33: Different parameters for Policy Instrument Characterization

index	Parameters
a.	Name of the instruments: Legal/In-situ/Information…….
b.	Rationale and objectives of the instrument: brief explanation to justify the need for the instrument, its objectives and how it is expected to address the problem; is the instrument applied in a wider context or is it only applied in a particular case?
c.	It may be relevant to describe the baseline for the implementation of the instrument (e.g. on what basis are payments granted or taxes reieved? How is the obligation to offset impacts determined?). The baseline describes how property rights are assigned;
d.	Connect to EPI-BCS approach and objects;
e.	Spatial scope (e.g. CBD, national, divisional, district, local and National Park area).
f.	Current status and time horizon: In place from ….. to …….;
g.	Targeted actors (who is targeted by the instrument?). Distinguish between public and private actors/ activities/species/resources;
h.	Governance: includes relevant governance levels of instrument application- often governmental level, but not necessary (e.g. public agency responsible for its proposal and application); the governance level can be: International (e.g. CBD), national (e.g. state party), divisional (e.g. Sylhet division- study area); district (e.g. Moulvibazar district); Local (e.g. Lawachara National Park, and co-management team, Kamalganj sub-district).
i.	Financial issues: required funding/ funding sources/ revenues generated;
j.	Links to other relevant instruments (and new iteration alternatively): Does the instrument typically operate indepentdently or within a policy mix?

k.	Other relevant descriptors for the National Park area.

The performance of the particular tools in the integrated rules is evaluated in this phase. Policy instruments can use a wide range of regulatory and incentive mechanisms, ranging from limits and taxes on harmful activities (e.g. illegal logging), to providing payments for the providing of ecological systems (e.g. betel-leaf cultivation, afforestation program). It is necessary to understand the role of each of the instruments currently applied and the sequencing in their implementation.

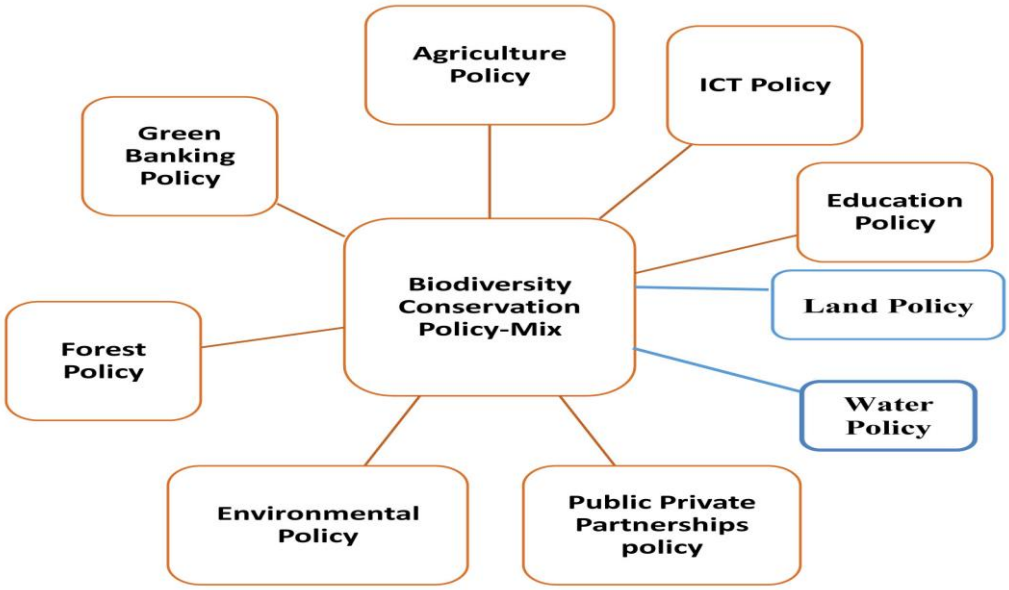


Figure 4.73: Policy Instruments and policy mixes

To identify the effects of policy interaction, the study should ask the relevant questions, like: (i) which other policy instruments are usually linked with existing instrument?, Yes, National Forest Policy, Environmental Policy, Water Policy, Agriculture Policy, and ICT Policy are linked with existing policy, (ii) what was the sequence of their implementation towards National Park?, Yes, the sequences of their implementation are possible through relevant policy improvement, stakeholder involvement and development of digital

conservation, (iii) - Are there hierarchies between legal, in-situ and informational instruments?, Yes, legal instrument tends to informational instrument in presence of in-situ instrument – a reciprocal relationship among them. According to the study, the answers are positive. A balanced combination of biodiversity conservation instruments is desired, and the need to find a synergistic, positive, supportive and complementary interaction among environmental, economic, social, institutional and technological instruments themselves and to avoid negative interaction is predominantly significant. The study can identify national biodiversity policy related interactions:

(i) What's interaction between different policies? Yes, the interaction of different policies is multi-dimensional phases towards Lawachara National Park Biodiversity Management. For example, Forest Policy and Agriculture Policy are interacted with National Park, Agro-biodiversity and Wetland biodiversity.

(ii) Positive interactions identification, Yes, established co-management policy at Lawachara National Park - is a positive interaction for conservation management, and

(iii) what process for negative action reduction? Yes, ensure active co-management team and stakeholder's participation with dynamic administration through effective policy for negative action reduction, like illegal logging, land encroachment at Lawachara National Park,

(iv) what's motivation for environmental education towards LNP? Yes, establishment nature education adjacent area of LNP through stakeholder engagement, negotiation and their participations with the help of technological application and political commitment. Besides, ensure education and training with Alternative Income Generating Activities (AIGA) and Green Income Generating Activities (GIGA) for betel-leaf cultivators. Actually, environmental policy instruments continue with innovative tools and techniques according to national demand and global priorities. Because, the mentioed

innovative instruments are used for environmental conservation systems with policy divergences and opportunities towards Lawachara National Park indicating "No-Net-Loss" conservation policy. Overall, the Government of Bangladesh takes initiatives for National Park biodiversity conservation through update NBSAP, BCHM, dynamic administration, sectoral policy integration and stakeholders' participation.

4.5.1 Effectiveness of environmental conservation policy and determination

The Government of Bangladesh controls Lawachara National Park. Therefore, the government expected to take comprehensive goals for promoting involvements among the Forest Department, Department of Environment, Water and Agricultural Sector. One of the advances of them intersects the improvements of unique objectives. In this condition, policy makers should to substitute advances in one instrument through damages among each other, which delivers rules and regulations to pertinent performers and stakeholders to accomplish better quality, shown as in Table 4.34.

Table 4.34: Policy effectiveness for National Conservation at National Park

Target-oriented options	Purpose	Data obtained	Policy Effectiveness
Dynamic co-management	Conservation and security	Time- series data: Weekly /monthly	Stakeholder Engagement
Rain water Harvesting	Protection of Wildlife and plants during odd seasons	Time- series data: Rainy season	Rainwater Harvesting Policy
Removal of Invasive species	Ensure native species protection	Time- series data: Monthly/yearly	Wildlife conservation and security Act , ABT 2020
Afforestation program	Regeneration gap filling	Time- series data: Monthly/yearly	Forestry Policy 1994 and draft policy 2016
Intensive Monitoring systems	Quality Reporting and relevant decision-making	Time- series data: Monthly/quarterly	Clearing House Mechanism and digital conservation
Budget allocation	Dynamic efficiency incentives	Cost-benefit analysis	Cost-effectiveness

Effectiveness of environmental conservation policy connected through the capacity of the relevant instrument to complete the policy strategies in the target-oriented results link to the anticipated objectives of the environmental policy instruments, for example: scarcity of water for wildlife in winter season. For this purpose, effective instrument, like rainwater harvesting can be used for natural water reservation, which affect in the conveyance of vital ecological provision. Performance of selected policies enhanced to identify the utmost applicable and suitable indicators to evaluate the effectiveness on the social, policy and demanded costs as stated indicators, which as shown in Figure 4.74.

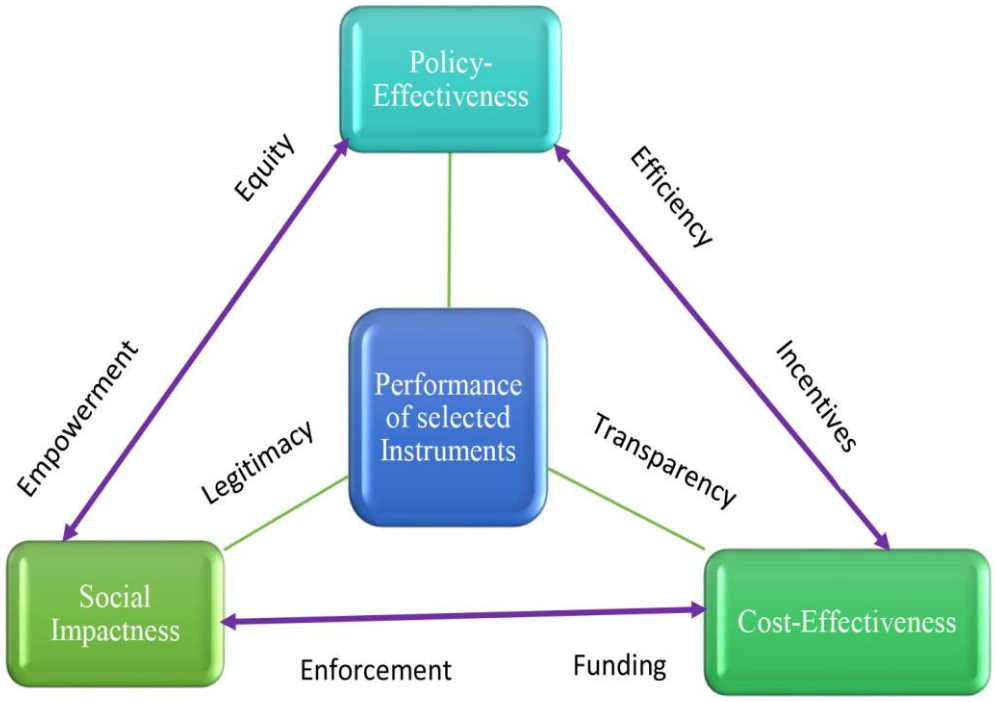


Figure 4.74: Performance evaluation of selected policy instruments

Improvement for Innovative policy instrument: This is last phase of policy framework, which is concerned with (i) the identification of the root causes of the existing park, (ii) key significances for existing policy enhancement, and (iii) prospects for presenting innovative tools. The main requirement for this phase to recognise the root causes are (a) no permanent

water body, and (b) lack of environmental conservation awareness. The study identified that the consciousness may increase social impactness through environmental education among the local and indigenous people, while the poverty will be eliminated and avoided encroachment activities. The key significances for policy enhancement are integration among different sectors, such as: (a) Forest Department integrated with Department of Environment, Agricultural Sectors, Education Sectors, Green Banking Sector and other relevant sectors. For example: with the cooperation of Park Administration and Co-Management Team, LNP recovered 20 acre encroached forest land and increased grant financing than other national parks in Sylhet division from ecotourism activities.

4.5.2 Prospects for presenting innovative tools

The study proposed to identify propositions for innovative conservation policy instruments (Figure 4.75) towards Lawachara National Park with the update on enforcement of Wildlife Conservation and Security Act 2012 as per the requirements of CBD policy (for example: Malawi enforcement system for wildlife protection stated at Chapter 5). The existing Act of Bangladesh connected with other relevant policies, like Education Policy for Environmental Education, Green Banking policy for betel leaf cultivators, Agriculture Policy for Home Garden, Forest Policy for Social Forestry and ICT policy for Biodiversity Clearing House Mechanism. The presenting of innovative instruments recognised gaps, with the aims to support supplementaries and sinergies as well as to evade conflicts and restrictions. The study tries to analyse different data according to its objectives with graphical and tabular formats. The research reveals the environmental policy instruments using information systems for conservation of biodiversity towards National Park. For this purpose, the study finds several mathematical views aw well as logical views regarding applications of biodiversity information systems and its stakeholders' opinions, growth of

National Parks and its distribution, clearing house mechanism and its present status, NBSAP and its structure to compare with other state parties, controlling measure of Invasive Alien Species, and relevant policy status and comparing with Malaysia's policy.

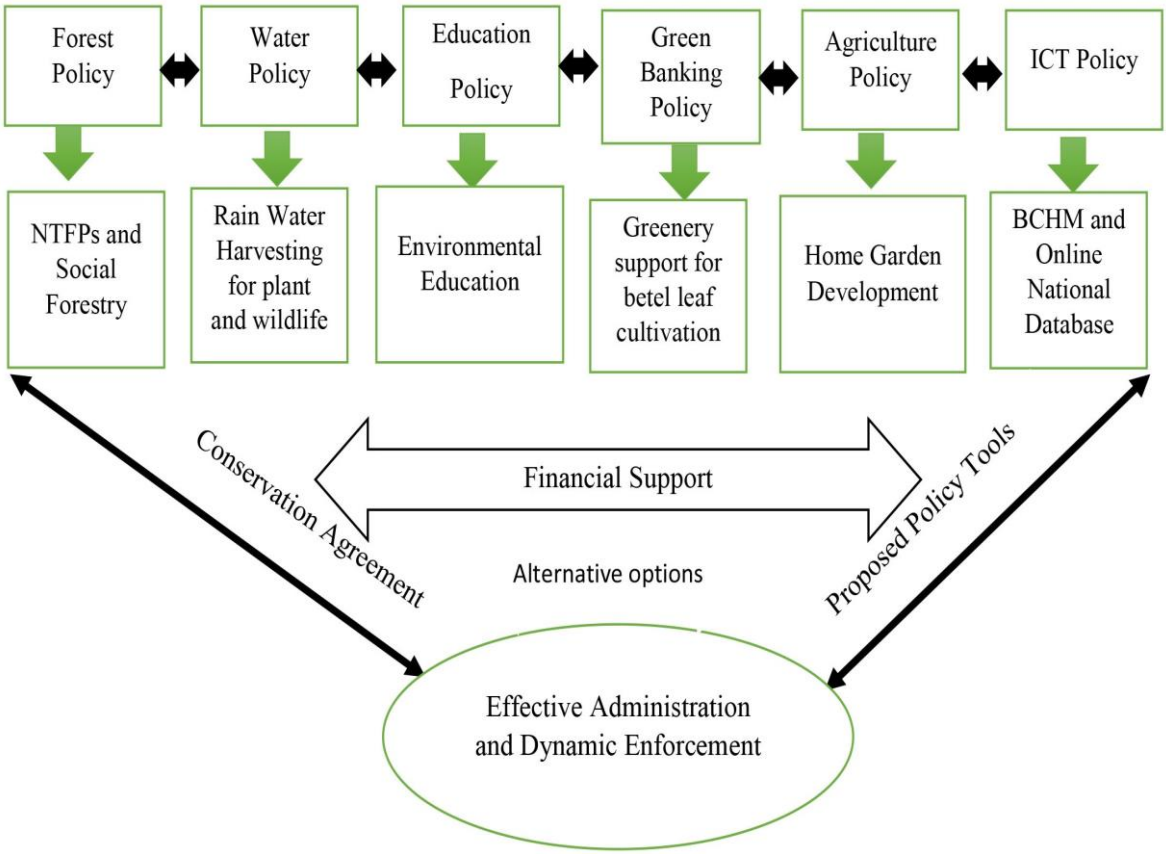


Figure 4.75: Environmental Conservation related new and alternative policy instruments

Over all, the researches try to find the policy analysis, its effectiveness to the Aichi Biodiversity Targets 2020. As a developing country, Bangladesh has little research on environmental policy instruments for conserving biodiversity, where there are many analysis gaps. In this regard, the research finds suitable argument on the priority of observing gaps, which illustrates in the Chapter 5 in connection with discussion on research findings.

CHAPTER 5

DISCUSSION

5.0 Overview Discussion

The discussion on analysis of research findings on environmental policy instruments, along with the assessment of information systems evaluates the biodiversity conservation at Lawachara National Park in Bangladesh. Result of this study clearly demonstrates that '*In-situ*' environmental conservation policy instrument is more suitable than legal and informational instruments for biodiversity conservation. Limited comparison of legal and and informational instruments suitably have been undertaken and conclusions differ. In this study, the development of produced policies declaration of National Parks and applications of biodiversity clearing house mechanism were analysed as criteria for suitable biodiversity conservation. The three mentioned environmental conservation policy instruments analysed had different effects on National Park Biodiversity Management, Policy Development and application of digital digital conservation of Bangladesh – as a signatory State Party of CBD's objectives requirements.

The findings on the existing policy instruments are inadequate in connection with national and global perspectives, where there are some gaps, like policy formulation, sectoral integration, national park declaration, establishment of digital conservation. However, this chapter contains different sections model development of stakeholders' engagement, criteria for policy improvement, and enhancement frameworks for National Park Biodiversity Conservation and Sustainability, Priority-based logic model for community-based conservation and assessment of using update technology for biodiversity conservation at national parks in Bangladesh, which illustrates successively.

5.1 Assessment of Environmental Conservation Policy Instruments

Environmental Conservation Policy Instrumental research implies with various tools, techniques, policy and technology based on the results, which discussed in different sub-sections as below:

5.1.1 *In-Situ* Instruments and Effect on Conservation Policy

Conservation policy instruments exist at all stages of the policy process with specific tools—*in-situ* instrument, for example national park. From the result, it is shown that the Lawachara National Park has affected by the national conservation policy. This effect is required to national park's demarcation and recovery of encroachment.

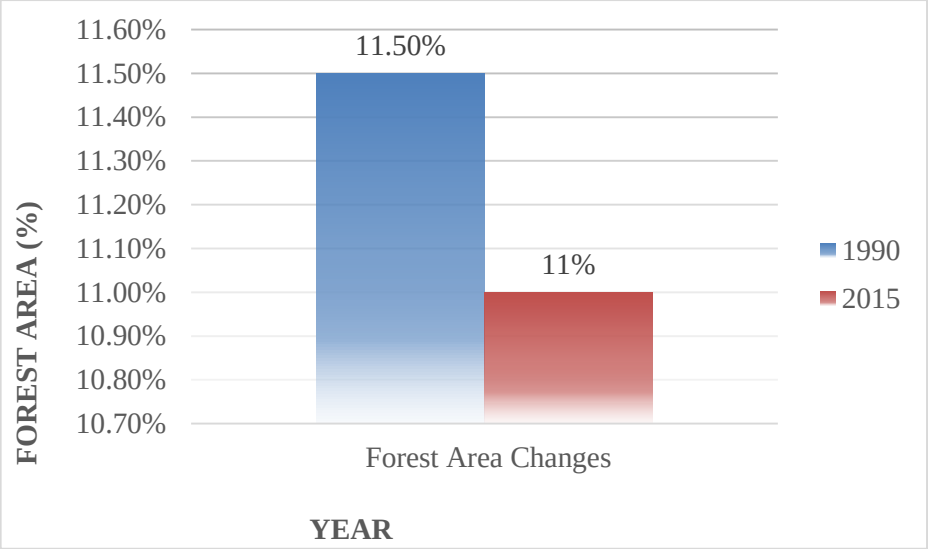


Figure 5.1: The percentage of Forest Area Changes from 1990 to 2015 in Bangladesh (Source: Modified FAO, 2015)

The Aichi Biodiversity Target (ABT) indicates the national parks regions using to protect national biodiversity. According to specific objective of Target 11 of ABT (2010), every state party augments national parks, but decreases forest, which as shown in Figure 5.1. It stated in Chapter 2 of this thesis earlier that every member country should to conserve 17%

of landscapes and 10% of seascapes areas' biodiversity associated with operative reserved area-based protection. There is continued loss of forested habitats in Bangladesh. In Bangladesh, decrease forest area and increase loss of biodiversity due different parameters which is mentioned earlier. From Figure 5.2, the study observed that the percentage of forest area changes is 11.5% in 1990, and 11.0% in 2015 in Bangladesh (WB, 2016). This changes reflects on the national green economy as well as alarming on environmental issues. The study also compared with Malaysia and other countries in south-south-east Asia (WB, 2016).

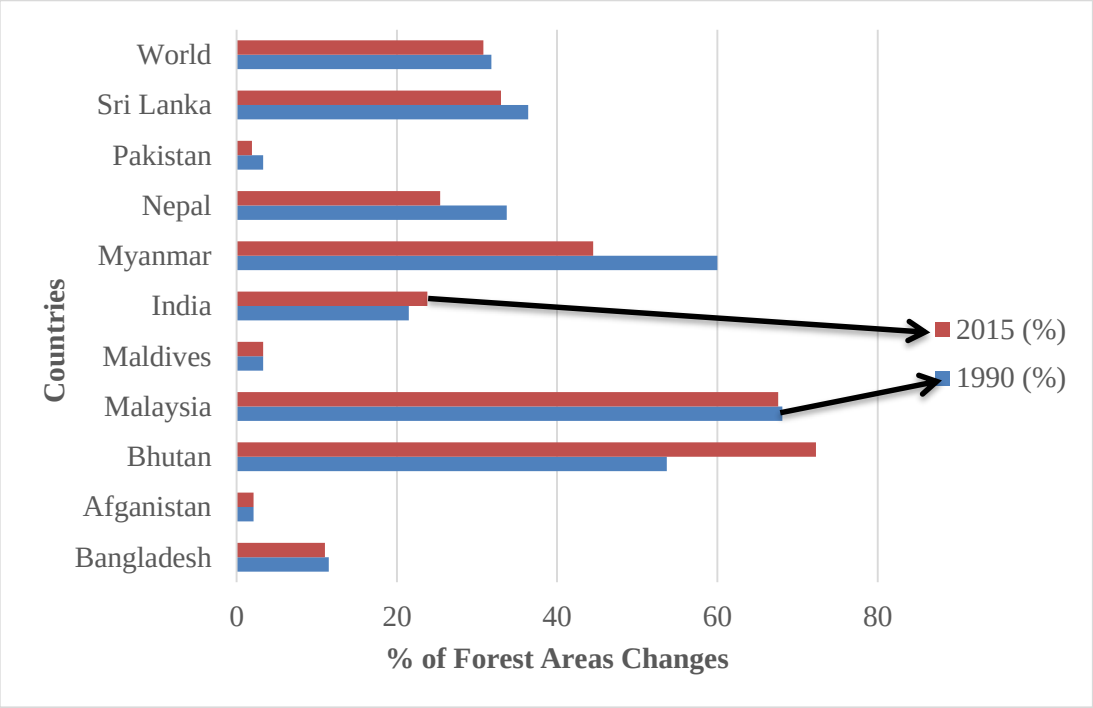


Figure 5.2: Forest areas changes in Bangladesh to compare in Southeast Asia (Source: WB, 2016)

From the FAO report, the study illustrated that every year 26,00 ha forest area changes. In 2000, the total forest area 1468,000 ha, in 2005 and 2010, it was 1455,000 ha and 1442,000 ha in Bangladesh respectively. It was changes tremendously in 2015 as 1429,000 ha. Food and Agriculture (FAO)-2015 reported a gradual decline in forest area over the period 1990 to 2015 in Bangladesh. In 1990, the total forest area of Bangladesh was 1494,000 ha and in

2015 it became 1429,000 ha, as shown in Figure 5.3 (FAO, 2015).

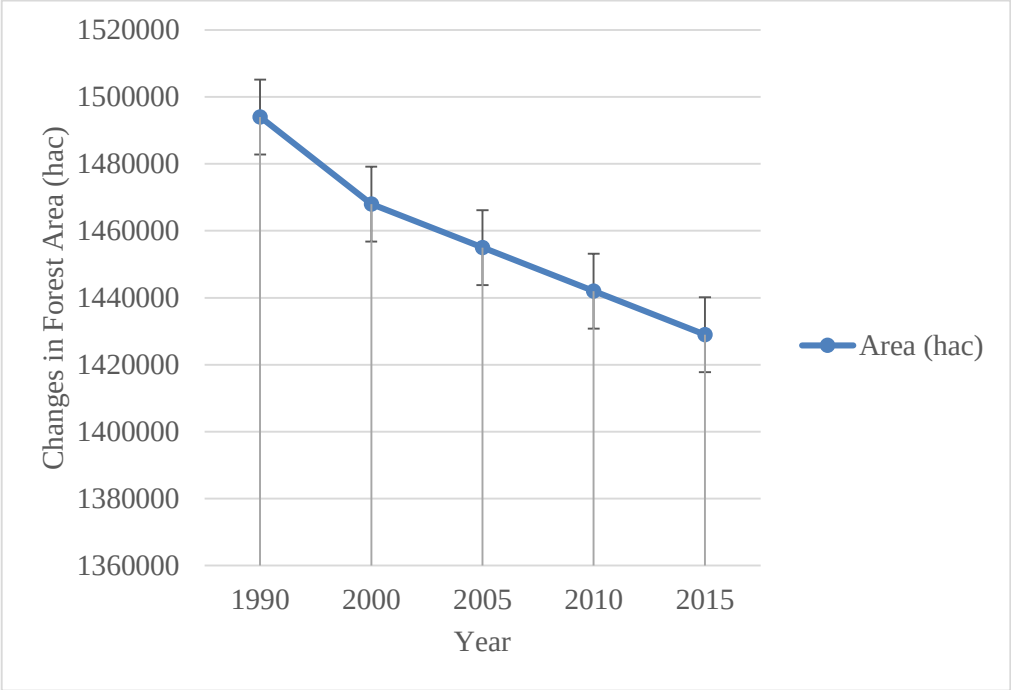


Figure 5.3: Changes in Forest Area in Bangladesh from 1990 to 2015. (Source: Modified FAO, 2015)

5.1.2 Status of Loss of Biodiversity and Invasive Alien Species

Lawachara National Park (LNP) is situated in Sylhet division, where comprises of evergreen forest and deciduous forest (Das and Alam, 2001). From the result of LNP's biodiversity survey, it is identified that losses of species diversity of LNP gradually increased. The study assumed the losses of biological diversity and environmental dilapidation unexpectedly in Bangladesh. The losses rate of biological diversity (Alamgir *et al*., 2014) and bionetworks degradation increase gradually in this country. Figure 5.4, the scoring study observed the rank is 7 on favor of scoring 18.8 for Malaysia, whereas Bangladesh ranking 18 tends to scoring 7.1 (GRR, 2016a). The study indicates the losses of biodiversity, which influence negative impact in future on biological diversity and bionetworks services to the upcoming generations of BD.

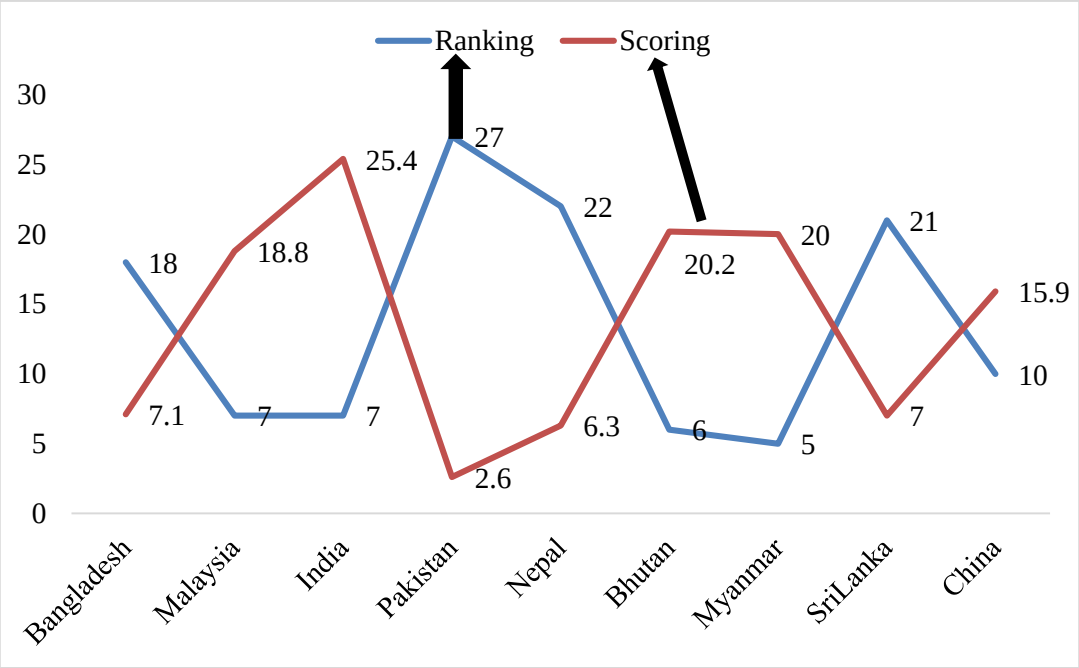


Figure 5.4: The ranking and scoring of loss of biodiversity and ecosystem collapse (Source: GRR, 2016a)

Lawachara National Park is affected by Invasive Alien Species (IAS). According to the policy of CBD (1992) in the Article 9, each state party takes initiatives for controlling measure of species invasions. Meanwhile, Government of Bangladesh produced the new Act for removal of species invasions. The focal point of Bangladesh responded to CBD for eradication measure of invasions according to structured questionnaire, which stated in (Appendix-M). Government of Bangladesh has organized an expert team including relevant other stakeholders according to rules and regulations so as to formulate exception report on species invasions. Composed material scrutinized and combined by the expert team. The respondents' reflection stated with their opinions on controlling measures on IAS sequencially.

5.1.3 Outcomes of Stakeholders' Perception on Biodiversity Information Systems

To assess environmental conservation policy instruments, one of the parameters is that the affected stakeholders are incorporated and well represented through the policy instrument systems for national park biodiversity conservation. Therefore, stakeholder engagement theory is associated with the policy assessment using stakeholder analysis. The outcomes of the study on stakeholders' roles in national park's biodiversity management that the policy instrument process would be effective when stakeholder clearly understand the goals of their involvement, their responsibility in the course of action and the issues implicated (Treves *et al*., 2005). To date, Bangladesh has no Integrated National Biodiversity Database with Clearing House Mechanisms. Therefore, there is a lot of nature conserving problems faced on biodiversity management systems. The study integrates technological information from stakeholders like park manager, biological diversity specialists, network officers, ecological specialists, policy-makers, wildlife managers, academicians and relevant bodies, as shown in Figure 5.5.

The study signifies the uniqueness of the tools used to enhance national park conservation professionals on the national biodiversity strategic action plan through existing policies and conservation technology. It is very imperative to engage with key stakeholders to converse and recognise challenges and possible solutions related national park biodiversity losses and associated ecosystem service declines (Rose *et al*., 2014). The study authorises the dynamic evidence required for wide-ranging data transfer and sharing, indexing, online publishing and reports to the effective international institution, like CBD with the cooperation of Resources Information Management System (RIMS).

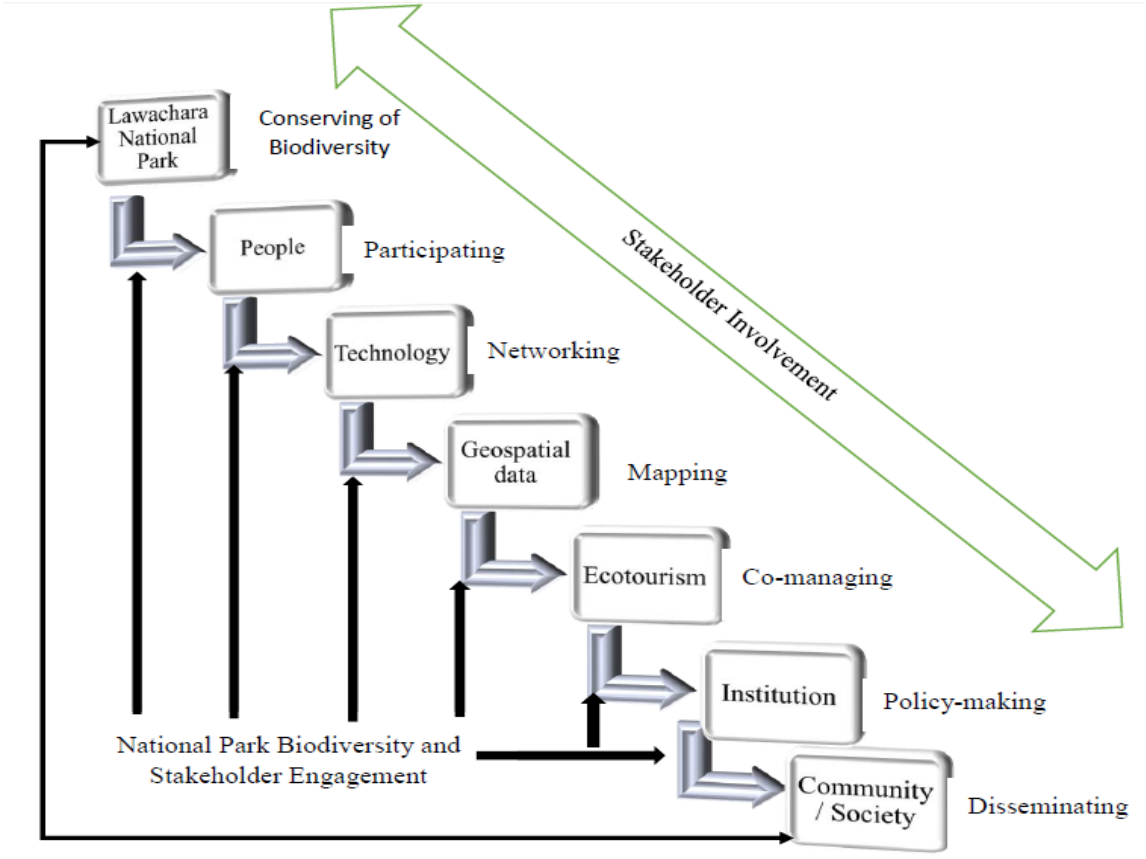


Figure 5.5: Stakeholder Engagement on National Park Biodiversity

Participatory dialogue comprehensive of multiple stakeholders is crucial to appreciate and discourse different perspectives and needs (Martin, *et al*., 2000), and considered many benefits to policy and technology implementations (e.g. BCHM, greater legitimacy decisions, higher-quality decisions, increased compliance) (Menzel and Teng, 2009). This type of discussion can also familiarise stakeholders to potential policy concepts, based on information from other areas. Finally, the study advocates a new collaborative approach to drive the stakeholders' potentiality to further incorporate the information systems integrating next generations' biodiversity conservation perspectives. The study suggested that engagement of stakeholders enhances the conserving of national park biodiversity with required policy guidelines.

5.1.4 Assessment of Informational Instruments for Biodiversity Conservation

Assessments of Informational Instruments for National Park's Biodiversity Conservation are highlighted elaborately in modern environmental informatics. Human beings live in the age of information with modernized technology. This informational instrument enhances the protection, storage, and sharing of information with rules & regulations to make a significant facet of economic, cultural and scientific affairs at scales from local to global (Michael *et al*., 2006). It is clear that Information Communication and Technology (ICT) has become a driving force in the area of biodiversity conservation and the establishment and management of protected areas (ICEM 2003; Wilson, 2003; Henry and Armstrong, 2004; Eken *et al*., 2016).

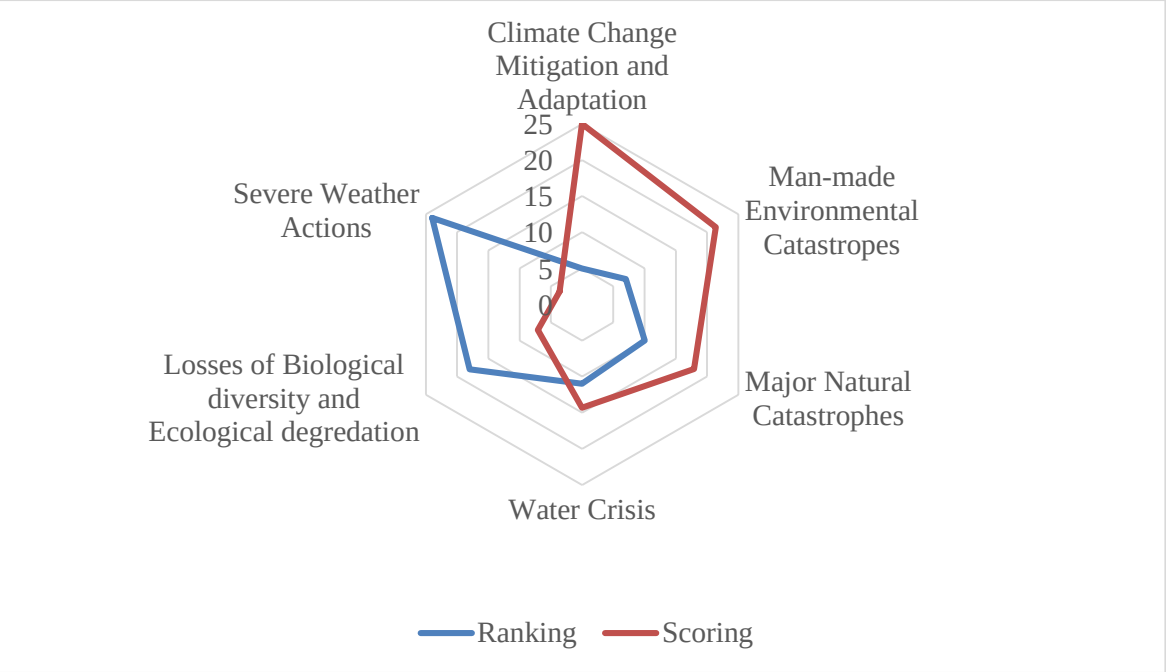


Figure 5.6: The most likely environmental risks in Bangladesh.
(Source: GRR, 2016)

There is a great deal of academic discourse and debate around theories of the information society (Fuller, 2005) and protected areas. Bangladesh is the most likely environmental risks, shown as Figure 5.6. These areas operate with rules and regulations for promoting and

harmonizing of biodiversity policy through conservation systems. These systems integrate with Information systems developing dataset biological diversity Information Systems (BDIS). The BDIS is a group of tools, which can increase the competitiveness and gain better information for decision making with relevant diversity's system and orders. Nearly 58% of respondents expressed their opinions for development of BDIS for Lawachara National Park, which connects with geospatial technology, biodiversity clearing house mechanisms, IOBIS and modern conservation technology.

But till to date, there is no effective national biodiversity database including clearing house mechanisms (CHM) as well as information systems in Bangladesh and other local places. Consequently, many organizations decide to implement BDIS to improve the effectiveness and efficiency of their organizations particularly in monitoring protected areas. Researchers in Bangladesh had attempted to develop a framework of information systems with biodiversity conservation policy systems in Bangladesh particularly for Lawachara National Park in Moulvibazar district. The study also linked with the most likely environmental risk in Bangladesh (GRR, 2016a), as shown in Figure 5.6. Bangladesh affected to the risks on: (i) catastrophe to climate change, (ii) environmental and natural catastropes, (iii) water crisis, (v) losses of biological diversity, and (vi) severe weather actions.

5.1.5 Outcomes of Results on Rain Water Harvesting and Policy Formulation

The outcomes of 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 northeastern part of Bangladesh. From global perspectives, the study observed that the water ranking of Bangladesh is 11 where scoring 14 (WEF, 2016) showed in Figure 5.7.

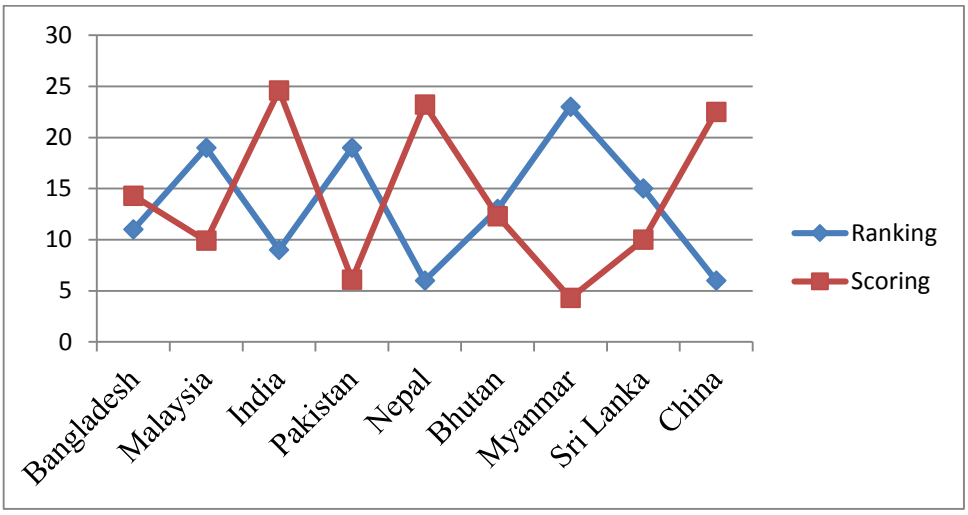


Figure 5.7: Water Crisis in Bangladesh and other countries in Asia.
(Source: WEF, 2016)

On the other hand, Malaysia's ranking is 19 but scoring 9.9, i.e. Bangladesh is more water crisis than Malaysia. Overall, the research was accomplished the terrestrial water harvesting scientifically at national park areas with requirements policy improvement for sustainable biodiversity conservation (WFP, 2012) to the effective policy makers.

Rain Water Harvesting Systems at Lawachara National Park precedes the obligation of water supply for plant and wildlife conservation by the cooperation of the Government, private and other sectors. It has been documented in the Lawachara National Park, where local government has mounted relevant policies supporting the installation of rainwater harvesting at national park. The research encourages vital actions through the involvement of national park co-management council (Borrini-Feyerabend *et al.*, 2013) including local administration, private institutions, Non-governmental agencies, Indigenous community members, water supply board, Water and Sewarage Company, Park Manager, Team Leader of Co-management Committee, Ethnic Community Leader, Academician, Biodiversity Specialist, Botanists, Zoologists, Researchers, Environmentalists and Lawyers, Land-users,

Learners, Local Government Leaders, Policy-makers and effective other stakeholders. However, the potentiallity of job creations with rainwater preserving systems for protection of national park biodiversity are separated opportunity of this observation, review, and effect on the national park to enhance nature conservation during summer and winter seasons and other socio-economic considerations to lead the important query for policy-makers thinking with the economic importance.

5.1.6 Outcomes of Growth of National Parks

The implementation and effectiveness of National Parks are influenced by diverse social, economic, political and technological factors (Maciel *et al*., 2008). National Parks (NPs) are instrumental in supporting biodiversity conservation as well as providing many benefits.

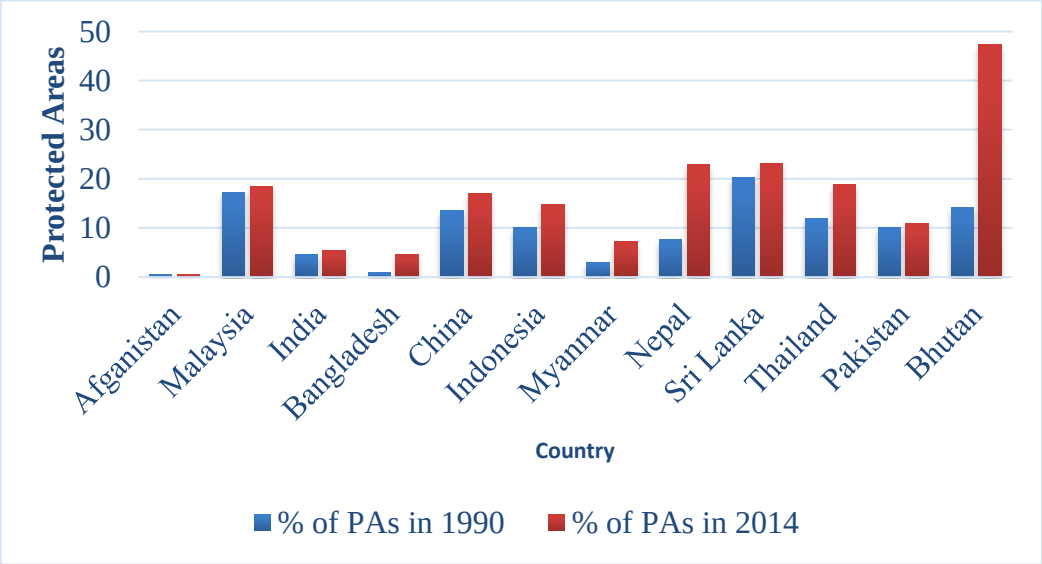


Figure 5.8: Protected areas of State Parties in Southeast Asia between 1990 and 2014 (Source: Juffe-Bignoli *et al*., 2014)

Asia is the most populous region in the world, with a substantial number of global biodiversity hotspots (Myers *et al*., 2000) and several megadiverse countries, like Malaysia, with rich cultural and natural heritages (NPS, 2016). In this region, the natural heritage with protected areas is under threat with high tendency to losses of biodiversity is continued

(Mulongoy and Chape, 2004). This study tries to relook at the key factors that strengthen the policy towards conserving biodiversity at National Parks (NPs) of Bangladesh and Sarawak, Malaysia. There is comparative analysis on the quantity of protected areas in Asia to compare with 1990 and 2014, as shown in Figure 5.8. The study suggests for learning and taking decision from each other country on increase on protected areas (Juffe-Bignoli *et al*., 2014) individually. Different parameters on protected areas of Bangladesh are mentioned with terrestrial and marine in Table 5.1. However, National Park is a type of environmental conservation tool in national and global supporting biodiversity conservation (Balmford *et al*., 1995) and providing various benefits. These parks include the peak portion (about 23%) of the entire global region protected (Chape *et al*., 2003; Muhumuza and Kevin, 2013). In terms of coverage, the terrestrial national park areas have augmented to continue (UNEP-WCMC, 2017**;** UNEP-WCMC, 2016) , which documented in Figure 5.1. These Parks (NPs) are also good instruments for biodiversity conservation in Bangladesh.

Table 5.1: Different parameters on Protected Areas Country Profile for Bangladesh

Parameters	**Terrestrial**	**Marine**
Protected Areas	49 protected areas	2 marine areas
Total Land Area	140160.2 km^2	84563.20 km^2
Land Area Protected	6456.00 km^2	4530.00 km^2
Area coverage in percent (UNEP-WCMC, 2016).	4.60%	5.40%
Protected Area Management Effectiveness (PAME)	PAME Score 39.30% (Coad, *et al.*, 2015).	

(Source: WDPA, 2017)

The study augments the present tools including conservation policy, growth of national parks and legal aspects to heighten conservation activities (Commoner, 1990) within and around the areas through literature reviews, observations of some of the parks, as well as interviews with related officers and reflection on indigenous community's involvement. The study showed that the growth of NPs maximized for the period of 2010 to 2014 both in Bangladesh

and Sarawak, Malaysia reflecting the significance that both states are employing upon the national park biodiversity conservation and relevant services they deliver to the present and upcoming nations. National biodiversity conservation related with law, policy, park area and technology, as shown in Figure 5.9.

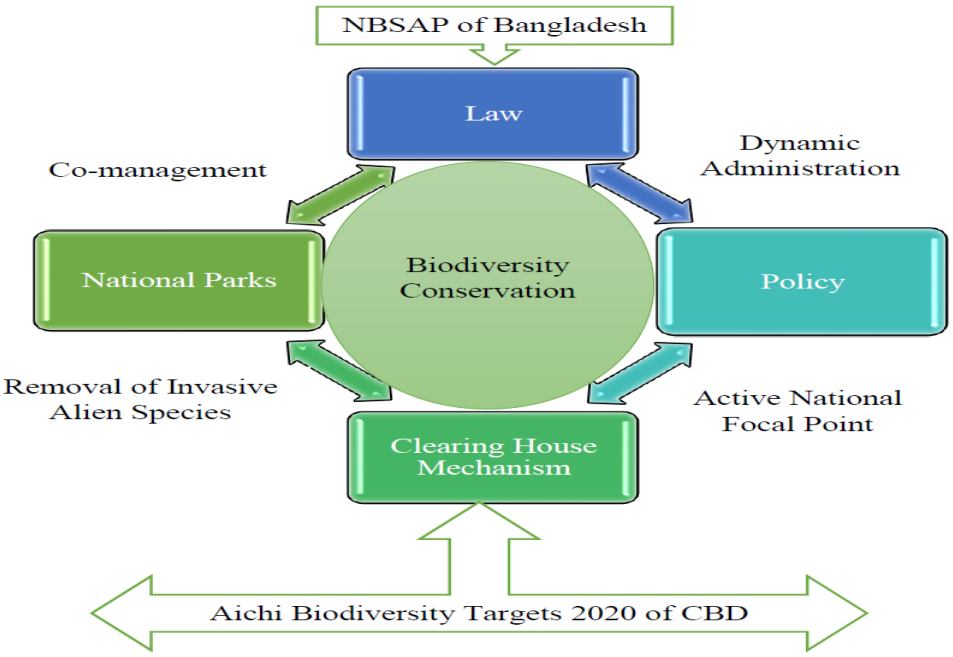


Figure 5.9: Framework of National Park Biodiversity Conservation

This is indeed a positive sign both two countries in the direction of accomplishing Aichi Biodiversity Target (ABT) 11 for the world-wide national park areas' domain. The study identified gaps on effective NBSAP, dynamic administration and co-management team, active national focal point and removal of IAS for the fulfilment of conservation instrument. Overall, the study suggests that the dynamic policy-making decisions on sustainable biodiversity protection at NPs in both countries should incorporate development with environmental, economic, social, institutional and administrative domains.

5.1.7 Application of the anticipated SWOT analysis in decision-making

The results of the anticipated SWOT analysis can be suitable for defining conservation instruments or national biodiversity strategies planning. The stated analysis design can be positively improved to sustenance decision-making at diverse stages of biodiversity governance for multiple sites (Scolozzi *et al*., 2014), divisional administrative units or national and even global for national park regions. This SWOT analysis offers various understandings of the nature conservation, geospatial, and socio-economic features of Bangladesh's national parks, particularly Lawachara National Park, which can conserve national park biodiversity management and policy making in multicriteria. In general, it permits to:

- Evaluate both the external and internal factors supporting to the success or failure of a biodiversity network of LNP,
- Better thinking the relationships between Lawachara National Park area and its' outside buffer zones,
- Highlight organisation and provision of bio-resources in order to advance policies and actions directing at protecting risk areas, national park area's networks or biogeographical areas,
- Compare diverse park areas by classifying its environmental conservation potentials.

The above mentioned ideas can support national biodiversity strategic planning in order to extent a desired status in the SWOT factors. National biodiversity protection strategies could represent on external and internal factors, improving on strengths and opportunities, as well as minimizing weaknesses and threats. For example, market instruments can adopt conservational externalities, i.e. considering the probable costs, due to losses of biodiversity, or the paybacks and the engaged stakeholders (Schomers and Matzdorf, 2013; Engel *et al*., 2008). Improving national political and social supports, and involving local or indigenous

stakeholders with co-management team is a vital factor of conservation strategic planning (Morrison and Aubrey, 2010), mentioning as, rain water harvesting for mitigating water scarcity inside LNP during summer and winter seasons.

5.1.8 Outcomes of Results for Updating NBSAP of Bangladesh

Update NBSAP is the basic instrument for implementing at national level for the purpose of state biodiversity conservation. It has been updated in order to fulfil the commitment of Bangladesh towards implementing the specific objectives indicating (a) national biodiversity conservation, (b) effective and justifiable use, and (c) reasonable and unbiased allocation. National Focal Point (NFP) of Bangladesh is the coordinator to implement of the NBSAP with cooperation of other Ministries, agencies, organizations, institutions, academic institutions, and co-management team for actions that fall within their responsibilities. The revised NBSAP (2016) creates new idea than that of NBSAP 2004, as shown in Figure 5.10. The update NBSAP highlights as follow:

(a) Aichi Biodiversity Targets (ABTs), (b) Biodiversity Clearing House Mechanism (BCHM), (c) Adoption of local and traditional knowledge, (d) Sustainable Development Goals, (e) Update National Policies, (f) Digital conservation technologies, and (g) Stakeholders engagement.

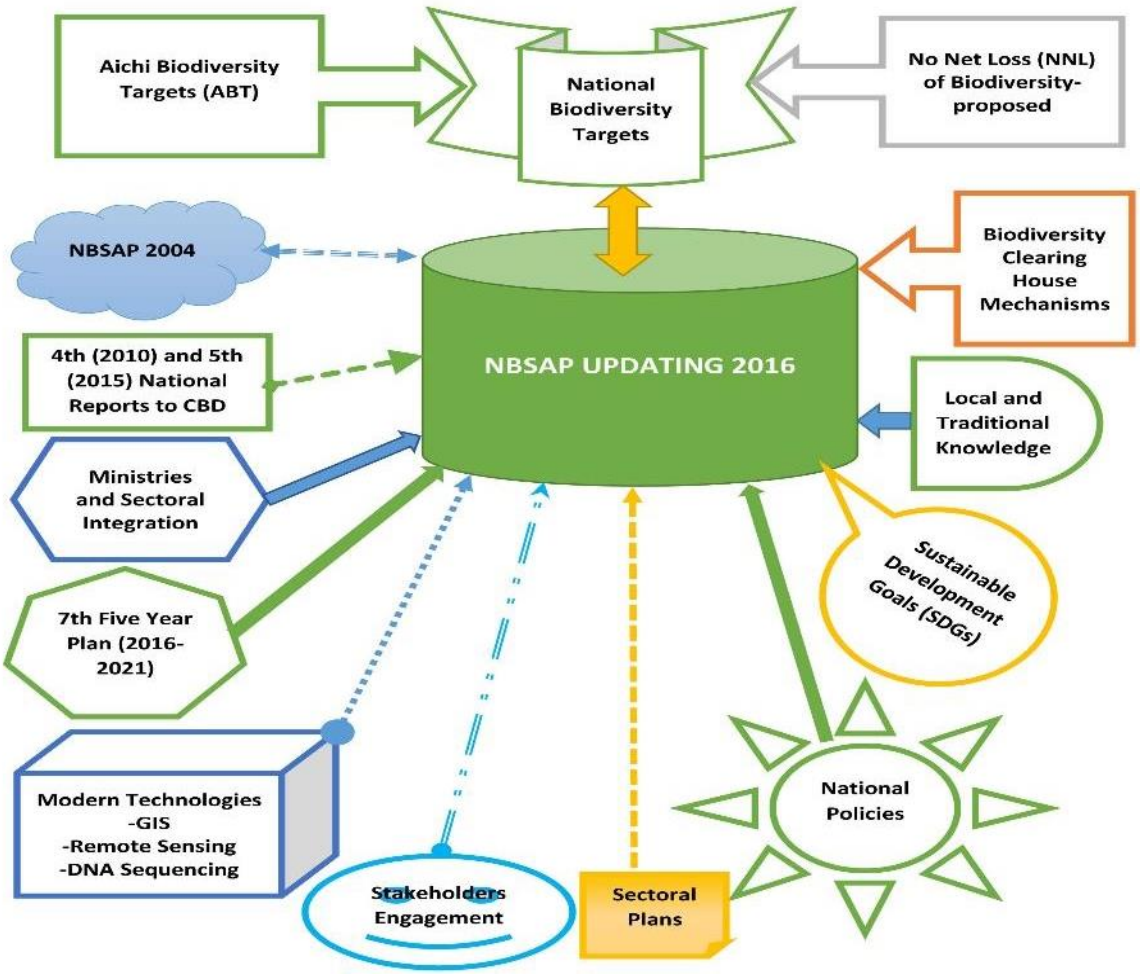


Figure 5.10 Input updating NBSAP of Bangladesh

Government of Bangladesh submitted revised NBSAP to CBD on 2016, which is being late. The study identified being late submission NBSAP, is very difficult to fulfil the targets within 2020. The study suggested for taking alternative motivational programmes to develop Lawachara National Park area for conserving of biodiversity. For example: Green Banking Activities, Green Awareness programme, School Gardening, College Gardening, Institutional Gardening, Religious Institutional Gardening and reforestation programme

5.1.8.1 Assessment of NBSAP Implementation Status in Bangladesh

There are some parameters of NBSAP which are related to biodiversity conservation, as shown in Table 5.2. The study suggests to require effort on the mentioned parameters according to identify problems during revised edition of NBSAP in connection with Lawachara National Park.

Table 5.2: Parameters of NBSAP involvement in biodiversity conservation

Parameters	Purposes	Progress	Problems
Species Conservation and habitat management in protected areas	(i) Strengthen the capacity of LNP communities. (ii) To control poaching activities and effective implementation of CITES. (iii) To resolve park and people conflict. (iv) Ensure long-term conservation of forest biodiversity.	(i) Strengthen the community-based anti-poaching operation. (ii) The poaching of endangered species reduced. (iii) Development of botanical garden, zoo, arboretum, and orchards. (iv) Species Action Plans developed.	(i) Transfer of officers frequently. (ii) Weak Human Resource Department. (iii) Population pressure on natural resources. (iv) Inadequate law enforcement. (v) Invasion of alien and invasive species.
Forest Biodiversity Conservation through Participation	(i) To conserve biodiversity rich large block of forest and ecosystem.	(i) Community forest user groups manage forest. (ii) Encourage farmers for domestication of high value NTFPs for income generation.	(i) Excess use of forest resources. (ii) Weak capacity for biotechnology and marketing.
Hill Biodiversity	(i) Manage watersheds. (ii) Connect development program for conserving of biodiversity through poverty reduction.	(i) Use of combined watershed controlling methods to recover native species. (ii) Cultivation of NTFPs in the farm as a cash crop, particularly betel-leaf cultivation.	(i) Lack of public education and awareness. (ii) Lack of financial and technical resources. (iii) Geographical remoteness. (iv) Lack of adequate scientific research.

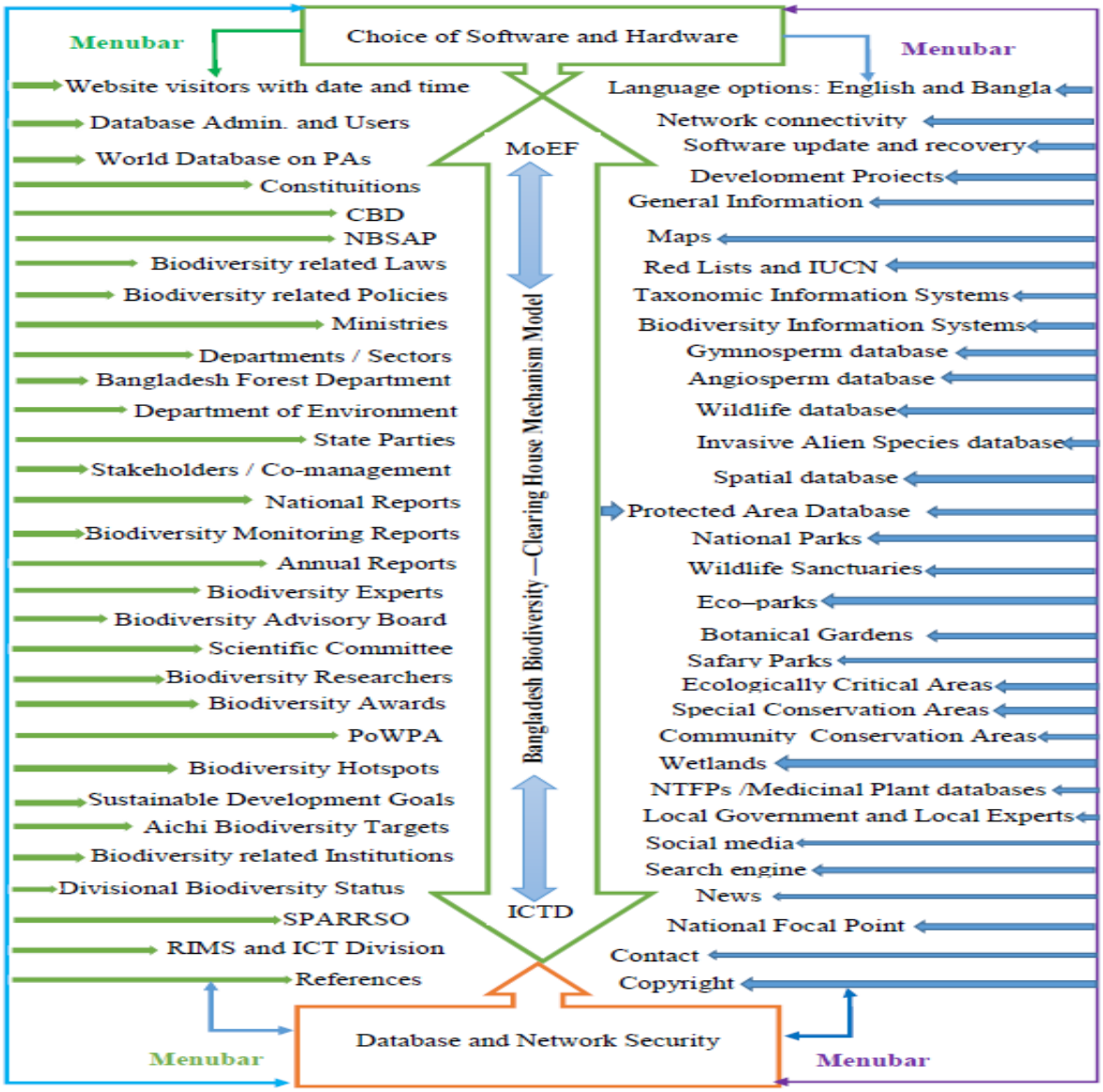
Table 5.2 continued

Agro-biodiversity	(i) Establishment of national data bank on indigenous livestock, and Germplasm bank.	(i) Gene Bank established (ii) Use of Environmental Impact Assessment to reduce adverse impact on national park biodiversity. (iii) Initiation of community biodiversity registration	(i) Inadequate capacity. (ii) Lack of technology Transfer
Poverty Reduction through biodiversity Conservation	(i) Conserve biodiversity in and around the PAs with the operation strategy focusing on the improvement of socio-economic and cultural conditions of communities. (ii) To develop sustainable tourism in PAs.	(i) Park revenue goes to community development through co-management.	(ii) Inadequate conservation awareness among the local communities. (iii) Inequity of benefit sharing among the communities.
Institutionalization of Biodiversity Conservation	(i) Accomplish comprehensive documentation and registration of biological resources in protected areas and buffer zones comprising all groups of plants, animals and microbial diversity	(i) Establishment of co-management team in the country. (ii) Establishment of 17 national parks, 21 wildlife sanctuaries, 7 Eco-parks, 3 safari parks, 2 botanocal gardens and 13 ecologically crical areas. (iii) National biodiversity flora established and provide information to planners, scientists, students, and public users.	(i) Conflict between community forest user group and Government for benefit sharing. (ii) Human-wildlife conflict. (iii) Lack of compensation mechanism.

5.1.8.2 Develop National Biodiversity Clearing House Mechanism Model

A planned stronger and operative clearing house mechanism developed new multi-channels of communication globally, such as (a) support development of environmental awareness, (b) creating associations to the on-going nature conservation activities, (c) Consciousness levitation, (d) biodiversity information broadcasting. The study illustrates the participation

of all the sponsors for necessary actions of national government and non-governmental organisations, private industries, local community leaders, Network Specialists, ICT Company, Park Manager, Team Leader of Co-Management Committee, Indigenous community Leader, Academician, Biodiversity Specialist, Botanists, Zoologists, Researchers, Environmentalists and Lawyers, Local Government Leaders, Policy-makers and effective other stakeholders.



Where, (i) ICTD- Information Communication and Technology Division, (ii) PoW-Programme of Work on Protected Area., (iii) MoEF-Ministry of Environment and Forests
RIMS-Resource Information Management Systems

Figure 5.11: Development Model for Biodiversity Clearing House Mechanism

The biodiversity clearing house mechanism creates new effort to the national conservation awareness and disseminating worldwide through online connection as well as interlinked with CBD and other state parties (Figure 5.11). This model will be enhanced by the state party for developing of national biodiversity clearing house mechanism, which fulfils the requirements of CBD's CHM. For example: National Plant Species Database, Wildlife Database, National Park Database and so on. These are interlinked with clearing house mechanism either state party as well as Convention on Biological Diversity. This model also can enhance national reporting to CBD. The assessment of the study that it is connected with world database on protected area, Asian protected area network, CBD state parties' networks, IUCN Red List Database, Global Taxonomic Database, Conservation International Database, Taxonomic Database Working Group and digital conservation related new network database. The BCHM is suitable for information dissemination and collection by the researchers, academia, scientist, botanists, zoologists, biodiversity specialist, taxonomists, environmentalists, Lawyers, Environmental educationists, Digital conservationists and natural science philantropists with development of biodiversity.

5.2 Establishment of National Park Database Security Systems

The national park database security is to safeguard the national park information contradiction of coercions using both practical and governmental controls. Plant and Wildlife Security attentions do not only relate to the database; that is, the data itself. The biodiversity security controls based on computer and non-computer systems. Computer-based controls are (i) permission, (ii) interpretations, (iii) encryption, (iv) accuracy (v) check-pointing, (vi) journaling, (vii) backing-up, and (viii) connected actions. Gaps of retreat could disturb additional portions of the nature conservation system as well as relevant biodiversity information sharing, indexing, retreating and uploading data, as shown in Figure

5.12. Non-computer-based control for national park database is the general database environment in combination with the network-based security controls with national park biodiversity such as species, monitoring, commentary, strategies, contracts and other managerial controls.

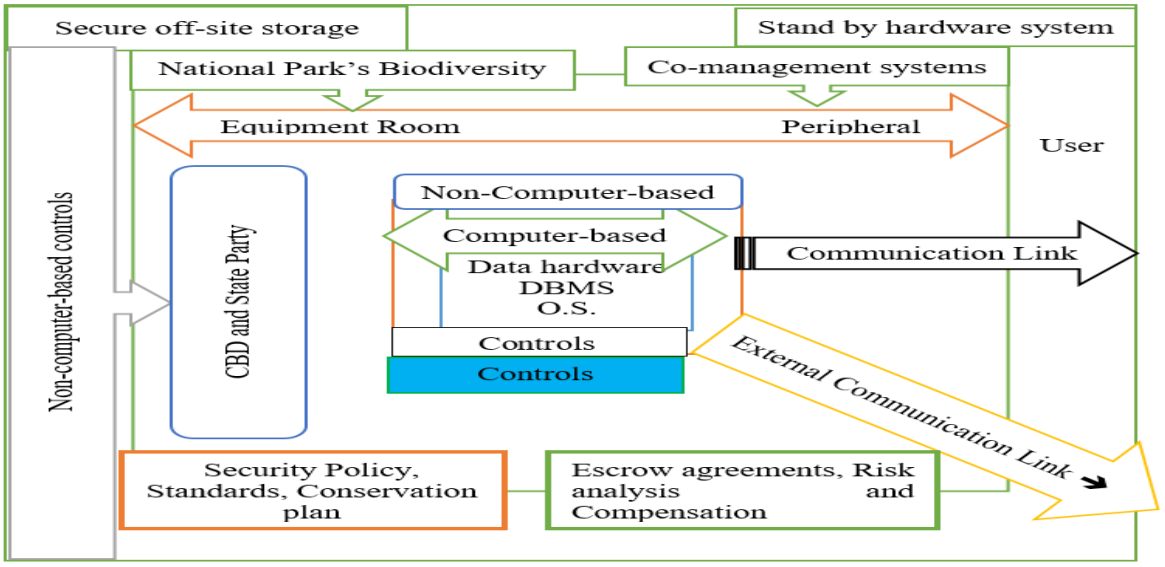


Figure 5.12: National Park Database Security Systems
(Source: Author's Compiled Data, 2017)

The study measured: (i) formation of a biodiversity security policy and conservation design, (ii) park staff management controls, (iii) protected placing of apparatus, (iv) Safe and sound geodata and genuine software, (v) escrow treaties for biodiversity database administration, (vi) biodiversity database maintenance agreements, (vii) Users' physical access control, (viii) national park biodiversity database building control, (ix) emergency response and arrangements.

5.2.1 Establishment of a CHM Security Policy and Conservation Plan

A Clearing House Mechanism database security policy is quite diverse from a conservation connectivity plan. A state party should have both a security policy document and a

conservation connectivity plan document. To be able to maintain a secure system requires a written security policy, and establishing this policy should be of prime importance to senior management. A security team under the leadership of a member of senior management should be established, and drafting a security policy should be one of their first tasks. Details contained in a security policy should include: (i) the area of the national park's biodiversity it covers, (ii) responsibilities and obligations of park employees, (iii) penalising action that inform from gaps of the policy, (iv) trials which must be monitored. This final point will give rise to other specific procedures that explicitly refer to particular parts of an information system, but which are not part of a security policy statement. For example, the policy may state that only authorized personnel shall use the DBMS's application systems, but will not state how this is to be achieved.

On the other hand, a conservation connectivity plan should be established to deal with unusual events that are not part of the normal daily routine. Again, there may be one conservation connectivity plan for the whole national park or several, each covering different areas. Conservation connectivity plans detail the response necessary to deal with the types of event (Angelstam *et al*., 2003) that may occur; for example, a forest fire. It is essential that any conservation connectivity plan also take into account people as well as equipment, and such like.

Table 5.3: Schedule of Conservation Connectivity Plan

No.	Schedule of Conservation Connectivity Plan
(i)	Who the key personnel are and how they can be contacted
(ii)	If key personnel are unavailable, a list of alternative personnel and how they can be contacted.
(iii)	Who decides that a conservation connectivity plan exists and how that is decided.
(iv)	The technical equipments of transferring operations elsewhere.
(v)	The operational requirements of transferring operations elsewhere.
(vi)	Any outside contracts who may help.
(vii)	Whether any insurance exists to cover the situation.

This is because in some situations, key personnels may not be available. Senior staff should be familiar with the conservation connectivity plan, of which there should be several copies stored safely in different locations (Table 5.3). Any plan should also be periodically reviewed and tested as far a practicable (Connolly *et al*., 1997).

5.3 Bridging the responsibility Gap

Bridging the responsibility gap is essential between environmental and other policy sectors including (a) dynamic demand-based tools, (b) effective and obligatory accountability arrangements, and (c) Partaking decision-making determinations, as shown in Figure 5.13.

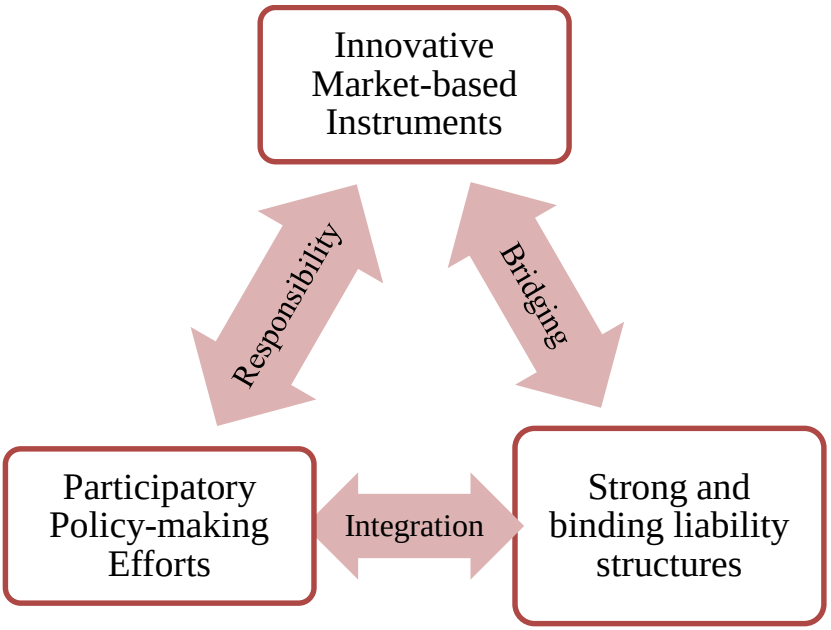


Figure 5.13: Bridging the responsibility gaps
(Source: Author's Compiled Data, 2017)

The bridging connects with social integration to the community and administrative responsibility for conservation of biodiversity and park management. Because, biodiversity conservation systems drive at many diverse spatial and temporal scales, the policy response must take into account the corresponding bridging levels of government. The gap determines

the nature of skills, knowledge or resource gaps and establishing how they may be bridged (FAO, 2007).

5.3.1 Conceptual Framework on Human-Biodiversity Reflection

Today more than 75% of the terrestrial surface is impacted by human (Ellis *et al*., 2010).. Human-biodiversity interactions enhance to counteract possible outcomes (Gardner *et al*., 2009).

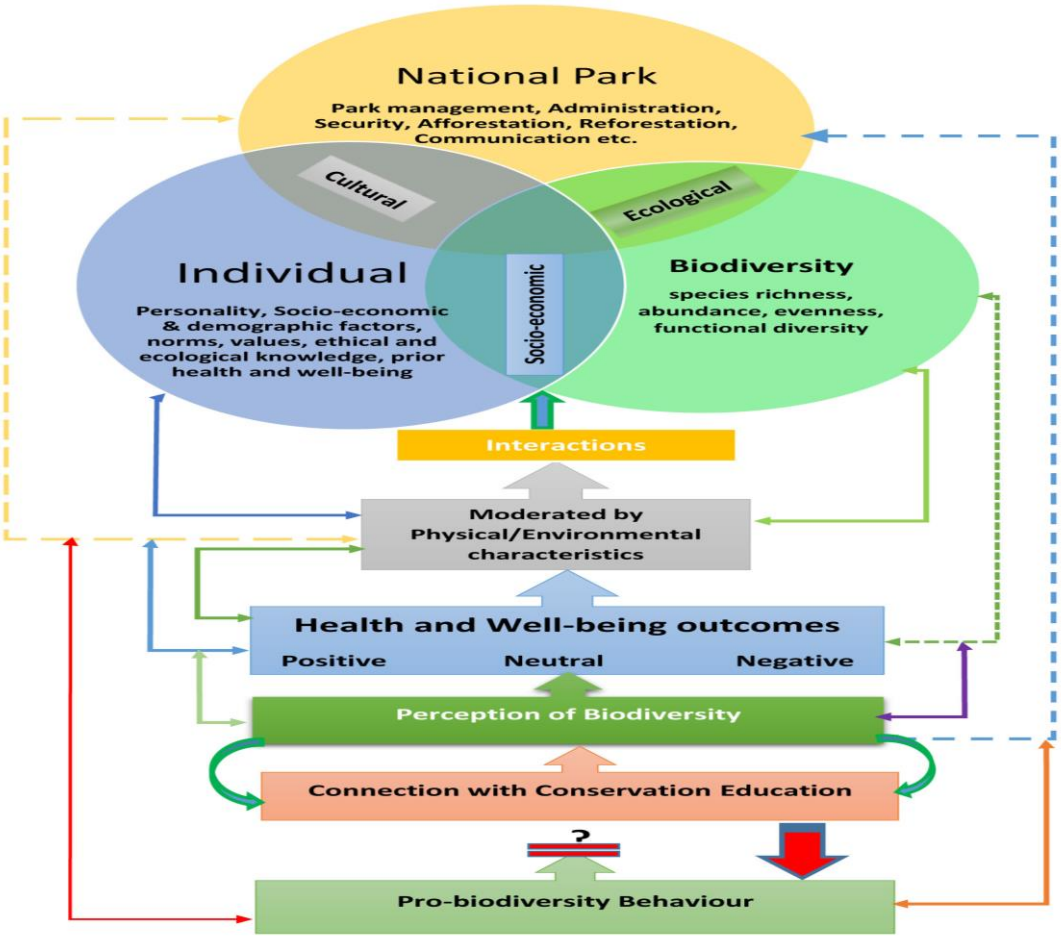


Figure 5.14: Conceptual Framework of human—biodiversity and national park interactions (Source: Modified Gardner *et al*., 2009).

This is the intangible outline of human—biodiversity and national park connections and possible outcomes for strength and safety (Barber, 2004), perception of biodiversity,

connection with conservation education and pro-biodiversity behaviour (Pett *et al*, 2016). From this framework, conserving of biodiversity reduced anthropocentric pressure from adjacent areas' inhabitants, particularly dependency of human beings towards national parks. This is shown in Figure 5.14 that the question symbols signify less well-understood associations. The spotted lines characterise response from results back to biodiversity or the specific object. Meanwhile, human-biodiversity reflection connects with local and indigenous people for environmental education to manage national park biological diversity conservation, especially on health and well-being outcomes including the ratio of total landscape area, national park area and population density. In Sylhet division, total area 12635.22 km^2 and national park area 21.7171 km^2, while population density 779/ km^2 to compare with Mymensingh (BBS, 2013) as shown in Table 5.4. It is mentioned that population density of sub-district Kamalganj is 534 to compare with Moulvibazar Sadar (BBS, 2013) for anthropocentric pressure to national park biodiversity.

Table 5.4: Total Area, National Park and Population density of Bangladesh

Divisions	Total Area (km^2)	Area of National Park (km^2)	Population density/ (km^2)
Sylhet	12635.22	21.7171	779
Barisal	13225.20	16.13	613
Chittagong	33908.55	268.7448	813
Dhaka	20593.74	134.58	1751
Khulna	22284.22	na	699
Mymensingh	10584.06	3.4413	1074
Rajshahi	18153.08	2.6412	1007
Rangpur	1618.99	10.1961	960

(Source: BBS, 2013)

5.3.2 Enhancement of Green Banking Applications

Green Banking is a new and growing tool to conserve biodiversity and its habitat to deal with the distributive effects of conservation in an integrated innovative way (Bagnoli *et al*., 2008). Money is channelled from Bankers /Financial Institutions Owners, who would like

to use national park biodiversity rich areas to those who protect and manage national park on their properties in connection with Government's Green Banking Policy requirements. This way, distributive issues are solved through market-based mechanism on the required targets of afforestation and reforestation programmes. Green Banking is one of the Banking activities that concentrates on socio-economic and environmental (ecological) factors with an aim to protect the environment and conserve natural resources (Rengasamy, 2014).

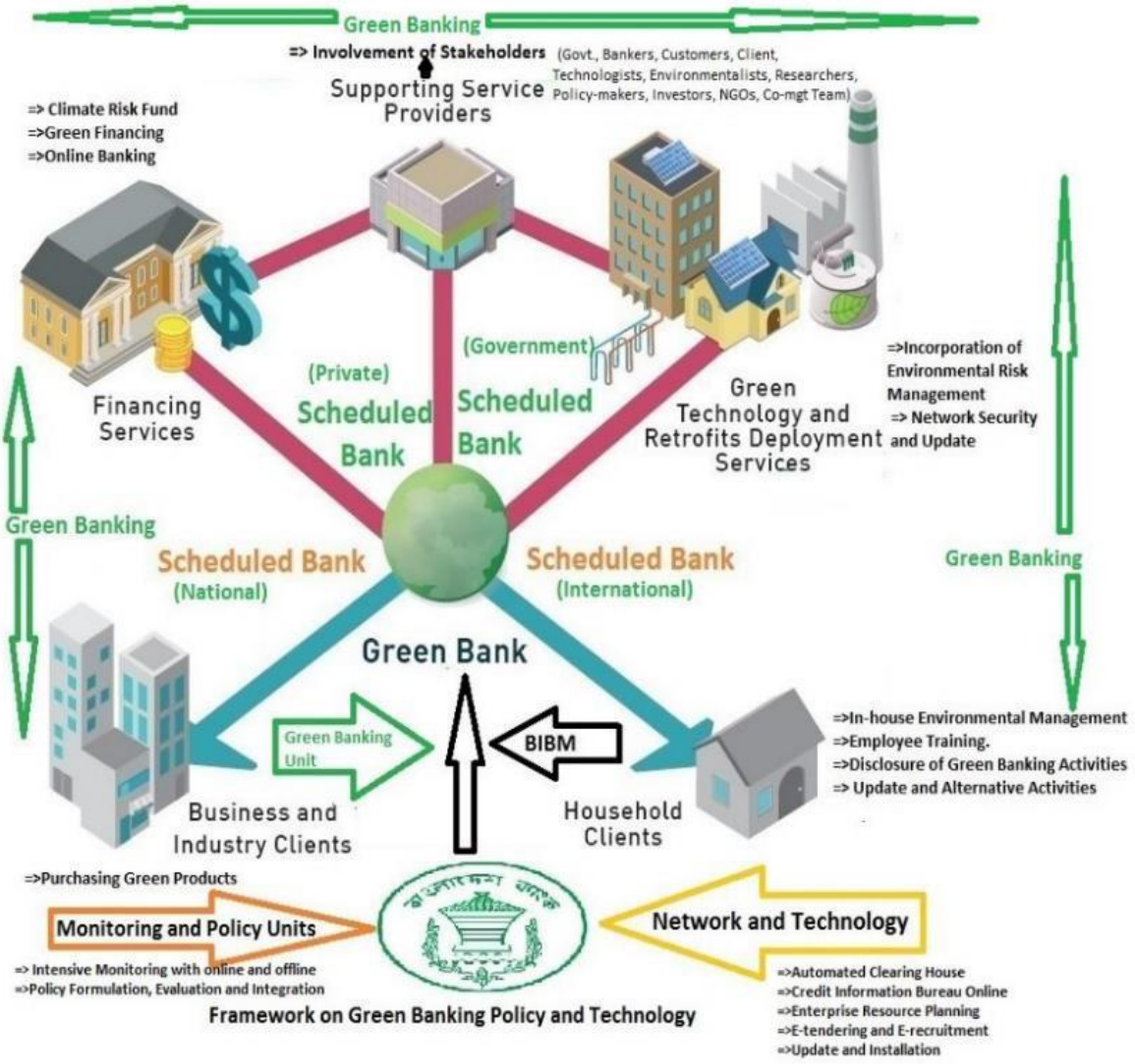


Figure 5.15: Framework on Green Banking Policy and Technology Adoption

Environmental policy instrument is connected with socio-economic factors with environmental considerations at the heart of decision-making on environmental issues among others includes biodiversity, climate change and ecosystem decline. Biodiversity is the core arena of these environmental issues. Bangladesh is one of the most vulnerable countries facing the impacts in environmental degredation (Orts, 1995). The countrymen recognize the fact that the contribution of banking sectors with digital technologies are very crucial in growth and development activities (Figure 5.15), which can play more effective role in mitigating the environmental degredation (Rahman and Barua, 2016). The current time of technological development indicates huge relaxation and luxurious lifespan where tend to an upsetting condition of massive ecological dilapidation integrated through the alarming actions. Authorities of Lawachara National Park can partipate in this green banking programme. The study investigates the Green Framework and Computing Applications through green investments and community environmental awareness (Sharpe, 1982) at the surrounding areas of Lawachara National Park (LNP) in Moulvibazar district. The study showed that 44% and 53% of the respondents respectively stated that it is essential and very essential for the authority to undertake the necessary actions to fulfill the policies providing by Bangladesh Bank towards Scheduled Banks at the existing areas investment for sustainable conservation.

The study represents the central bank's green banking alertness through constituting scanning, association and connection, evaluation and judgement, which positively influence the key stakeholders. Thompson and Cowton (2004) either concluded that banks may be supportive through environmental disclosure practice voluntarily or required by regulation. If the authority of Banking sector can be introduced the activities of Green Banking with proper policy and technology including environmental consciousness, Green financing,

Green marketing, Green Income Generating Activities (GIGA), Brick Burning Chimney Controlling Activities and so on. According to the report of BBS (2013), the 20-forest nursery and seven brick kiln are existed at Kamalaganj sub-district, but no horiticulture centre there. International Standards Organization 14000 is also another global initiative, which is a series of voluntary compliance standards for environmental practices (Murray *et al*., 1997) through Green Banking activities. Green Banks ensure that a given level of Biodiversity will be maintained while making development possible that might otherwise compromise a species (Bagnoli *et al*., 2008), at least plant or animal species. The study also highpoints on the paces, ingenuities (Stewart, 2006), paybacks and upcoming of national green banking technology in Bangladesh perspective to further incorporate the need of imminent generations on banking policy using technology in stimulating environmental sustainability.

5.3.3 Role of National Park Visitors and Ecotourism

Ecotourism is a growing services market (UNEP, 2004). Visitors can enhance the ornamentation of National Park biodiversity management depending on access and movement. Visitors' numbers in most national park areas around the world are increasing (Balmford *et al*., 2002; Holden, 2016; UNTWO, 2017). Therea are two types of visitors, such as (i) national visitors, and (ii) foreigner visitors in Lawachara National Park (Figure 5.16). In 2011, there were 773 foreigner visitors out of 648,13 to Lawachara National Park in Bangladesh (IPAC, 2012), meanwhile 305,31 foreigner visitors out of 42,810 of Malaysia in the same year (SF, 2012). From the findings, political instability and lack of security are the root causes of less foregner visitors in Bangladesh. It mentioned that the entry fee at Bako National Park is RM 20/-, where RM 1/- (equals BDT 20) the entry fee at Lawachara National Park.

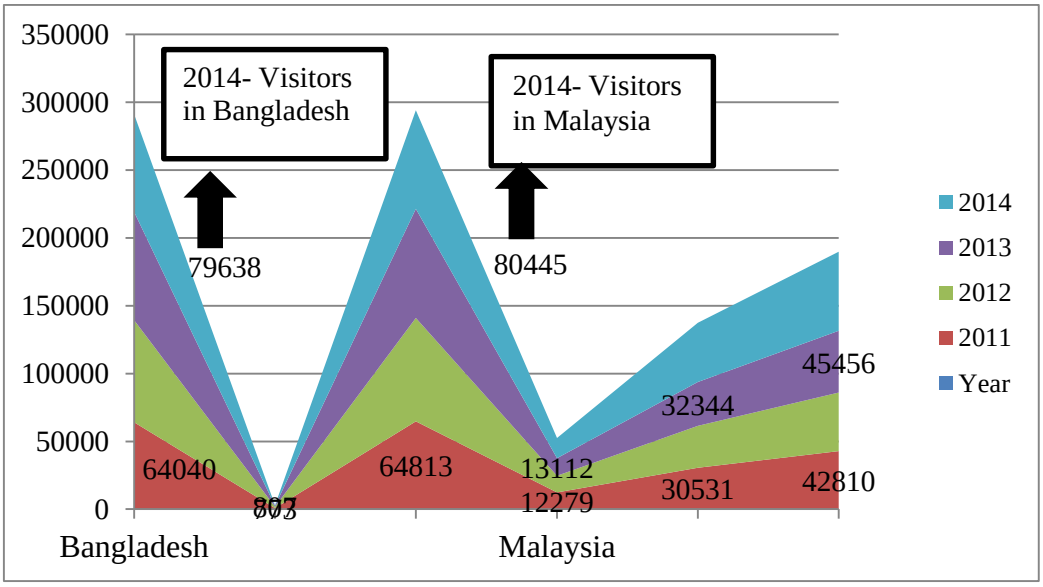


Figure 5.16: National Park visitors between Bangladesh and Sarawak, Malaysia

For attracting more visitors and mitigating impacts need conservation reserve as a means of value adding that can alter visitors experiences (Zhang *et al*., 2009). For the purpose of national park biodiversity conservation and recreation, uncertainties surround whether negative impacts occur. The reported trend in recreational activity requires debate; policy direction and target areas need national park area management effectiveness evaluation to assess conservation implications (Newsome and Hughes, 2018) in connection with ecotourism activities at Lawachara National Park.

5.3.4 Augmenting Environmental Education

Community's environmental education is essential for protection of National Park biodiversity. Because the quick losses of biological diversity throughout the previous decades, which managed to sprouting trepidations at local, divisional, regional and national as well as global stages (Solh *et al*., 2003). Natural heritage such as Lawachara National Park (LNP) is under threat with high tendency to losses of biodiversity (CNRS, 2000). Local

community and indigenous people over-exploit national park biodiversity but none can effectively conserve due to lack of systematically dynamic environmental educational tools. Encouraging field-based-student-scientist commitments to protect local biodiversity is an imperative goal of education (Jacobson, 1987) for sustainable development in Bangladesh and elsewhere. The task attempts to overlook the EE to create knowledge, awareness and necessary skills to solve the key aspects with references to the local context, which reform the policy towards conserving biodiversity at LNP in Moulvibazar district. The study showed that almost 65% of the respondents opined their opinions for augmenting EE with systematic curriculum development, scientific action-oriented programmes, and empirical education, enthusiastic to digital conservation, ecological field exposures, sectoral integration, and academia effective trainings.

Table 5.5: Literacy rate of various sub-districts of Moulvibazar

Sub-districts	Literacy rate (%)
Kamalganj	48.6
Barlekha	52.4
Juri	52.3
Kulaura	51.9
Moulvibazar Sadar	54.9
Rajnagar	48.6
Sreemangal	48.3

(Source: BBS, 2013)

The study signifies that the frequencies of national environmental conservation related legislations maximized for the period of 2010 to 2016, which are placing upon the EE. The research fostered a comprehensive framework to explore the efficacy of EE (Solh *et al*., 2003) on government and non-governmental policies and its effectiveness. This is indeed a positive sign on key stakeholders' awareness upon the sustainable biodiversity conservation and EE for Bangladesh towards achieving Aichi Biodiversity Targets beyond globally environmental networks. Overall, the study emphasizes the dynamic policy-making decisions on sustainable conservation at NPs further environmental motivation at local,

natoinal and global collaborative approaches should incorporate development with social, political, economic, institutional and administrative purviews. The literacy rate of Kamalaganj is 48.6 % (Table 5.5) to compare with Moulvibazar Sadar in consciousness of environmental education at Lawachara National Park (Appendix E).

5.3.5 Setting National Biodiversity Monitoring Information Systems

Biodiversity monitoring information system enhances in emerging national park biodiversity portfolio and structures to take up monitoring options in biodiversity (BLI, 2006) through reporting the present conditions and changes as shown in Figure 5.17.

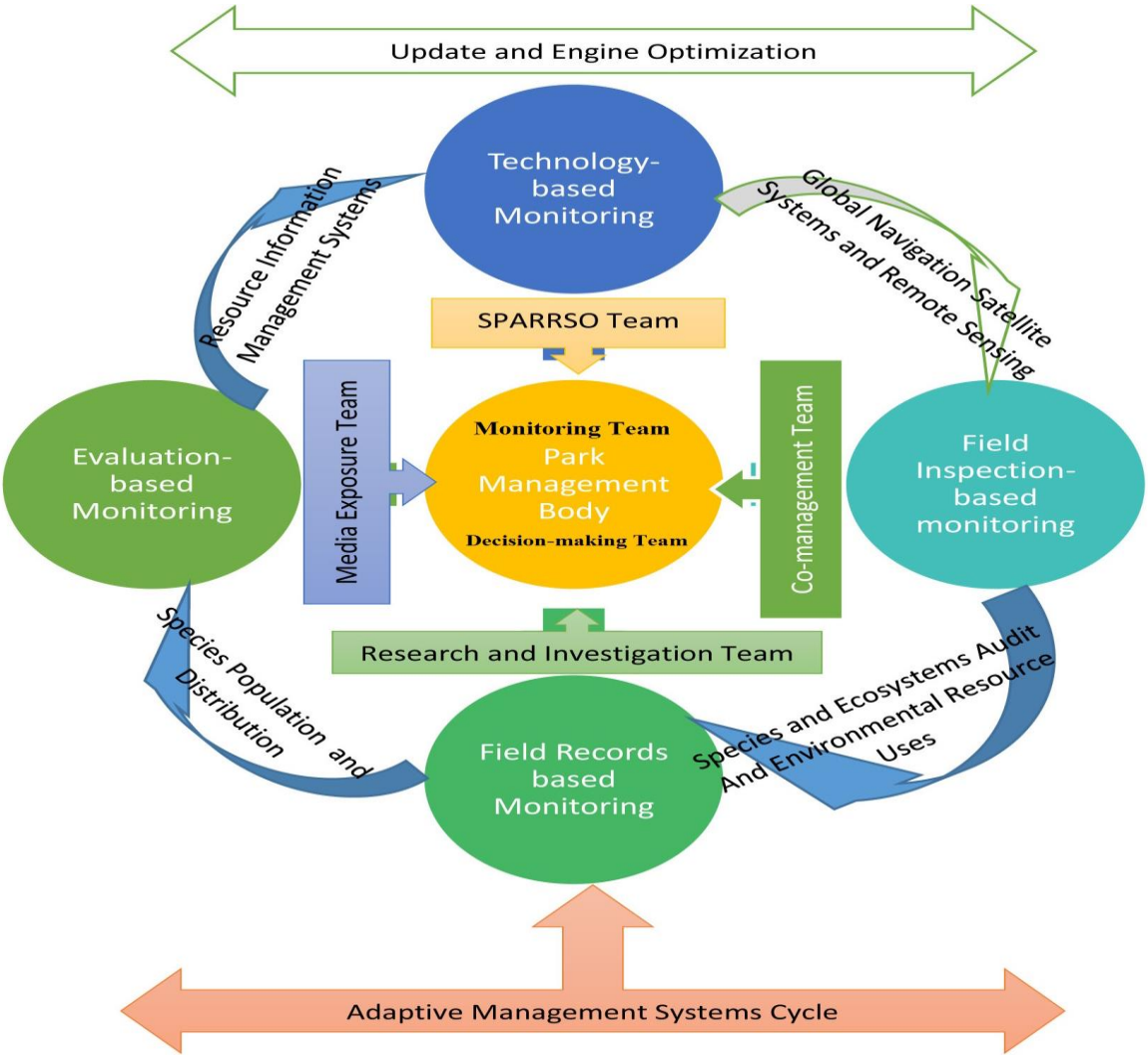


Figure 5.17: Biodiversity Monitoring Information Systems

In Bangladesh, it is the parts and parcels of natural heritage management systems with framework status and reporting trends involving multi-phase and multi-scale systems of biodiversity indicators. The national biodiversity monitoring database includes national park management. This database would interlink with biodiversity monitoring information systems, where includes (i) technology-based monitoring, (ii) field Inspection-based monitoring, (iii) field records- based monitoring, and (iv) evaluation-based monitoring systems. The idea of biodiversity conservation parameters is extensive and an important indicators of national park biodiversity monitoring systems.

5.3.6 Develop 7R's Policy for National Park Biodiversity Conservation

The 7R's Policy is essential for national park biodiversity conservation. Here includes seven parameters rule indicating first letter capital "R" as shown in Figure 5.18, such as:

(i) **R**eformation integrated policy in connection with forest policy, environmental policy and relevant other policies,

(ii) **R**estoration national parks,

(iii) **R**eplacement Invasive Alien Species (including plant invasion and wildlife invasion),

(iv) **R**eforestation with biodiversity targets indicates on afforestation for forestaion on the priority of Aichi Biodiversity Targets 2020,

(v) **R**eintegration communities commitment (i.e. they are mainly local, indigenous and national communitie as well as regional and global communities),

(vi) **R**euse biodiversity technology i.e. application of digital technology and biodiversity information systems,

(vii) **R**ecovery valuable resources (i.e. using resource information management systems for protection of natural resources).

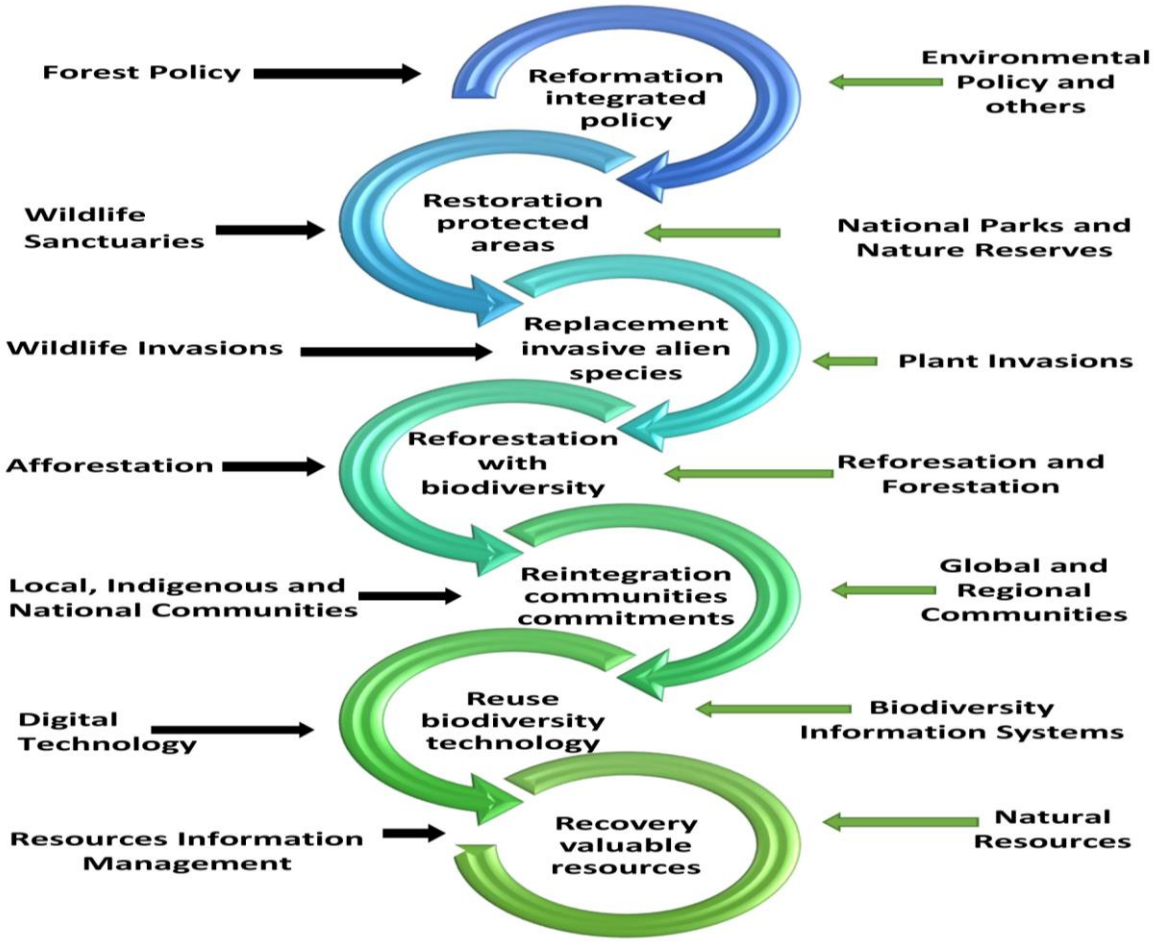


Figure 5.18: 7 R's Policy theme for conserving of national park biodiversity.

The 7R's policy improves the national policy reforms and enhances to development of BCHM, particularly Lawachara National Park Database linking with reformation, restoration, replacement, reintegration, digital conservation and resource recovery.

5.3.7 Sectoral Policies Integration for conservation of National biodiversity

Bangladesh is a developing country, consists of different sectors and departments, like Bangladesh Forest department, Department of Environment, Department of Agriculture and so on. Each sector has individual policy, viz. forest policy, agriculture policy, environmental policy, and land policy etc, as shown in Table 5.6 with necessary examples. There is a shared

important link among these sectors for sustainable development, social and economic reforms and their integrations for specific policy areas (Owens and Hope, 1989).

Table 5.6: Different Sectoral Policies Integration

Sectors	Important Roles
Agriculture	Agriculture and land management perform a significant role in preserving and cultivating the environmental condition of the cultivated landscape biodiversity, site index, water quality and capacity for carbon storage. The combined agricultural policy shows a role in stimulating both basic and more improved forms of environmental conservation.
Forestry	Integrated policies directly or indirectly influence forests and forestry, for example: Forestry Master Plan, National Environmental Management Plan as well as environmental legislation on nature protection, climate change and air quality. The national forest policy enhances the implementation of sustainable forest management and supporting national forest programs.
Environment	Environment remains one of the most important sectors influencing the state of environmental resources. It enhances with the natural resources to ensure a sustainable and responsible management of environmental concerns.
Others	There are several sectors, like Fisheries, Tea, Energy, Maritime, Transport, Trade, Communication, ICT, and International Affairs and so on. These sectors can cooperate for conservation of biodiversity and relevant programs.

From the point of research, biodiversity policy relates with public policy, which is related to National Biodiversity Strategy and Action Plan (NBSAP). Article 6 of the CBD requires each State Party to develop a NBSAP for implementation of the Convention's objectives, to integrate the plan's objectives into sectoral policies and to report to other Parties about related efforts, successes and failures (CBD, 1992). Government of Bangladesh adopted a NBSAP to halt the loss of biodiversity in Bangladesh and to reconcile protection with the interests of users (DoE, 2016). The National Strategy is based on the CBD's biodiversity

strategy; with connect to a number of related national sectoral strategies inter alia National Conservation Strategy, the Country Perspective Plan and linking within the Sustainable Development Goals.

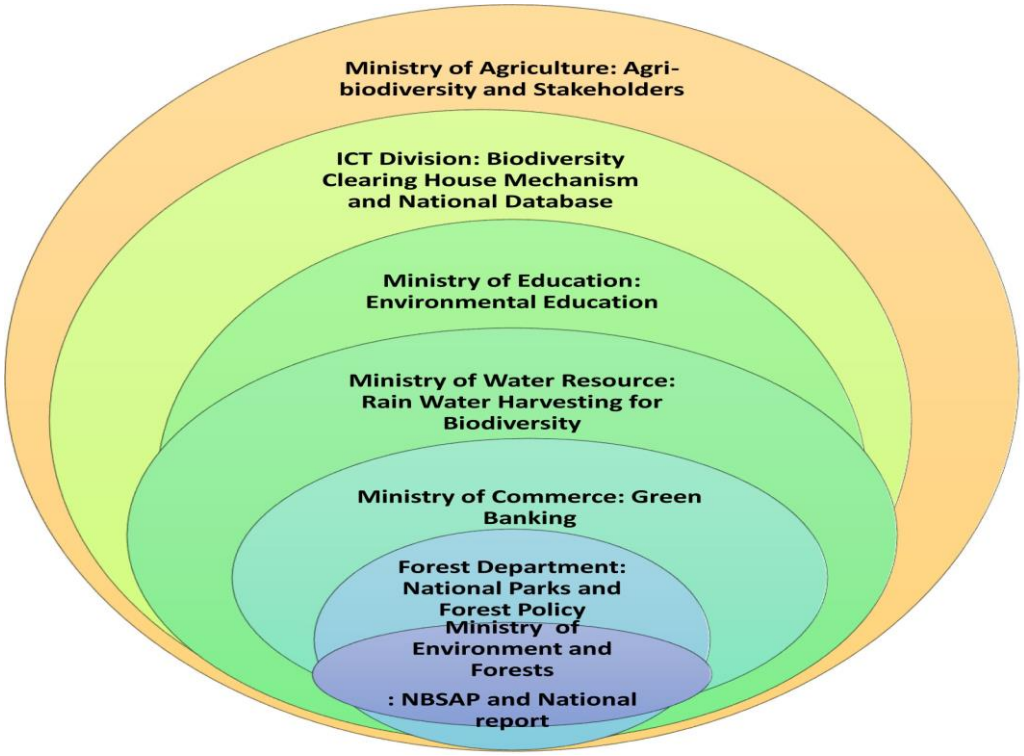


Figure 5.19: Sectoral Policies Integration for conservation of biodiversity
(Source: Author's Compiled Data, 2017)

So, the study tried to analyse for integration with following ministries of Bangladesh, as shown in Figure 5.19, through different policy options analysis, such as: (i) NBSAP and national report from Ministry of Environment and Forests, (ii) Environmental Education from the Ministry of Education, (iii) Green Banking services from the Ministry of Commerce, (iv) National Parks from Forest Department. The study also observed that there are opportunities for multi-sectoral cooperation both on macro, micro and meso levels – while ethical, good practice and assessment frameworks for self–regulation will need to be developed. The study argued that broad interdisciplinary science and academia practice

partnership are central integration to a sustainable development of digital conservation (Arts *et al.*, 2015) towards National Park Management.

5.3.7.1 Sectoral Contribution

There are several government sectors perform as a national economic review indicator on gross domestic products. Agriculture and forestry sector perform determined valuation than the other sectors (BBS, 2011), as shown in Figure 5.20 indicating standard deviations of individuals.

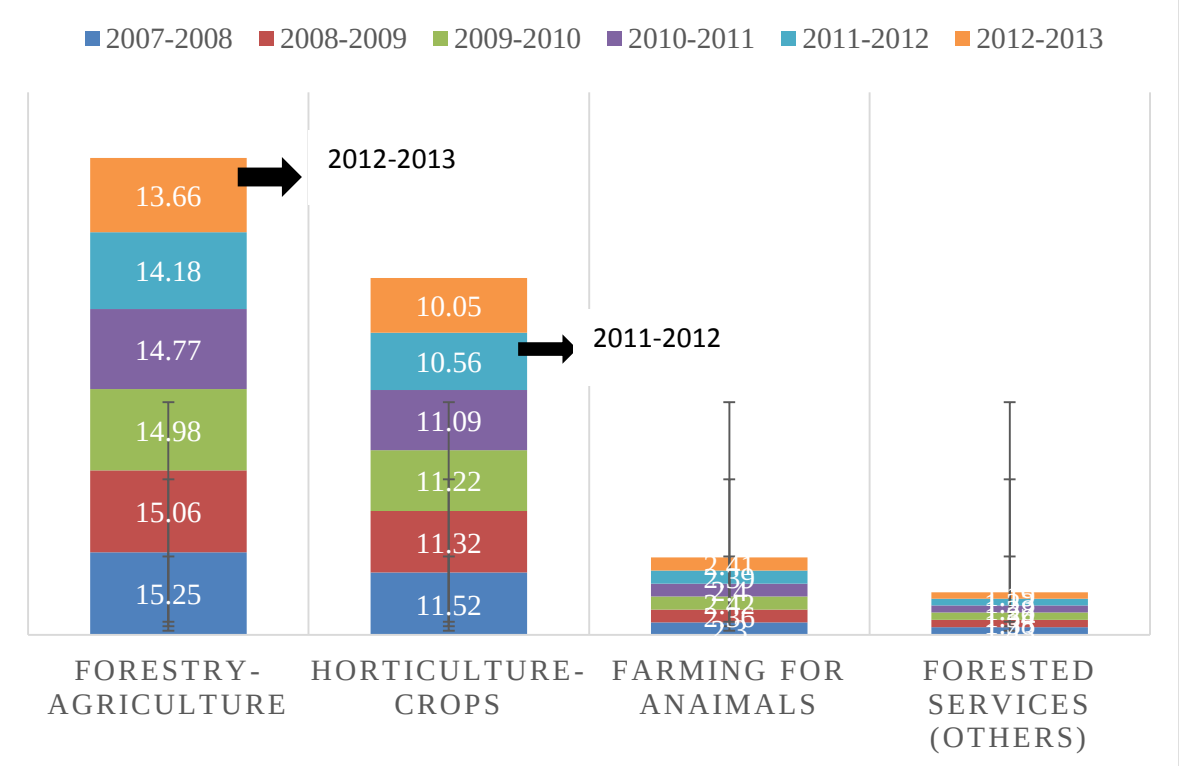


Figure 5.20: Sectoral GDP Performance in the following year (BBS, 2011).

Sectoral's contribution ehnaces to sectoral policy integration for conservation of biodiversity including Lawachara National Park biodiversity. For example, the GDP of Forestry and Agriculture sector is 13.66 during the period of 2012–2013, meanwhile the stated GDP is 10.05 in the same years. However, forestry and agriculture sector enhances the conservation

instruments for national park biodiversity protection, particularly safeguard of Lawachara National Park biodiversity. The research also compared with the GDP of Asian countries. In Bangladesh, the GDP was 6.1 in the year 2013 but in 2016 it was 6.7 (GEP, 2016), which as shown in Figure 5.21. The National GDP reflects on the contribution of local and national community's well-beings. Sustainable biodiversity conservation depends on community's well-being to uplift the socio-economic status.

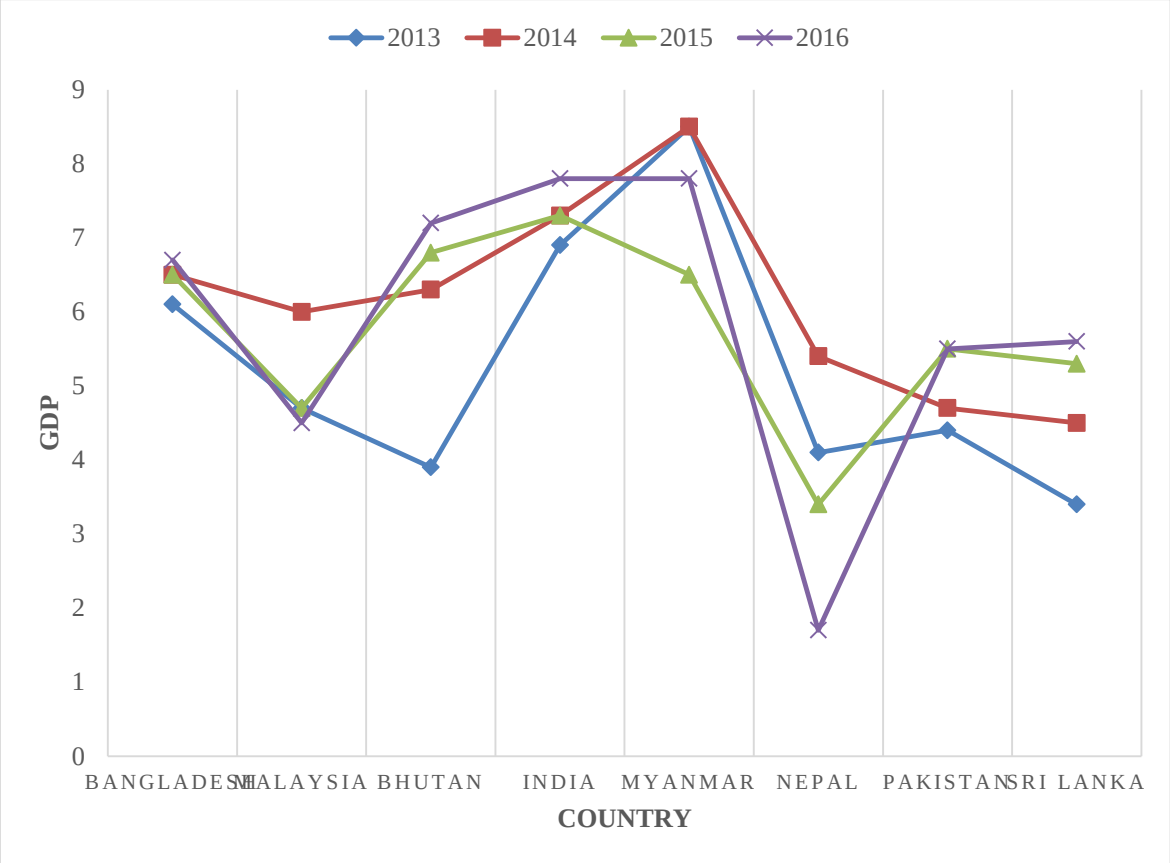


Figure 5.21: Gross Domestic Product of Asian Countries (Source: GEP, 2016).

5.3.8 Conservation through Technological Innovations

Digital conservation system is the better than the traditional and adjournment systems. Innovation of technology refelects the digital conservation towards national park at regional,

national and global networks successively. These innovations include with Political, Economic, Ecological and Social (PEES) in connections with National Park Biodiversity (Stem *et al*., 2016), Legal Systems and Technological Standards. By mandating specific technologies, the development of more effective or efficient technologies is discourage by prescribing specific losing levels, there is little incentive to reduce below those levels to inhibit technological innovation (Golub, 1998b; Cohen, 1997), as shown in Figure 5.22.

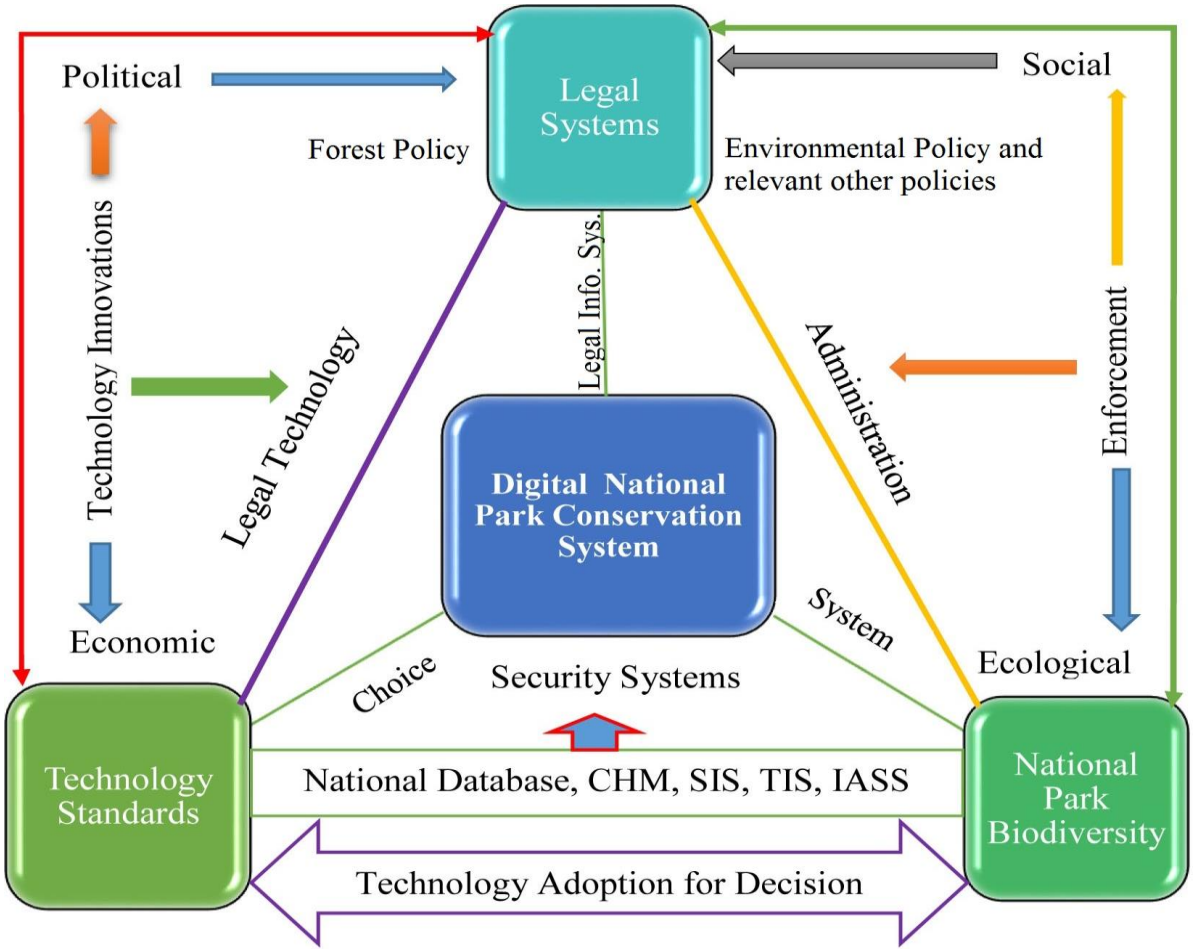


Figure 5.22: Conservation through Technological Innovations

The technological innovations for national park biodiversity create new ideas on national biodiversity database for State Party's requirements, Clearing House Mechanisms for CBD's requirements, and species information systems (SIS), Taxonomic Information Systems (TIS) and Invasive Alien Species Systems (IASS), which connect with the World.

Database on Protected Areas (WDPA) for the improvement of Digital National Park Conservation Systems (DNPCS). This DNPCS builds effective administrative (Golub,1998b) and legal technological systems stated enforcement (Chertow and Esty, 1997) according to legal systems and legal information systems for enhancement of digital conservation towards national park. The study considers the impact and significance of digital technology, understood as the collection of processes and materials related to the innovations, development, implementation and diffusion of digital technology (Arts *et al*., 2015). Technological innovation links the nature conservation practice like conservation science is 'mission-driven' (Meine *et al*., 2006; Mace, 2014; Maffey *et al.,* 2015) to view it as vital for conservationists to understand how their mission is affected by digital innovative technology (Arts *et al*., 2015). Attention need to be paid to who most benefits from digital conservation and who does not, who is in control of information flows and processes and how democratisation may be promoted on conservation decision-making.

5.3.9 Top Ten Biodiversity Governance for Lawachara National Park

Top ten-biodiversity governance thinking is the new ideas of developing world for biodiversity conservation applying towards Lawachara National Park. These ideas connect each other reciprocally with governance perspective. These are as: (i) Protection and security of national park biodiversity, (ii) Co-management and cooperation, (iii) Policy science and technology, (iv) National park stewardship, (v) Biodiversity policy precautionary principles, (vi) Ecosystem based biodiversity management, (vii) Potential sustainability and equity, (viii) Good governance for conservation (UN, 2014), (ix) Polluter pays for reinventing marketing (Kotler, 2011; Kotler, 1971), and (x) Respect for the national and global laws of national parks, as shown in Figure 5.23. These collaborative approaches

are commonly analysed in the field of sustainable environmental management (Hajer and Wagenaar, 2003, Reed, 2008; Sandström, 2009; Primer *et al*., 2015).



Figure 5.23: Top ten Biodiversity Governance Thinking
(Source: UN, 2014)

These governance thinkings are integrated approach in which decision-making within and across sectoral safeguards with national park ecosystems to ensure their long-term conserving of biodiversity and justifiable practice. The collaborative approaches reviewed emphasise the importance of knowledge accumulation, collective learning, and sensitivity to changes, which are the ideas of adaptive governance of social-ecological systems (Gunderson and Holling, 2002; Crona and Bodin, 2006). These biodiversity collaborative governance approaches are used in the field of sustainable environmental conservation

management (Hajer and Wagenaar, 2003; Reed, 2008; Sandtröm, 2009; Primmer *et al*., 2015). It is an essential portion of spatial planning and networks of terrestrial national park based management measures for biodiversity conservation. Public participation is a fundamental legal principle in environmental management (Darnall, 2008) and decision-making with access to information and access to review for transparency through national park biodiversity conservation. The top ten thinking reflects the notion of fairness or equity (de Snoo GR *et al*., 2013) for present and future generations while maintaining national park ecosystem integrity. For this reason, national and global organizations sholud apply the precautionary widely in order to conserve and protect national park biodiversity for environmental decision-making.

Policy science and technology is a new international instrument for decision-making in all aspects of nature conservation and resource sustainability. Stewardship is the responsible for acting as stewards on behalf of present and upcoming generations in their management of national park biodiversity. According to Rio Declaration (1992) that every polluter should bear the cost of pollution in principle, which can the basis be for costs of Environmental Impacts Assessment (Bond *et al*., 2003), pollution prevention measure or clean-up costs etc. CBD provides a list of legal options for national park biodiversity protection, which provide an important legal instrument relevant to monitoring, compliance and enforcement. These analyses aim at integrating a range of arguments both analytically and pragmatically, and highlight integration of norms, values and stakeholders' commitment (Östrom, 1990) in line with what has famously been termed "collective governance".

5.4 Ecosystem Based Management: The challenges of change

Several challenges for biodiversity conservation systems through ecosystem-based experiments, which illustrated with site execution, site quality, relevant update policy, and database administrative security. A particular value of IBDIS is to identify species, which can be used as bio-indicators of ecosystem based management and provide early warning of changes in national parks and other areas (CBD, 2016; Hawksworth *et al*., 1992). Several parameters related to National Park's Conservation Management illustred as follows.

5.4.1 Adaptive Co-Management

A wide variety of management approaches in connection with stakeholders' engagement is now called Adaptive Co-management (ACM). The ACM reflects on ranging from relevant conservation management in which actions or approaches change through time. It demands integration of models, active investigation, monitoring, decision analysis, and a mix of alternative management actions, whose comprehensible development is informed through learning by doing (Keith *et al*., 2011). Biodiversity adaptive co-management cycle consists of policy planning process, policy implementation, monitoring, evaluation and improved understanding including similar situation, public interests and decision-makers. The contributed study include novel theoretical and modelling perspectives designed to accommodate the complexities of real-world application of adaptive co-management (Keith *et al*., 2011). Lawachara National Park (LNP) – as a case study and reviews that address various applications of the stated approach have revealed many problems that can cause failure of adaptive co-management programmes (Walters, 1997 and 2007; Stringer *et al*., 2006; Duncan and Wintle, 2008; Allen and Stankey, 2009). A co-management system continues in Lawachara National Park with council and committee for biodiversity protection and national park management, which mentioned in the section 21 of the Wildlife

Conservation and Security Act, 2012 (BFD, 2017). Adaptive co-management enhances biodiversity conservation planning with implementation and monitoring for achieving the national report through evaluation (Theobald and Hobbs, 2002). This evaluation connects with environmental policy instruments for conserving of biodiversity towards National Park, particularly Lawachara National Park (Figure 5.24).

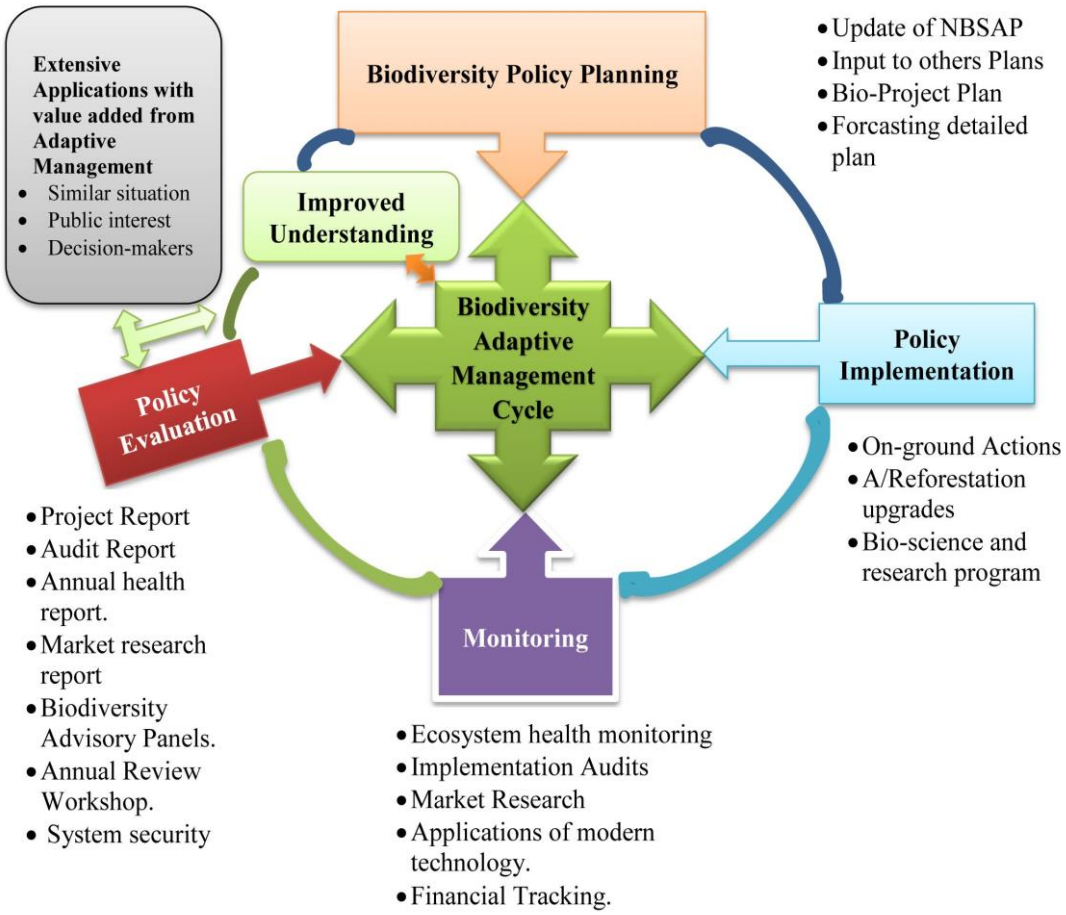


Figure 5.24: Biodiversity Adaptive Co-Management components
(Source: Modified Allen *et al*., 2011; Caves *et al*., 2013 and Staudinger *et al*., 2015)

There is a critical need to develop both innovative modelling approaches that aid in recognition of critical uncertainties and hypothesis development, and for identification of novel and win-win policy options (for example: Co-management System at Lawachara National Park). The study also reflects with environmental variability and alternative

management actions (Howes *et al*., 2010; Rumpff *et al*., 2011) for National Park Biodiversity protection. The major reflections of ACM are listed as follows:

(i) Innovative conservation monitoring approach.

(ii) Models for policy screening

(iii) Embracing uncertainty

(iv) Detect institutional barriers

(v) Conflict resolution

(vi) Embracing uncertainty and sensitivity

(vii) Imaginative synthesis

(viii) Experimental design to improve national park management performance using policy choices.

(ix) Enhancement of National Park services, particularly ecotourism.

5.4.2 Ecosystem-based management

The sensitivity of ecosystem-based management augments the societal, natural and economic viewpoints of national park conservational issues, steering for justifiable development by identifying their connections. Ecosystem-based management involves with technological systems and political systems combinely (Figure 5.25). Biodiversity conservation systems and sustainable economy develops the ecological economic system, meanwhile they interlink with social well-being for the development of socio-economic systems as well as bio-social systems in presence of political commitment, as shown in. This system can implement to the conservation of biodiversity at Lawachara National Park.

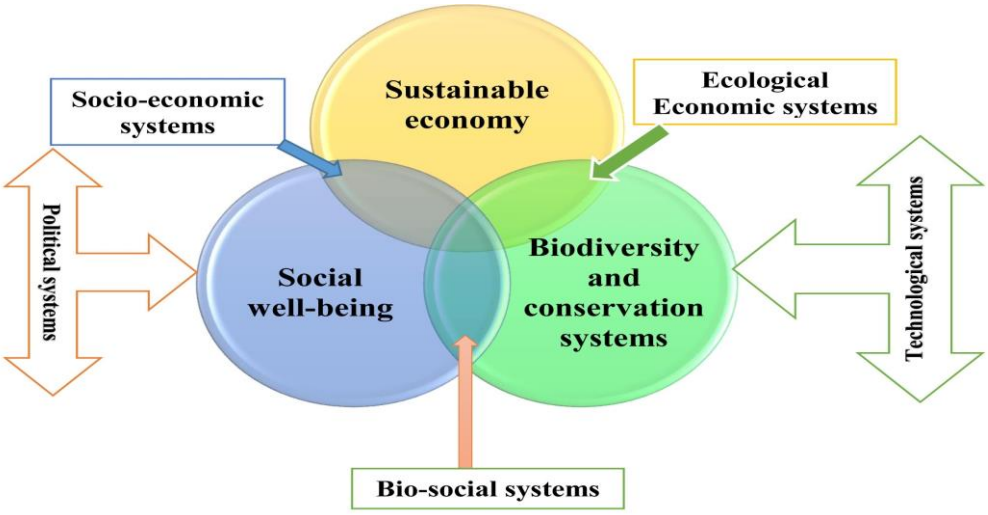


Figure 5.25: Ecosystem-based management

5.5 Choice of Policy Instruments to Achieve 'No Net Loss' (NNL) of Biodiversity

No Net Loss of Biodiversity can be applied to Lawachara National Park for policy instrument selection and interpretation for nature conservation, as shown in Figure 5.26 illustrating socio-technological systems through stakeholders' engagement, donor requirements and institutional agreements.

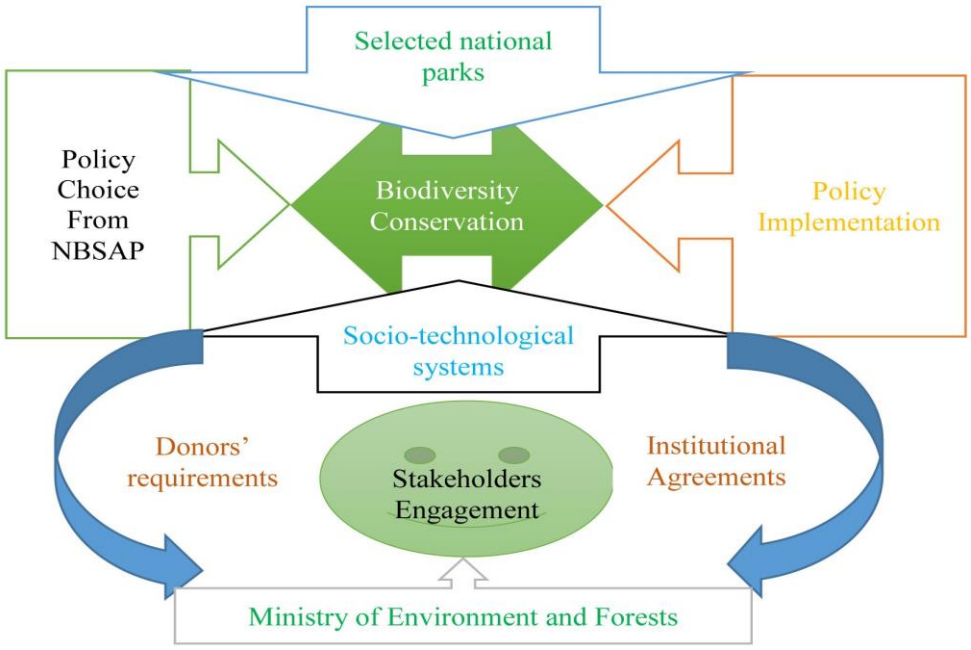


Figure 5.26: Choice of policy instrument to achieve 'No Net Loss'.

According to Aichi Targets 2020, every party intends to develop a 'halt biodiversity loss' or 'no net loss' initiative according to choice of environmental conservation as portion of its national park biodiversity conservation strategic plan. However, a major step could be taken towards achieving the target by better implementaion of existing policies (wildlife conservation, national park protection, national environmental education, and national conservation strategy) in order to circumvent and abate impacts. For this purpose, MoEF tries to identify the NNL policy gaps and implementation deficiencies; a projected a series of policy options and packages that could provide to and ultimately achieve the NNL target. These choices involved the introducing biodiversity offsetting, the aim of which is to achieve the NNL of biodiversity by entirely compensating for losses that cannot be avoided, such as by restoring an equivalent area of habitat, particularly national parks areas. The research exposed that attaining NNL would be extensive and multifaceted challenges.

5.6 Key Evaluation of Environmental Policy Instruments

There are some key evaluations of environmental policy instruments for national park biodiversity conservation from the research, which were illustrated successively.

5.6.1 Challenges for Dynamic Conservation Policy

Bangladesh faces a number of challenges for empirical dynamic policies. Mainly, it is alarming that matters such as federal policy can be effectively executed at the State Government and department levels in Bangladesh; it would to need sectorial/departmental policies integration. According to Global Risks Report (2016), Malaysia is more risks country on cyber-attacks, but Bangladesh is more vulnerable on natural catastrophes than that of Malaysia which as shown in Table 5.7. On the other hand, Malaysia developed online

biodiversity clearing house mechanism (BCHM) according to CBD's requirements; till date, the BCHM is in on-going process in Bangladesh.

Table 5.7: Global Risks Report on technological arena between Bangladesh and Malaysia.

Parameters	Bangladesh		Malaysia	
	Ranking	**Scoring**	**Ranking**	**Scoring**
Cyber attacks	18	7.1	1	38.6
Natural Catastrophes	10	17.9	16	11.9
Data fraud/theft	24	3.6	4	21.8
Misuse of technologies	22	5.4	2	28.7
Critical Information Infrastructure breakdown	18	7.1	19	9.9

(Source: Global Risks Report 2016)

Additional major challenge between two countries is how to interconnect research findings in an easy to recognize matter to policy-makers and CBD so as to enable them to formulate policies that are favorable to sustainable national parks management for biodiversity conservation. From environmental performance index (EPI) report stated that biodiversity scoring of Malaysia is more (93.37%) than that of Bangladesh (EPI, 2015), which as shown in Table 5.8.

Table 5.8: Environmental Performance Index (EPIn)

Bangladesh		Malaysia	
Parameters	**Scoring**	**Parameters**	**Scoring**
Ranking 169 (178)	25.61 (100)	Ranking 51 (178)	59.31 (100)
Biodiversity and habitat	39.68%	Biodiversity and habitat	93.37%
Forests	22.83%	Forests	1.68%
Agriculture	92%	Agriculture	57.68%
Water and Sanitation	22.56%	Water and Sanitation	8.64%
Air quality	13.83%	Air quality	90.54%
Health Impacts	54.87%	Health Impacts	95.38%

(Source: EPI, 2015)

However, a policy mix in the context of biodiversity conservation is an integration of policy tools that has advanced to inspiration the magnitude and worth of conservation of national

park biodiversity (Ring and Schroter-Schlaack, 2011a) and growth of national parks options in government and non-governmental sectors. Therefore, several causes have been given to justify the cost effectiveness of policy integration for biodiversity conservation.

Table 5.9: World Competitiveness Ranking within (1–30 countries)

Country	Ranking 2017	Scoring 2017	Ranking 2016
Bangladesh	No listed within 1–30 countries		
India	45	69.701	(41)
Malaysia	24	83.53	(19)
Australia	21	85.245	(17)
China	18	87.758	(25)
Singapore	3	99.488	(4)

(Source: WCR, 2017).

The study compared with World Competitiveness Ranking 2017, which reflects on green economy in connection with sustainable biodiversity conservation towards national parks (Table 5.9).

5.6.2 Relevance and Quality Design

This thesis organises the primary point of reference for the evaluation during the study since it comprises the logical framework listing the four research outcomes and their outputs together with supportatble indicators and particular periods for achieving targets. It also shows a good appreciative of the issues to be focussed and is consequently cogitated to be highly relevant. The research overall objectives and goals clearly pursue on highlighting policy choice, sectoral integration, and update policy information on NBSAP with regional capacities in order to deal with national problems. Per se the research is regional in nature with essential activities and anticipated results at the national level. These include environmental policy instruments like national perspective plan, national conservation strategy as well as biodiversity clearing house mechanism based on the worldwide dissemination through developing State Party for national park biodiversity conservation.

5.6.3 Progress of Implementation and Efficiency

Lawachara National Park Biodiversity Research is connected with progress of implementation and efficiencies depending on the Government of Bangladesh. The research is based on bioenvironmental policy and technology for conservation of biodiversity towards national park. As a State Party, Bangladesh ratified with CBD to ensure commitments for sustainable use of natural resources. For these purposes, Government of Bangladesh takes initiative regarding the agreement for proper implementation and efficiency until to date. Government developed biodiversity related law and policies, plans, and strategies and to continue for formulation, update, modification and reforms according to institutional requirements. Some targets also delay in time for start-up is being compensated for with an extension period 2016 to 2021. Implementation delays were also caused by cumbersome procedures within participating state party government for update NBSAP, new declaration of national parks, new law on the wildlife conservation and security Act 2012, announcement bid for national biodiversity clearing house mechanism. In Bangladesh, further implementation delays were faced mainly because of national procedures for hiring consultants for services and studies.

With the good coordination of IUCN, UNDP, GEF, USAID, IPAC and other agencies, the updated NBSAP has been implemented efficiently and has achieved a number of outputs and outcomes. Obtainable inputs and means have been assigned in a transparent and sufficiently flexible manner to where they are most obligatory resulting in tangible outputs with the co-operation of co-management team. Implementation has been adjusted to the reality on the grounds and to the scope for action in different national parks of Bangladesh, particularly Lawachara National Park in Sylhet division. A high number of good-quality outputs have been formed and disseminated to the pertinent target groups and beneficiaries.

The several partners are involved in work planning and provide proper progress reports. The National Contact Point also submitted the fifth national report to CBD in time. The grant financing of Lawachara National Park is maximum from the period of 2009 to 2014 than other national parks in Sylhet, which stands out in its achievement as an impressive volume of task with significant impact. Bangladesh currently achieved 106.613 square kilometres of marine area inclusing 19.469 sq. km in the Bay of Bengal in 2014 by a legal judgement of United Nations Tribunal (Turley *et al*., 2016). On the other hand, the administration of Lawachara National Park achieved 20 acres' area from illegal encroacher in January 2017 (ALNP, 2017).

5.6.4 Conservation Instruments – Effectiveness to date

CBD is well on track to achieving most, if not all, premeditated Aichi Biodiversty Targets on time if the necessary course corrections (Bruner *et al*., 2001) are time-honoured. It has supported the promotion and implementation of NBSAP and BCHM of each state party of CBD within stipulated time. The Government of People's Republic of Bangladesh (MoEF) has approved the Bangladesh Biodiversity Act, 2017, while the Ministry of Environment and Forests announced circulation for bid on BCHM. The research is making a big step effectively introducing environmental policy instruments along with information systems for conserving biodiversity towards national park in Bangladesh, to be incorporated into divisional and district –level plans and actions according to national policies and CBD guidelines/ requirements. Media coverage efforts are being strengthened to raise the national parks, and numerous articles have been published in refereed international journals and conferences.

5.6.5 Impact Prospect towards Conservation Instruments

The research is clearly contributing to the objectives of strengthening capacity at divisional and national levels for sustainable biodiversity management, minimizing degradation of national parks in Bangladesh, acclimatizing and sustainably managing targeted national parks; and augmenting the livelihoods of local communities through sustainable national park management. Its focus on strengthening national park governance is highly effective. Public-Private-Partnerships have been forged among government, privaye and civil society actors (including co-management team and local communities), whereby government of Bangladesh held more accountable for natural resource use and investment decisions affecting national parks. Ministry of environment and forests, Bangladesh forest department, ICT division have also been encouraged to put best management plans/ practices in place and practise corporate social responsibility.

The active engagement of the private sector, through the Roundtable on Sustainable Environmental Conservation, is expected to perform a significant part in the enduring protection of national parks' biodiversity. Moreover, communities' capacities to trace and fight illegal logging have been improved. The research uses all relevant media (newspaper, internet, radio, television, facebook, twitter, conferences, seminars etc.) effectively to reach a wide audience and maximize impact, which also benefits the visibility of CBD, IUCN, GEF, UNDP, FAO and WB. The research produces a number of positive indirect benefits: (i) Stakeholders' engagenment to contribute national park biodiversity management, (ii) community- level action is having a broader development and empowerment impact in terms of environmental education and digital conservation awareness and user rights, (iii) inter-agency cooperation in national park areas is improved as a result of the facilitating roles of

MoEF, (iv) the research contributes to stronger SPARSSO and ICT division national integration.

5.6.6 Environmental Policy Instruments towards Sustainability

Environmental development is a pre-condition for green economy, which is a crucial challenge for sustainable biodiversity in Bangladesh (BER, 2016). Because, efforts are on to integrate issues pertaining to environment with mainstream development policies to ensure economic growth and environmental sustainability. Moreover, sustainability depends on 17 goals of Sustainable Development Goals (SDG), such as: poverty, food, health, education, women, water, energy, economy, infrastructure, inequality, climate, consumption, habitation, marine ecosystem, ecosystem, institution and individual's sustainability (UN, 2015; MoEF, 2016).

Grant for research activities is largely dependent on donors (for example global-GEF, UNDP, USAID; national- ICT division), although national cash and in-kind contributions are significant. Although a certain level of national subsidy is likely to continue to be made accessible, international financial mechanisms to reimburse for the predetermined use of national park needs to be further settled. Such alternative funding mechanisms are under development by the national or regional research project executing agencies for bioenvironmental conservation towards national parks management. This research provides a good overview on biodiversity conservation system, growth of national parks, comparative analysis on CHM and NBSAP for the present and upcoming generations' sustainability. Payment for ecosystem services (PES) is among the advocated viable options on developing returns from sustainable economic activities, such as national park biodiversity conservation through rainwater harvesting or ecotourism development. Corporate social responsibility

funds from private companies (for example- HSBC, Dutch Bangla Bank) are an increasingly important complementary sources of funding of national park biodiversity management activities in Bangladesh, where citizens' contribution in the form of volunteer tree planting are also snowballing. In the way, the research is fully embedded in permanent structure of the target groups through community level to bureaucracy levels, who are involved in planning, decision-making and implementation of activities operational, technical, institutional and management capacities are being developed at all levels.

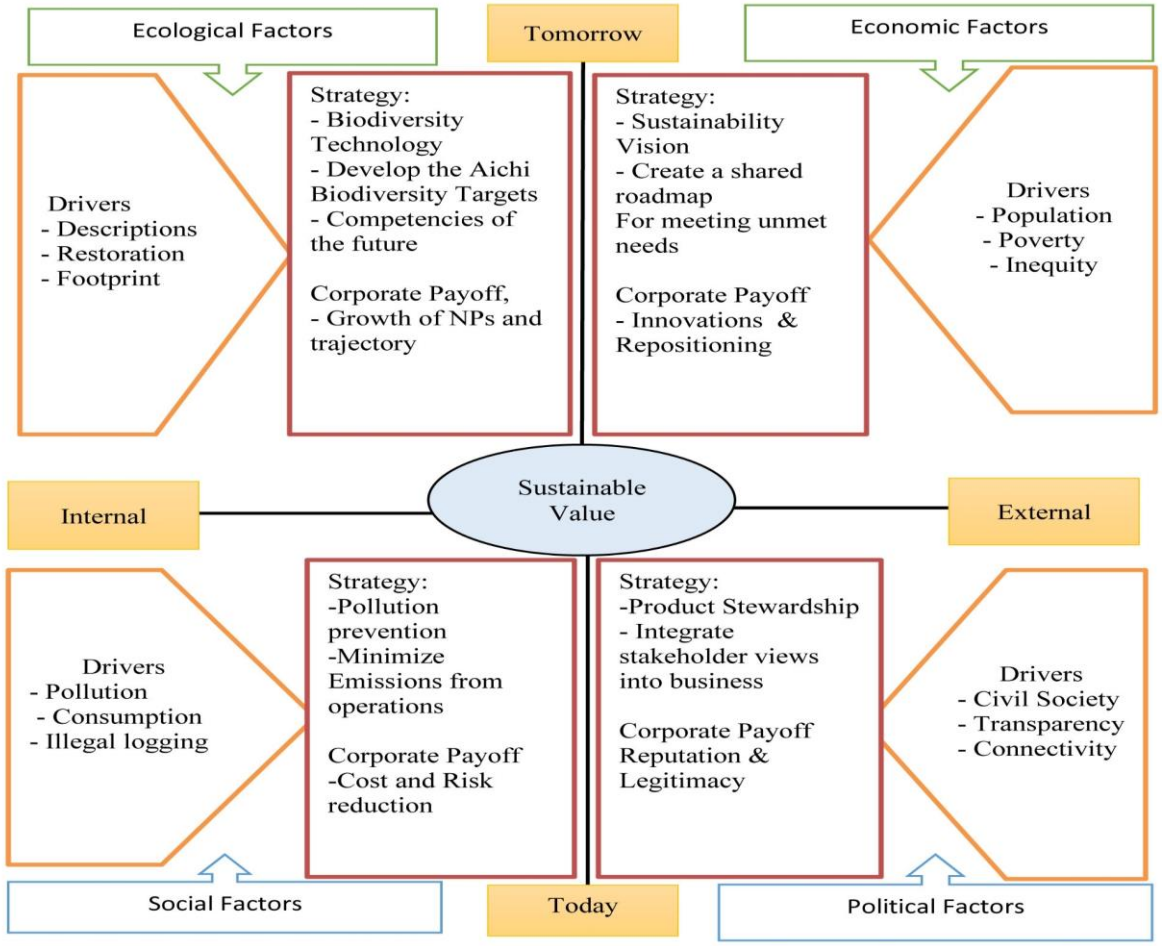


Figure 5.27: Potential sustainability for biodiversity conservation

As a result, target groups, at all levels show full ownership of research activities including ecological, economic, social and political factors, as shown in Figure 5.27 indicating today–tomorrow with internal and external services and benefits for potential sustainabl

biodiversity conservation towards national parks. Regular reporting to CBD, which enhance the high-level profile and supports, facilitates the active engagement of national contact points of Bangladesh and Secretariat of CBD. The high-level meetings / roundtablings have also agreed to advance the national park biodiversity conservation systems and to highlight its use at the head-of-state/ government level.

5.6.7 Systematic Assessment of Environmental Policy Instruments

Global rethinking enhances the dynamic law, policy, technology and relevant government orders on forestry, environment and biodiversity related instruments to connect with national and regional institutions for improvement to the dynamic environmental policy instruments. From the results showed that the mentioned instruments (legal, *in-situ* and informational instruments) have several comparative advantages against other instruments in Bangladesh and Southeast Asian countries. However, there are several systematic assessment (Figure 5.28) that could be included in the Wildlife Conservation and Security Act 2012 and the Bangladesh Biodiversity Act 2017 to make it more effectively implemented and enforced, while at the same deter the occurrence of biodiversity offences. For example, Malawi is making great strides in the global fight against wildlife crime through new legislation that gives courts the power to sentence traders of illegal wildlife to up to 30 years of imprisonment, the new National Parks and Wildlife Act has already curbed wildlife criminal operations. (IELP, 2016). For this perspective, need for improvement of separate biodiversity, as the State Party of CBD's requirements to conserve the National Park's Biodiversity. Meanwhile, the Government of People's Republic of Bangladesh has taken initiatives for the rest of 13 new protected areas declaration and National Biodiversity Clearing House Mechanism, are on-going processes for development simultaneously (WDPA, 2017).

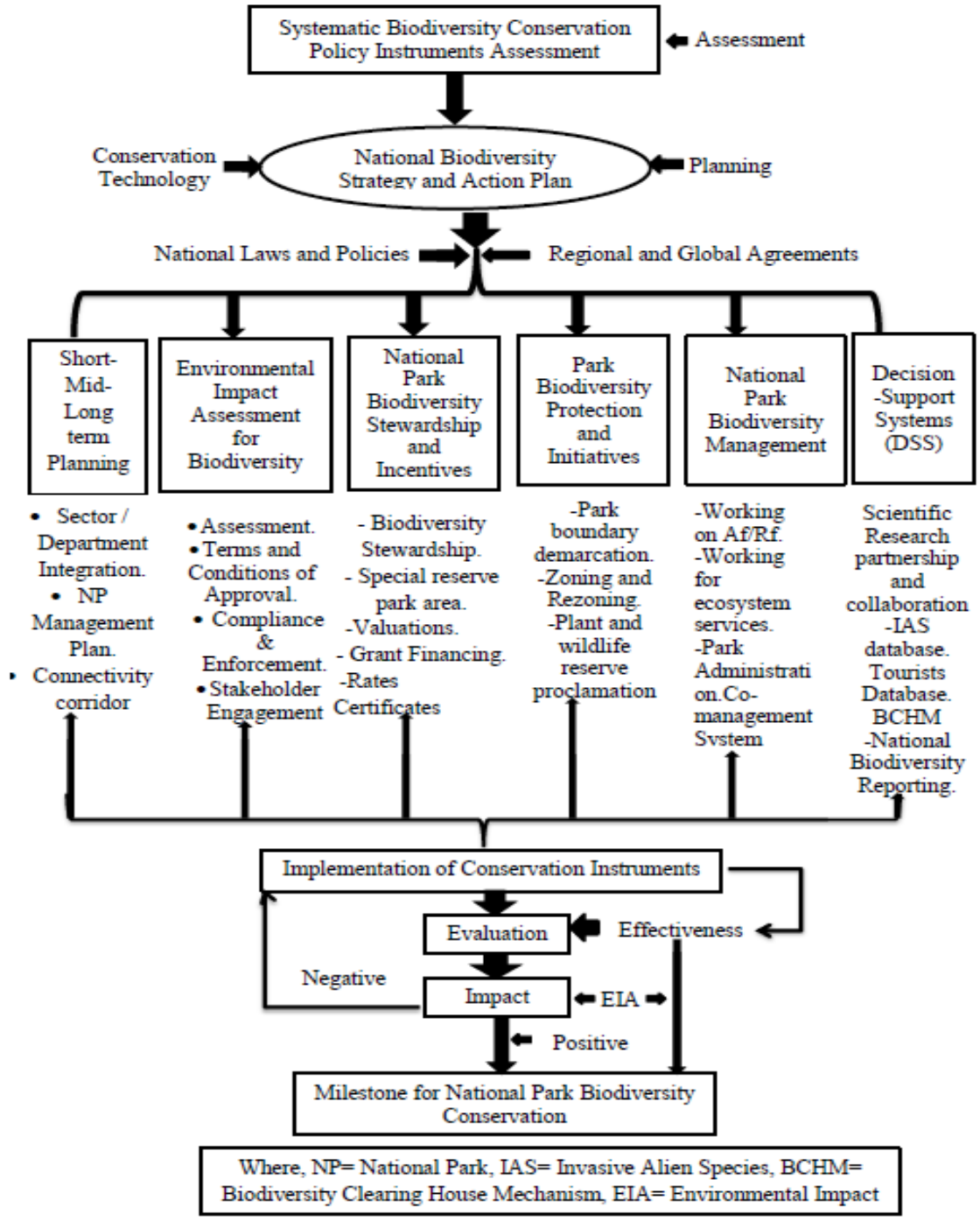


Figure 5.28: Systematic Assessment of Environmental Policy Instruments

5.6.8 Impact of Intellectual Property Rights on Biodiversity

Biodiversity is the hallmark of life in the world in connection with sustainability of biological resources. These resources include plants, animals and microorganisms or parts

through their genetic materials and by–products with authentic prospective use or value except human genetic material. As a ratified State Party of Convention on Biological Diversity (CBD), Bangladesh should use these biological resources on the priority of access benefit sharing (ABS). The recent Intellectual Property Rights (IPRs) regime connects with ABS, which is encouraging commercialization of seed development, monoculture, protection of new plant varieties, microorganisms, and genetically modified organisms for the present and upcoming generations. Because of this study, Lawachara National Park (LNP) Biodiversity is being eroded irrevocably. For this reason, the study tried to find out a pathway to create an alternative approach that will take a balance in between formal Intellectual Property system and sustainable development of National Park Biodiversity and indigenous knowledge management.

LNP has a rich and uniqueness of biodiversity. It consists of total 460 species together with floral 167, and 293 faunal species including amphibian 4, reptiles 6, birds 246, mammals 20, insect 17 (IPAC, 2012; Jalil, 2009). In order to comply with the TRIPS (Trade Related Intellectual Property Rights) and CBD, Bangladesh has passed the Bangladesh Patent Act 2003 and Bangladesh Biodiversity Act 2017 respectively. According to the country patent Act, the duration of the term of patent has been extended to 20 years for all product and process (under the existing Act of different Sections as well as those included in the Biodiversity Law. Now microorganisms will be patentable subject in Bangladesh. In addition, new plant varieties will get PBR certification in Bangladesh as Bangladesh has joined recently in UPOV (1978 Act). Earlier Bangladesh also passed Plant Protection Bill to develop a sui generis system (a system of its own). The deposit of biological materials has also been included in compliance with the Budapest Treaty, which as shown in Figure 5.29.

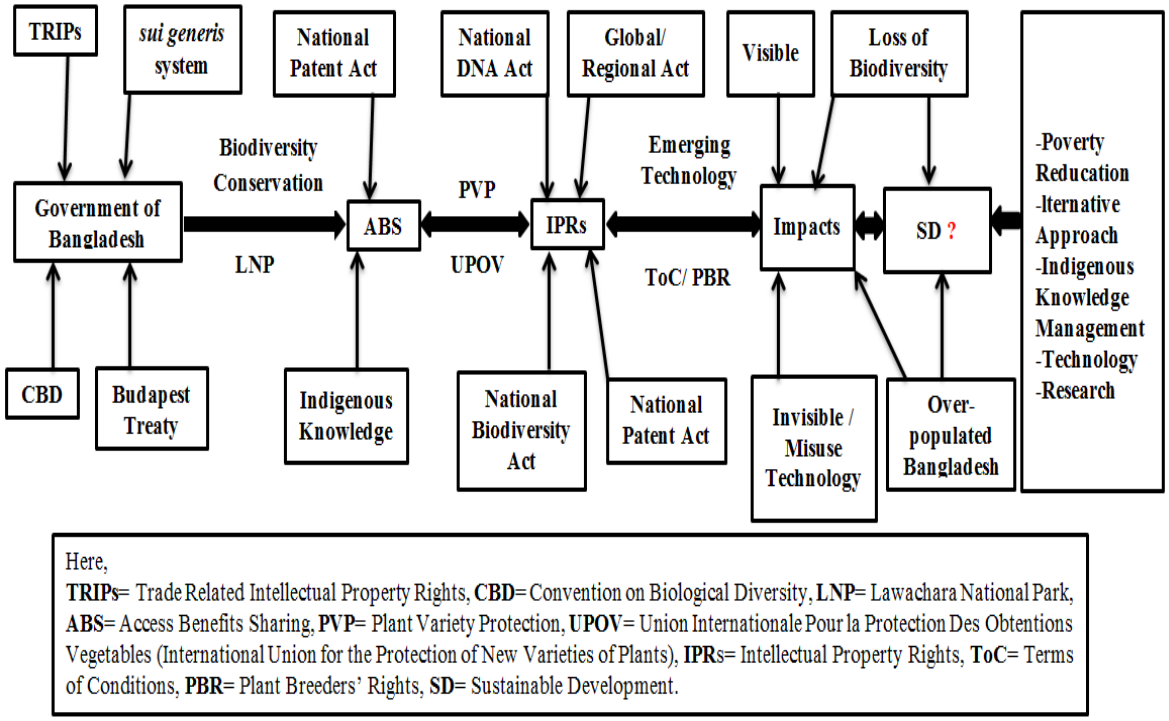


Figure 5.29: Impacts of IPRs on National Park Biodiversity

As a result, there is a gap of unprotected genetic information of LNP in Bangladesh related to IPRs to the capital-rich west and a protected flow in the reverse direction mainly through patents and Plant Breeders' Rights (for example: Betel-Leaf Cultivators' Rights at LNP). It has both visitble, invisible and unwanted impacts on biodiversity conservation. Genetic attrition is one of the most important invisible impacts that are long run revealed visibly with the losses of biodiversity, and misuse of emerging technology is unwanted impacts on biodiversity conservation.

5.6.9 Annotation of National Park Biodiversity Data

Conservation of Biodiversity studies are usually basis on the use of bio-data associated with field observations. These data are frequently associated with a geographic location and elevation. Most of existing biodiversity information provides support for processing, storing and querying geographic data for annotating via internet. This study presents an annotation web service to correlate biodiversity data and geographic information. Annotation has been

recognized as one of the most important services in digital library systems to foster the cooperation among users and the integration of heterogeneous information resources (Figure 5.30).

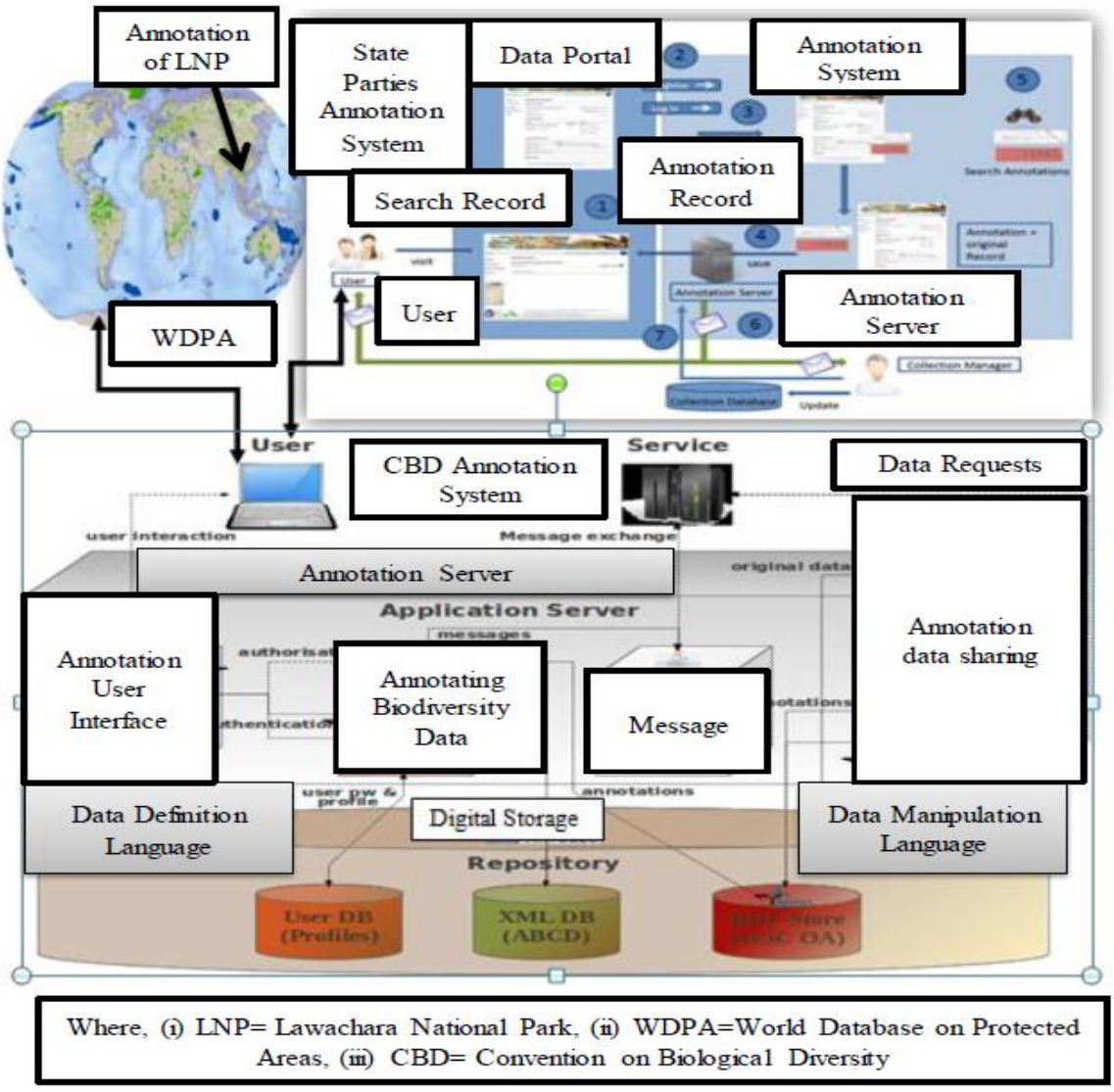


Figure 5.30: Annotating Biodiversity Data in Connection with WDPA

This annotating Biodiversity Dataset connects with World Databse on Protected Areas (WDPA) for national park data repository, data sharing and information exchange and biodiversity clearing house mechanism activities among contact persons and related other stateholders at national, regional and global state parties of Convention on Biological Diversity (CBD).

5.6.10 Biodiversity Career Path

Biodiversity career path connects with the transformation of biodiversity specification assortments for a new paradigm to help individual make up-to-date career choices and advance the necessary employability and self-management skills. The career management paradigm in biodiversity identifies that career development is a long-life advancement of skill achievement and building through a variety of biological or natural sciences education enhancement and mastery. Its aim is to help local and indigenous people of Lawachara National Park (LNP) area to become self-reliant, agreeing them to afford for themselves and their families, and to subsidize positively to changing workforce with career decisions (Jarvis and Keeley, 2003). Therefore, biodiversity career decision is a very complex social, biological, educational, philosophical and regular phenomenon that involve in the preparation of career decision and decision-making with environmental conservation science. Biodiversity career path may be familiar in the Cognitive Information Processing (CIP) theory of career problem-solving and decision-making (Peterson *et al*., 1996) uses the CASVE Cycle, a generic problem solving and decision making model, which as shown in Figure 5.31. The CASVE implies Communication, Analysis, Synthesis, Valuing and Execution enhancing access benefit sharing and disseminating through biodiversity clearing house mechanism (BCHM), they are as follow:

(i) Communication: Biodiversity career interventions emphasis on the ‘gaps’ between peripheral demands and center effective, environmental perspectives and social or biological conditions surrounding the LNP.

(ii) Analysis: It involves a review of all the causal aspects that contribute to gaps in the community of LNP. It enhances self-knowledge by expounding values, interests, skills and employments on biodiversity and national park service system.

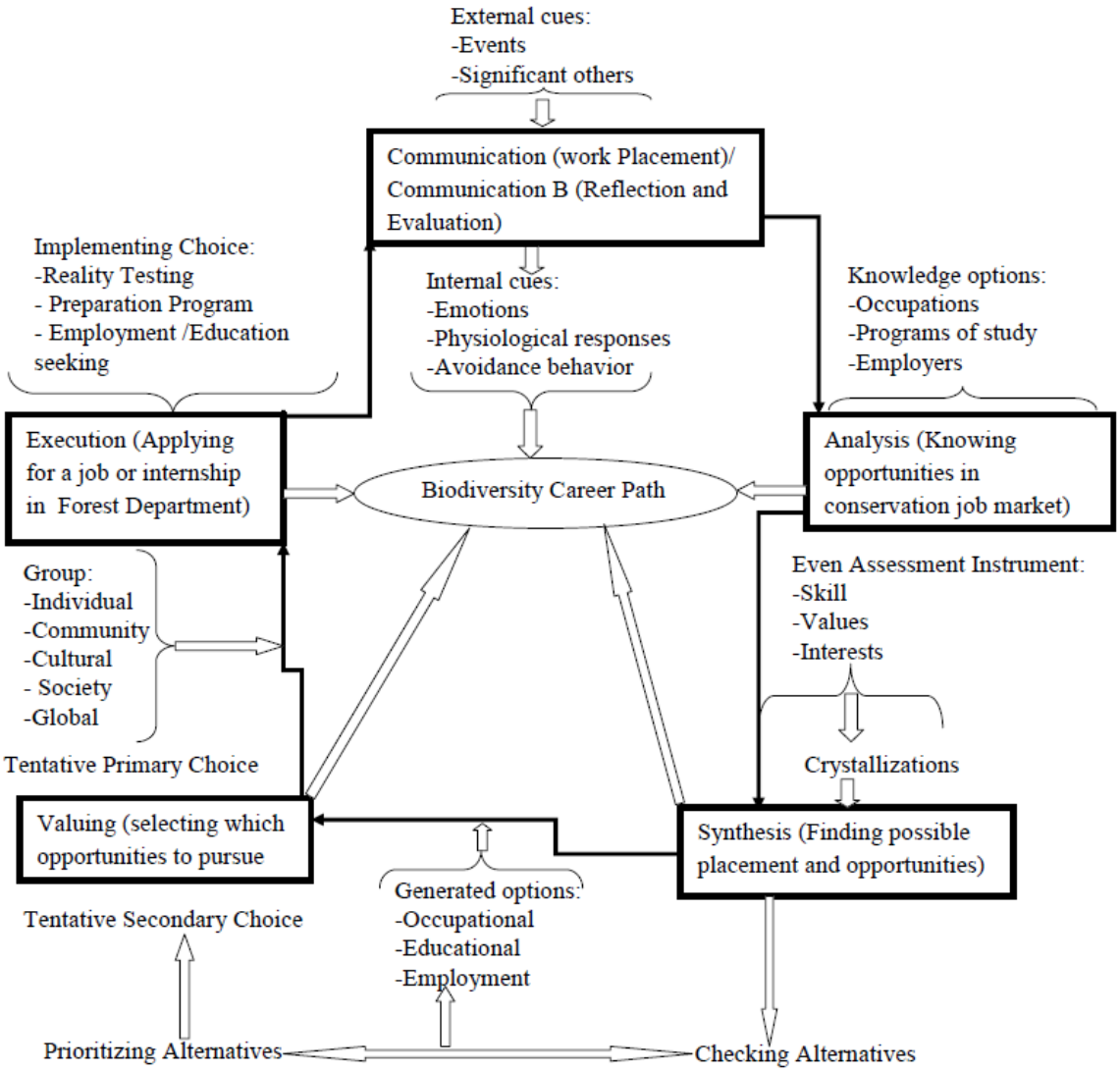


Figure 5.31: Biodiversity Career Path towards Forest Department
(Source: Modified Peterson *et al*., 1996)

(iii) Synthesis: Synthesis includes reviewing all possible opportunities in the LNP area for elaboration to recognize the determined number of prospective alternatives (Green Banking, Betel-leaf cultivation, rain water harvesting, eco-guide, and other alternative income generating activities) and crystallization; to contracted potential professions programmes (Biological Research project or public private partnership) of biological study, or environmental jobs to a controllable number of options in the department of environment.

(iv) Valuing: Finding to the costs and benefits of each alternative income with total economic value (TEV) to individual or group as well as significant others, e.g. family, co-management team, indigenous community, local society at large, and highlight alternative standards for conserving of biodiversity at LNP.

(v) Execution: Formulate a LNP management plan for implementing a tentative choice in connection with National Biodiversity Strategy and Action Plan (NBSAP): preparation programme (environmental education / conservation training experience), reality testing (full-time, part-time and /or eco-guide and volunteer work, as well as taking biodiversity courses or forest nursery training) and employment seeking in Bangladesh Forest Department (BFD).

5.6.11 Stimulating Tools of Environmental Psychology for Biodiversity Conservation

Environmental psychology stimulates the park manager, visitors, local community leaders and co-management team in terms of achieving desired behavioural responses for the protection of Lawachara National Park (LNP) Biodiversity. From the field survey, about 65% respondents opined for augmenting of environmental education. However, environmental psychology is the knowledge of connections between these respondents and national park's physical settings (Gifford, 2007a). In these connections, these stakeholders recover their national park environmental conservations, their behavior and experiences are improved by their national park's biodiversity protection. It includes theory, research, practice, performance or communication connected with stimulating the built environment more humane and improving human relations with the national park biodiversity habitation (Gifford *et al*., 2011). Therefore, environmental psychology is the key component of both human and national park welfare through collaborative management that promotes desired emotional or behavioral outcomes (Donovan and Rossiter, 1982). Environmental

psychologists investigate the impacts of spatial environments on behaviour (Appendix Q). Emotional responses to national park conservational stimuli fall into three dimensions, (i) pleasure, (ii) arousal, and (iii) dominance (Donovan and Rossiter, 1982). The stakeholder's emotional state is thought to facilitate the behavioural responses either approach or avoidance behaviour towards the LNP Biodiversity protection.

Policy-maker, Park Manager, Co-management team leader and conservation specialist can use perceptions from environmental psychology to conserve biodiversity that improve preferred emotional positive effects. For example, ornamental and flowering species for natural scenic view, music for biodiversity protection, watching feeding habit of wildlife and jumping of monkeys, which attract to the visitors and increase revisit of them to national park. Visitors' contributions enhance national park's biodiversity conservation, which interlinked with cognitive, emotional and psychological responses. For instance, human interactions with national park and the role of psychology contribute in climate change (Gifford, 2008a) to overcoming sustainability problems in the national and global ecosystems (Gifford, 2007b; Nickerson, 2003). Therefore, environmental psychology stimulates the individual's behaviour for biodiversity conservation at Lawachara National Park in Bangladesh.

5.7 Robust Policy in support of alternative approaches

Robust Policy provides a primer on some alternative approaches for conservation and protection. For constrictions or prohibitions to be effective, still constraints should be pooled with policy measures that provision alternatives to relevant policy supports. The growing interest in the use of alternative conservation policy instruments for national park biodiversity management has been driven by several separate but related phenomena (Hatch,

2005). The alternative approaches are shown in Figure 5.32 sequentially. However, the sources of environmental conservation problems looming today are oftem smaller, more diffuse and thus less amenable to traditional instruments (Hatch, 2005).



Figure 5.32: Policy in supports for alternative approaches for biodiversity conservation

There are some alternative approaches to support environmental policy instrument for conservation of biodiversity at national parks. Government law and policies that unambiguously distribute resources to the research needed to identify feasible alternatives and that encourage Alternative Income Generating Activities (AIGA), for example–betel leaf cultivation, and Green Income Generating Activities (GIGA), for example–Green Banking supports, are precarious to the success of these measures surrounding the Lawachara National Park.

5.8 Decision making for National Policy Formulation and Necessary Actions

Different decision-makings for national policy formulation are listed below:

5.8.1 Decision-making for national policy-makers

National Conservation Policy links a variety of key players in the policy process through their involvement with decision-makning. Individuals, institutions, and agencies involved in the decision-making process are called actors. These actors are (a) Governmental (for example: executive, legislature, judiciary), (b) Non-governmental (example: Civil society, NGO-NACOM/ CNRS, Co-management Team), and (c) International (example: Countries Apex Representative, International Institutions, like- UNO, IMF, CBD, WB, UNDP, IUCN and TRAFFIC. Government is often thought of to be the only entity involved in policymaking. Government of Bangladesh does have the ultimate decision-making and funding power, but there are some other actors that contribute to public policy, often a network on which government relies for the delivery of committed policy goals (Mackay, 2017), such as: (i) Government, (ii) Cabinet, (iii) Public Servants, (iv) Political Parties, (v) Media, (vi) Interest Groups, (vii) Legal System experts, and (viii) Public elected government. The important feature of public outlooks towards conserving of biodiversity is the utmost level of encouragement of visual, virtuous, ancestral, spiritual as well as patriotic norms and values in stirring a sagacity of accountability for mentorship on policy decision-making.

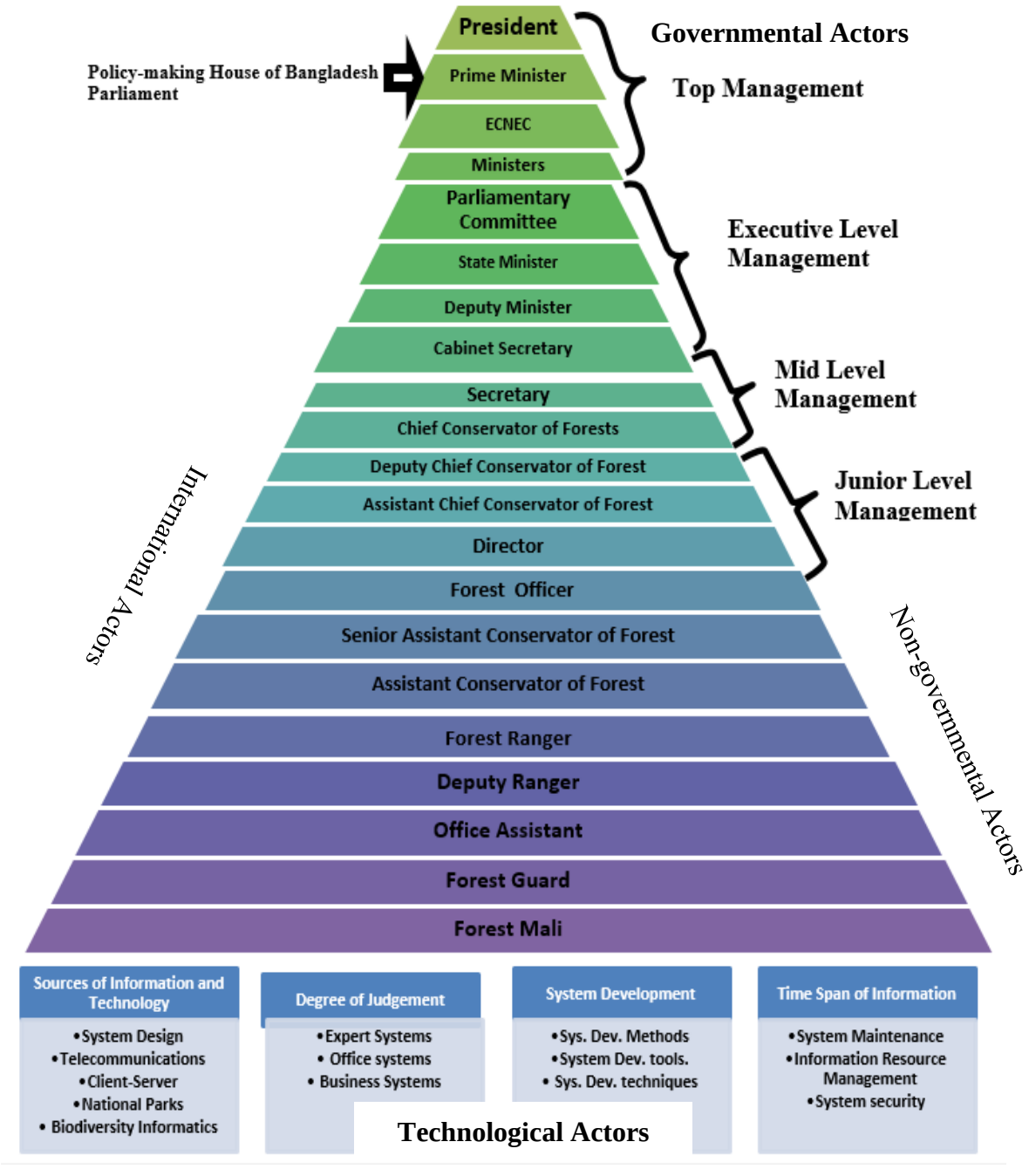


Figure 5.33: Pyramidal Executive Information Systems for Biodiversity Decision-Making

There are some apex-bodies, who are responsible for policy formulation, implementation, evaluation, new policy adoption with alternative options. They are junior level management, mid level management, executive level management and top management. Government organises the Wildlife Advisory Board according to the Section 3 under Chapter 2 of the

Wildlife Conservation and Security Act 2012 related to national biodiversity conservation including a Chairman and necessary number of members from among the persons with expertise in conservation of biodiversity, forests and wildlife that mentioned in Figure 5.33.

The Government also constitutes a Scientific Committee consisting of not more than 7 (seven) members from among the eminent and famous experts in wild animals and plants. The Chief Warden, Additional Chief Warden and Warden are the Authorised Officers for management of national biodiversity. The decision-makers are the top executive members of the country who are involved to make law, order, policy, ordinance and relevant legislations according to the national constitution. For this study, environmental policy instruments are associated with divisional and sectoral priorities to protect and preserve the Lawachara National Park biodiversity and health of our national environment conservation and are consistent with divisional and sectoral roles and responsibilities. The study advocates for the significance of biological diversity conservation within Bangladesh and internationally to funding the wide-ranging partnership required among the various stakeholders who share responsibility for sustainable use of national park biodiversity.

5.8.2 Major Challenges and Opportunities for Conservation of Biodiversity

Lawachara National Park (LNP) is governed by the Government of Bangladesh, that as ratified State Party of Convention on Biological Diversity. There are several major challenges and opportunities for conservation of biodiversity at LNP in Bangladesh, as shown in Table 5.10 successively. From the study, Government of Bangladesh has taken necessary initiatives for separate law of State Biodiversity Conservation.

Table 5.10: Major challenges and opportunities for conserving biodiversity

Major Challenges		Opportunities
LNP is surrounded by 18 villages with high density population.	1.	Revised and update NBSAP according to CBD's requirement.
Extreme poverty in rural areas	2.	Achieved global recognition for environment and Climate change mitigation.
Lack of Sectoral integration and public private partnerships.	3.	Declaration Prime Minister-National Plantation Award for environment and forest.
More expensive to develop the Biodiversity Clearing House Mechanism with Geospatial Applications.	4.	Update co-management policy and ECA schedule and to continue for implementation towards specific protected areas in Bangladesh.
More difficult to fulfill the revised NBSAP indicatots and Actions for sustainable conservation	5.	Augmenting women's participation and awareness on environmental conservation education program.
Till to date no separate Biodiversity Administrative Institute with specific law and policy.	6.	Most of national laws and policies developed within the period of 2010-2016.
More challenge to cover the Aichi Biodiversity Targets 2020 within the stipulated time.	7.	Government takes initiatives for extension research on biodiversity conservation systems using ICT.
Lack of Political commitment between Government and Donors.	8.	Government developed national conservation strategy and perspective plan.
Lack of extensive research Grants on biodiversity and national parks perspectives.	9.	Government developed Forest Policy 2016 (Draft) and ICT Policy.
More risks recovering the Sustainable Development Goals within the specific time.	10.	Government takes initiative for separate biodiversity law "Bangladesh Biodiversity Act 2015" (bdnews24, 2015).
Bangladesh is the most flood prone area in south-east Asia	11.	Implemented Green Banking Policy towards scheduled Banks in Bangladesh
Increase Climate change degredation tremendously.	12.	Government updated Environmental Law 2013 and Environmental Court Act 2010.
Increase loss of biodiversity rapidly.	13.	Bangladesh is situated at deltaic region and Indo-Burma Biodiversity hotspot.

5.8.3 Actions Necessary to Conserve Lawachara National Park Biodiversity

There are some necessary actions for biodiversity conservation, as shown in Table 5.11. The study suggests for taking necessary actions on the priority of root causes. The study represented on lack of administration and institutional capacity, meanwhile, it is needed dynamic administration with trained-up staff through training, coordination, cooperation and rapport building.

Table 5.11: Necessary Actions for conservation of Biodiversity towards National Park

Root Causes	Actions Necessary	Remarks
Lack of administration and Institutional Capacity.	A1. To reinforce the institutional capacity of department of environment and department of forests including wildlife and nature conservation circle, wildlife crime control units with relevant resources, instruments, technology and training.	Training and tools
	A2. To follow up the milestones of donor-supported projects to indoctrinate the impacts within the institutional mandates of GoB particularly DoF and DoE.	Coordination
	A3. To support the National Biodiversity Advisory Board that coordinates flora and fauna species conservation activities, including migratory birds, national park wildlife and mother tree species.	Cooperation
	A4. To support and inspire biodiversity network programs at divisional, national and internaltional levels, professional studies— research and training and globally cooperation with similar institutions.	Cooperation
	A5. To support the placement of national and international experts in key biodiversity conservation institutions.	Rapport building
Lack of Coordination anmong different government and private agencies	(i) To strengthen mechanism where international donors and project implementing agencies in the environmental arena gather regularly to share on-going project results, data, lesson learned and information on planned project.	Technology and tools
	(ii)To support shared wildlife crime and natural resources trafficking training for police, forest guards and other law enforcement agencies.	Awareness
	(iii)To reconcile the overlap between the Ministry of Land (MoL), Ministry Fisheries and Livestock (MFL, and Ministry of Environment and Forests (MoEF) in environmental permitting and sensitive land allocation policies.	Reconcilation
Policy and Information	(i)To develop a national biodiversity monitoring system and support its implementation to include collection of baseline data on status, abundance and distribution of species and regular monitoring of changes.	Intensive monitoring

Table 5.11 continued

related knowledge gaps	(ii)To encourage development and implementation of recovery plans for endangered species.	Backup
	(iii)To encourage co-management activities that include sound representation from local communities, not only the rich or political individual.	Team building
	(iv)To stop the practice of resettlement of people into areas near national park areas and in Ecologically Critical Areas.	Legal awareness
Lack of effective enforcement	(i)To increase the profile environment and natural resources crimes in all law enforcement institutions (police, forest guards, border guards, rapid action battalions etc.).	Legal action
	(ii) To reduce bureaucratic procrastination	Gestation
Lack of adequate technological system of national park areas	(i)To strengthen enforcement of NP and ECA laws including resource use, land encroachment etc.	Legal action
	(ii)To restrict tourist activities and most human activities in core zones and critical biodiversity areas at LNP in Bangladesh.	Ecotourism
Corruption and misappropriation	(i) To conduct institutional and legal reforms to clearly separate the responsibilities and actions of those responsible for environmental law enforcement from those that is involved in daily management of natural resources.	Policy Reforms
	(ii) To reduce nepotism with illicit-felling	Responsibility
Lack of political commitments and norms	(i)To work with local politicians to raise profile of forest and wildlife and to build public opinion about the value of natural resources to their own future.	Stability
Lack of environmental awareness	(i)To integrate biodiversity and environmental sustainability themes into national educational standards and curricula.	Integration
	(ii)To support informal learning activities involving nature, like festivals, nature clubs, and school nurseries near national park area. Develop and promote “animal characters” that can help teach children about nature. Encourage responsible tourism and use of national parks	Behaviour
	(iii)To enhance the role of NGOs and civil society in conducting environment education campaigns.	Mass media

Table 5.11 continued

	(iii)To encourage media attention to the issues of conservation and sustainable use that provide practical approach which, people can implement. Work with prominent leaders or significant public figures on spreading the message on the importance of wildlife and biodiversity in Bangladesh.	Utilization
Lack of alternative income generating activities	(i)To expand upon programs that provides alternative sources of income for those living near national park.	Alternative options

5.8.4 Lawachara National Park's Biodiversity and Global Network Connection

The global treaties and covenants ratified to stimulate the conserving of national park biodiversity through the 196 state parties of CBD, which have highlighted the significance of natural resources and appropriate practice of biological diversity (Solh *et al*., 2003). Lawachara National Park is connected with world database on protected area (WDPA) as a listed national parks of CBD. It's information disseminates to global network through WDPA, IUCN, and Clearing House Mechanism (CHM). Besides, Bangladesh is a developing country in the world as well as state party with some international treaties and agreements related to biodiversity conservation (Islam, 1996), such as CBD, CITES, WCNH, IPPC, UNCCD and so on, as shown in Figure 5.34.

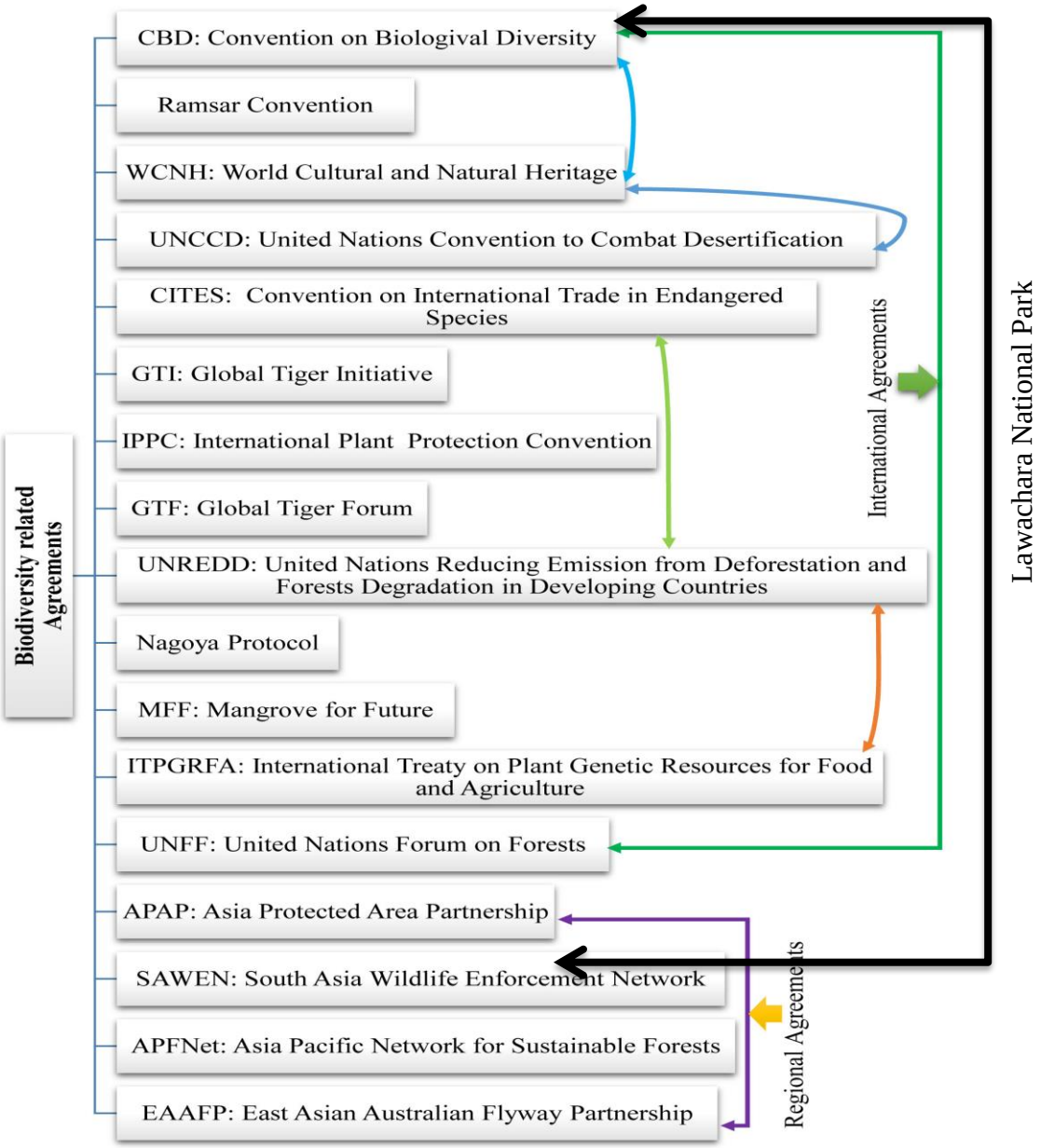


Figure 5.34: Biodiversity related regional and global treaties/ agreements

These treaties and agreements enhance to conserve biodiversity through donors requirements, research and development, global networks, diplomatic connections, information exchange with biodiversity clearing house mechanisms, national and international NGOs collaborations for the present and upcoming national generations, and national-global public-private-partnerships etc. At present, the leading institution, Convention on Biological Diversity (CBD) performs globally recognised through its State

Parties for conserving, promoting, and encouraging different parameters in connection with genetic resources. Till date, Government of People's Republic of Bangladesh signed/ratified with 17 organizations for national biodiversity, protection, policy formulation and relevant technology development. These agreements enhanced the country's biodiversity conservation and national parks declaration increased from the period 1971 to 2016.

5.9 Policy and Technology Development Combined Model

Biodiversity Policy and administration connect with Lawachara National Park. However, policy and technology is correlated for conserving biological diversity towards national park. Sustainable development could not think without their combination, particularly in conservation systems, which stated sequencially.

5.9.1 Policy and Technology Developmental Model for Biodiversity Conservation

Policy and technology relate with development activities for Lawachara National Park conservation sytem, as shown in Figure 5.30. The study suggests for combination of policy instruments to enhance sustainable conservation of national park biodiversity. National park is a designated hub area indicator of outstanding scenic and natural beauty, particularly multi-strata diversity. This multi-strata diversity provides education, research and recreational facilities, which indicates proper conservation systems. Biodiversity conservation systems depend on national and international indicators, as shown in Figure 5.35. National indicators are, (i) Afforestation and Reforestation Program, (ii) Poverty reduction, (iii) Conservation Awareness, (iv) Education, (v) Stakeholders' Engagement, and (vi) Media exposure, in the presence of (a) effective forest policy, (b) Efficient national institute and Administration, (c) Conservation Strategic Plan (SCBD, 2011), (d) Clearing House Mechanism with spatial technology (CHM, 2010),

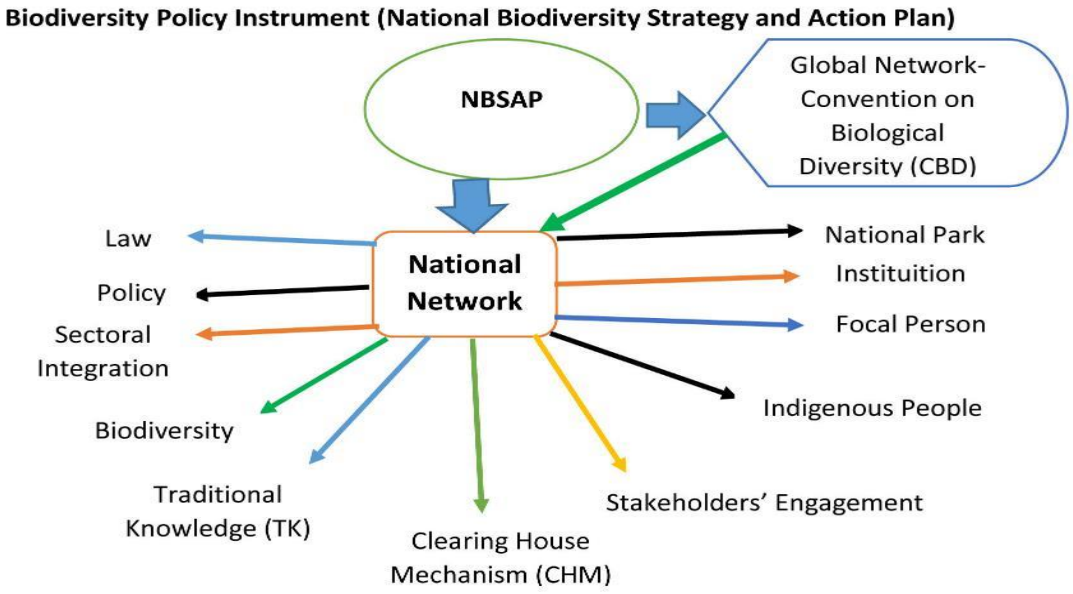


Figure 5.35: Biodiversity Policy and Technology Combined Model

(e) Political commitment, (f) Sectoral integration, (g) Intensive monitoring, (h) Co-management, and (i) Global networks. On the other hand, international indicators are, (i) Research Grants, (ii) State Parties Collaboration, (iii) Treaties and Agreements, (iv) Integrated Networks sharing with best practices for biodiversity conservation.

5.9.1.1 Integrated Model using Environmental Conservation Instruments

For this purposes, a subgroup of collective indicators could be established in the world with effective parameters towards national, divisional and district levels to measure the quality of ecosystems and biodiversity monitoring particularly at Lawachara National Park area. This policy-technology development enhances to conservation instruments for Lawachara National Park biodiversity protection. This integrated model identifies monitoring and sharing systems at district, divisional and national levels in connection with the requirements targets of NBSAP as well as Aichi Biodiversity Targets 2020. For this, the root role player is the efficient national biodiversity administrative institute. From the study, Government of

Bangladesh will take necessary initiative for setting such institute. The relevant conservation instruments are shown in Figure 5.36.

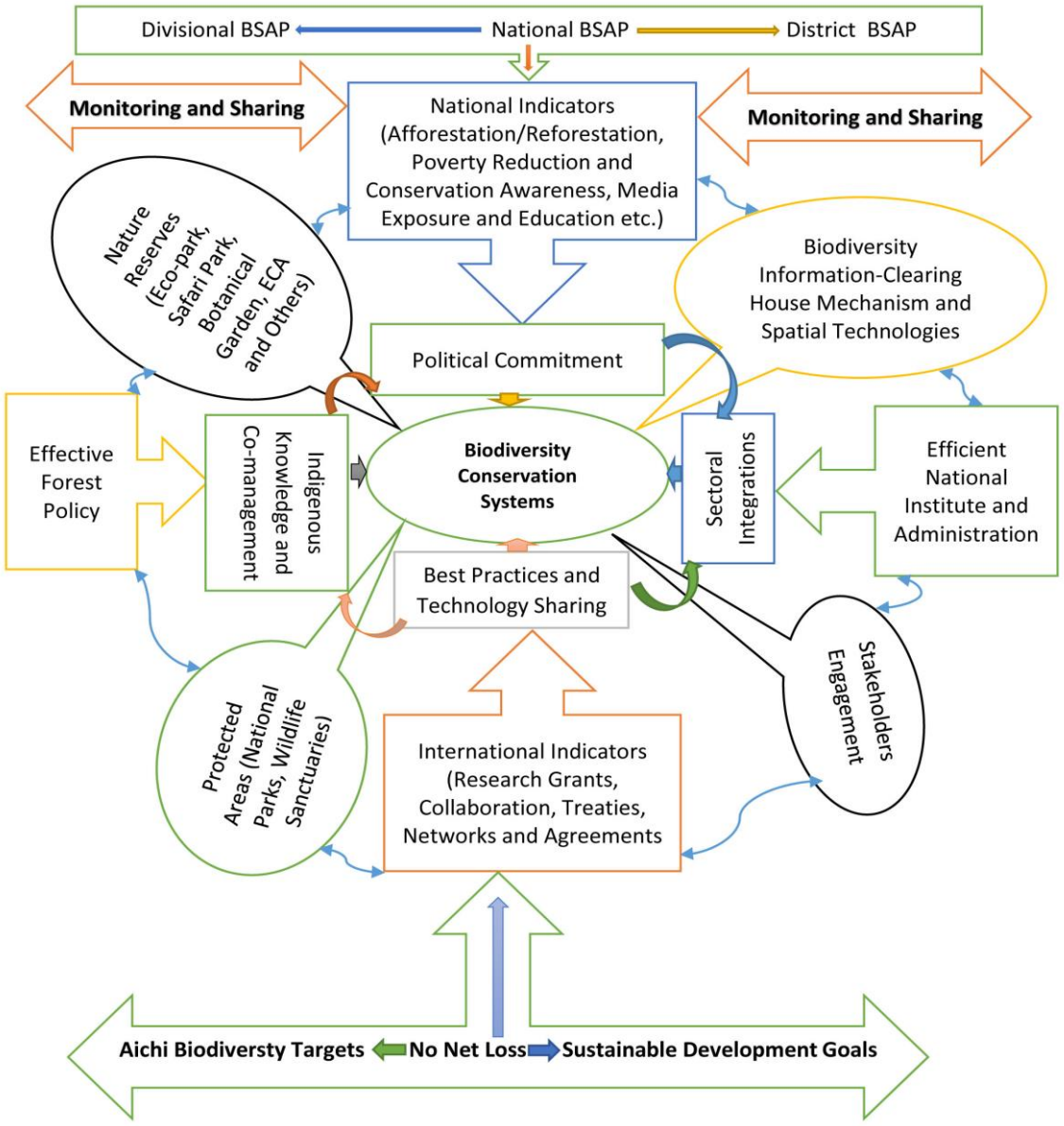


Figure 5.36: Integrated Model for Lawachara National Park Biodiversity Conservation

This model includes (i) national indicators with afforestation and reforestation programme, (ii) Biodiversity Information- Clearing House Mechanism and Spatial Technologies, (iii) Stakeholder engagement, (iv) International collaboration, treaties and agreements, (v)

Indigenous knowledge and co-management, (vi) Declaration new protected areas and relevant other parameters.

5.9.1.2 Relationships between Conservation Policy and Technology

Public policy and conservation technology assist, operate and focus biodiversity knowledge and science innovation. However, public policies and instruments in biological science, technology and innovation can control market research and system failure. They shape conservation market research and help stimulate knowledge creation and innovation. In addition, bio-environmental conservation policy science and digital technology have driven National Park management service for attracting the tourists, revisit opportunities as well as getting more grant financing from ecotourism activities. So, there is a reciprocal relationship between digital technology and conservation policy. Innnovative technology proportionates to improvement of policy. Therefore,

Innovative Technology $\propto$ Improvement of Policy.

Or, Digital Conservation Technology $\propto$ Improvement of Bio-environmental Policy,

Or, DCT $\propto$ IBP,

Or, DCT= KIBP + ETR.....(i)

Where, K= Constant Conservation Instruments, like Stakeholder Engagement, Conservation Site and Species Diversity.

And, ETR= Eco-technological Risks alongwith time bound including social and network security.

Digital technology improves according to the requirements of national park's demand. The experts can use this technology as for positive purposes to enhance biodiversity conservation exposure, protection and scientific research. On the other hand, someone can misuse this

conservation technology as for negative options to introduce loss of biodiversity. However, the use or misuse of technology depends on update operation and implementation policy. Policy-makers develop existing conservation policy on the priority of digital conservation, management and global agreements. Meanwhile, digital technology, stakeholders' engagement, conservation area and species diversity are connected each other as reciprocal relationships at national, regional and global perspectives. Sometimes, social and network security creates eco-technological risks due to misuse of technology. Reduction of these risks need update conservation policy. Otherwise, traditional conservation policy could not recover or reduce the relevant risks and augment loss of biodiversity, i.e. presently in Bangladesh, update technology belongs to inverse traditional conservation policy, i.e.

$$\text{update technology} \propto \frac{1}{\text{Traditional Conservation Policy}}$$

For example, Online Integrated Lawachara National Park Biodiversity Database (OILNPBD). The OILNPBD provides information on digital conservation with specific users access. These users follow some rules and regulation to disseminate/use digital data. These users are mainly data administration and general indicating local, divisional, national and global users. The data administrative users include operation level, management level, executive level and top policy making level. Each level limits to other levels except top level according to digital conservation management information system policy. On the other hand, general users are academia scholar, researcher, scientist, document manager, biodiversity specialist, environmental educationist, NGO officers, botanist, zoologist, environmental lawyer, students and others. If OILNPBD can be increased, then proportionately increase policy improvement. All OILNPBD databses connected with National Database, Biodiversity Clearing House Mechanism (BCHM), World Database on Protected Area (WDPA) and IUCN Red List Database.

Public policy–most politicians are not environmental scientists by National Park biodiversity conservation. Some of them are Law background or political sciences or so relevant fields. Because of this reality, the way public policy is formed in regards to digital technology, is mostly shaped by the National Bureaucrats or Co-management Council, which rely on them for Access Benefits Sharing (ABS)– each State Party individually provided to the Convention on Biological Diversity (CBD). This options can lead to some disagreements in how public policy treats technology versus what's stakeholders desire from the update technology for online digital conservation services and the relevant laws/policies which govern them with update policies. For example: Biodiversity Clearing House Mechanism (BCHM) was developed by CBD to disseminate with State Parties for information sharing on digital conservation and connectivity with World Database on Protected Areas (WDPA). This WDPA provides information on National Parks (NPs), Wildlife Sanctuaries (WSs) and Nature Reserves (NRs) of each State Party with specific rules and regulations as follows:

i. Acceptance of Terms and Conditions.
ii. The agreement is between digital biodiversity research and Access Networks for NPs, WSs and NRs and relevant topic.
iii. Ownership of National Park Site.
iv. Access to services and termination of Network connection.
v. Conservation digital content management.
vi. Disclaimer of content.
vii. Take down conservation group policy.
viii. Disclaimer of authentication.
ix. Limitation of users liability.
x. Intellectual Property Rights and Licensing.

Limitations of Conservation Policy and Technology relationship

There are limitations on this relationship on National Park Biodiversity, such as:

(i) Illegal enforcement application on forest user group, researchers and relevant stakeholders.

(ii) Misuse of policies and conservation corruption on biodiversity information.

(iii) Display false interface on biodiversity legal information related National Park Management.

(iv) Digital killing on plants and animals by using modern technology. For example: Telematics misapplication.

(v) Digital poaching, hunting and tracking of biodiversity (BMAPU, 2017)..

(vi) Misapplication of digital technology on conservation security (STR, 2017).

In modern era, Conservationists are more worried due to misuse of emerging technology, particularly TELEMATICS towards National Park Biodiversity. Poachers misused update technology for poaching of wildlife. For example: (i) Macaque monkey declines from Lawachara National Park (LNP), (ii) Proboscis monkey reduced from Bako National Park, (iii) Rhino declines from Krugar National Park (STR, 2017). If current trends continue on wildlife at nationally and globally, the national majestic macaque, rhino, proboscis and other large and iconic wildlife species will be extinct (Shipman and Silverberg, 2017). LNP dedicated to wildlife conservation lack the resources to protect wildlife from criminal syndicates that profit from poaching. The modern technologies have the potentials to change the dimension of the global fight against wildlife crime (WWF, 2012). But poachers misused these modern technologies and poached wildlife tremendously. If maintenance of biodiversity is a primary goal of the conservation movement, then the movement is falling. In general, the on-going loss of species can still be greatly reduced or curtailed. But in order

for that to happen, we need a new conservation paradism. This paradism must acknoledge the lessons of history, the realities of the present and rationalized generations, and what can be anticipated with reasonable certainty in the coming decades. It also must cope with inevitable and inescapable uncertainties in a prudent and precautionary manner (Lavigne, 2006). The study explored to rapidly pivot from a top-down technology driven approach to a bottom-up problem-driven approach if we were a meaningful impact on the poaching crisis. New technologies are being developed everyday to combat the poaching and trafficking of wildlife (Bale, 2016). Wildlife has now become atool of sophisticated organised criminals to finance other atrocities and cause chaos (Allan, 2016).

The study mentios to need new and equally sophisticated solutions to disrupt these criminal networks, expose corrupts officials, and shake up consumers that are driving the demand (Christy, 2016). Poaching is one of the biggest threats to endangered wildlife, which are often killed for their valuable horns or necessary parts of body. Because the problem has become so serious, conservationists are constantly on the lookout for new and better methods to cut down on the illegal poaching product trade — and the use of sophisticated technology is starting to take the lead in the anti-poaching battle (Harvey, 2015). The Real-time Anti-Poaching Intelligence Device (RAPID) used to deter rhino poachers, but could not detect them.

The study suggested for anti-poaching scalable, modular and adaptable solution systems, which as shown in Figure 5.37.

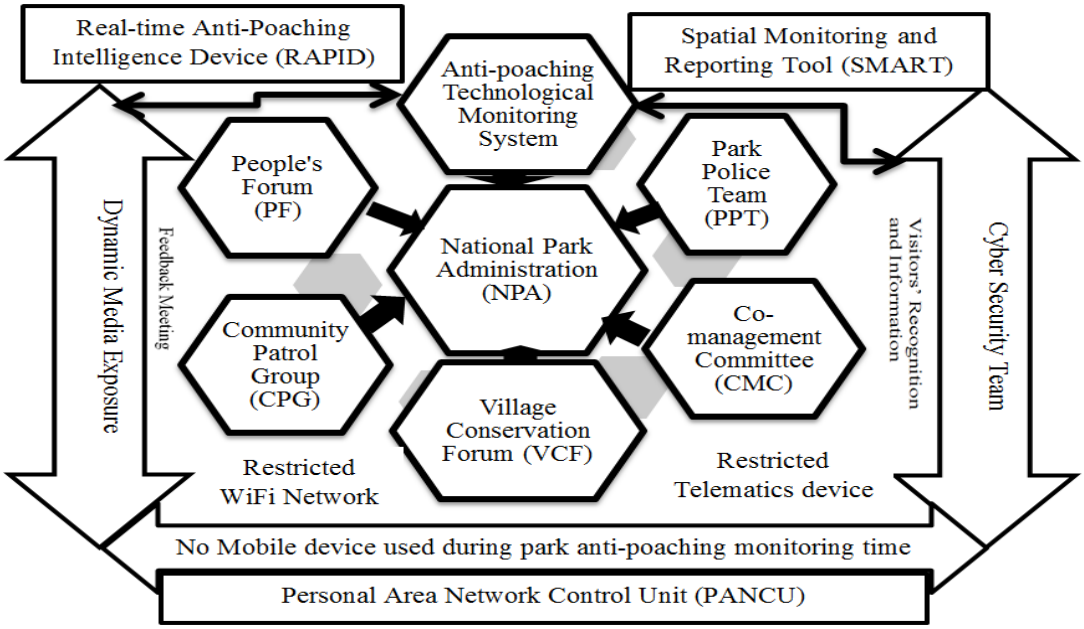


Figure 5.37: Misuse Reduced for Anti-Poaching Framework

5.9.2 Risk Management Support Systems

The Lawachara National Park (LNP) Management body works at risk administration in order to correctly retort to risks, which could provide severe hostile effect on park biodiversity conservation at Kamalaganj in Moulvibazar district. The fundamental persistence, however executing risk management support system, is to appreciate operative and resourceful total risk management, clutching comprehensively and scientifically as shown in Figure 5.38. This system is to establish and will be reacting to the risks neighbouring at the LNP, in order to growth of diversity, constancy, sustainably as well as usuable worth of the existing biodiversity. The study suggests for integrated decisions with the cooperation of chief executive, can take risk management effectively for national park biodiversity conservation. Moreover, the Management body has recognised an Ecological Risk Management Support

Systems (ERMSS) that offers inclusive maintenance for administrators through co-management system to cooperate with park management and local people for regular monitoring, reducing illegal logging, park land encroachment and ecotourism activities. To protect operative/competent the Ecological Risk Management Operation (ERMO), risks are considered and quantified as national park management jeopardies that portend to biodiversity loss or reason excessive effect on local community as well as impact on sectoral performance.

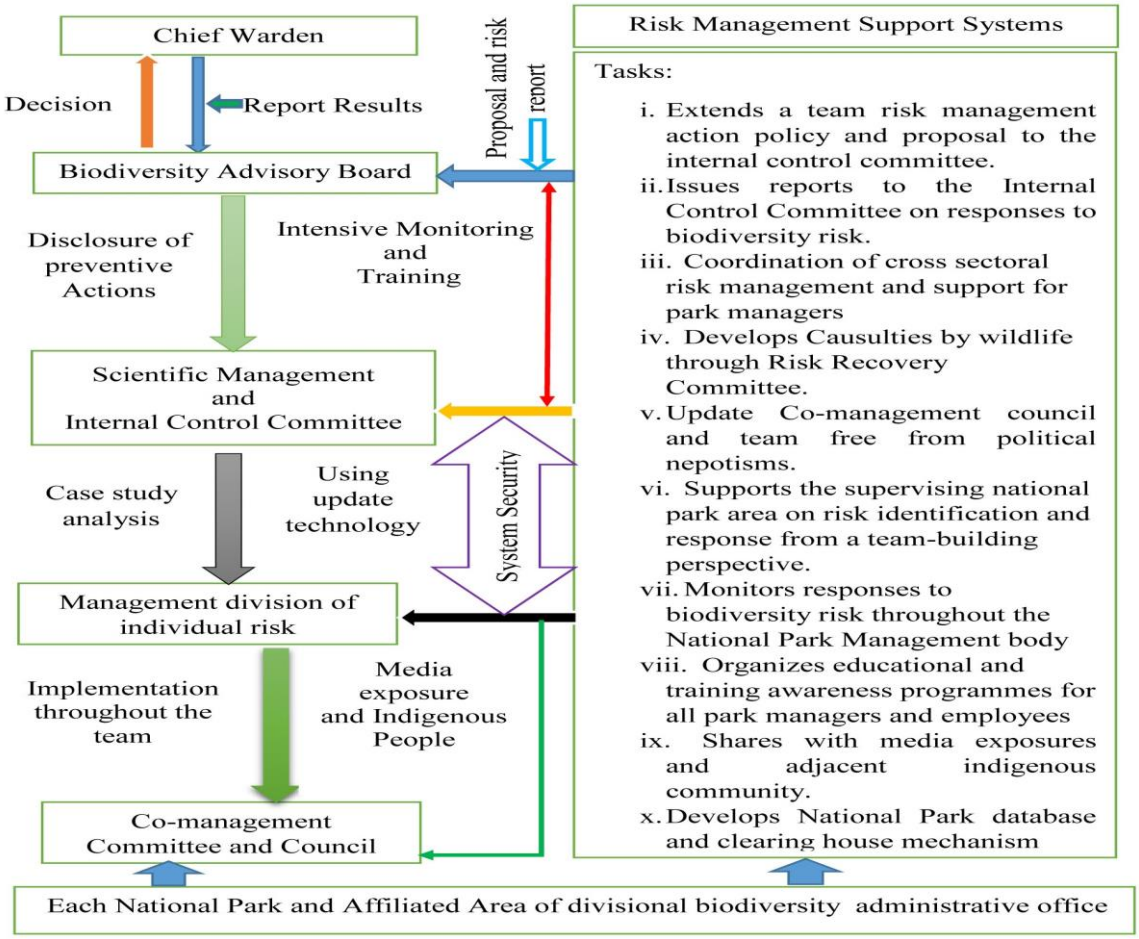


Figure 5.38: Lawachara National Park's Biodiversity Risk Management Support Systems.

5.9.2.1 Biodiversity Monitoring System

Biodiversity monitoring system (BMS) involved in the National Park Management Plan (NPMP) and Biodiversity Strategic Plan (NBSP) improved for LNP. These NPMP and

NBSP include a threat analysis and propose conservation actions accordingly. Eventually, the NBSP contains targets and actions or impacts indicators that can measure the success of implementation of the plan. Biodiversity monitoring parameters are separated between biodiversity indicators, ecological indicators, socio-economic indicators, hydrological indicators, policy indicators and technological indicators, which shown as Figure 5.38. The monitoring indicators are:

(i) biodiversity information status,

(ii) weather monitoring,

(iii) Forest and land use changes,

(iv) interface areas,

(v) water level,

(vi) annual rainfall,

(vii) interface areas,

(viii) wildlife information,

(ix) plant species information,

(x) mother tree species,

(xi) key animal species information,

(xii) forest harvesting,

(xiii) socio-economic features,

(xiv) co-management and afforestation /reforestation,

(xv) controlling of invasive alien species,

(xvi) wildlife crimes,

(xvii) illicit-felling,

(xviii) land encroachment,

(xix) amphibian species information,

(xx) reptiles species information,

(xxi) ecotourism information,

(xxii) biological research information,

(xxiii) repeat visitors information, and

(xxiv) Other ecological information of Lawachara National Park.

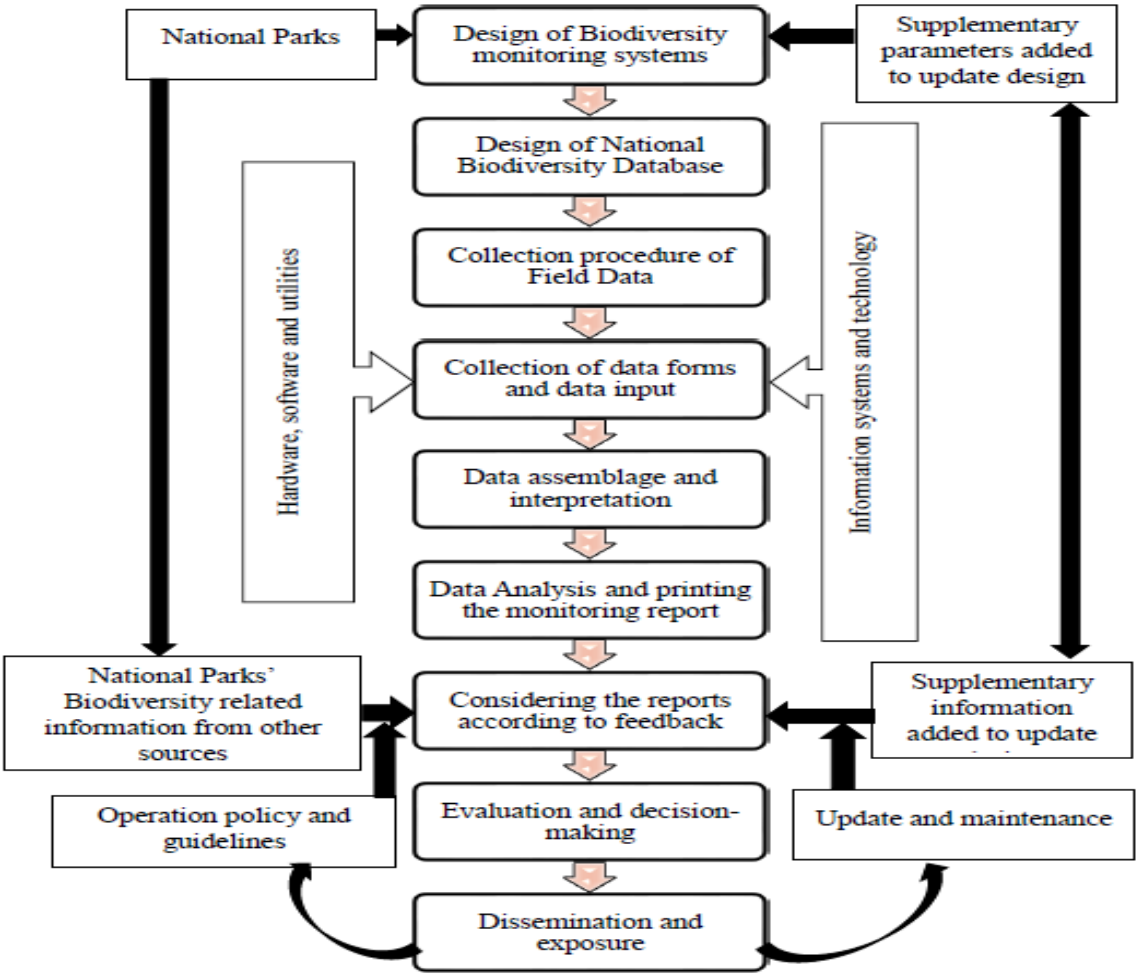


Figure 5.39: Structure of the Biodiversity Monitoring System for Lawachara National Park

The Biodiversity Monitoring systems enhance for data anaylsis, interpretation and decision-making on halting loss of biodiversity on the priority of Aichi Targets 2020.

5.9.2.2 Ecological Risk Assessment

The Ecological Risk Assessment (ERA) towards Lawachara National Park is the thematic phenomena that consists of "loss" or "gain" of ecosystem services in Bangladesh. Conservation policy instrument is the connectivity with loss or gain in presence or absence of specific indicators, which mentioned in Figure 5.40 with relevant indicators, such as computer-based and general risk assessments.

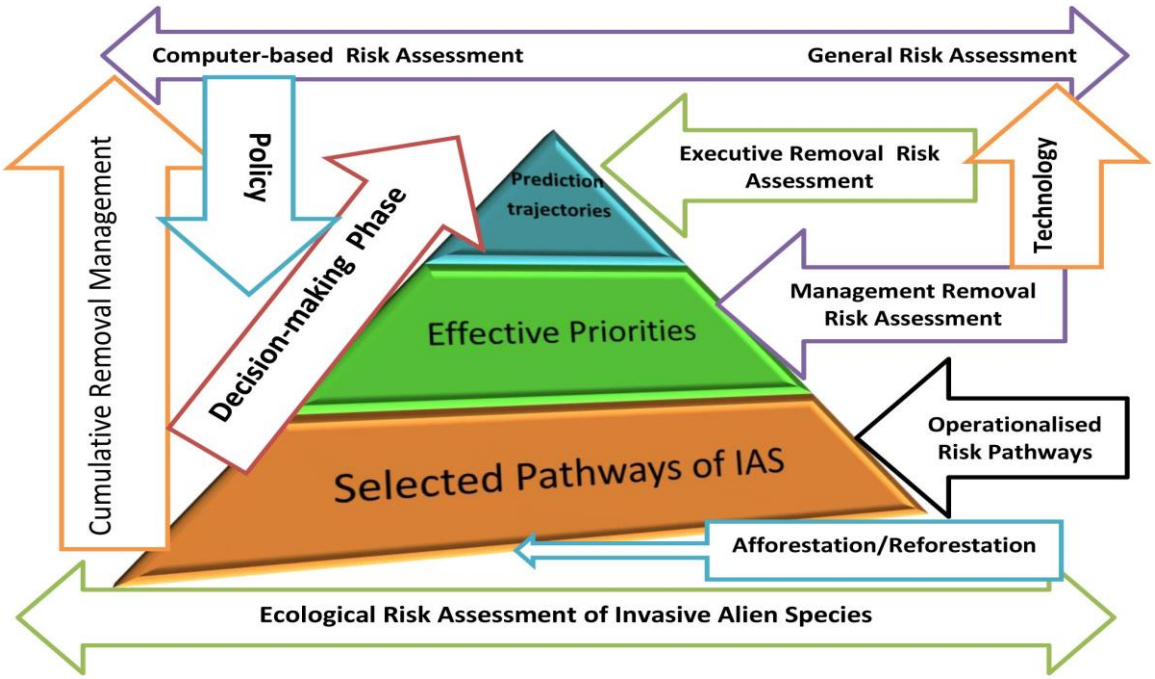


Figure 5.40: Ecological Risk Assessment of Lawachara National Park Area

Ecological risk assessment of LNP focused the effective decision-making in connection with sustainable biodiversity conservation according to the national and global requirements of Convention on Biological Diversity (CBD). According to the Article 8 (h) of Aichi Biodiversity Targets (ABT) 2020– every State Party of CBD eliminates Invasive Alien Species for effective conservation at National Parks within 2020 (ABT, 2010). Regulatory options also involve identifying to advise wildlife attacks of risks and safety measures,

mandatory information exchange between co-management team and adjacent communities surrounding the Lawachara National Park.

5.9.2.3 Develop Systematic Conservation Planning for National Park Biodiversity

Conservation Planning is an activity in which social, economic and political imperatives adaptation, sometimes drastically, scientific prescriptions (Margules and Pressey, 2000). The systematic conservation planning six stages are integrated with conservation data compilation and maintained with required values of conservation areas (Pressey and Bottrill, 2009) (Table 5.12). There are several functions of this systematic conservation planning on Lawachara National Park to focus on biodiversity conservation perspectives, such as:

(i) Effectively connect with financial and social capital of local communities

(ii) Reduction in threat from land conservation and park land encroachment

(iii) Increase persistence of valuable biodiversity to regional and national perspectives, i.e. natural capital.

The systematic conservation planning processes are interlinked with alternative options including inputs, processing, getting outputs for mainstreaming national park biodiversity. If all stakeholders are integrated for rainwater, harvesting inside the Lawachara National Park continued anti-poaching with proper integration of natural water and biodiversity conservation. For this purpose, systematic conservation planning is essential for national park biodiversity conservation. This conservation planning connects with National Park Biodiversity and National Biodiversity Strategy and Action Plan (NBSAP).

Table 5.12: Stages of Conservation Planning Processes

Stages	Conservation planning process	Purposes
Stage1	Data Compilation	Compile socio-economic variables and threats data of Lawachara National Park (LNP).
Stage2	Goals identification	Identify conservation goals of LNP Planning for conserving of biodiversity with adapting environmental conservation policy instruments.
Stage 3	Review gaps	Review existing conservation status of LNP.
Stage4	Select alternatives	Select additional conservation area of LNP and adjacent connectivity zone.
Stage 5	Implement the plan	Implement conservation action properly according the NBSAP and national conservation plan.
Stage 6	Maintain the plan	Maintain the plan with intensive monitoring and evaluation as well as identify best practices and disseminate with stakeholder

(Source: Modified Pressey and Bottrill, 2009)

For example, a systematic conservation-planning framework, as shown Figure 5.41 including inputs, processing and outputs are getting impacts with best practices forsetting milestones.

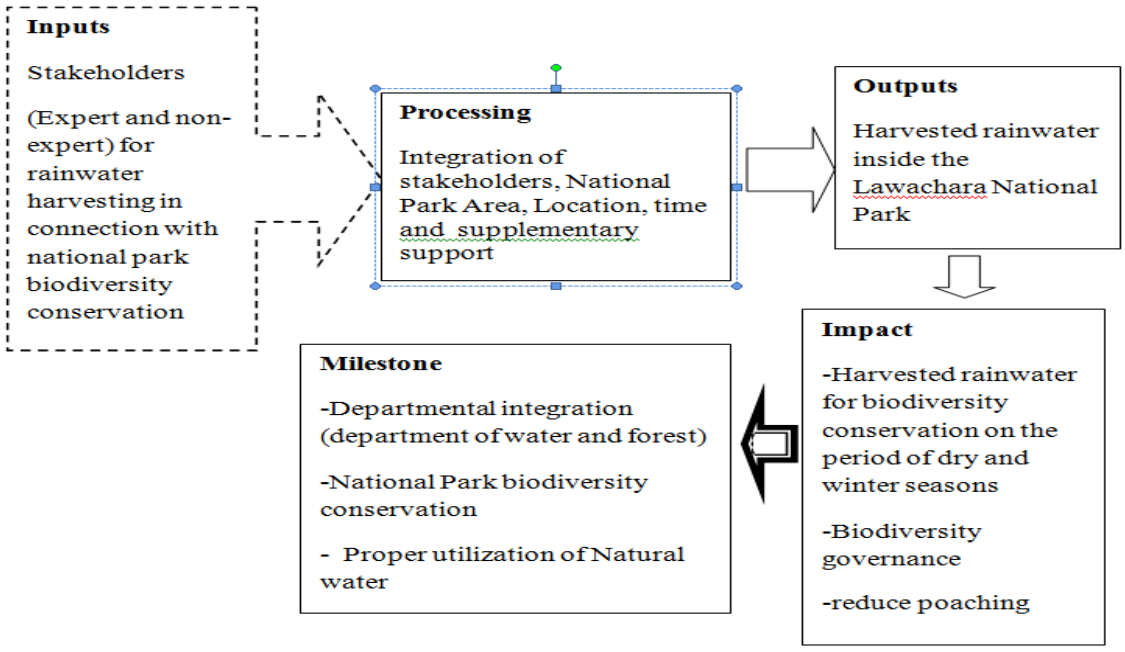


Figure 5.41: Systematic Conservation Planning framework for National Park Biodiversity.

This conservation planning consists of six stages for conserving of biodiversity, which as shown in Figure 5.42.

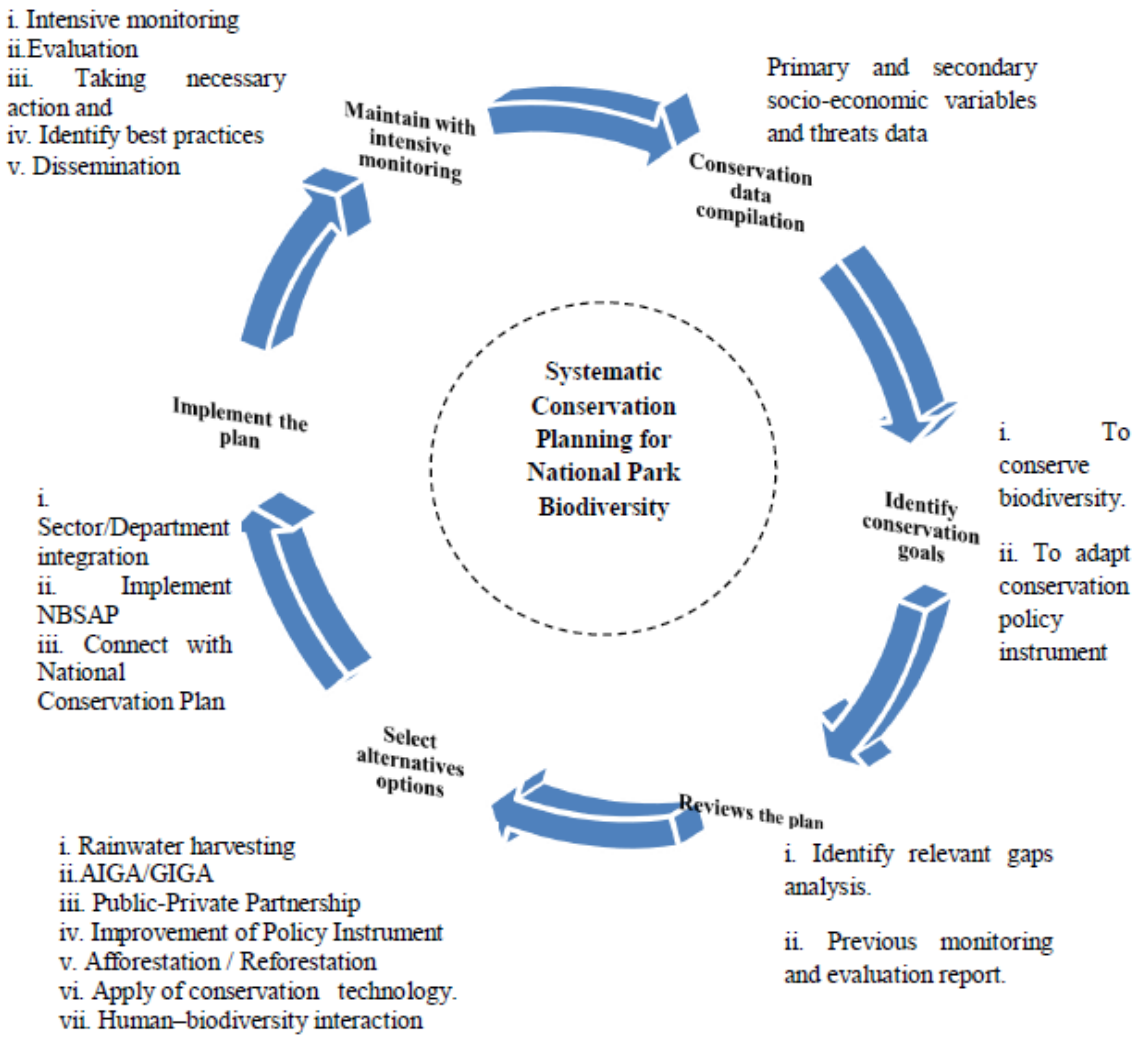


Figure 5.42: Systematic Conservation Planning for National Park Biodiversity (Source: Modified Pressey and Bottrill, 2009)

5.9.2.4 Socio-economic Impacts of IAS and Control Measures

Across the visited Lawachara National Park, the identified Invasive Alien Species (IAS) had various effects, which are heavily felt by local and indigenous communities. The Impact assessment is carried out manily on Park biodiversity protection, associated food security,

on local household and community welfare, wildlife protection and on other relevant activities. In addition, observed positive effects of IAS are also recognized on the priority basis. The results suggest that leguminosae and myrtaceae are the most affected families for loss of biodiversity at LNP. Though most invasive alien plant species were introduced early before 2012, the objective was to set a short period in National Biodiversity Strategy and Action Plan (NBSAP), where Bangladesh Forest Department (BFD) could remove selective species related to market values for the period today and tomorrow. However, biodiversity declines leading to increment in market prices cannot be solely attributed to the presence of IAS plant species at LNP biodiversity conservation system. Other factors, such the degree of illegal logging, poaching, natural calamaties, and wildlife diseases must be scientifically analysed and their impacts highlighted.

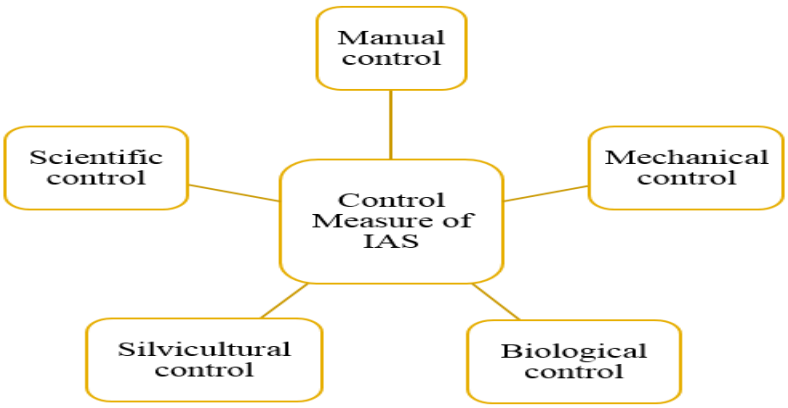


Figure 5.43: Control measure of Invasive Alien Species

Control measures options take weekly on new infestations and remove plant species as early as possible in connection with peak growth period and monthly when peak growth period has ended. For this purpose, control measures can be followed on: (i) manual control, (ii) mechanical control, (iii) biological control, (iv) silvicultural control, and (v) scientific control, which as shown in Figure 5.43.

5.9.2.5 Economic Conservation Instruments for Changing Behaviour

Community Behaviour change is the effective instrument surrounding the Lawachara National Park (LNP) for conserving of biodiversity. LNP Manager may interest in using fiscal instruments to change the behaviour of economic actors with respect to maintaining the National Park area and conserving biodiversity. A tax incentive for voluntary contributions for particular interests to LNP area is the impact of economic activities in the buffer areas of a park on the integrity of the park and conservation of biodiversity within the greater Kamalganj bio-region. Local, divisional and national fiscal instruments can be designed to encourage biodiversity-benefiting economic activities, such as: organic farming, ecotourism etc can be established around the LNP areas. For these activities, tax breaks related to income taxes, property taxes, employment taxes etc can be given to such biodiversity activity businesses. The authority of Tourism companies /industries who will bring visitors to the LNP and maintain biodiversity- benefiting standards in the operations could also be given tax breaks. The same holds for other economic activities, such as: (i) Farming, (ii) Fishing, (iii) Hunting, (iv) Sustainable wild harvesting, and (v) Biodiversity research and so on, which takes place within LNP area.

In addition to influencing economic activities in and around LNP areas, fiscal activities can also be used to influence household behaviour. For example, Magurchera punji and Lawachara punji within the park region, LNP is located. Tax incentive may be used in two indigenous villages through encouraging biodiversity-friendly practices in local home-garden including removal of exotic species and the establishment of wildlife corridors within the settlements. Revenue-generating instruments can be designed at various levels of the conservation policy systems for LNP. They can be at local government in connection with Bangladesh Forest Department. Depending on the fiscal policies and practices of the

Government, Manager of LNP may have autonomy to design specific fiscal instruments for LNP biodiversity conservation. For example: Entrance fee to LNP is one obvious example. User fees for the sustainable use of biological resources, such as: backpacking, fishing, or hunting fees- are also common. Licensing fees for tourist operations and filming rights are also possible. Such fiscal conservation instruments are based on the benefit principle and generate ear-marked revenue for the authority of LNP.

LNP manager may also be able to benefit from the design of fiscal instruments at the local level. For example: a portion or local sales tax – generated in part from the spending of park visitors in local economy– may be ear-marked to LNP area. Landowners who benefit from adjacent to on near LNP area may pay a portion of their property to the NP area. There are some fiscal instruments to assist for LNP biodiversity conservation, such as:

a) Special Area visit tax inside the park.
b) Biodiversity Green Fund
c) Biodiversity Tax deduction scheme.
d) Develop NP revenue stamp/ postal card
e) Biodiversity incentive through cultural programme.
f) Biodiversity Tax for those companies who received environmental clearance.
g) Using a NP lottery to help biodiversity fund.
h) Tourism company tax fund
i) Voluntary Fund for biodiversity
j) NP Boarding/Lodging rent tax for biodiversity fund
k) Green Banking Fund
l) Tax for LNP Vehicle Road and Railway Route permits
m) Biodiversity donation for spot picnic programme.

5.9.3 Scenarios Assessment of Conservation Instruments

The conservation of biodiversity towards national parks and rehabilitation of new special conservation areas are therefore crucial to preserving flora, fauna and their services to anthropocentric with human interferences. Biodiversity conservation and enhancement of national park can happen through various policy mechanisms at a diversity of scales. Policy instruments available are monetary or non-monetary incentives for national park augmentation, penalties for activities destructive by illicit-feller or encroacher in forested area or mandatory conservation set-asides. Perfectly, all of these instruments should be complemented by consciousness and education/training to ensure the highest rate of assumption and compliance. Accordingly, Bangladesh Forest Department and Co-management team should utilise information about illicit-feller or encroacher with a diversity of audiences (e.g. farmers, park manager, team leader and security officer). USAID, IUCN, Interpol and Bangladesh Security forces' assessment may deliver a vehicle to encourage national park conservation imperative for flora and faunal species. Besides, wildlife attacked or killed through railway or road-running vehicles during passing the roads. Each of these existing policy options can activate at large or small spatial scales targeting action in NBSAP for national park depending on the desired outcomes. The study advocates that co-management approach is good system for protection of Lawachara National Park biodiversity and to continue without procrastination and free from political nepotism.

5.9.4 National Policy Formulation for Lawachara National Park

Policy formulation is both a technical-rational as well as competitive phase. Out of all options brought forward by different parts of society like interests and pressure groups, civil society, mass media, international organization as well as political parties in front of the Government for action, field level staff recommendations, the agenda for policy formulation

is then set. Then the goals and objectives setting for the same is prepared realistically. It is then passed to enact a law by the legislature and give it legal status and authority to carry out its duties.

National Park Biodiversity policy is an integrated national policy with a precarious phase of the policy process. Absolutely the alternatives policy formulating those decision-makers reflects trustily inspirations the decisive dynamic policy options. Generally, less people to be convoluted in biodiversity policy preparation than were knotted in relevant agenda-setting development, and the policy-makers accept further of the effort to transpire in the public eye. It is a "measured plan phase" in which policy-makers' pursuit for policy alternatives (Alexander, 1982). In study area–Lawachara National Park, most of people are middle class. Their choices and expressions deliver on alternative income generating activities as a consideration of policy-makers to formulate policy. Because, local people involvement has several potential roles in policy decision-making as well as the reasons attainable for inspiring it are diverse (Wengert, 1976) for co-management, cooperation and eco-guides. National Policies formulate according to sectoral priorities as a whole as shown in Figure 5.44. For examples: (i) Forestry sector implies on forest policy, national park policy, NTFP policy, Invasive Alien Species removal policy, Biodiversity policy, wildlife conservation policy, plant quarantine policy and so on. (ii) Environmental conservation policy implies Ecologically critical area policy, Ecotourism policy, Rain water harvesting policy, NBSAP, National conservation strategy, Climate change and mitigation policy, Waste management and recycle policy, Environmental impact assessment and Country perspective plan.

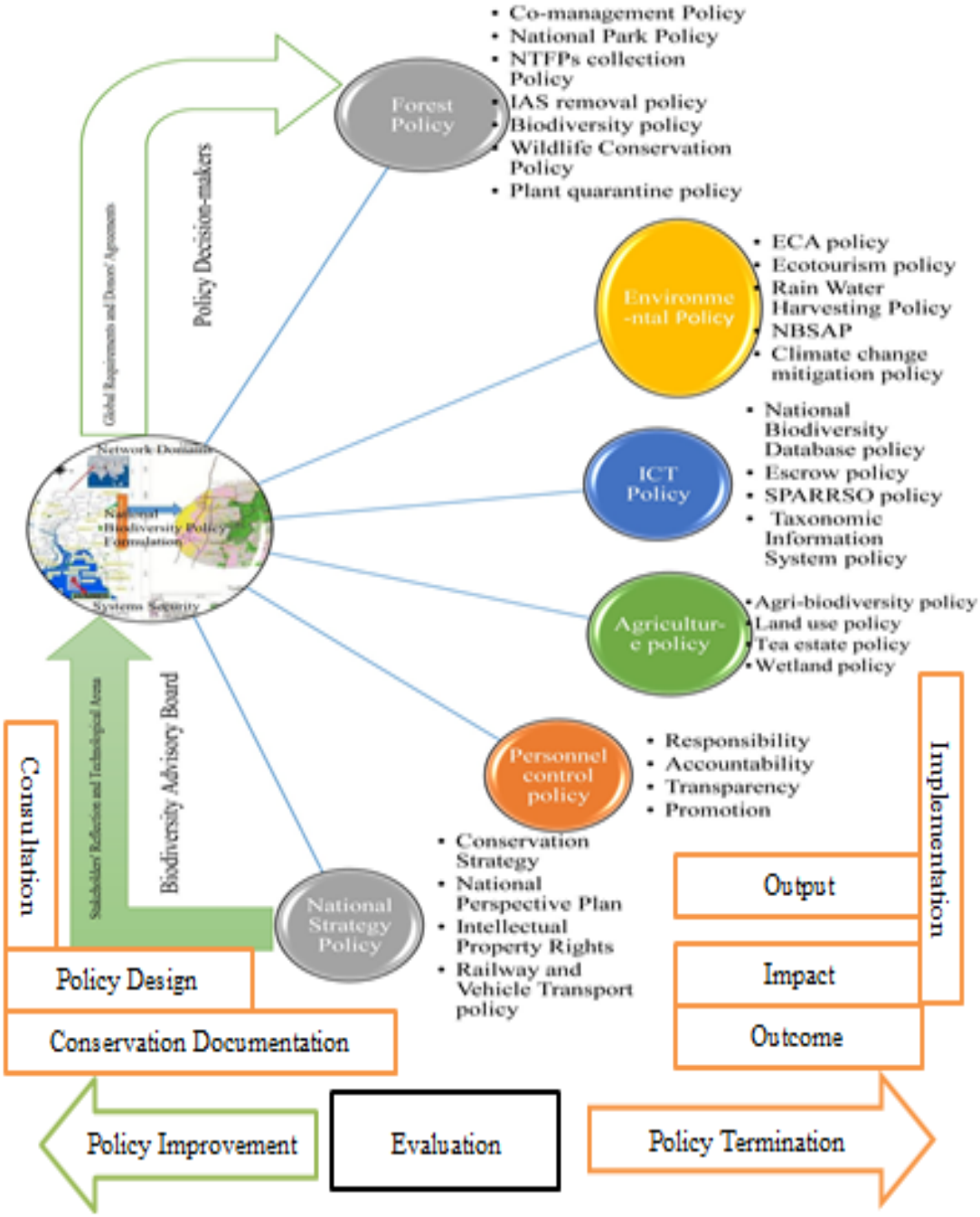


Figure 5.44: Different indicators enhanced formulating national policy
(Source: Modified Rabin, 2015; and Fransz, 2012)

(iii) National ICT policy implies National biodiversity database policy, Escrow policy, SPARRSO policy, Business technology policy, Taxonomic information system policy, Biodiversity Information system policy, National Invasive Alien species information system

policy, National wildlife information system policy. This national policy formulation enhances on environmental conservation policy instruments related to national park biodiversity protection.

5.9.5 Improving Performance for Sustainable Conservation of National Park

From the field observation at Lawachara National Park, co-management team leader stated that competitive tourism performance enhances better assistances on behalf of biodiversity conservation, native and indigenous communities, tourists and effective tourism business. Nature scenic beauty to reinforce purpose image and assimilative properties (Bättig *et al*., 1998) and expressive influences can be inferred from what visiting the attractions observed as their field trips highlight at Lawachara National Park (LNP). The LNP is the uppermost generally contentment and progress symbols. The park deals visitors some of the paramount probabilities to outlook fascinating megafauna, with hooluck. It offers extraordinary worth temptations in a moderately trifling terrestrial zone, creating it an exceptionally appropriate and extremely vendible visitor terminus in Kamalaganj sub-district in Bangladesh, where contains picnic spots, festival places, cultural and historical sites and wildlife attraction zones. The LNP is exclusive vegetative zone because indigenous communities are allowed to live inside the park. Visitors should be visible to how this is completed to attrack equilibrium among indigenous culture, norms, values and conserving of biodiversity observed within the Lawachara National Park. Visitors celebrated that the LNP delivered the the greatest excitement of a comfortable natural atmosphere concerning national parks in Sylhet division. The study illustrated that visitors originated with potentials prejudiced by based on records, text books, natural world lives, feature movies, radio and television news and hearing-of-mouth evidence. Therefore, it should to establish safer commitments and encouraging upcoming targets that apparent the visitors from side to side recap outings and

acclamations to the peers, therefore creating the ecotourism business more suitable in the Lawachara National Park area.

5.9.6 Set-up Biodiversity-Stakeholder Connectivity Corridor

Biodiversity connectivity corridor is a stage for socio-technocal management in which stakeholders' effort organised to conserve biodiversity connectivity to provide opportunities for sustainable development. They are the instruments that complement the role of LNP, from an ecological and socio-economic point of view, which as shown in Figure 5.45. However, conservation connectivity is the potential connections or interlinlinkaes of key processes within and between ecosystems (Lindenmayer and Fischer, 2007). Connectivity conservation has emerged as a big-thinking response to a range of threats to national park biodiversity (Pulsford *et al*., 2015) that include:

(i) Habitat degradation and destruction of national park area.

(ii) Fragmentation

(iii) Changed fire regimes

(iv) The spread of introduced species, and

(v) Changing climate

The design and management of biodiversity connectivity corridor approaches is of the key elements of participatory management for Lawachara National Park biodiversity conservation. Connectivity corridor management is a strategic approach tools that helps to link habitat across whole national park area, which can enable species and their ecosystems to move or adapt as condition change. It is the way of maintaining connections for biodiversity by involving community people (Pulsford *et al*., 2015).

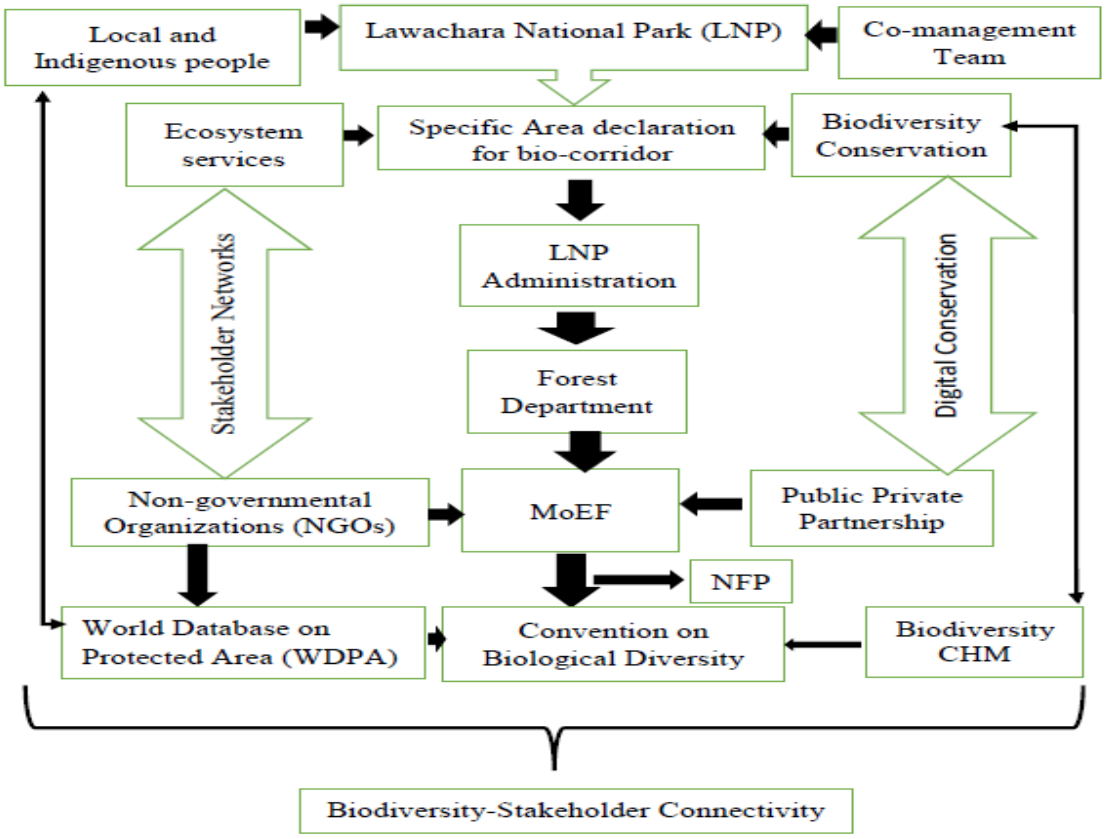


Figure 5.45: Biodiversity-Stakeholder Connectivity Corridor

This approach will continue to support capacity building in national instituitions engaged in the management of biodiversity corridor. The stated approach is meant to strength the capacity of management structure at the local level to increase their participation in decision-making objectives of national park biodiversity management. The Government of Bangladesh should require developing tools to improve adaptive co-management through biodiversity connectivity corridor, locally at LNP, Kamalganj as well as other national park of Bangladesh. This conservation connectivity prolonges from LNP to Forest Department from Ministry of Environment and Forests (MoEF), then disseminates to Convention on Biological Diversity (CBD), World Database on Protected Areas (WDPA) and other state parties. According to the response, we are witnessing a goal and political revolution in the care and management of National Park Biodiversity (Worboys and Mackey, 2013).

Biodiversity–stakeholder connectivity corridor establishes more strategic concepts on comprehensiveness, adequacy and representiveness (Pulsford *et al*., 2015). Therefore, it is a proactive, holistic and long-term approach (Papallacta Declaration, 2006).

5.9.7 Public and Private Partnership for Biodiversity Conservation

Public and Private Partnerships (PPP) is the new collaboration for sustainable management of National Park areas. If the Government cannot alone to meet the huge investment needs to protect, conserve, manage and restore the National Parks' Biodiversity, the Government of Bangladesh can build partnership with private agencies (IPAC, 2012). The PPP connects with different parameters for National Park biodiversity conservation (Figure 5.46).

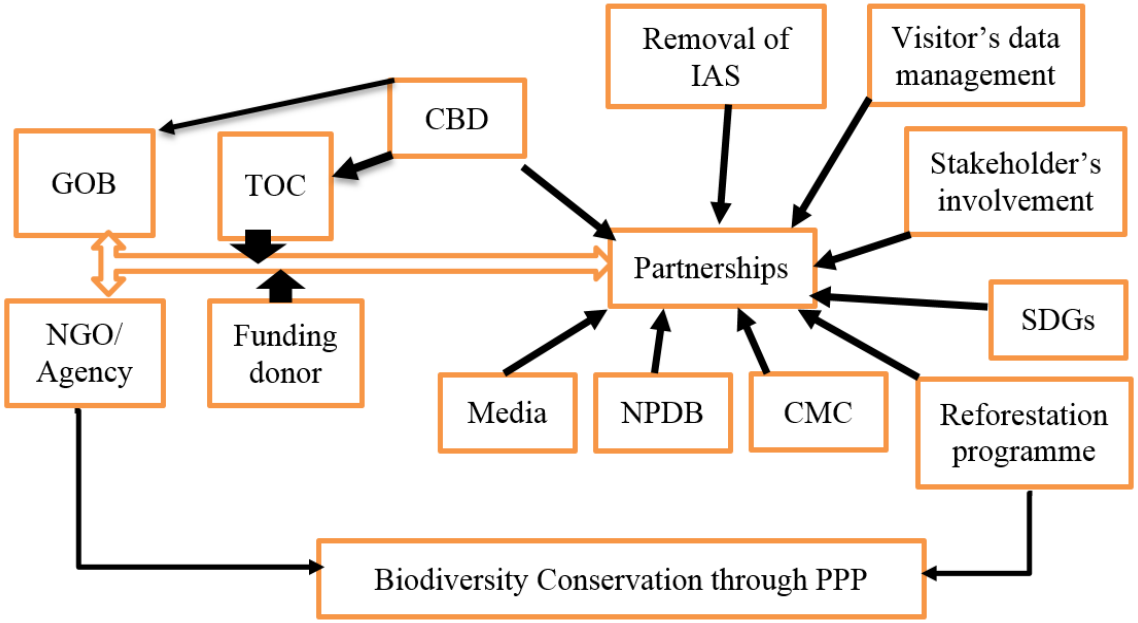


Figure 5.46: Biodiversity Conservation through Public-Private Partnership

On the other hand, Donor agencies funding is not sufficient to cover all the major aspects of biodiversity conservation. With careful planning, transparent management and a focus on delivering services to people, it should be possible to establish PPP for sustainable management and conservation of National Parks. The basis of the partnership is to recognize

a common future where the first generation communities transition into a greener sustainable economy. For example– The Nature Conservancy has been to conserve biological diversity through establishing nature reserves. It increased on the better information on the status and distribution of biological diversity which was needed to make the most effective and efficient use of limited resources. Mainly on:

(i) Gathering information from National Park and adjacent community areas.

(ii) Organise scientific information as the basis for sound conservation decision.

(iii) Growing public constituency interested in conserving biological diversity.

(iv) Standardised in information management system to track important biological data including Taxonomy, distribution, population trends, habitat requirements, relative abundance, quality, condition and viability.

Examples of non-biological information tracked are land ownership type, land use and management, distribution of National Parks, threats to species or other habitat.

The information management system has three major components, such as:

i. Structured paper files for biodiversity information management system.

ii. Geographic files (maps and computerized GIS) for temporal location and elevation.

iii. A Computerized database that integrates the biological and non-biological information.

The PPP conservation programmes have three functions, such as: (i). to collect information on the status and distribution of species and national communities from as many sources as possible. For examples: National Parks, Museum and herbaria, species experts, field inventories, published and unpublished literatures, (ii) to manage this information in a standard way, and to disseminate this information to a wide array of users (Groves *et al*., 1995). The Conservancy strengthens the network through training and technical supports in

standard methodology, database management, GIS and related technologies, vegetation classification and programme administration through–(a) Association for biodiversity information, and (b) Conservation information engineering related to BCHM. The PPP objective is to facilitate the development of core sector public infrastructure and services vital for the people of Bangladesh (PPPA, 2017). A wide variety of public-private partnership effort is currently expanded on protecting and restoring national park biodiversity including flora and fauna.

To ensure policy integration in different sectors (Figure 5.47) in order to fulfill the basis needs of the people of Bangladesh and to expedite socio-economic development in the interest of improvement of their living standards (PPPA, 2016). Because of this lack of public sector financial and human resources, the private sector has provided a significant portion of funding for managing National Park areas. Public Private Partnership Central Unit collaborated to develop a PPP model focused on management, conservation and operation of National Park areas, located in the country. The Authority of PPP aims to structure a single, singular national and international tourist track, aligning the unique natural and cultural elements of the project region. The new management model is demonstrating results for conservation and sustainable development, including the mobilization of public policies that value of national biodiversity. The project goal attracts private partners (Bitar *et al*., 2015) who will:

i. Conduct commercial operations in these areas through visitation, tourism and environmental education;
ii. Work to implement and maintain National Park areas' infrastructure in concession.
iii. Preserve historical and natural heritage, and promote environmental conservation;
iv. Respect environmental laws and the relationship with the surrounding communities.

The Public-Private Partnership project carried out through the PPP systems will have an estimated amount in initial private investment for implementation of ecotourism activities, accommodation, restaurants, visitation services, and other relevant infrastructure, and conservation of biodiversity in the National Park areas.

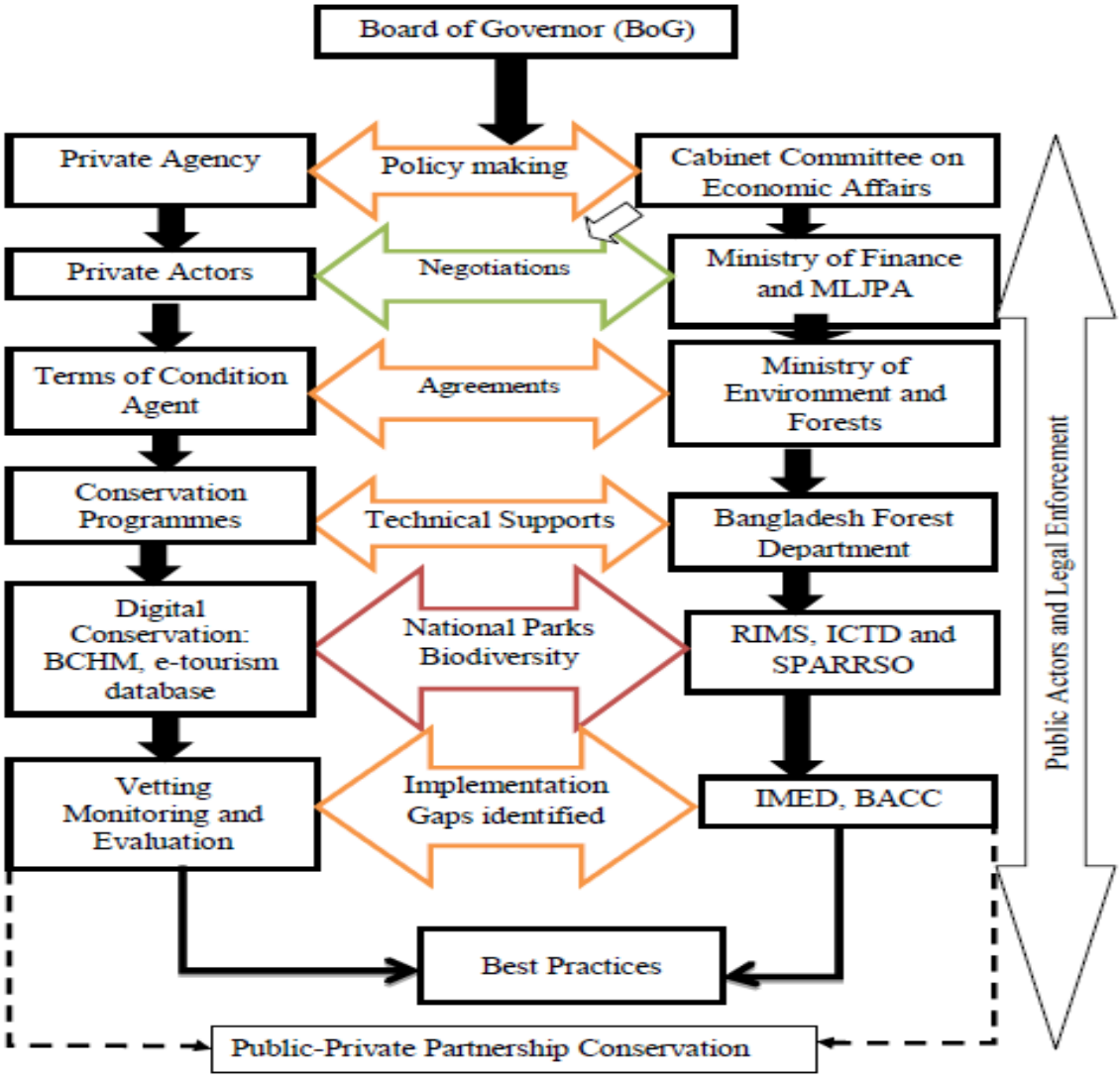


Figure 5.47: Public-Private Partnership Conservation Model

It is expected that, after the implementation phase of this project, the number of visitors will double within five years at the Lawachara National Park that is the part of this concession. One of the indicators aims to reflect the socio-economic impacts of the project on local and

indigenous communities including the income and employment generation within the Kamalganj sub-district areas are located, based on the idea of social bond. This object will strive to measure the income variations related to tourism, promoted from private partner performance. Another PPP related aspect for a PPP is how law enforcement handled. Even if government delegates the National Park area's management to a private partner, the responsibility for supervise and enforcing national park area legislation remains with the government.

In this context, the government holds the power to determine maintenance standards and quality of services offered in the contract, and also to supervise and monitor activities to ensure that the natural features of the park are being preserved. However, beyond the contract itself, the PPP operation structure provides incentives for maintaining a high standard of quality. The private partner is responsible to attract more visitors for the park and to maintain, conserve and preserve national park areas. On the other hand, the private concessionaire can develop supplementary activities, such as climbing, cycling, restaurants or hotels, since the government to increase the revenue generated and attract more visitors, which is critical to attracting and incentivizing the private partner, has approved it. PPPs can be an effective way to capture significant economic value natural assets. They can help improve the economic sustainability of National Park areas, enhance the quality of services and leverage investment in conservation. In long term, PPPs can function as a critical tool/ instrument for protecting biodiversity and improving surrounding communities. From the study, it was observed that grant financing of LNP is higher than other national parks in Bangladesh, which contribution is provided by the co-management team.

5.9.8 Bio-religious Conservation Integrity and Decision-making

Bio-religious knowledge implies with biodiversity and religion of local community in pivotal role of decision-making. Biodiversity is a major component of ecological integrity assessment (Andreasen *et al*., 2001; Parrish *et al*., 2003; Willamette Partnership, 2011; Unnasch *et al*., 2009; Faber-Langendoen *et al*., 2012a and b; NatureSurve, 2012; Vickerman and Kagan, 2014). Biodiversity conservation through local communities is an ongoing challenge, which is to develop the environmental religious knowledge that can be used for effective conservation and management. Biodiversity and community interlinked with mother tree, species composition, diversity, habitat quality, ecosystem structure, composition and function. From the study of Lawachara National Park (LNP), the mother tree reduced continues and affected on National Park Biodiversity. For religious consciousness of the value of biodiversity conservation, the local and indigenous community conservation integrity is necessary.

LNP is located Kamalganj sub-district, where the inhabitants are performed as Muslim, Hindus, Buddhist and Christian. The religious leaders of these religions can contribute the Community Conservation Integrity (CCI) for biodiversity on Lawachara National Park. This awareness dissemination will reflect positively with their beliefs, ethics and morals. For this purpose, Bio-Religious Knowledge Management Centre can be established at Mosque, Church, Temple, Pagoda for conservation integrity. The study also observed that the co-management committee (CMC) introduced at LNP. The CMC can assist the religious leaders for motivation to the neighbouring people on ‘religion and biodiversity’. For example: Islam and biodiversity. There are frequent references to several species in the Holy Quran. Out of 114 Surah (Chapters) of the Holy Quran, six are titled after animals and one plant, such as:

(i) Al-Baqarah (The Cows),

(ii) Al-An'Am (The Cattles)

(iii) An-Nahl (The Bees)

(iv) An-Naml (The Ants)

(v) Ankabut (The Spiders)

(vi) Al-Fil (The Elephants)

(vii) At-Tin (The Figs-tree)

Besides, approximately 30 animal species and 22 plant species are mentioned in various Quranic surah (Tlili, 2012; Khafagi *et al*., 2002). This species diversity has been the hallmark of biosphere and invaluable resource for human beings as well as for the natural environmental conservation (Solihu, 2014). In the Holy Quran stated "*And what He has created and multiplied for you on earth of different species or, of biological diversity*" (Surah An-Nahl, 16:13). Bangladesh Islamic Foundation under the Ministry of Religion can develop policy instrument on bio-religious conservation integrity for all National Parks of Bangladesh. Moreover, involvement of religious people can be performed for biodiversity conservation in different ways, which as shown in Figure 5.48 including involvement, recruitment, inclusion, legislation, multiplication, incorporation and conservation consciousness of cultural exchange for biodiversity protection with Lawachara National Park vegetational conditions.

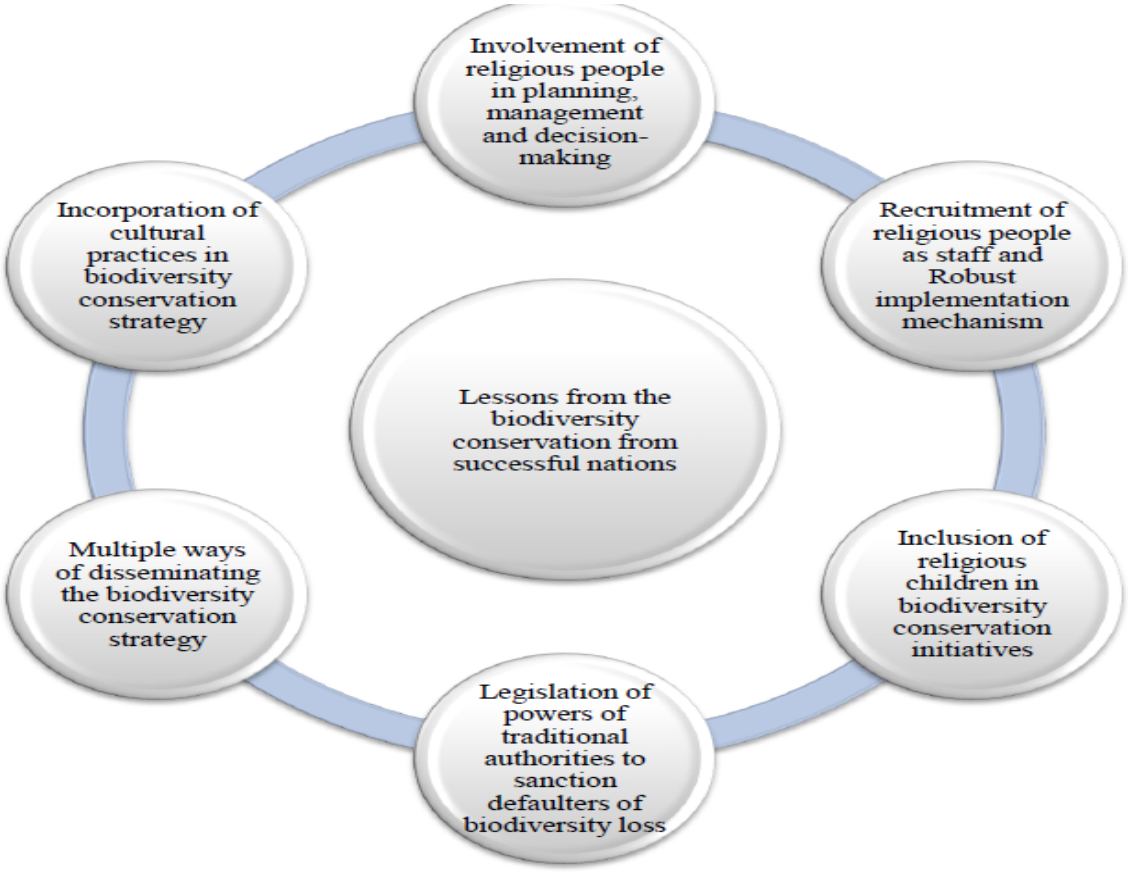


Figure 5.48: Biodiversity Conservation Integrity among local people.

Regarding people's mind changing and conservation integrity, the holy Quran stated that "*Indeed, Allah will not change the condition of a people until they change what is in themselves"* (Surah Ar-Ra'ad, 13:11). For change ourselves with realization for biodiversity conservation, the Administration of LNP, Co-management Committee and involvement of stakeholders could be motivated ethically on biodiversity protection for upcoming generation. Otherwise—

"*Mischief has appeared on land and sea because (of the meed) that the hands of men have earned, that (Allah) may give that a taste of some of their deeds; in order that they may turn back (from Evil)*" (Sural Ar-Rum, 30:41).

5.9.9 Policy Intervention to Control Illegal Logging

Ending illegal logging is natural best chance to conserve biodiversity and defend the rights of national park communities. It is one of the quickest and most cost effective ways to curb environmental conservation issues indicating for the illegal logging free future. The causes of illegal logging at Lawachara National Park vary from region to region at Kamalganj sub-district. These are over-exploitation, excessive inhabitants, cattle grazing, unseasonal NTFPs collection, poverty and umemployment. In addition, some corrupted Forest Department and Police Officials and other crisis. There are some solutions against illegal logging for National Park Biodiversity Conservation. These are : (i) Dynamic National Park Administration, (ii) Collaboration, (iii) Power of Local Marketplace, (iv) Standing with Indigenous Peoples, (v) Promoting Sustainable Choices, (vi) Changing Politics, (vii) Poverty Reduction Programme, (viii) Application of update Conservation Technology, (ix) Public Awareness and Media Exposure, (x) Forest footprint and product life-cycle analysis, (xi) Supply Chain tracing, (xii) Suppliers requirements and green procurement, (xiii) Eco-certification and eco-lebeling, (xiv) Suppliers audits, (xv) Stakeholders partnership, and (xvi) Sustainability reporting.

5.9.10 Environmental Conservation Impact Assessment and Control Measures

National park biodiversity assessment has always been an integral tool of environmental conservation impact assessment (ECIA). The study identified the impact appraisal of Lawachara National Park (LNP) indicating park inside railway route and vehicle road. The ECIA process can be improved on the priority of national park biodiversity consideration, which is connected with Aichi Biodiversity Targets (ABT) of Convention on Biological Diversity (CBD). Therefore, biodiversity is a political concept, which conservationists have formed and highlighted in an effort to shift the focus of national park conservation from

endangered species towards a more integrated ecosystem approach (Byron and Sheate, 2003). According to CBD (1992), "Each Contracting Party, as far as possible and as appropriate, shall: (a) introduce appropriate procedures requiring environmental impact assessment of its proposed projects that are likely to have significant adverse effects on biological diversity with a view to avoiding or minimizing such effects and where appropriate , allow for public participation in such procedures. and (b) introduce appropriate arrangements to ensure that the environmental consequences of its programmes and policies that are likely to have significant adverse impacts on biological diversity are duly taken into account;….". In Bangladesh, implementation of the obligations of the CBD has focused on the requirement to produce and implement a national biodiversity strategy and action plan (NBSAP). This plan set out the broad strategy and targets for conserving and enhancing national park's species and wildlife for the period of 2021. However, the wildlife of LNP declines with the collision of railway and vehicles. According to the Co-management Team and Focus Group Discussion (FGD), the existing route and road should to shift with proposed new project related on environmental conservation impact assessment (Figure 5.49). The new project deals with policy integration, practical incorporation or guidance for incorporating biodiversity considerations in to ECIA, strategic environmental assessment and policy appraisal towards LNP in a new characterisation based approach to assessing environmental policy instruments.

The current environmental conservation impact assessment (ECIA) process is implicitly illustrated Lawachara National Park's biodiversity conservation aspects, current ECIAs of railway route and vehicle road projects are not integrating the completed range of biodiversity considerations. Development of the new methodological approach should enhance consideration of conserving biodiversity in ECIA and address certain specific

weaknesses (Byron and Sheate, 2003) in current practices. However, it is argued that existing implicit treatment of biodiversity issues is insufficient from the result of the EIS reviews and that any event ECIAs should be explicitly expressing biodiversity conservation. In addition, the Environmental Conservation Impact Statement (ECIS) review evidence shows that biodiversity conservation assessments in route and road ECIAs are still inadequate. Therefore, the study is argued that current ECISs do assess biodiversity implicitly in that they may contain habitat and species lists. However, a species list, which looks at species richness alone, is only one method of measuring biodiversity and does not address other fundamental aspects of biodiversity such as species abundance and distribution. An ECIA that only considers a species list of LNP is not thoroughly addressing biodiversity.

The latter is essential to ensure that policies / programmes and decisions in other areas, which are detrimental to biodiversity conservation, do not undermine achievements of specific biodiversity policy and programmes, etc. In light of this integration aim of the Biodiversity Convention it is essential that biodiversity considerations be dealt with explicitly in ECIAs to ensure that other issues do not erode their importance. Certain other countries including the Malaysia, Singapore and Brunei Darussalam have adopted the explicit treatment of biodiversity in ECIAs and have felt that this issue is of sufficient importance to warrant preparation of specific guidance. Explicit treatment of biodiversity in ECIAs should help counter challenges by NGOs that biodiversity issues have not been dealt with sufficiently. Biodiversity is not limited to the rare habitats and species but has a much wider focus (the variety of all life). Hence for ECISs to deal with biodiversity issues they should look not only at impacts on rare habitats and species but must also consider wider countryside issues such as impacts on non-protected areas and non-protected species.

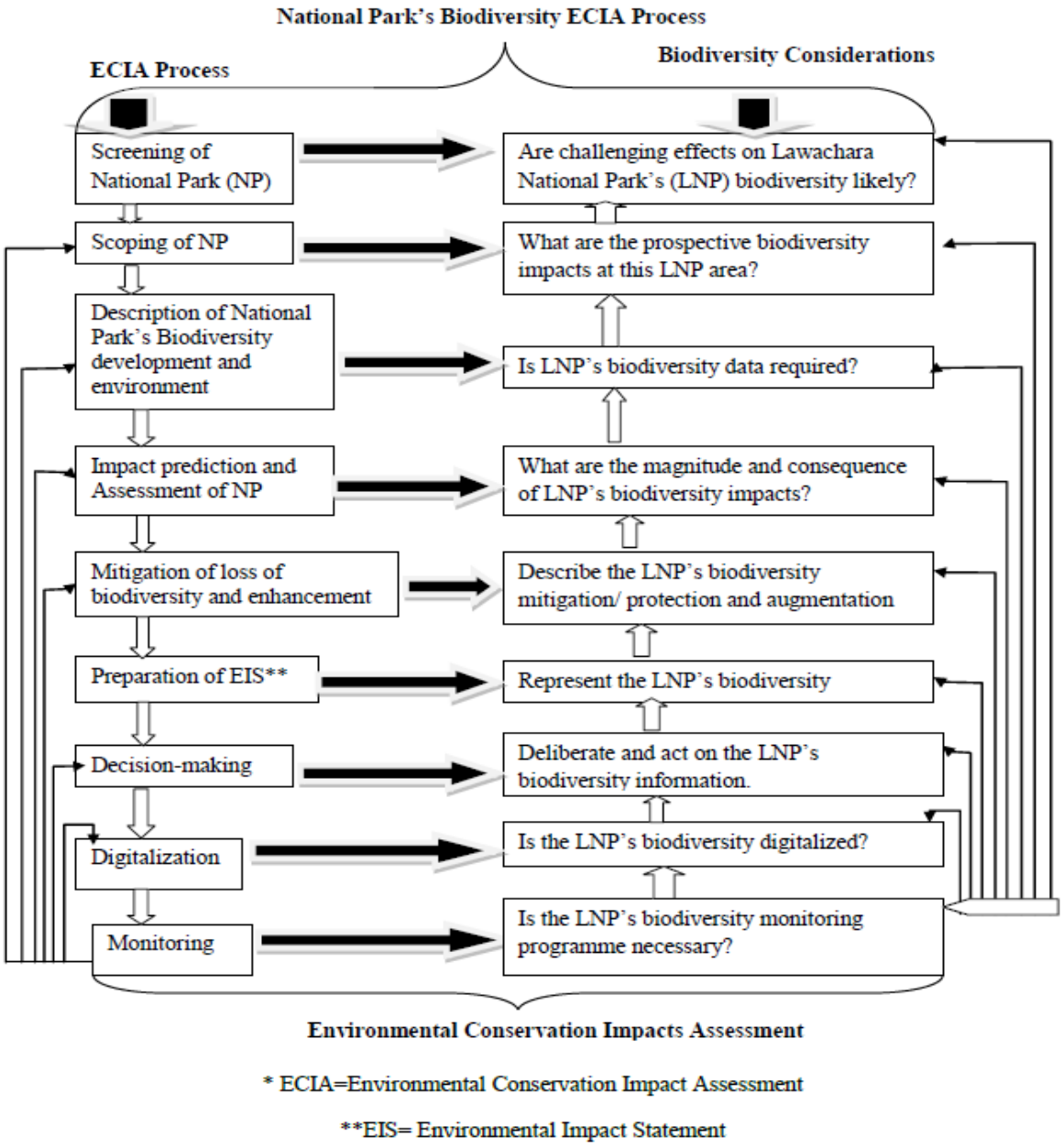


Figure 5.49: Methodology ties in to the ECIA process and National Park Communication

The issue of scale is closely related to issues of the wider countryside. Current ECISs tend to have a fine scale i.e. they concentrate on the immediate route of the proposed and pay very little attention to the context of this route in its wider environment— the ecosystem context of the proposed route and the biodiversity in this Lawachara National Park. The

control measure of vehicles to communicate LNP is essential for sustainable biodiversity conservation on the priority of Aichi Biodiversity Targets 2020 (Figure 5.50).

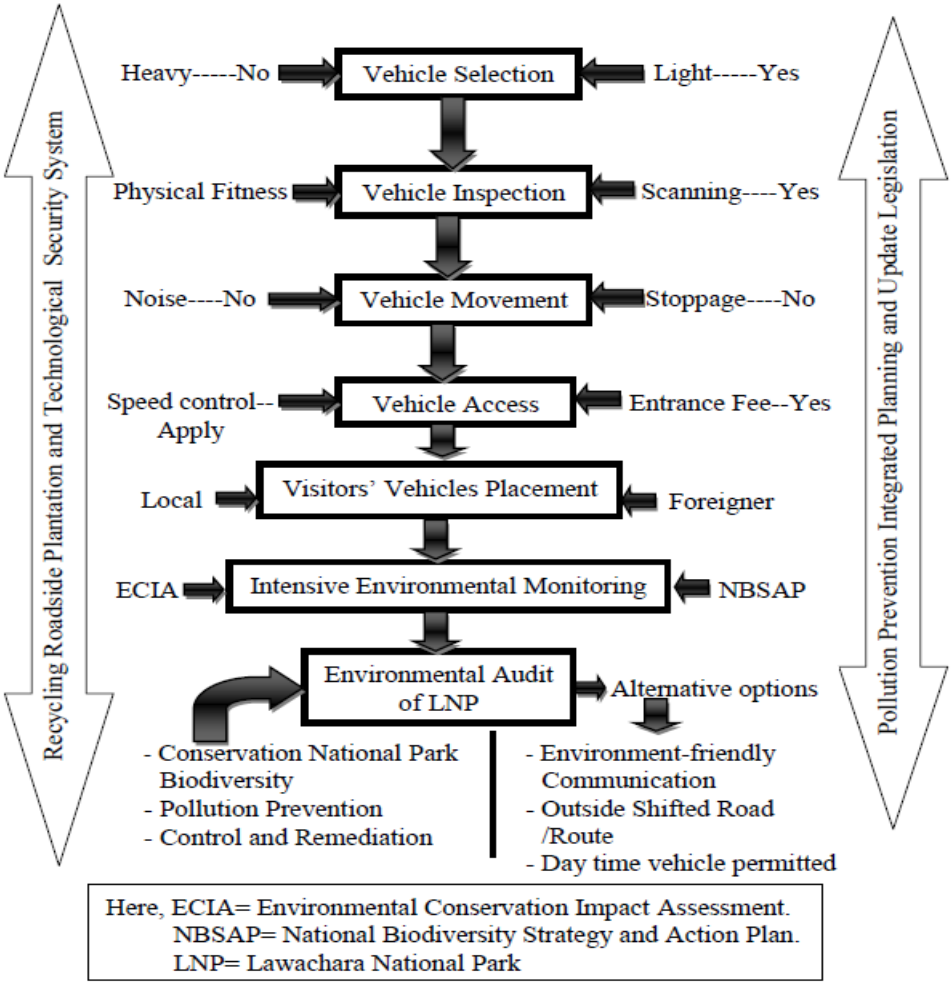


Figure 5.50: Control Measures of Vehicles to communicate National Park

5.10 Biodiversity Policy Integrated Logic Model for Lawachara National Park

The biodiversity policy integrated logic model is a universal model to enhance sustainable conservation towards Lawachara National Park (LNP). There are several components of this model, such as: (i) Different Parameters, (ii) Inputs, (iii) Processing, (iv) Outputs, (v) Targets Audience, and (vi) Outcomes leading to direct, intermediate and final towards impactness. There is a flow chart from parameters to final impact. For example: Targets (Aichi

Biodiversity Targets 2020) imput (national biodiversity data), the national focal point processed these data and send to CBD as a national report. The responsible of CBD checks these processed data with monitoring, analysis and evaluation on the priority of NBSAP targets actions and then try to find out its outcomes and future impact as a State Party of CBD.

From the Biodiversity Policy Logic Model, the study will get outcomes in three ways, such as, (i) Direct outcome, (ii) Intermediate outcome, and (iii) Final outcome. There are some characteristics which as shown in Figure 5.51. These are mentioned shortly as below: Direct outcome: (a) Biodiversity is mainstreamed in government policies, plans and programs at national and local levels, and (b) It is place-based planning and decision-making at multiple scales. Intermediate outcome: (1) Bangladesh has significant input to global assessments and influence on the global biodiversity agenda, and (2) Bangladesh meets its obligations under international biodiversity and genetic resources agreements. Final outcome: (a) Genetic resources and adaptive potential, and (b) Sustainable use of biological resources. From this logic model, five areas can be evaluated at LNP, such as, (a) LNP design evaluation, (b) species input evaluation through afforestation/reforestation programme, (c) monitoring process evaluation, (d) annual report as an output evaluation, and (e) outcome evaluation for impact identification. This logic model enhances to the conservation policy instruments through policy processes, policy enablings, policy enthusiastics and successing to achieve the impacts of sustainability. It is providing coordination and cross-cutting support, both nationally and globally for conservation of biodiversity initiatives (ECC, 2012).

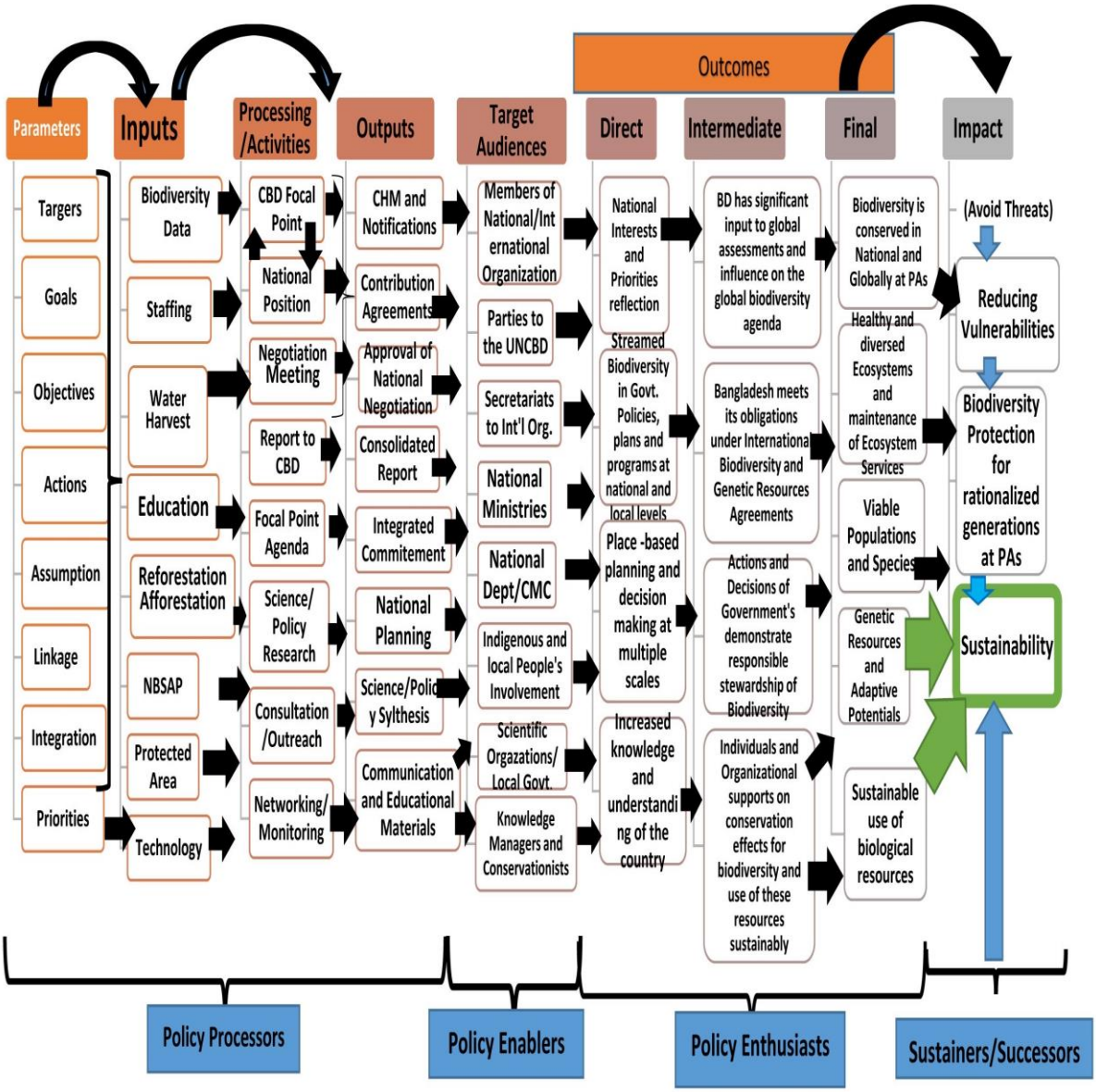


Figure 5.51: Biodiversity Policy Logic Model for Lawachara National Park (Source: Modified ECC, 2012).

5.11 Advocated Pre-Requisite Conservation Activities for Biodiversity Mainstreaming

Research on best management practices and valuation of environmental conservation services has augmented over the earlier era (Rose *et al.*, 2014). Yet, the perception of environmental conservation instruments is still not well implicit or familiar at the policy level in several areas of the world. Whereas envisioned to offer a more holistic interpretation of the value and functions of biodiversity conservation, policy-makers frequently recognise

the conception of environmental conservation services in largely abstract terms. Therefore, concentrated and directed awareness-raising and mainstreaming efforts are indispensable for both policy-makers and the broader public (Cowling *et al.*, 2008). Major challenges to mainstreaming environmental conservation services into public policy within national park management effort must safeguard tangible species and natural resources, along with visible information system advancements. Sometimes, species protection is sound categorised in laws and regulations, policies to support the bio-environmental dealings themselves are less common, as shown in Figure 5.52.

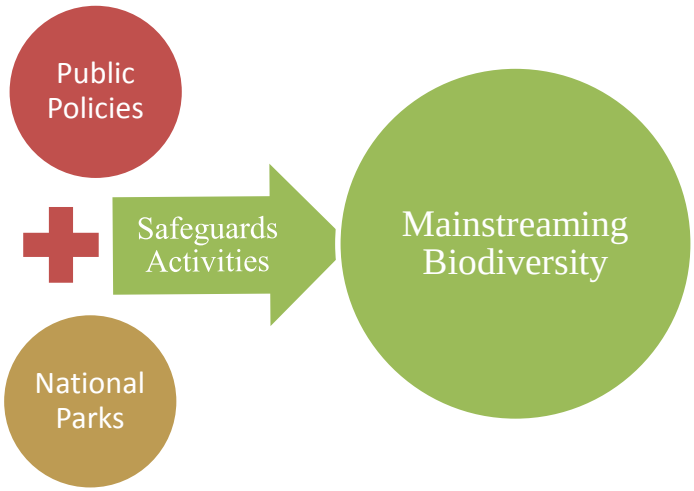


Figure 5.52: Mainstreaming Biodiversity towards Lawachara National Park

For example– legal protection for Endangered Species (Hooluk gibbon) through the International Convention on Trade in Endangered Species, or migratory species within the International Treaties on Migratory Birds, but such species are not constantly applicable to provision of specific biodiversity conservation systems. The purpose of this section is to afford deliberations for integrating the perception of environmental conservation services into decision-making various actions prior to policy outline can meaningfully develop the chances of effective assumption.

5.12 Dynamic Environmental Policy Instruments for Biodiversity Conservation

Lawachara National Park biodiversity consists of various instruments including natural resources, forest and environmental policy, invasive alien species, forestation, visitors, species protection and national park database, as shown in Figure 5.53. Policy Instruments assess with existing parameters for sustainable management of national park biodiversity. For these purposes, Government initives and stakeholders' engagement through applications of update technology are the major priority for effective conservation and protection of biodiversity. Government provides administration and technology, meanwhile stakeholders engage through co-management, team building and participation, i.e. no conflict among each other for national park biodiversity conservation and sustainable environmental management.

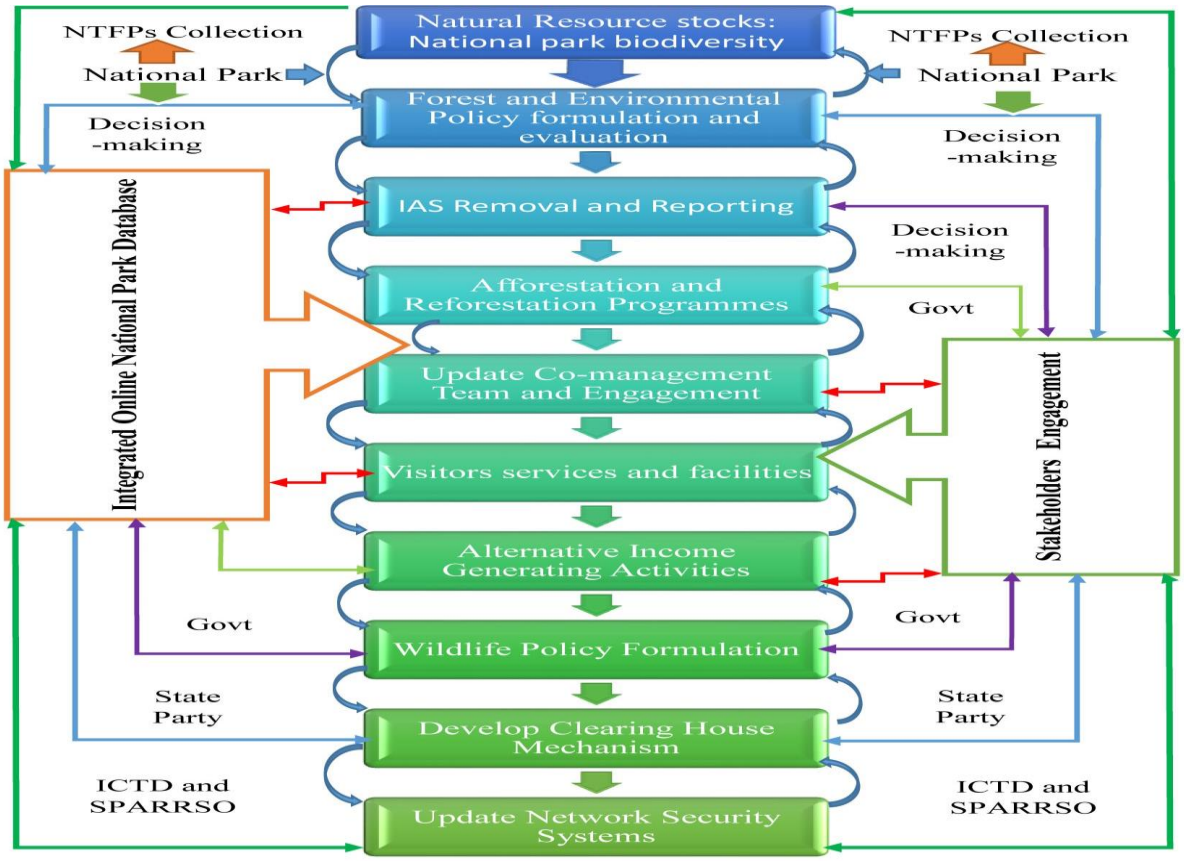


Figure 5.53: Dynamic Policy Instruments for conservation National Park Biodiversity

5.13 Improvement to the Wildlife Conservation and Security Act 2012

The Environmental Conservation Policy Instruments have become outdated on the wildlife habitat losses and in many cases, inappropriate (IPAC, 2012) on the priority of political commitment and global agreements. However, the Wildlife Conservation and Security (WCS) Act 2012 is the latest as well as pioneer revision of conservation law in Bangladesh. From the result, it was shown that the law has a comparative advantage against other conservation laws in Bangladesh and South-south-east Asian region. However, several improvements could be included in the WCS to make it effective implemented and enforced. These are mentioned as below:

(a) The WCS Act and Forest Act are the provisions for nature conservation for the present and future citizens in Bangladesh, which allow the local and indigenous communities to freely involvement for the development with specific part of forest areas. It might be better to integrate both protected areas and reserved forests into national park on the priority of Aichi Biodiversity Targets 2020. In addition, the Act should explicitly describe the functions on national park, wildlife sanctuary, botanical garden, eco-park, safari park, special conservation and community areas. This could augment the protection of biodiversity by obligatory the loyalty of forestry organizations to accomplish the national park according to the functions with access benefit sharing provided by this Act.

(b) The WCS Act 2012 has no Section for the protection of undergrowth species, which is a part of biodiversity of national park. These species contribute the enhancement of soil surface and vegetation structure with nutrient recycles. This could enhance the protection of national park biodiversity according to the requirements of Convention on Biological Diversity (CBD).

(c) The WCS Act 2012 has no a single section for the development of national park biodiversity database on the priority of biodiversity clearing house mechanism (BCHM) of CBD. The BCHM is the system of exchange information among of all state parties according to the constitutional requirements of CBD. Till to date, Bangladesh has not effective national park biodiversity database in connection with CBD. But the Government of Bangladesh has taken initiatives for it, meanwhile she declared as "digital Bangladesh" with its vision 2020. The BCHM could enhance the biodiversity informatics of national park resources to share information of each state party as well as sending nation biodiversity reports to CBD.

(d) The WCS Act 2012 included the collaborative management system for protection of national park resources. It is good Section to involve the various stakeholders. But the Section could not mention specifically some stakeholders, such as: indigenous community leader, sawmill licensee, brick manufacturer, tea estate manager, and academic researcher, manager of green banking performed activities, rain water harvester, forest nursery manager, betel-leaf cultivator, home gardener, social forester, pesticide entrepreneur and environmental educationists. It might be better including them that could be enhancing the protection of national park biodiversity. For example, the Iban have been settled in and around the Batang Ai National Park at Sarawak in Malaysia. They have historically played a major role in orang utan conservation as they have a strict taboo against harming these animals; some group believe these animals are inhabited by the soul of departed ancestors (SF, 2016).

(e) The advancement towards national park biodiversity management and multiple use of park resources shall take leading indication. However, these phenomena are augmenting attentiveness and prerequisite for the national park to be achieved sustainably, as it is dynamic means of natural resources in preventing environmental catastrophe and climate

change. Amid this, it is surprising that the WCS 2012 has not include a single Section or Article on these issues, excluding a nebulous provision for formation of rules on the obligation for national park management and restoration of NBSAP as well as means to take advantage of ecosystem services. Hence, it is imperative for the provision on sustainable management, multiple uses of parks to be incorporated in this WCS Act. At the same time, the proposed improvement Act should recognize the importance of public participation and education in order to increase the effective enforcement of this Act, and inculcate the responsibilities in protection of national park resources in the country. In addition, the improving legislation intends to harmonise national park biodiversity conservation laws and policies. The objectives of improving WCS Act 2012 are prioritised six main aspects, such as:

(i) Conserving biodiversity – Constitutional Rights (Article 18A).

(ii) Enhancing productivity and functionality of the National Park Ecosystem

(iii) Safeguarding variety, i.e. beauty and recreational value of National Park.

(iv) Access Benefit and Sharing (ABS) in connection with CBD's objectives.

(v) Application of digital conservation technology on the priority of BCHM, e.g. National Park database, Monitoring database, Tourist database.

(vi) Scientific Policy for Removal of Invasive Alien Species in connection with ABT.

From Table 5.13, the study observed that only 36% 'In general' and 64% 'Not mention'. Therefore, the existing law needs to improve. Moreover, from the desktop observation, the existing conservation related laws and policies contain some evaluation gaps (Mickwitz, 2003) for sustainable biodiversity conservation in connection with Sustainable Development Goals 2030. In addition, Bangladesh requires a comprehensive biodiversity law in response to the UN Convention on Biological Diversity (CBD), which embraces the three objectives

of the CBD, (a) conservation of biodiversity, (b) sustainable use of resources, and the fair and equitable sharing of the benefits from the utilization of genetic resources to satisfy the needs of present and upcoming generations on the priority of intra-inter generational equity.

Table 5.13: Criteria and Policy Improvement Gaps

Criteria	Relevant gaps	Remark
Effectiveness	To what degree do the achieved outcomes correspond to the intended goals in connection with NBSAP?	In general
Attractiveness	Does the law attract to the civil society as for political commitment?	Not mention
Efficiency (cost effectiveness)	Does the law justify the Acees Benefit Sharing applied?	Not mention
Update	Does the law formulate recently for national conservation administration?	In general
Dynamic legitimacy	To what degree do individuals and organizations, particularly non-governmental organisations (NGOs), interest organisations and industries accept the law for dynamic conservation activities?	Not mention
Transparency	To what degree are the outputs, outcomes of the conservation policy, and processes used in the implementation observable for donors and outsiders?	Not mention
Equity	How are the outcomes and costs of national park's environmental conservation distributed?	Not mention
Predictability	Does the law make the output rather predicatble in practice?	Not mention
Relevance / Separate	Does the law separate for biodiversity conservation?	Not mention
Impactness	Is it possible to identify impactness that is clearly due to the conservation policy and their implementation?	Not mention
Persistence	Are the effects persistent in such a way that the law has a lasting effect on the country of national park environment?	Not mention
Flexibility	Can the law cope with changing national park's condition?	In general
Enforcement	Does the law enforce/misuse positively to the society?	In general
Connectivity	Does the law properly match with regional and global biodiversity connectivity corridor?	In general

(Source: Modified Mickwitz, 2003)

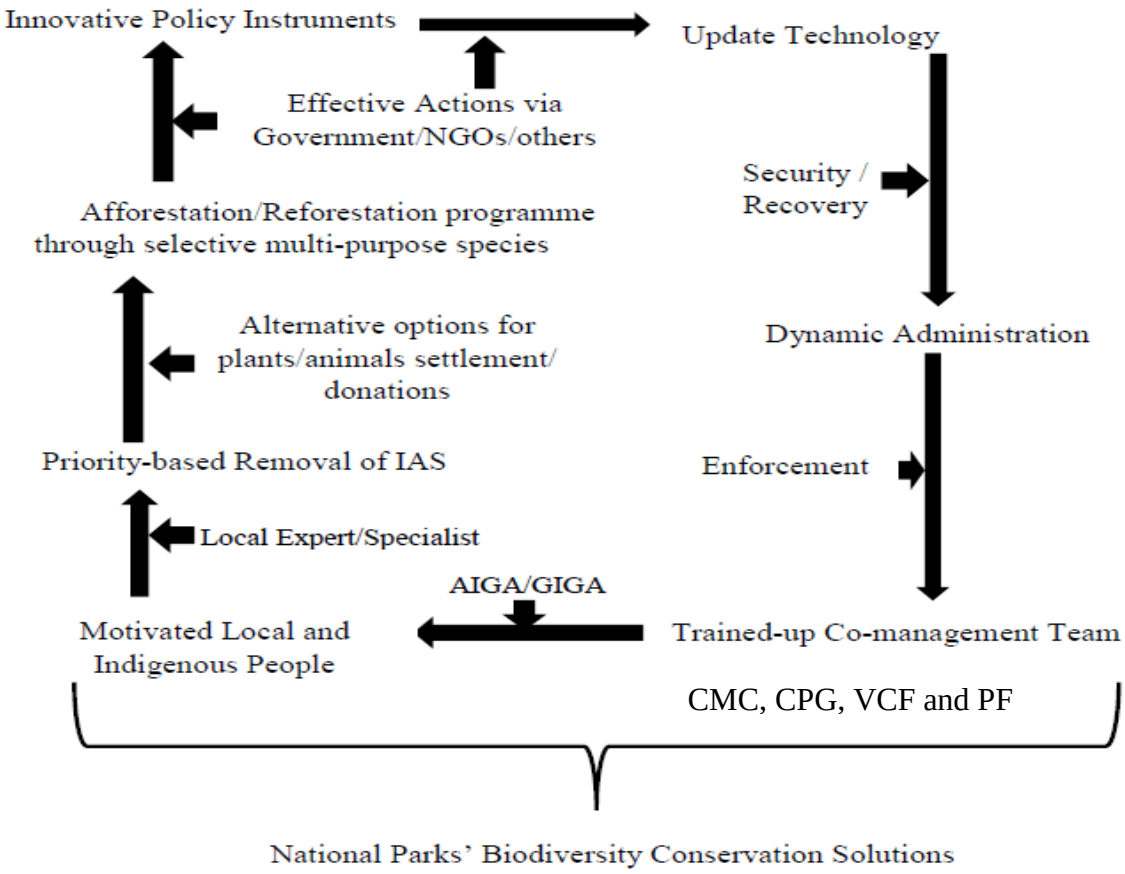
As a ratified country of CBD, Bangladesh Biodiversity law connects with national, regional and global laws interlinks with CBD, RAMSAR, CITES, IUCN, APAP, Green List, IPR and pertinent organizations.

From the field survey, the 56% of the respondents opined their opinions as 'inadequate'. Besides, according to Section 14 (f) of the WCS Act 2012 stated that 'no person shall disturb or threat any wildlife, which may destroy its habitat. From the field observations, opinions of Focus Group Discussion and Key Informant Interviews, the existing running railway is hampered to the growth and development of Lawachara National Park's wildlife. The whistle of Train could be disturbed on genetic biodiversity, particularly leaf flashing, germinating, flowering, fruiting and breeding period. Section 21 of the WCS Act 2012 stated that the introduction of co-management system for proper utilization, conservation and management of natural resources of the national park involving forest department, minor ethnic community, local community on participatory basis to ensure active participation of the parties therein. Nevertheless, the Section 21 did not mention on the connection of Co-management Committee between Village Conservation Forum, Community Partol Group and People's Forum—that stated in the Protected Areas Management Rules 2017. Overall, the existing law needs to improve.

5.14 Bottlenecks and Lawachara National Park Conservation Solution

From the study, it is identified that policy assessment framework helps to progress the superiority and consistency of the strategic advancement practice, and well participate Lawachara National Park biological diversity concerns. These all, perform by demanding the documentation of the probable confident and adverse effects of diverse potential policy strategic activities (for example: NBSAP), permitting well-versed rigid decisions to be

completed connecting the proposition and recognise adjustments in realising challenging ideas. This consents for policy-makers develop their choices on the base of enhanced evidence. Well-versed policy-making could evidently lead to effective decisions (TEEB, 2011). For this purpose, it is necessary innovative policy instrument with update technology for dynamic administrative body, which provided the trained-up co-management team for motivated local and indigenous people by them.



Here, CMC=Co-management Committee, CPG= Community Patrol Group, VCF= Village Conservation Forum, PF=People's Forum, IAS= Invasive Alien Species, AIGA= Alternative Income Generating Activities, GIGA= Green Income Generating Activities

Figure 5.54: Lawachara National Park Conservation Solution

These all members including local experts took initiatives for removal of invasive alien species from national parks. Then, the authority set-up new multipurpose species through

afforestation or reforestation programmes with effective actions, which as shown in Figure 5.54. These actions included monitoring, evaluation, feedback meeting and dissemination. At national and divisional levels, the solution will be more or less the same. In general, all identified problems can not be resolved by state government. Occasionally, policy-science and technology can support to advance environmental values and to motivate novelties in biodiversity, agricultural, corporate or other relevant departments. Methodological resolutions can contribute to effective advancements, particularly selected areas, such as: remote area and /or dense population zone, core zone or declared corridor zone. It is mentioned that the Wildlife Management and Nature Conservation Division has sent a proposal to the higher authories of Government of Bangladesh for shifting the Bhanugachh –Kamalganj –Srimangal railway route and vehicle road outside the park (SOD, 2016).

5.15 Lawachara National Park Biodiversity Management Model

Lawachara National Park Management is the tasks with overall management of its status of flora, fauna, biological environment and physical co-factors. National park is a research think-tank like a university. Therefore, its biodiversity management is essential. There are some indicators to enhance development of the national park biodiversity model. These showed in Figure 5.55 including some parameters of national park, environment, biodiversity, policy, administration, visitors and relevant others fauna. These are:

(i) Historical stress including over human population pressures, illegal logging, encroachment and NTFPs excessive collection;

(ii) Active stress including over-exploitation, agricultural land expantion and environmental issues;

(iii) Control habitat including boundary demarcation, harvest control, digital conservation and enforcement;

(iv) Control resource uses including co-management for harvest control, sustainable harvesting, develop alternative income generating activities or green income generating activities,

(v) Control environment in catchment,

(vi) Biodiversity conservation including ecosystem conservation, habitat conservation and species population conservation,

(vii) Recreational potentials including local and indigenous communities' involvement,

(viii) Ecotourism activities,

(ix) National park databases including floral database, database and visitor's databases,

(x) Biodiversity experts including national, global and technological experts– particularly group decision support systems,

(xi) Monitoring information systems,

(xii) Policy reforms and sectoral integration,

(xiii) Research and publications,

(xiv) Capacity building,

(xv) Effective Administration,

(xvi) Inspections and transparency,

(xvii) Park systems, and

(xviii) Evaluation and decision-making.

This model enhances national park biodiversity management effectively connecting with state parties and CBD for the present and upcoming generations. Previous research stated

that this LNP was niche as the home for wildlife, particularly for Hoolock hoolock (Islam *et al*., 2006, 2007 and 2011).

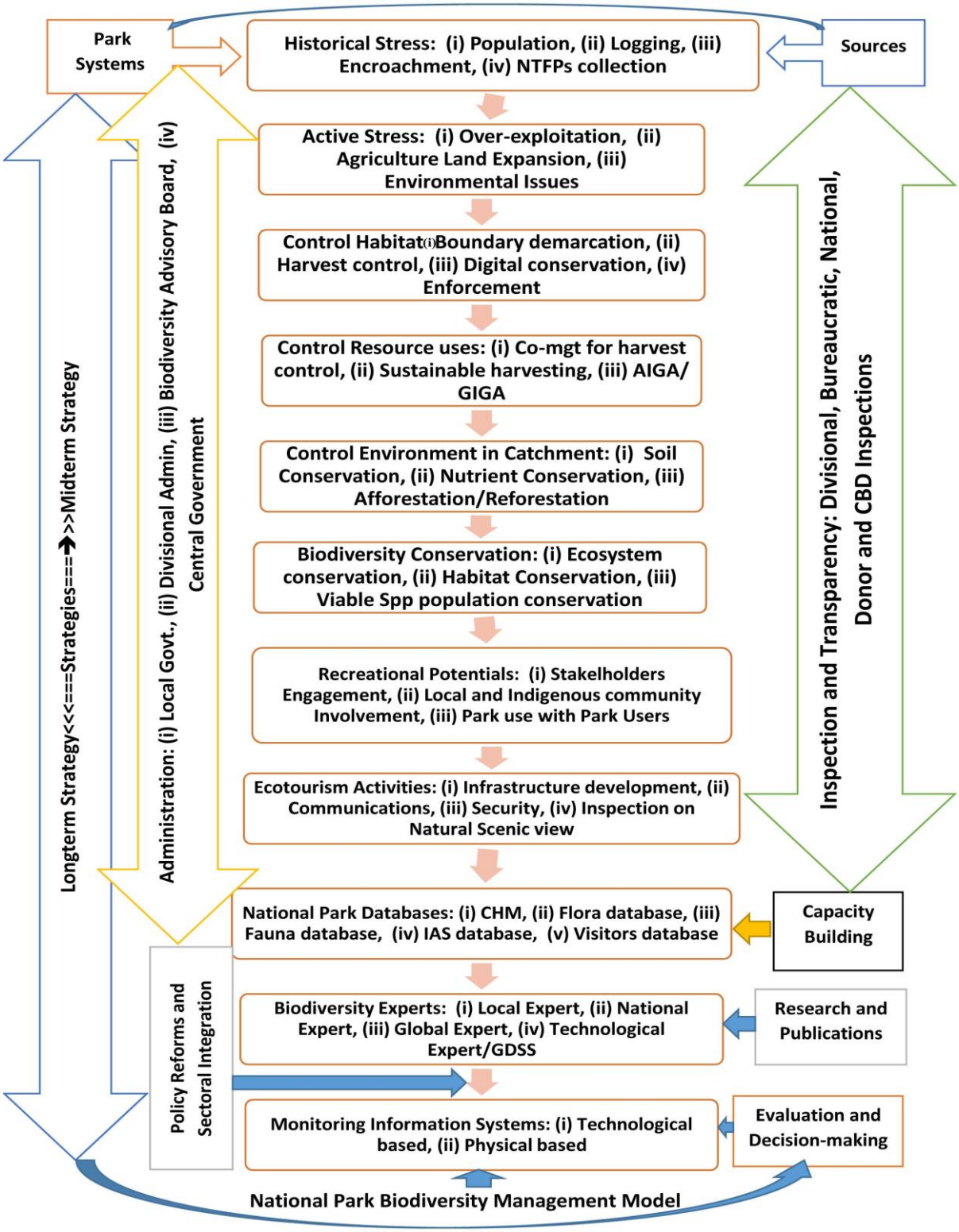


Figure 5.55: Lawachara National Park Biodiversity Management Model

However, the key areas of focus for the stated model included: (a) National park biodiversity conservation policy, (b) Partnership with the Convention on Biological Diversity, (c) Bangladeshis National Conservation Strategy, (d) The Genetic Resources Policy related to Access and Benefit Sharing (ABS), (e) National Biodiversity Monitoring and Reporting Systems. All these parameters are connected with plant species, wildlife, and park land and its management. Some species are at this time endangered gradually as well as their natural habitation in jeopardy. Forest Department takes initiatives to halt hankering on natural resources with the cooperation of Nishorgo Support Project (NSP) through co-management system. Conversely, such recompense was virtually exposed insufficient effects in the park. Illicit-tree felling has been augment pervasively in the LNP, which tends to unfluctuating rather large. While these incidences are predominantly recognized to insufficient trained-up staff, lack of conservational technology and paraphernalia. Besides, Bureaucratic procrastination on decision-making, as well as self-indulgence and delicate self-esteem of the park administration remains also questionable in these trepidations (Islam *et al*., 2004).

However, the study discussed on the results of policy instrumental models using information systems to evaluate the perception of stakeholders, growth of national parks distribution, development of national strategic plan and biodiversity clearing house mechanism. Research findings augmented the stakeholders' perception for conservation of biodiversity towards national park in the period of 2010 to 2016, when relevant policies are more in number than the previous one. On the other hand, growth of national parks also increases within this period. The findings of this research have a great scope for biodiversity conservation to compare with other State Parties of CBD. Thus the findings demonstrate that successfully achieved the mentioned objectives of this research.

5.16 DPSIR Framework of Lawachara National Park

The DPSIR framework is an effective and simple framework for illustrating National Park based biodiversity conservation and management. From the study, it is identified that DPSIR framework shows the different parameters of Lawachara National Park including driving forces, pressures, state, impacts and responses, which as shown in Figure 5.56.

Relating large –scale drivers of the change (increase in population and human activity) to the pressures they exert (domestic grazing, illegal logging and deforestation) which cause changes in the State (socio-cultural status) of the Lawachara National Park environment (e.g. habitat degradation and land encroachment) resulting in impacts on biodiversity, human well-being and socio-economics (wildlife habitat destruction), there by leading to institutional (e.g. Bangladesh Forest Department) response, policy, technology and target setting measures (for example, reforestation).

The study on environmental conservation and national park biodiversity was done to recognise the major cause and effect relationship of socio-economic and environmental factors. In this context, DPSIR approach was used to deliver and connect conservation knowledge on the social status and change the causal factors related environmental conservation policy instruments on national park biodiversity management. A total of 58 indicators were organised according to the DPSIR framework where as 32 indicators were adopted from LNP management plan, and the remaining were arranged by an interactive discussion with different actors of LNP. These actors were LNP administration, co-management team, local and global NGOs officials, member of FGD, Government officials, academia, tourists, scientists, lawyer and researchers. The indicators were used to evaluate the current NBSAP and alternative conservation management strategies with regards to the period of 2021 and 2030. This is mentioned that concern of update national park

management plan in connection with NBSAP would be useful for the sustainable biodiversity management of Lawachara National Park.

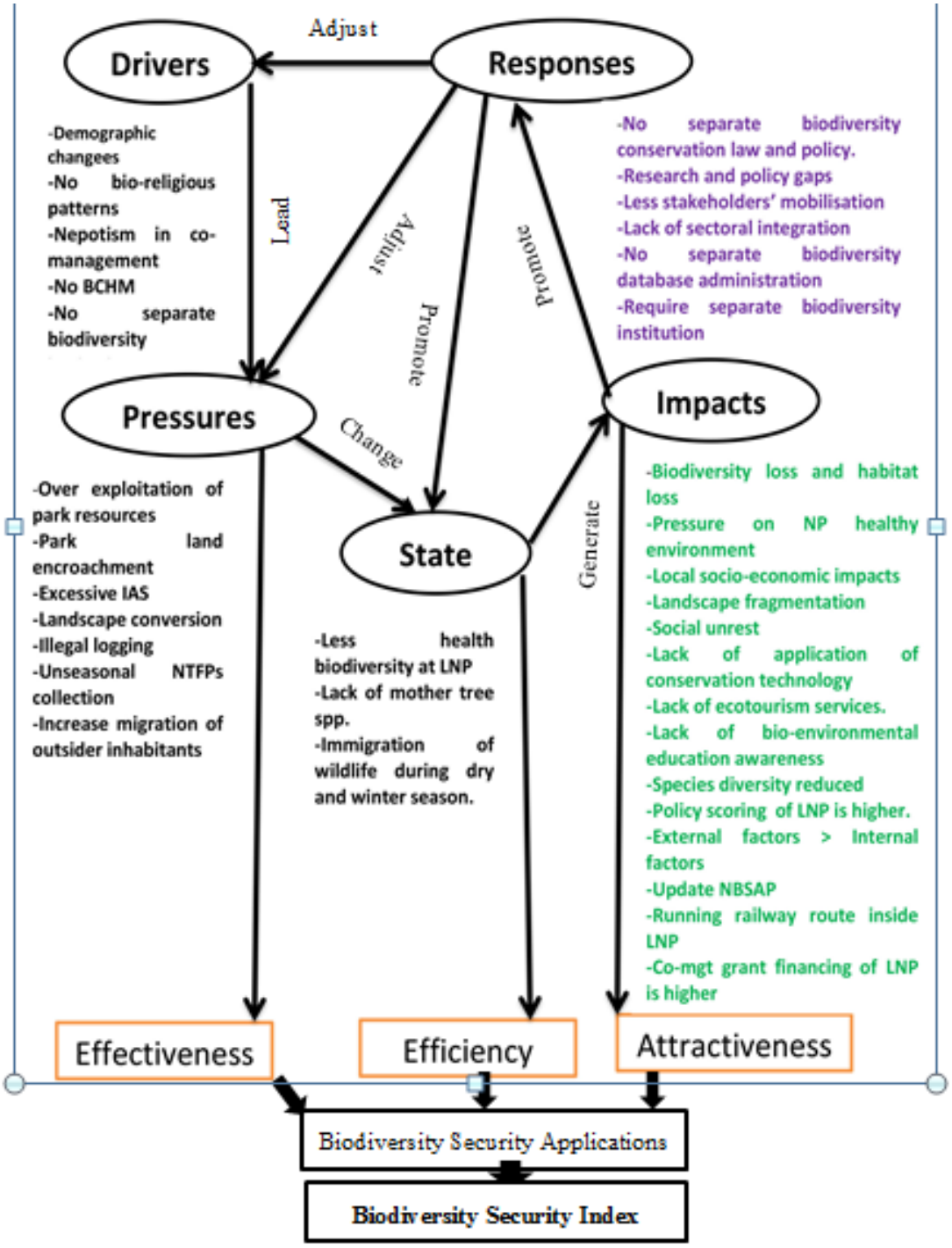


Figure 5.56: DPSIR Framework of Lawachara National Park

5.17 Establish Biodiversity Information Management System Model

Biodiversity, information and technology are interlinked among each other towards digital conservation. For this purpose, diverse sectors / departments are working within the countryside surrounding the Lawachara National Park (LNP) within special responsibilities for accumulating biodiversity information for decision-making based on the information they assemble themselves or get from the different relevant sources. This collected information enhances sharing through biodiversity information management system and national biodiversity clearing house mechanism (BCHM). At present there is an absence of an efficient biodiversity information management system that collects and shares information at national, regional and global perspectives. In its absence, staffs of government and non-governmental organizations spend a significant amount of their time gathering information on an individual source through dialogue and negotiations, or formal / informal get-together. This unstructured collection of information exchange is essential for building scientific work communication. However, it cannot be measured sufficient for acquiring and continuing a general idea of all applicable features that the stakeholder particularly desires to recognize about to do their efforts professionally.

Moreover, these considerations and integrations can obtain up a huge of time. Confident prearranged form of biodiversity information exchange and documentations are expected to advance sectors / departments competence throughout complementing and supplementing instantly verbal communication between individuals and organizations. Setting-up this additional information management system model well-organized information exchange will allocate a harmonized monitoring of environmental instruments that clinches responsibilities of numerous stakeholder institutions. This is what the research tries to establish information management systems through a biodiversity monitoring database. The

major purposes of the anticipated information management system are to assist national park managers of the forest department and other sectors in accomplishing their goals by sustaining their decision-making and strategic planning processes, particularly Lawachara National Park's biodiversity information management systems in all ways: vertical, horizontal and tangentially reporting communication.

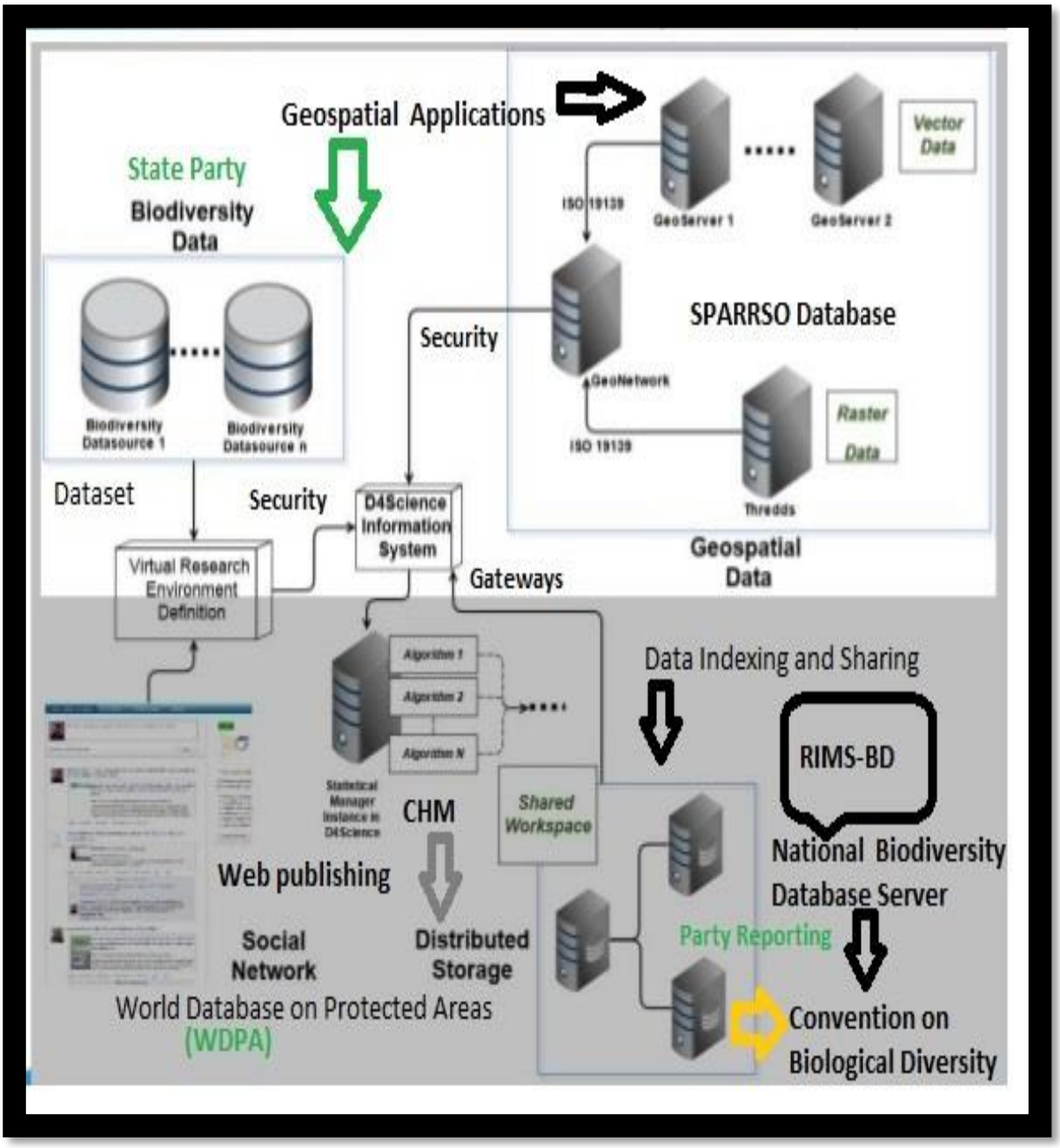


Figure 5.57: National Biodiversity Information Management System Model

The reporting outputs of the biodiversity monitoring systems are intended to be simply understandable to all people occupied, from the field level up to the decision-makers at country level. Valuable and resourceful information management system is accomplished if the data composed are turned into information and knowledge, which then assists the accomplishment of the goals setting by the Government of Bangladesh for the biodiversity conservation management of Lawachara National Park. National Park Managers work on to Aichi Biodiversity Targets (ABT) that are set within National Biodiversity Strategic and Action Plan (NBSAP), and which in the existing case are detailed within the Integrated Management Plan for LNP. The function of this information management system is to steer organization involvement and report on the success of administrative interventions helpful, such as:

(a) generally, the biodiversity data will give an evaluation of the overall 'health' of the national park's ecosystem with effective sign of changes in environmental instruments that may have consequences for the forestry sector or for human population of the LNP landscape,

(b) Overall biodiversity monitoring data also represent information on Bangladesh performance of International Conventions /Agreements, such as– Convention on Biological

Diversity (CBD), RAMSAR, as well as Government contributions to national programmes and biodiversity conservation targets. From the study on national biodiversity clearing house mechanism, Government of Bangladesh should to establish the information management system model, which as shown in Figure 5.57 on the requirements of CBD. This model is proposed for biodiversity clearing house mechanism, which connects with CBD, WDPA, SPARRSO, RIMS, Social Media and Global Navigation Satellite Systems.

5.18 Roadmap in the Scenario Planning for Biodiversity Conservation

Roadmap in the Scenarion planning for biodiversity conservation is a popular and flexible tool used to inform integrated national park biodiversity protection. Because biodiversity conservation decisions making about who, how, when, where and for whom to act are typically based on our expectations (Butler *et al*., 2015) for the present and future generations. When the world is highly unpredictable and we are working from a limited range of expectations, however, our expectations will frequently be proved wrong. Moreover, the roadmap expectations consist of four parameters with stipulated timeframes, which are listed as follows:

(i) Challenges (ii) Actions

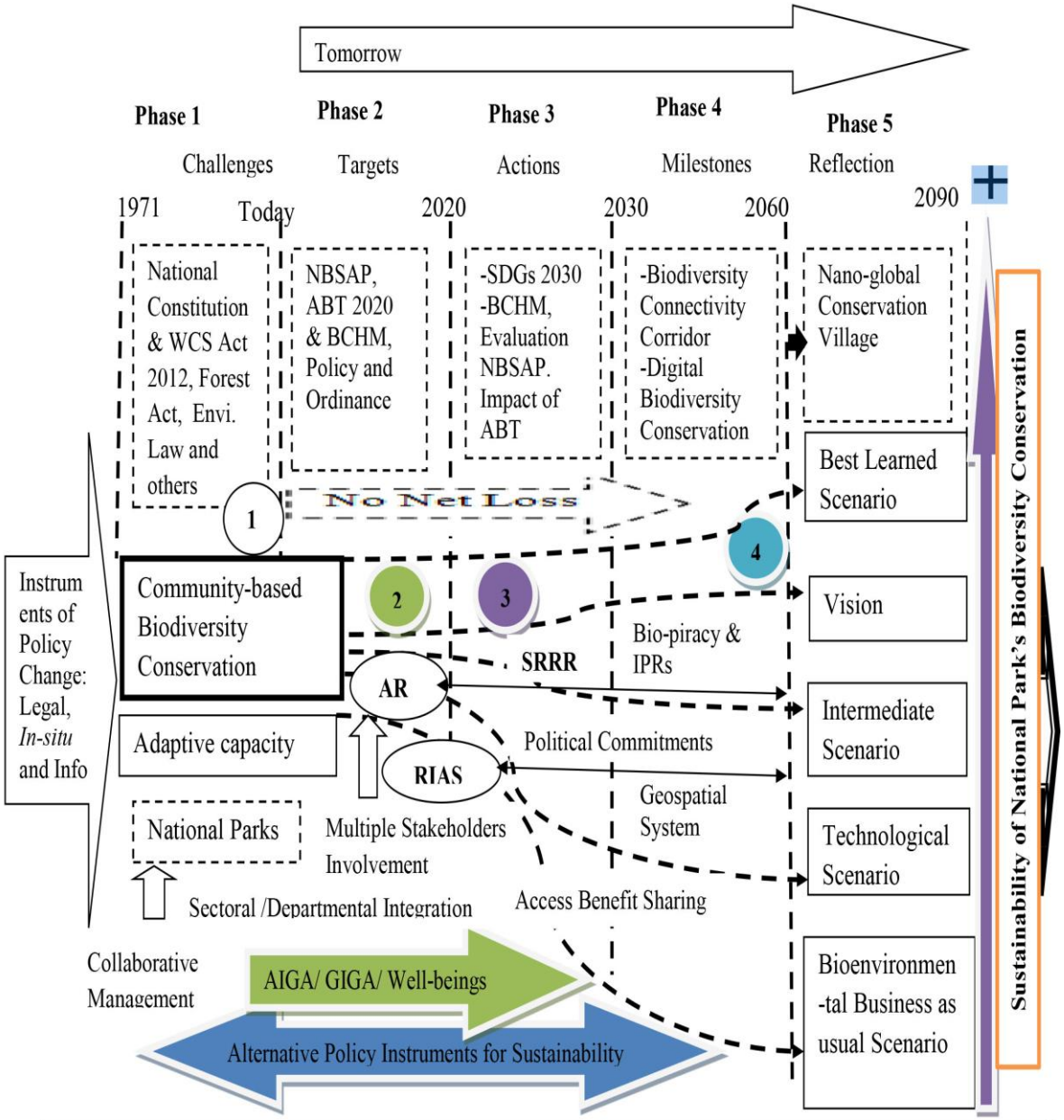
(iii) Targets (iv) Milestones

The scenario planning relates with conservation policy instruments (e.g. legal, *in-situ* and informational instruments) for community-based biodiversity conservation towards National Parks in Bangladesh. The mentioned questions in Table 5.14 are interlinked with the scenario planning, which offers a framework for developing more resilient conservation policies when faced with uncontrollable, irreducible uncertainty. A scenario in this context is an account of a plausible future. It consists of using a few contrasting scenarios to explore uncertainty surrounding the future consequences of a decision (e.g. modified present laws and policies for sustainable biodiversity conservation with best learned scenarios). Because, it can incorporate a variety of quantitative and qualitative information for National Park Biodiversity Conservation with decision-making processes, except considerations of this diverse information in a systematic way leads to better decisions. It has five phases consisting of four relevant questions in Table 5.14.

Table 5.14: Response on Scenario Planning.

	Scenarios related questions	Response from the study	Remarks
i.	Are the existing policy instruments for conserving of biodiversity towards National Park (NP) adequate?	No	Need to improve
ii.	How effective are the implementations of environmental policy instruments concerning biodiversity conservation in the NP of Bangladesh context?	Multiple/ Diverse ways	Stakeholder's involvement
iii.	How the values of diverse stakeholders are interlinked in biodiversity information systems tools in the studied NP area?	Digital Conservation	BCHM
Iv.	Can the Wildlife Conservation and Security Act 2012 be improved further as a conservation instrument for NP biodiversity protection on the desired future?	Yes	Political commitment

From the study observation, the Wildlife Management and Nature Conservation Division, Ministry of Environment and Forests, Government of People's Republic of Bangladesh stressed the need for finding a more effective solution to prevent illegal logging and unwanted dealth of wild animals (SOD, 2016). For this purpose, the scenario planning for national park biodiversity conservation enhances the relevant solution, which as shown in Figure 5.58. The scenario planning derived from the qualitative approach to share many features (Wack, 1985a; Millet, 1988; Schoemaker, 1991 & 1995; Bunn and Salo, 1993; May, 1996; Van der Heijden, 1996; Bossel, 1998; Ringland, 1998; Wollenberg *et al*., 2000).



1. Are the existing policy instruments for conserving biodiversity towards National Park (NP) adequate?
2. How effective are the implementations of environmental policy instruments concerning biodiversity conservation in the NP of Bangladesh context?
3. How the values of diverse stakeholders are interlinked in biodiversity information systems tools in the studied NP area?
4. Can the Wildlife Conservation and Security Act 2012 be improved further as a conservation instrument for national park biodiversity protection on the desired future?

SRRR=> Shifting Railway route and vehicle road from park inside, **AR**=>Afforestation /Reforestation Programme; **RIAS**=> Removal of Invasive Alien Species; **IPR**=. Intellectual Property Rights; **AIGA**=> Alternative Income Generation Activities; **GIGA**=> Green Income Generation Activities; **WCS** => Wildlife Conservation and Security Act; **NBSAP**=> National Biodiversity Strategy and Action Plan; **BCHM**=> Biodiversity Clearing House Mechanism; **SDGs**=> Sustainable Development Goals;

Figure 5.58: Roadmap in the Scenarios Planning for Biodiversity Conservation

For examples:

(a) Reforestation programme at Lawachara National Park (LNP),

(b) Removal of Invasive Alien Species programme,

(c) Shifting railway route and vehicle road from inside LNP,

(d) Integrated Online National Parks Database in connection with WDPA,

(e) Biodiversity monitoring systems by co-management team.

Furthermore, another participation of a diverse focus group of people in a systematic process of data collecting, discussing and analysing scenarios builds shared understanding. The study discussed from community's business perspectives in connection with future well-being (e.g. alternative income generating activities / green income generating activities), so far reduction of dependency of them on national parks. For optimal control, adaptive management may be appropriate responses (Peterson *et al*., 2003).

5.19 Environmental Conservation Model Sensitivity and Uncertainty

Environmental Conservation models are the key way that has to assessment the multiple effects of alternative tools design and operating policies on National Parks' Biodiversity Management. However, the effectiveness of these conservation models depends in part on the accuracy and consistency of its outputs. Because all environmental conservation models are imperfect ideas of certainty and precise input, conservation data are infrequently if constantly available, all output conservation values are subject to fuzziness. Input conservation data errors and modelling uncertainties are not self-governing of each other, when they can interrelate in several ways. The completion result is imprecision and uncertainty connected with conservation model outputs.

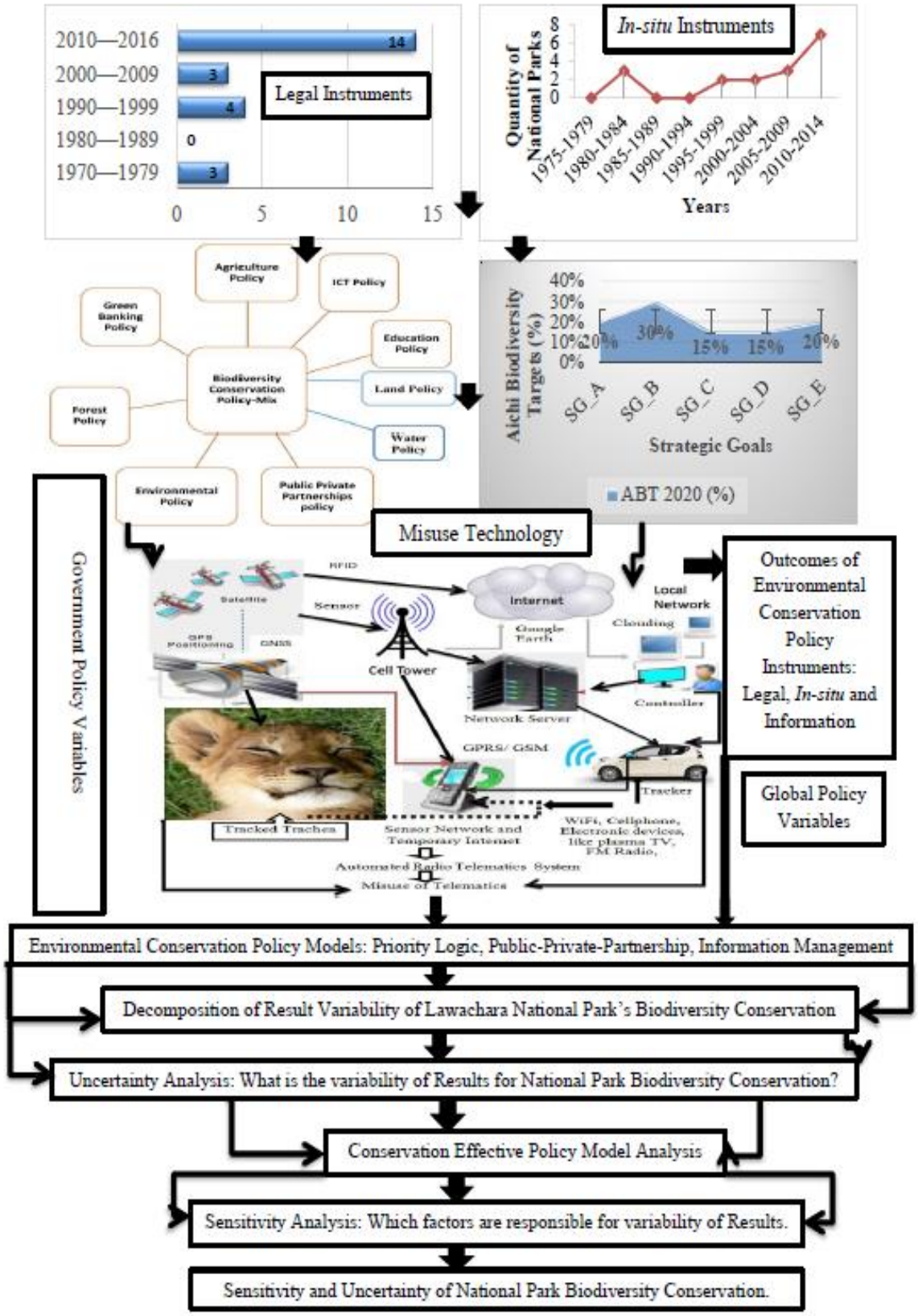


Figure 5.59: Uncertainty and Sensitivity analyses of model output (Source: Modified Ligmann-Zeilinska *et al*., 2014)

This model analysis is an important way to summerise detailed biological information and it is a way of information product that used to inform the local level decision-making process, which indicated on environmental conservation model as sensitivity and uncertainty. The Environmental Conservation Models are sensitivity and uncertainty depending variability of results and decomposition of results including conservation policy analysis and improvement of Wildlife Conservation and Security (WCS) Act 2012, declaration of new National Park and development of Biodiversity Clearing Mechanism and relevant scientific conservation instruments according to political commitment. Instrument-based conservation models (IBCMs) have been broadly used to study bio-environmental conservation systems on national parks. They are functional for researching such systems because of their capability to integrate micro-level behaviors among interrelating instruments, and to recognise evolving occurences due to these collaborations. Moreover, IBCMs are naturally stochastic and make suitable conducting of uncertainty.

The study suggests a simulation framework established on quantative uncertainty and sensitivity analyses to build cost-effective IBCMs that perform on (i) assessment of the outcome conservation area to replicate low-probability except high consequence activities that may have meaningful biodiversity policy implications, and (ii) justification of model environment to illustrate the conservation system with higher accuracy. The anticipated conservation policy framework is applied to the predicament of modeling national park conservation stemming in applicable policy improvement and update conservation technology adoptions. The study occupies output variance disintegration based on quasi-random selection of the input area and perform three environmental conservation policy instruments, such as legal, *in-situ* and information (Figure 5.59). The study represents uncertainty analysis to improve conservation model environmental legitimacy, where the

national park distribution of results apprises us about the anticipated value that can be legalised against separate biodiversity data, and delivers national park biodiversity information on the variance nearly this mean in addition to the ultimate results. There are some models input data and factors used in IBCMs, such as auxiliary resources including species diversity of national park, existing policies, spatial spectrum signature, stakeholders' involvement, focus group discussion, environmental benefit index and performance index, land use/land cover, rain water harvesting, green banking initiatives, co-management committee and grant financing, ecotourism services and biodiversity clearing house mechanism.

The study retains conservation sensitivity analysis to make on park distribution and digital conservation of the rest of IBCMs. First, input park area is reduced only to inputs that generates the anthropogenic variance of the identified IBCMs, resulting in a conservation model with output reforestation similar to the preliminary national park model. Second, we enhance the value of the clearing house mechanism input, giving a conservation system model that maintains the mean of the output of the opening IBCMs but with less data coverage. These simplications can be expended to (i) ecologically explore conservation model outcomes incorporating externalities of Lawachara National Park that may be significant reflections in the design of robust conservation policies, and (ii) perform descriptive policy analysis that represents the lowest number of inputs motivating the secure national park management objectives of the modeled conservation system in Bangladesh.

Overall, it is decided the existing conservation policy instruments are not adequate properly for conserving of national park biodiversity, particularly at Lawachara National Park at Sylhet division in Bangladesh. For this reason, it is necessary to improve the existing "the

Wildlife Conservation and Security Act 2012", which discussed in this Chapter earlier. Meanwhile, the implementations of existing Environmental Policy, Forest Policy, Agriculture Policy, Information and Communication Technology Policy, Water Policy etc need to improve for sustainable biodiversity conservation towards Lawachara National Park along with Clearing House Mechanism supports. For example, separate Bangladesh Biodiversity Conservation Law/ Policy, National Park Database for digital conservation in connection with Clearing House Mechanism (CHM) and World Database on Protected Area (WDPA), which stated in National Biodiversity Strategy and Action Plan (NBSAP). For these purposes, it is necessary human-biodiversity interactions through stakeholder engagement and connectivity bio-corridor including co-management, knowledge management and digital conservation systems. Because, the values of diverse stakeholders are interlinked with Biodiversity Information systems sharing through integrated online conservation and protection along with Bio-safety requirements of Convention on Biological Diversity (CBD). As Bangladesh is a State Party of CBD, the Government of Bangladesh should take necessary initiatives the above-mentioned priorities for the fulfilment of National Biodiversity Strategic Targets 2020 and Sustainable Development Goals 2030.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.0 Conclusion

The study had assessed three of four types of conservational instruments of Convention on Biological Diversity. These are legal, *in-situ* and informational instruments for Bangladesh with Lawachara National Park (LNP) – as a study site. Based on these instruments, LNP is not well managed on the priority of national park management effectiveness and political commitment for biodiversity conservation. However, this study has attempted to develop a complete scenario of the causes of less management on LNP Biodiversity Conservation in Bangladesh. The findings of this study clearly indicate that traditional forest policy, illegal logging, wildlife poaching, NTFPs collection, parkland encroachment, excessive invasive alien species and no national park database in connection with biodiversity clearing house mechanisms are important sources for loss of biodiversity at LNP.

However, the predisposing conditions of this LNP also have the influential effects on local corruption and politics along with weak government policies, institutional weakening to the losses of biodiversity and this would be implemented by sustainable alternative policy approaches, which provide immediate to poor households. At the same time, National Park Biodiversity Management will need to be modernized through a long term effective national biodiversity strategy and action plan including all dynamic administration, pertinent stakeholders and update National Park Database for biodiversity clearing house mechanism in this process.

The results of this study support the adoption of environmental policy instruments that create National Park Biodiversity Protection in Bangladesh. The analysis observes the Aichi Biodiversity Targets 2020 based on National Biodiversity Strategy and Action Plan. The analysis also supports using compositional targets based on natural disturbance and settlement simulations at the community level with the involvement of various stakeholders. Spatially explicit, quantitative National Park biodiversity conservation model developed for a focal set of plant and animal species describe the target levels and range of variability in national park conditions required, as a minimum to support the occupied supplement of Lawachara National Park Biodiversity. The simulated range of in-situ instruments helps define the legal and informational instruments that should be expected for both environmental conservation instruments and associated alternative policy options. The approach is of strategically modelling long-term patterns, but using realistic operational constraints, adds both validity and complexity to model interpretation.

A critical evaluation of environmental policy instruments relevant for biodiversity conservation at Lawachara National Park is documented through this research as a means to ensure acceptance of its dynamic process and impacts. These extended impact ideas improve the practice on the priority of digital conservation with current technologies. Digital conservational data access through world database on protected areas, web services on national reports to Convention on Biological Diversity, revision of National Biodiversity Strategy and Action Plan for state parties, and national park database networks including clearing house mechanisms tends to bring new scenarios and dimensions to novel attitudes in biodiversity information systems, growth of national park analysis, predictive modelling, and synthesis, geodata exchange and visualization of biodiversity information. Policy innovation and biodiversity database infrastructure developments significantly reduce long-

term data capture costs in the wider national park biodiversity community. The study shows that formulation and biodiversity related legislations peaked in the period in 2010 to 2016, and the growth of national parks were maximal in the same period in Bangladesh. This reflects the importance that the relevant national and global decisions that are placed on the conservation of biodiversity and the ecosystem services they provide. This is indeed a positive sign in Bangladesh towards achieving Aichi Biodiversity Target 11 for the global protected areas network. The study suggests that the dynamic policy-making decisions and, using update technology with augmentation and visualisation on sustainable biodiversity protection in the National Parks of Bangladesh should incorporate development with environmental, economic, social, institutional and administrative domains.

Appropriate policy integration and effective management are absent till date for enhancing fresh water biodiversity conservation at Lawachara National Park. Rainwater harvesting reduces water scarcity and removal illegal hunting during wildlife migrates outside at dry and winter seasons. Overall, the research stated the terrestrial rainwater harvesting at national parks with requirements policy improvement for sustainable nature conservation to the effective policy makers and relevant bodies with interconnected training and socio-technical arena, which contributes to park management at national and global perspectives.

Management Control of Invasive Alien Species is a Convention on Biological Diversity's vital regulations for national park's biodiversity protection in Bangladesh. Government has taken initiatives for Invasive Alien Species control from national parks according to the requirements of Convention on Biological Diversity. However, biodiversity protection is often insufficient to stop the spread of invasive species into National Parks. In addition, in the absence of devoted institutional funding for controlling of Invasive Alien Species from

national parks, augmented policy arguments of expertise between Bangladesh and Convention on Biological Diversity, along with emerging and prompting initiatives for the removal of invasions species are required. With explicit tools on national park management, biodiversity protection, stakeholder engagement, active participation of co-management team, using update information systems and government reviews convolutedly linked to agenda-setting actions, particularly legislative rules and norms related to decision making performance and consequences, and other linked to biodiversity policy evaluation according to national requirements.

This thesis has exemplified the significance of National Biodiversity Strategy and Action Plan development and implementation in Bangladesh. In terms of actionable planning—the what, where, when, how, who and why of strategy development in Bangladesh, that has met these six criteria to different extent. The country has not covered these criteria entirely, but Government of Bangladesh has identified the key concerns of relevance to the nation and has made appropriate commitments within the Convention on Biological Diversity to address these concerns. Nonetheless, Government of Bangladesh has taken initiatives towards conserving biodiversity with its limited resources. For this purpose, the task for implementation of updated National Biodiversity Strategy and Action Plan should ensure effective engagement of all stakeholders and development partners. Mainstreaming of this biodiversity plan in all relevant sectors/departments would be the prime work that needs urgent and immediate attention to be initiated by the Ministry of Environment and Forests. It is a challenging task to implement this biodiversity plan towards building financial and technical capacities, accomplishing the valuation of goods and services with national biodiversity information systems and monitoring for achieving national targets. By implementing the targets within the timeframe for halting loss of biodiversity, the country

can contribute to the fulfilment the vision of living in harmony to achieve the Sustainable Development Goals by the year 2030 and with nature by the year 2050.

This research is significant to Bangladesh for national park management, particularly Lawachara National Park. Thus, it points the implication of leading wildlife policy formulation and the execution for biodiversity conservation and security at the national, divisional and local levels, which identifies dynamic indicators for the active implementation of national biodiversity policy and technology. Integration of biodiversity related policies and application of digital conservation processes in Bangladesh were evaluated to offer evidence of what institutes effective policy and technology development and implementation towards biodiversity conservation national parks. This was achieved by studying and determining through growth of national parks, stakeholders' perspectives and experiences based on clearing house mechanisms websites' evaluation criteria. Commendations for efficiently incipient biodiversity policy with relevant technology assembled and vindicated by the stakeholders' involvement for effective decision-making and engagement towards national parks. To provision access to incorporated data, ranging from genes to ecosystem diversity, and information ranging from scientific and technical to socio-economic research, the Convention on Biological Diversity performs the Biodiversity Clearing House Mechanism, which inspires practical and systematic supports, and interchange of information to all state parties and relevant institutions. In multi-dimensional ways, national park biodiversity networks are leading researchers and policy-makers to the conclusion that functioning on those concerns together will be more effective than dealing with them discretely.

The current study conducted on environmental policy instruments for conserving biodiversity and focused on developing a model on policy analysis framework. Due to

limitations of time and resources, large areas in biodiversity conservation policy and technology remain understudied. There are several issues to legalise more attention on bio-policy and technology in future research. As a governmental issue, it is necessary to clarify the foundations of socio-economic valuation of biodiversity conservation systems. The practice of concept biodiversity conservation systems has been primarily linked to the necessity to effective value of biodiversity in monetory terms in order to replicate them in prices and national accounts. The study is being motivated for raising environmental knowledge and awareness of the contribution of biodiversity at national parks to human well-being, together with accentuating the socio-economic preferences among stakeholders and communities. It can be an instrument to facilitate the integration of stakeholders' opinions regarding biodiversity conservation systems in decision-making, and thus assist in their participation in the governance and technology preferences of national parks.

The study has assessed the environmental instruments that strengthens the potentialities of the biodiversity conservation approaches to integrate stakeholder viewpoints in decision-making and promote environmental justice. In general, studies need to be expected to evaluate its precise magnitudes in terms of biodiversity protection, also in evaluation with other instruments and institutions. This proposition has connected the insinuations of this modification in terms of environmental policy instruments by showing allied problems of marginalisation of certain stakeholders, relevant policy and technology in participatory processes supporting authority. The research identifies which type of policy instruments choice or incorporations of informational instruments are most effective in preventive rebound and so assure effective biodiversity conservation systems at national parks.

The study concluded that environmental policy instruments along with information systems have significantly contributed to the effective management of Lawachara National Park's

Biodiversity. However, the challenge for the Lawachara National Park is to identify and clearly define and adopt conservation instruments that integrate legal, in-situ and information systems and that are parsimonious in their uses of scarce development and management park resources. This study is expected to reduce the gaps of environmental policy instruments for protecting of National Park's Biodiversity in Bangladesh.

6.1 Research Implication

In Bangladesh, the concept of environmental conservation policy instrument process has become to a greater extent recognized as a crucial element of the decision-making process at all levels. Problems in expanding and executing the environmental conservation policy instruments in Bangladesh curtail from numerous causes, which need to be solved, as stated in Chapter 4 and Chapter 5. One of the causes was an unstable political circumstance, which appeared when the research was conducted. Considerably, one vital reason that generates this process more complicated is the conventional decision-making procedure by the authorities, which always overlooks the public.

Besides, the national constitution, laws, orders, rules and regulations must be reformed to ensure that national park biodiversity management is flaxen, clear and visible, and supports a public involvement strategy within the Government of Bangladesh Administration. Laws reform initiatives, above all the outlining process, should apply a participatory appraisal to national park biodiversity management. The reforming process should allow all stakeholders, specifically the public, academics, researchers, relevant government bureaus, NGOs, co-management team and local inhabitants be involved in making their opinions recognized during the writing of these laws on environmental conservation so as to achieve their goals. To achieve an effective environmental conservation policy instrument, a

comfortable thinking, accepting and knowledge of national park biodiversity are desired. Practical training and guidance, biodiversity conservation- related workshops and career paths should be conducted for the organizational concerned, co-management team, local communities, officials and the public.

6.2 Research Limitations

This dissertation aimed to assess the effectiveness of environmental policy instruments for biodiversity conservation at Lawachara National Park in Bangladesh by investigative the process of conservation policy instruments formulation and implementation. The research results highlighted a challenging study of the policy instruments as they were based on a national biodiversity policy at Lawachara National Park— a case study in Bangladesh connecting with Aichi Biodiversity Targets. The strength of the research relied on its constrained design. While the respondents were chosen using snowball sampling to make discretely them more self-determining and less bias. The national park case study approach and the small sample size of respondents limit the applicability of the research outside the context within which it was conducted. It was also found that complicatedness in conversation to the forest department government officials at Ministerial level, mainly once the perceptive issues were raised such as illegal logging and poaching at Lawachara National Park. This congested the researcher to ask any questions because the respondents were not open-minded and unexpectedly deferred the matter. The interviewees were only a group of preferred samples, which had less concern on environmental conservation policy instrument different from the assessment criteria. They had been used up more time for understanding this matter during filling up the research questions. The results of this policy instrument study are applicability based on the preferred case study in Bangladesh context, in particular the Lawachara National Park Management Model or DPSIR Framework; it could be implicit

that the research findings are the representative of the whole practice of the environmental conservation policy instruments in Bangladesh. On the other hand, at any time the contexts are altered, this research may represent on a set of national park cases with similar distinctiveness, such as under an unstable political circumstance, which rather appears in developing countries.

6.3 Recommendations for Future Research

The study advocates future research trajectories of a new kind collaborative alternative approach to drive the methodological agenda and recommendations on how to further incorporates the demanding bioenvironmental conservation policy instruments towards national parks' biodiversity management. There are some recommendations included are:

i. It is recommended that an institution, perhaps called "Bangladesh Institute of Biodiversity Conservation and Management" be established through a legislative enactment as soon as is achievable. The same will be a hybrid version of the Biodiversity Conservation Division of Bangladesh Forest Department and Ministry of Environment and Forests. Its foremost mandate will be deal with all biodiversity conservation issues, particularly the protection, research and development of biological resources along with national parks management services.

ii. It is recommended that issues relating to Access to Benefits Sharing, Intellectual Property Rights and other relevant biodiversity issues be left to the proposed institution to deal with when it is established. In the provisional, the fundamental procedures and rules related to above mentioned benefit sharing and property rights promulgated proposed institution continue to apply.

iii. It is recommended that a national workshop be held to discuss aspects of this research, and especially, previous recommendations. The national workshop should involve representatives of relevant stakeholders such as, Resource owner, Co-management Team Leader, State Agencies, Divisional and local-level government's representatives, research organizations, industry and non-governmental organizations, and academia. There are strong indications that given the country's weak policy and legal framework on biodiversity on biodiversity, issues of bio-piracy and loss of potential economic investments and gains pose a serious concern for the development of the country. It is therefore imperative on the government and the proposed institution to move speedily on these recommendations to ensure the protection of the country's biodiversity and to obtain maximum benefits from positive results of biological research and development.

iv. Increase funding agency support for co-management strategies giving communities greater control over their resources and alternative livelihoods that replace the unsuatainable, and in many cases illegal, extraction of natural resources.

v. Continue to work with Government of Bangladesh and Private sectoral integration on structural changes in how biodiversity and natural resources are managed including institutionalizing of baseline biological data, sorting out discrepancies among agencies and other efforts to bring biodiversity and forest concerns to the forefront.

vi. Develop the capacity of Bangladesh Forest Department, Department of Environment, and Resource Information Management System to use modern

technology and methods to enforce laws against poaching, trafficking, illegal logging and encroaching.

vii. Bring stronger focus to the Lawachara National Park that is part of the Indo-Burma biodiversity hotspot and still contain considerable diversity that could be assisted through effective co-management and alternative livelihoods strategies.

viii. Expand support for media programs on well-watched Bangladesh Television and other channels, including television, radio, newspapers and magazines that highlight positive conservation activities in Bangladesh to build awareness.

ix. Support to declare new national parks to fulfil the requirements of Aichi Biodiversity Targets 2020. For example: Proposed Bhanugachh Reserved Forest, Moulvibazar and Inani Park in Cox's Bazar district can be declared as national park, which park code already developed by the authority of World Database on Protected Areas.

x. Support to announce the Prime Minister National Biodiversity Award with appropriate guidelines.

xi. Should establish Nature Education Centre adjacent of national park community area to raise awareness on the need to protect our biodiversity.

xii. Should need ethical knowledge dissemination through mosques, gereza, pagoda, theatre hall and other relevant cultural and religious institutes.

xiii. Should develop sectoral integration between Bangladesh Railway and Forest Department for transfer of running railway route from inside Lawachara National Park to Balagaon tends to Langurpur with adjacent Madhobpur bazar and Dolubari forward to Radhanagar proposed connectivity route.

xiv. It is recommended that national biodiversity database with clearing house mechanism can be developed urgently for Bangladesh, as a state party of Convention Biological Diversity's regulations.

xv. Should improve policy instruments consistent and transparent decision-making progressions through committed issues concerning the appropriateness of biodiversity conservation projects connecting species at risks Scheduled under the Wildlfe Conservation and Security Act 2012 with existing operating and maintenance resources towards Lawachara National Park.

The study concluded through taking dynamic initiatives on engagement of stakeholders, improvement of conservation policy, increase reforestation and development of biodiversity clearing house mechanism in connection to Convention on Biological Diversity and World Database on Protected Area for sustainable management of Lawachara National Park's Biodiversity through the application of environmental policy instruments.

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APPENDICES

Appendix- A: List of Publications and Conferences

Publications

1. Miah, M.R., Sayok, A.K., Sarok, A. & Uddin, M.B. (2017). Rain Water Harvesting for Sustainable Biodiversity Conservation at Lawachara National Park in Bangladesh: A Study on Policy Challenges. *OIDA International Journal of Sustainable Development*, Ontario International Development Agency, Canada ISSN 1923-6654 (print) ISSN 1923-6662 (online).url:http://www.ssrn.com/link/OIDA-Intl-Journal-Sustainable-Dev.html.

2. Miah, M.R., Sayok, A.K.., Sarok, A. & Uddin, M.B. (2016). Applications of Biological Diversity Information Systems towards Conservation at Lawachara National Park in Bangladesh. *Malays. j. med. biol. res.*, *3*(2), 93–104. ISSN 2313-0008 (Print); ISSN 2313-0016 (Online). url: http://i-proclaim.my/archive/index.php/mjmbr/issue/view/8

3. Miah, M.R., Sayok, A.K.., Sarok, A. & Uddin, M.B. (2017). Growth of National Parks Information Knowledge for Improving Biodiversity Conservation in Bangladesh: An Outlook on Policy Perspectives. *International Journal of Forestry Research*, 1–31. url:www.hindawi.com/journals/ijfr/aip/3847861.pdf (Accepted).

4. Miah, M.R., Sayok, A.K.., Sarok, A. & Uddin, M.B. (2017). Towards Dynamic Policy Instruments for Enhancing Biodiversity Conservation in National Parks: A Case Study on Bangladesh and Sarawak, Malaysia. *Borneo Journal of Resource Science and Technology*, *7*(1), 11–30. url: http://publisher.unimas.my/ojs/index.php/BJRST/article/view/391.

Conferences

1. Presenter, Md Rahimullah Miah, topic: Biodiversity Information Systems in Geospatial Applications for Protected Areas in Bangladesh (Ref# TDWG2016#973). Venue: Santa Clara de San Carlos, Costa Rica on December 5-9, 2016, organized by Biodiversity Information Standards-TDWG. url: https://mbgserv18.mobot.org/ocs/index.php/tdwg2016/paper/view/973

2. Presenter, Md Rahimullah Miah; Title: Rain Water Harvesting for Sustainable Biodiversity Conservation at Lawachara National Park in Bangladesh: A Study on Policy Challenges (Ref#: 071/Mal/16). Venue: Pearl International Hotel, Kuala Lumpur, Malaysia on September 6-8, 2016. Organized by Ontario International Development Agency, Ottawa, Ontario, Canada. url: www.ontariointernational.org.

3. Presenter, Md Rahimullah Miah, Title: Policy and Environmental Education reform needs for Sustainable Conservation of National Park Biodiversity in Bangladesh.WEEC Conference 2017 (Abstract submitted).

4. Presenter, Md Rahimullah Miah, Title: Dynamic Indigenous Knowledge Technology Augmented Sustainable National Park Biodiversity Conservation. ICLS Conference, UNIMAS (Abstract Accepted).

Appendix-B: Research Questionnaire

Topic: Assessment of Environmental Policy Instruments along with Information Systems for Biodiversity Conservation in Bangladesh : A Case Study on Lawachara National Park.

Ph.D. Program/Institute of Biodiversity and Environmental Conservation/UNIMAS

Questionnaire No.------- Date:
Type of Interview:
Name of Respondent: Gender:
Educational Status: Age:
Address: Profession:

Part A: Quantitative and Qualitative questionnaire

Section A:

1. Do you know that Lawachara is a National Park? □1 Yes □2 No

2. If yes, what do you know about National Park?

3. As a member of the community of LNP, please check the appropriate following options that describe you: □1 Local resident □2 Local business owner □3 Tour Guide □4 Park employee □5 Others (*please specify*) ……..……

4. What is your main source of income: □1 Business □2 Agriculture □3 Service □4 Tourism □5 Others

5. What is your secondary source: □1 Business □2 Agriculture □3 Service □4 Tourism □5 Others

6. Average total income/month: Tk. _ _ _ _ _ _

7. Are you involved in any activities of conservation development at Park? □1 Yes □2 No

8. If yes, please tell me the details about those activities (please tell me whether any other family member is involved in conservation activities).

9. If yes, are you officially employed? If yes: □1 Full time □2 Part-time □3 No. Please explain it.

10. Do you know—what causes the loss of national park biodiversity? ----------

11. Would you like to be involved/more involved in collection of forest products activities at this Park?

□1 No □2 Perhaps/Maybe □3 Yes □4 Certainly □5 No opinion

12. Do your community or the park get any benefit from tourism from this Park?

    □1 No □2 Yes, directly □3 Yes, indirectly □4 No comment

13. Do you get disadvantage from tourism from this Park?
    □1 No □2 Yes, directly □3 Yes, indirectly □4 No idea

14. Are more visitors coming now-a-days than previous time? □1 Yes □2 No □3 Don't know

15. How do you consider outsider domestic visitors and foreign visitors at this park? Do you think that foreign visitors will contribute more to you?

16. Are you aware of co-management approach at this park? (i). Suitable, (ii) Good, (iii) Approximately, (iv) Biasness, (v) No comment, if any else.....?

17. How do you prevent Invasive Alien Species from this park and its surrounding?

18. Among several activities which activities are carried out under the environmental education program?

19. How does the co-management approach provide you advantages and disadvantages by tourism in comparison to previous initiatives?

20. What do you expect more from tourism at this park?

21. Who benefits most from tourism due to the co-management approach at this park? How does it happen?

22. Do you know the biodiversity conservation policy to help the improvement of tourism quality?

23. What are your opinions for Rain Water Harvesting to improve the biodivesity conservation at LNP?

24. Others (if any): ---------

Section B:

1.) Are your national park's priority species and pathways identified in the updated National Biodiversity Strategies and Actions Plans (NBSAP)?
    a. Yes
    b. No, please indicate the reason----------.

2.) Have you contacted the main authority or academic institutions to conduct invasive species risk analysis to minimize the risk?
    a. Yes
    b. No, please indicate the reason why risk is not considered……

3.) Have you contacted the main authority to apply phyto-sanitary measures on imports to national parks?
    a. Yes

b. No, please indicate why not involved----------

4.) Have you developed a national plan for eradication of invasive alien species?
   a. Yes.
   b. No, please indicate why eradication will not take place.

5.) Does LNP have existing funded projects to achieve Aichi Biodiversity Target 9 on Invasive Alien Species?
   a. Yes, please indicate who the donors of these projects are----------
   b. No

Section C:

1. Importance of Biodiversity Information
   (a) Very essential (b) Essential (c) Approximately (d) No comment.

2. Research Role Play with Biodiversity Information
   (i) Academic staff (ii) Research Assistant (iii) Document Manager (iv) Others.....

3. Knowledge on Biodiversity information systems
   (a) More informed (b) Informed (c) Simple (d) Nothing

4. Application of Biodiversity Database Security
   (i) More secure (ii) Secure (iii) Less secure (iv) No idea

Section D:

1. Idea on Green Banking Policy with Environmental Awareness
   (a) Very essential (b) Essential (c) Approximately (d) No idea

2. Nature Conservation with Indigenous communities

   (i) ----------
   (ii) ----------
   (i)----------

3. How to improve environmental Education Awareness?
   (i) ----------
   (ii) ----------
   (iii) ----------
   (iv) ----------

4. Progress of National Parks in Sylhet Division
   (a) Lawachara National Park----------
   (b) Satchari National Park----------
   (c) Khadimnagar National Park----------

5. Your opinion on the following term for national park management and its impacts.

(i) Afforestation----------
(ii) Reforestation----------
(iii) Deforestation----------
(iv) Illegal Logging----------

6. Essential Law and Policy Adoption for National Park Management

(a) Strongly Agree (b) Agree (c) Disagree (d) No comment

Section E:

1. The Idea of Biodiversity Clearing House Mechanism for National Biodiversity Database----

-

(i) Excellent (ii) Good (iii) General (iv) No comment

2. Lawachara National Park has connected with national CHM website? Yes…. No……..

3. If No, Do you think, when the LNP will have connect with CHM website? ----------

4. What are your suggestions to improve the digital biodivesity conservation at LNP?----------

Section F

1. What is your other overall opinion (if any) about the technological contributions (both positive and negative impacts) of this research interventions in the community?

2. Please tell me if there is any other opinion or remark:

Name of the interviewee: **Signature with date and time:**

Name of the Witness: **Signature with date and time:**

Name of interviewer: **Signature with date and time:**

Appendix–C: Questionnaire for Key Informant Interviews

Question 1:

What are the main purposes of this department/organization in relation to environmental policy instruments for conservation of biodiversity towards national park in Bangladesh?

……

Question 2:

How frequent does the department visit national park for inspection and monitoring?

……

Question 3: What does department aim to achieve in inspection and monitoring of national park biodiversity?……

Question 4: How many national parks are declared in Bangladesh according to IUCN category?……..

Question 5: Is the Wildlife Conservation and Security Act 2012 adequate for biodiversity conservation towards national park in Bangladesh.....

Question 6: *Does the Government of Bangladesh take initiative for development of national park biodiversity database on the basis of clearing house mechanism?.....*

Question 7: *Are there any biodiversity related international laws, regulations, conventions or treaties targeted towards national parks that is being used or adopted by Bangladesh?*

……

Appendix-D: Protected Areas in Bangladesh

Sl. No.	National Parks (NP)	Location		IUCN Category	Area (ha.)	Gazette notification date
		District	Division			
1	Himchari N. P.	Cox's Bazar	Chittagong	IV	1729.00	15-2-1980
2	Bhawal National Park	Gazipur	Dhaka	IV	5022.00	11-5-1982
3	Ramsagar N.P.	Dinajpur	Rangpur	IV	27.75	30-4-2001
4	Lawachara National P	Moulavibazar	Sylhet	II	1250.00	7-7-1996
5	Kaptai National Park	Rangamati	Chittagong	II	5464.00	9-9-1999
6	Nijhum Dweep NP	Noakhali	Chittagong	II	16352.23	8-4-2001
7	Medhakachhapia NP	Cox's Bazar	Chittagong	IV	395.92	8-8-2008
8	Satchari National Park	Habigonj	Sylhet	II	242.91	15-10-2005
9	Khadimnagar NP	Sylhet	Sylhet	IV	678.80	13-04-2006
10	Baroiyadhala NP	Chittagong	Chittagong	II	2933.61	06-04-2010
11	Kuakata National Park	Patuakhali	Barisal	II	1613.00	24-10-2010
12	Nababgonj NP	Dinajpur	Rangpur	IV	517.61	24-10-2010
13	Singra National Park	Dinajpur	Rangpur	IV	305.69	24-10-2010
14	Kadigarh NP	Mymensingh	Mymensingh	IV	344.13	24-10-2010
15	Altadighi NP	Naogaon	Rajshahi	IV	264.12	24-12-2011
16	Birganj National Park	Dinajpur	Rangpur	IV	168.56	24-12-2011
17	Madhupur National Park	Tangail and Mymensingh	Dhaka and Mymensingh	IV	8436.00	24-2-1982

No	Wildlife Sanctuary	Location		IUCN Category	Area (ha.)	Gazette notification date
		District	Division			
1	Rema-Kalenga Wildlife San.	Habigonj	Sylhet	II	1795.54	7-7-1996
2	Char Kukri-Mukri Wild. Sanc.	Bhola	Barisal	IV	40.00	19-12-1981
3	Sundarban-East Wildlife Sanct.	Bagerhat	Khulna	Ib	31226.94	6-4-1996
4	Sundarban (West) Wildlife San.	Satkhira	Khulna	Ib	71502.10	6-4-1996
5	Sundarban (South) Wildlife Sa.	Khulna	Khulna	Ib	36970.45	6-4-1996
6	Pablakhali Wildlife Sanctuary	Rangamati	Chittagong	II	42087.00	20-9-1983
7	Chunati Wildlife Sanctuary	Chittagong	Chittagong	IV	7763.97	18-3-1986
8	Fashiakhali Wildlife Sanctuary	C's Bazar	Chittagong	IV	1302.43	11-4-2007
9	Dudpukuria-Dhopachari WS	Chittagong	Chittagong	IV	4716.57	6-4-2010
10	Hajarikhil Wildlife Sanctuary	Chittagong	Chittagong	II	1177.53	6-4-2010
11	Sangu Wildlife Sanctuary	Bandarban	Chittagong	II	2331.98	6-4-2010
12	Teknaf Wildlife Sanctuary	C's Bazar	Chittagong	IV	11615.00	24-03-2010
13	Tengragiri Wildlife Sanctuary	Barguna	Barisal	II	4048.58	24-10-2010
14	Dudhmukhi Wildlife Sanctuary	Bagerhat	Khulna	II	170.00	29-01-2012
15	Chandpai Wildlife Sanctuary	Bagerhat	Khulna	II	560.00	29-01-2012
16	Dhangmari Wildlife Sanctuary	Bagerhat	Khulna	II	340.00	29-01-2012
17	Sonarchar Wildlife Sanctuary	Patuakhali	Barisal	II	2026.48	24-12-2011
18	Nazirganj Dolphin W.Sanctua.	Pabna	Rajshahi	VI	146.00	01-12-2013
19	Shilanda-Nagdemra Dolphi. WS	Pabna	Rajshahi	VI	24.17	01-12-2013
20	Nagarbari-Mohanganj Dolp.WS	Pabna	Rajshahi	VI	408.11	01-12-2013
21	Swatch of No-Ground Marine Protected Area	South Bay of Bengal	Khulna Adjacent	Not Reported	173800	27-10-2014

Ex-situ Conservation Areas of Bangladesh (Ahsan *et al.*, 2016)

Ex-situ Areas	Ecosystem	District	Area (ha)	Year
Baldha Garden	Secondary Forest	Dhaka	1.37	1909
Bangabandhu Sheikh Mojib SP	Deciduous Forest	Gazipur	1542.51	2014
Banshkhali Eco-park (EP)	Mixed Evergreen	Chittagong	1200.00	2003
Borshijora Eco-park	Mixed Evergreen	Moulvibazar	326.07	2006
Dulhazara Safari Park (SP)	Mixed Evergreen	Cox's Bazar	600.00	1999
Kuakata Eco-park	Mixed Evergreen	Patuakhali	5661.00	2005
Madhabkunda Eco-park	Mixed Evergreen	Moulvibazar	265.68	2001
Madhutila Eco-park	Deciduous Forest	Sherpur	100.00	2001
National Botanical Garden	Secondary Forest	Dhaka	84.21	1961
Sitakunda Botanical Garden and EP	Mixed Evergreen	Chittagong	808.00	2000
Tilagar Eco-park	Mixed Evergreen	Sylhet	45.34	2006

Table C-1: Study area status with administrative districts, division, population and area in the north-eastern part of Bangladesh.

Name of district	Administrative Division	Population (thousand)	Area (km^2)
Habiganj	Sylhet	2059	2637
Moulvibazar	**Sylhet**	**1902**	**2799**
Sunamganj	Sylhet	2443	3670
Sylhet	Sylhet	3404	3490
Grand Total			

Table C-2: Number of Household, Population and Density 2011 at different sub-districts in Moulvibazar.

Sub-district	**Household**	**Population**	**Density per sq.km.**
Kamalganj	51895	259130	534
Barlekha	44192	257620	574
Juri	27509	148958	800
Kulaura	66465	360195	660
Moulvibazar Sadar	62881	342468	995
Rajnagar	43070	232666	688
Sreemangal	65165	318025	706
Total	361177	1919062	686

Table C-3: Literacy rate (%) at different sub-districts in Moulvibazar.

Sub-district	Literacy rate (%)		
	1991	2001	2011
Kamalganj	28.6	40.7	48.6
Barlekha	34.6	42.7	52.4
Juri	-	-	52.3
Kulaura	28.8	42.4	51.9
Moulvibazar Sadar	36.1	48.6	54.9
Rajnagar	27.2	36.2	48.6
Sreemangal	29.8	39.6	48.3
Average	30.8	42.1	51.1

Table C-4: Temperature, Rainfall and humidity during the period 2008—2011 in Moulvibazar.

Years	Temperature (centigrade)		Rainfall (milimetre)	Humidity (%)
	Maximum	Minimum		
2008	34.1	8.2	3356	79.0
2009	33.2	10.7	2407	78.0
2010	34.0	8.7	1868	63.7
2011	23.7	8.6	2071	78.8

Table C-5: Number of nursery, horticulture centre and brick kiln at different in Moulvibazar

Table C-6: Total Area, Land Area and Reserve forest area (sq.km.) in different sub-districts of Moulvibazar district.

Sub-district	Total Area	Land area	Reserve forest	Riverine area
Kamalganj	485.26	372.62	112.64	0
Barlekha	448.86	416.46	32.40	0
Juri	186.30	11.33	173.87	1.10
Kulaura	545.73	523.81	20.56	1.36
Moulvibazar Sadar	344.32	336.68	4.27	3.37
Rajnagar	338.15	314.27	20.44	3.44
Sreemangal	450.73	434.15	16.58	0
Total	2799.40	2473.4	316.76	9.27

Appendix-F: CHM Websites of Some State Parties

(a) CHM–Bahrain: Web: http://bh.chm-cbd.net

(b) CHM–Cambodia: Web: http://www.chm.gdancp-moe.org

(c) CHM–China: Web: http://english.biodiv.gov.cn

(d) CHM–Indonesia: Web: http://www.menlh.go.id

(e) CHM–Malaysia, Web:http://www.mybis.gov.my/one/

(f) CHM–Myanmar, Web: http://www.myanmarchm.gov.mm/eng/

(g) CHM–Yemen, Web: http://ye.chm-cbd.net

(h) CHM–Republic of Korea, Web: http://www.cbd-chm.go.kr/eng/main/main.do,

(i) CHM–Japan: www.biodic.go.jp

(j) CHM– India: www.envfor.nic.in/envis/envis.html

And

State Parties' CHM Focal Point and Mailboxes Status, url: https://www.cbd.int

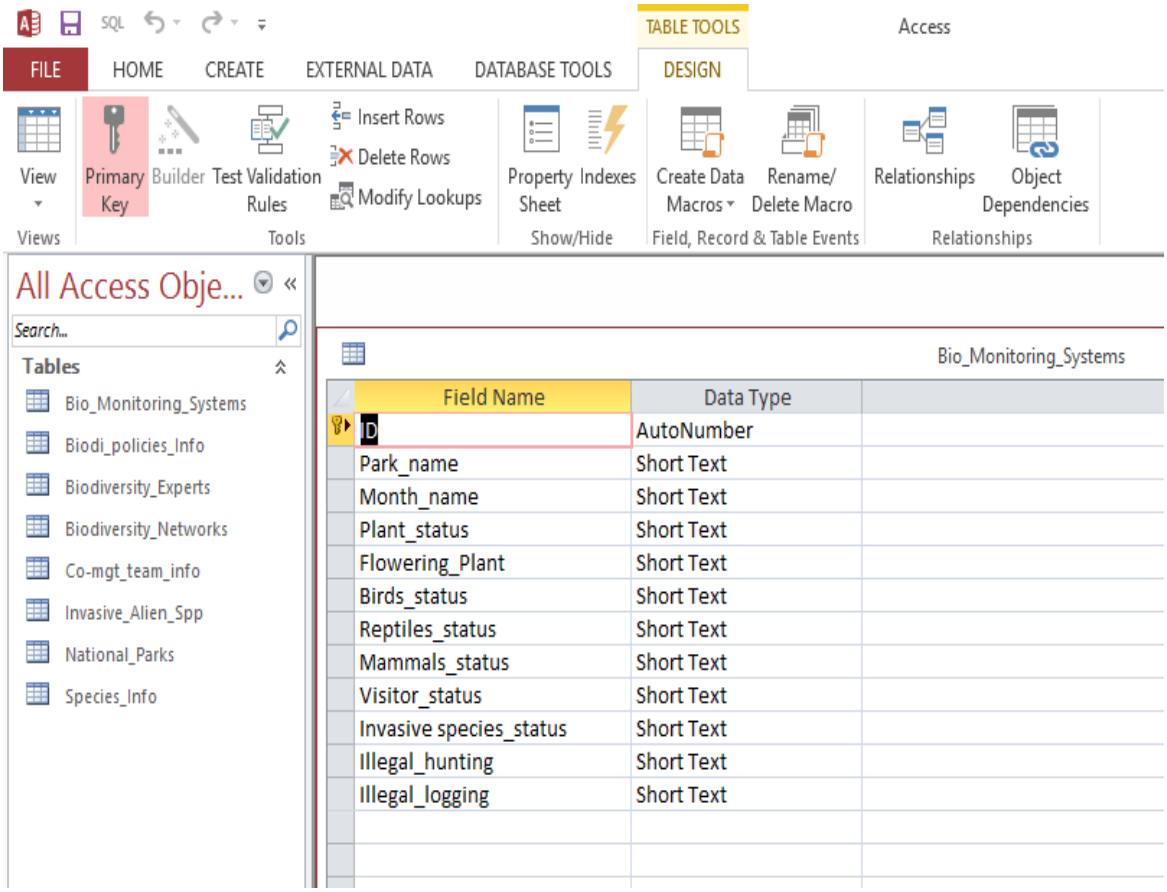
Appendix-G: Present Status of CBD's CHM Networks

The CHM Network: Regional CHM Status

Regions	Countries (+EU)*	CBD Parties	CHM NFP	CHM Mailboxes	CHM Websites
Africa	54	54	50	50	29
Asia and the Pacific	57	57	45	43	19
Central and Eastern Europe	23	23	17	17	15
Latin America and the Caribbean	33	33	27	27	20
Western Europe and Others	31	29	23	23	21
Totals	198	196	162	160	104

Source: https://www.cbd.int/chm/network/default.shtml#tab=1

Appendix H: Biodiversity Information Systems User Database



Appendix-I: CBD's Present Status of NBSAP

STATUS OF DEVELOPMENT OF NATIONAL BIODIVERSITY STRATEGIES AND ACTION PLANS OR EQUIVALENT INSTRUMENTS (NBSAPS) AT 7 FEBRUARY 2017

A. Parties that have revised NBSAPs
(year of completion indicated where year of adoption is unknown)

1. Albania (1999, 2016)
2. Algeria (2005, 2016)
3. Armenia (1999, 2015)
4. Australia (1996, 2010)
5. Austria (1998, 2005, 2014)
6. Azerbaijan (2004, 2016)
7. Bahrain (2007, 2016)
8. Bangladesh (2006, 2016)
9. Belarus (1997, 2010, 2015)
10. Belgium (2007, 2013)
11. Belize (1998, 2016)
12. Benin (2002, 2016)
13. Bhutan (1997, 2002, 2009, 2014)
14. Bosnia and Herzegovina (2011, 2016)
15. Botswana (2005, 2007, 2016)
16. Brazil (2002, 2006, 2016)
17. Bulgaria (2000, 2005)
18. Burkina Faso (1998, 2011)
19. Burundi (2000, 2013)
20. Cabo Verde (1999, 2014)
21. Cambodia (2002, 2016)
22. Cameroon (1999, 2012)
23. Canada (1996, 2016)
24. Chad (1999, 2014)
25. China (1994, 2010)
26. Colombia (2005, 2012)
27. Comoros (2000, 2016)
28. Congo (2001, 2015)
29. Côte d'Ivoire (2002*, 2016) *Strategy only
30. Croatia (1999, 2008)
31. Cuba (1997, 2006, 2016)
32. Czech Republic (2005, 2016)
33. DPR Korea (1998, 2007)
34. Democratic Republic of Congo (2000, 2002, 2016)
35. Denmark (1996*, 2004**, 2014) *Strategy, **Action Plan
36. Dominica (2002, 2013)
37. Ecuador (2001, 2016)
38. Egypt (1998, 2016)
39. El Salvador (1999, 2013)
40. Equatorial Guinea (2005, 2015)
41. Eritrea (2000, 2014)
42. Estonia (1999, 2012)
43. Ethiopia (2006, 2015)
44. European Union (1998, 2006, 2011)
45. Finland (1997, 2006, 2012)
46. France (2004, 2011) *Strategy adopted in 2004; Sectoral Action Plans adopted between 2006-2008 and revised in 2009; Strategy revised in 2011
47. Gambia (1999, 2015)
48. Georgia (2005, 2014)
49. Germany (2007*, 2015**) *Strategy, **Nature Conservation Action Programme 2020 for Strategy (2007)
50. Ghana (2002*, 2016) *Strategy only
51. Grenada (2000, 2016)
52. Guatemala (1999, 2014)
53. Guinea (2001, 2016)
54. Guinea-Bissau (2001, 2015)
55. Guyana (1999, 2007) * Action Plan only
56. Hungary (2008, 2015)
57. India (1999, 2008, 2014*) *Addendum to NBAP 2008
58. Indonesia (1993, 2003)
59. Iran (2006, 2016)
60. Ireland (2002, 2011)
61. Jamaica (2003, 2016)
62. Japan (1995, 2002, 2008, 2010, 2012)
63. Jordan (2001, 2015)
64. Kiribati (2006, 2016)
65. Kyrgyzstan (1998, 2002, 2014)
66. Lao PDR (2004, 2016)
67. Latvia (2000, 2003*, 2014) *Action Plan revised
68. Lebanon (1998, 2005, 2016)
69. Lithuania (1998, 2015)
70. Luxembourg (2007, 2017)
71. Madagascar (2002, 2007, 2016)
72. Malawi (2006, 2015)
73. Malaysia (1998, 2016)
74. Maldives (2002, 2015)
75. Mali (2001, 2014)
76. Mauritania (1999, 2014)
77. Mexico (2000, 2016)
78. Mongolia (1996, 2015)
79. Montenegro (2010, 2016)
80. Morocco (2002, 2004, 2016)
81. Mozambique (2001, 2003, 2015)
82. Myanmar (2012, 2015)
83. Namibia (2002, 2014)
84. Nepal (2002, 2014)
85. Netherlands (1995, 2001, 2008, 2013)
86. New Zealand (2000, 2016)
87. Nicaragua (2001, 2016)
88. Niger (2000, 2009, 2014)
89. Nigeria (2006, 2015)
90. Niue (2001, 2015)
91. Norway (2001, 2004, 2006, 2015)
92. Paraguay (2003, 2016)
93. Peru (2001, 2014)
94. Philippines (1997, 2002, 2015)
95. Poland (2003, 2007, 2015)
96. Qatar (2004, 2014)
97. Republic of Korea (1997, 2009, 2014)
98. Republic of Moldova (2000, 2015)
99. Romania (1996, 2001, 2014)
100. Russian Federation (2001, 2014)
101. Rwanda (2003, 2016)
102. Saint Kitts and Nevis (2004, 2014)
103. Samoa (2001, 2015)
104. Sao Tome and Principe (2005, 2016)
105. Senegal (1998, 2015)

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106. Seychelles (2008, 2015)
107. Singapore (1992, 2002, 2009)
108. Slovakia (1998, 2002*, 2014) *Action Plan updated only
109. Solomon Islands (2009, 2016)
110. South Africa (2005, 2015)
111. Spain (1999*, 2005*, 2011**) *Strategy; **Action Plan
112. Sri Lanka (1998, 2016)
113. Sudan (2000, 2015)
114. Suriname (2006*, 2013**) *Strategy; **Action Plan
115. Sweden (1995, 2006, 2014)
116. Switzerland (2006, 2012)
117. Tajikistan (2003, 2016)
118. Thailand (1997, 2002, 2008, 2015)
119. Timor-Leste (2011, 2015)
120. Togo (2003, 2014)
121. Tonga (2006, 2016)
122. Turkey (2001, 2007)
123. Uganda (2002, 2015)
124. Ukraine (1998*, 2000**, 2010***, 2011****) *Strategy only; **Strategy and Action Plan, ***Revised Strategy; ****Revised Action Plan
125. United Kingdom (1994, 2006, 2011)
126. United Republic of Tanzania (2004, 2015)
127. Uruguay (1999, 2016)
128. Venezuela (2001, 2010)
129. Vietnam (1994, 2007, 2015)
130. Zambia (1999, 2015)
131. Zimbabwe (2002, 2014)

B. Parties with NBSAPs under revision

(year of completion indicated where year of adoption is unknown)

1. Bahamas (1999)
2. Kenya (1999)
3. Saint Lucia (2000)
4. TFYR Macedonia (2005)
5. Tunisia (1998)
6. Turkmenistan (2002)

C. Other Parties with completed NBSAPs

(year of completion indicated where year of adoption is unknown)

1. Afghanistan (2014)
2. Andorra (2016)
3. Angola (2006)
4. Antigua and Barbuda (2014)
5. Argentina (2003)
6. Barbados (2002)
7. Bolivia (2001)
8. Brunei Darussalam (2015)
9. Central African Republic (2003)
10. Chile (2003)
11. Cook Islands (2002)
12. Costa Rica (1999)
13. Djibouti (2001)
14. Dominican Republic (2011)
15. Fiji (2003)
16. Gabon (1999)
17. Greece (2014)
18. Honduras (2001)
19. Iceland (2008*, 2010**) *Strategy; **Action Plan
20. Iraq (2015)
21. Israel (January 2010)
22. Italy (2010)
23. Kazakhstan (1999)
24. Kuwait (completed 1997, not adopted)
25. Lesotho (2000)
26. Liberia (2003)
27. Liechtenstein (2014)
28. Malta (2012)
29. Marshall Islands (2000)
30. Mauritius (2006)
31. Micronesia, Federated States of (2002)
32. Nauru (2010)
33. Oman (2001)
34. Pakistan (1999)
35. Palau (2005)
36. Panama (2000)
37. Papua New Guinea (2007)
38. Portugal (2001)
39. Saint Vincent and the Grenadines (2004)
40. Saudi Arabia (2005)
41. Serbia (2011)
42. Sierra Leone (2003)
43. Slovenia (2001) * Strategy only
44. Somalia (2015)
45. Swaziland (2001)
46. Syrian Arab Republic (2002)
47. Trinidad and Tobago (2001)
48. Tuvalu (2013)
49. United Arab Emirates (2014)
50. Uzbekistan (1998)
51. Vanuatu (2000)
52. Yemen (2005)

D. Parties with first NBSAP under development

1. Cyprus
2. Haiti
3. Libyan Arab Jamahiriya
4. Monaco
5. South Sudan

E. Parties for which there is no recent information about the status of NBSAPs

1. San Marino
2. State of Palestine (became a Party on 2 April 2015)

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Appendix-J: Status of Biodiversity related National Legislation Scoring

Biodiversity related National Legislations	Weight (%)	LNP	SNP	KNP
The National Constitution 2011	5	5	5	5
The Wildlife (Conservation and Security) Act 2012	5	5	5	5
Bangladesh Environmental Conservation Act 2010 (amendment)	5	5	5	5
Bangladesh Forest Act (amended) 2000	5	5	5	5
Environmental Policy 1997	4	4	4	4
National Forest Policy 1994	4	4	4	4
Environmental Court Act 2010	5	5	5	0
National Biodiversity Strategic Action Plan 2016	4	4	4	4
Compensation Policy for Casualties caused by Wildlife 2010	4	4	4	0
Saw-Mill (License) Rule 2012	4	4	4	4
Forest Products Transit (Control) Rule 2011	4	4	4	4
Social Forestry Rule (amendment) 2011	4	4	4	4
Brick Prepared and Kiln Establishment (Control) Act 2013	5	5	5	5
The Prime Minister Award Giving Rules 2013 on Plantation	3	0	0	0
ICT Act 2013	5	5	5	5
ICT Policy 2015	4	4	0	0
Ecologically Crical Areas Rules 2016	4	4	4	0
Tea Act 2016	5	5	5	5
National Education Policy 2010	4	4	4	4
Water Act 2013	5	4	4	4
Government Order on Co-management Organizations 2010	4	4	4	0
Plant Quarantine Act 2011	5	5	5	5
Community Based Nature Interpretation Centre through Public Private Partnership, Government Rules, 2010	3	3	3	3
Total weight	100	96	92	75

*Where, LNP= Lawachara National Park

SNP=Satchori National Park

KNP= Khadimnagar National Park.

Appendix-K: Recorded Species at Lawachara National Park

a. Recorded Species from the Study Area

Botanical name	Family	Local Name	Common Name	Order	Class
Acanthus ilicifolius L.	Acanthaceae	Hargoza	Kolimulli	Lamiales	Asterids
Mangifera indica L.	Anacardiaceae	Amm	mango	Sapindales	Rosids
Annona muricata L.	Annonaceae	Ata	Soursop	Magnoliales	Magnoliids
Holarrhena antidysentica (L.) Wall.	Apocynaceae	Kurchi	Conessi tree	Gentianales	Magnoliopsida
Ilex godajam Colebr. ex Hook.f.	Aquifoliaceae	Ludh	cassina	Aquifoliales	Magnoliopsida
Areca triandra Roxb. ex Buch.-Ham.	Arecaceae	Bon supari	betel tree	Arecales	Commelinids
Areca catechu L.	Arecaceae	Supari	betel palm	Arecales	Commelinids
Ceiba pentandra	Malvaceae	Shet Shimul	Kapok	Malvales	Rosids
Tamarindus indica L.	Fabaceae	Tentul	tamarind	Fabales	Rosids
Lophapetalum fimbriatum Wight	Celastraceae	Rokton	Taung-yemane	Celastrales	Magnoliopsida
Garcinia cowa Roxb.	Clusiaceae	Kau	saptree	Malpighiales	Rosids
Mesua nagessarium (Burm. f.) Kosterm.	Calophyllaceae	Nagersar	Ceylon ironwood	Malpighiales	Rosids
Terminalia arjuna (Roxb. ex DC.) Wight & Arn.	Combretaceae	Arjun	arjun tree	Myrtales	Rosids
Terminalia bellirica (Gaertn.) Roxb.	Combretaceae	Bohera	Beleric	Myrtales	do
Terminalia chebula Retz.	Combretaceae	Horitoki	chebulic myrobalan	do	do
Terminalia catappa L.	Combretaceae	Kath badam	Indian-almond	do	do
Dillenia indica L.	Dilleniaceae	Chalta	elephant apple	Dilleniales	Eudicots
Shorea robusta Gaertn.	Dipterocarpaceae	Sal	sakhua	Malvales	Rosids
Hopea odorata Roxb.	Dipterocarpaceae	Telsur	Ta-khian	Malvales	do
Diospyros malabarica (Desr.) Kostel.	Ebenaceae	Gab	Gaub tree	Ericales	Asterids
Elaeocarpus robustus Roxb.	Elaeocarpaceae	Jalpoi	Bhadrasey tree	Oxalidales	Rosids
Phylanthus emblica L.	Euphorbiaceae	Amloki	Emblic tree	Malpighiales	do
Baccaurea ramiflora Lour.	Euphorbiaceae	Lotkon	Burmese grape	Malpighiales	do
Trewia nudiflora L.	Euphorbiaceae	Tipali	False white teak	Malpighiales	do
Taphrosia candida DC.	Fabaceae	Bogamedula	hoang pea	Fabales	Rosids
Quercus spicata Smith	Fagaceae	Batna	Quercus	Fagales	Magnoliopsida
Vitex diversifolia Kurz ex C.B.Clarke	Verbinaceae	Sada awal	chastetree	Lamiales	Asterids

Tectona grandis L.f.	Verbinaceae	Shegun	Teak	Lamiales	do
Litsea monopetala (Roxb.) Pers.	Lauraceae	Boro kukurchita	Menda	Laurales	Magnoliids
Cinnamomum tamala (Buch.-Ham.) T.Nees & Eberm.	Lauraceae	Tejpata	Indian bay leaf	Laurales	Magnoliids
Carya arborea Roxb.	Lecythidaceae	Kumbi	Wild Guava	Ericales	Asterids
Leea crispa L.	Vitaceae	Bon chalta	Pucok Merah,	Vitales	Rosids
Acacia auriculiformis A. Cunn. ex Benth	Fabaceae	Akasmoni	Ear-leaf Acacia	Fabales	Rosids
Albizia lebbeck (L.) Benth.	Leguminosae	Kalo koroi	lebbek tree	Fabales	Rosids
Albizia chinensis (Osbeck) Merr.	Leguminosae	Koroi	Silk Tree	Fabales	do
Erythrina resupinata Roxb.	Leguminosae	Lal dumur	coral tree	do	do
Erythrina crista-galli L.	Leguminosae	Lal menda	cockspur coral tree	do	do
Xylia dolabriformis Benth.	Leguminosae	Lohakat	ironwood	do	do
Paraserianthes falcataria (L.) I.C.Nielsen	Fabaceae	Malakana	batay	do	do
Erythrina variegate L.	Fabaceae	Mandar	sunshine tree	do	do
Acacia mangium Willd.	Fabaceae	Mangium	black wattle	do	do
Albizia procera (Roxb.) Benth.	Leguminosae	Silkoroi	White siris	do	do
Michelia champaca L.	Magnoliaceae	Champa	Joy Perfume Tree	Magnoliales	Magnoliids
Sterculia foetida L.	Malvaceae	Bon badam	Java olive tree	Malvales	Rosids
Bombex ceiba L.	Malvaceae	Simul	red cotton tree	do	do
Chickrassia tabularis Wight & Arn.	Meliaceae	Chikrasi	Bastard cedar	Sapindales	do
Melia azedarach L.	Meliaceae	Gora neem	chinaberry t ree	do	do
Amoora wallichii King	Meliaceae	Lali	Amari	do	do
Swietenia mahagoni (L.) Jacq.	Meliaceae	Mahogani	West Indian mahogany	do	do
Aphanamixis polystachya (Wall.) Parker	Meliaceae	Pitraj	Rohituka tree	do	do
Toona ciliata M. Roem.	Meliaceae	Toon	Indian cedar	do	do
Ficus benghalensis L.	Moraceae	Bot	Banyan	Rosales	do
Ficus lamponga Miq.	Moraceae	Buti dumur	fig tree	do	do
Artocarpus chaplasha Roxb.	Moraceae	Chapalish	Chaplash	do	do
Artocarpus lacucha Roxb.	Moraceae	Deua	barhar	do	do

Ficus hispidia L. f.	Moraceae	Dumur	Tropical fig tree	do	do
Artocarcus heterophyllus Lamk.	Moraceae	Kanthal	Jackfruit	do	do
Ficus religiosa L.	Moraceae	Panbot	sacred fig	do	do
Ficus auriculata Lour.	Moraceae	Para dumur	Elephant ear fig	do	do
Ficus hispida L.f.	Moraceae	Sada dumur	Small fig tree	do	do
Streblus asper Lour.	Moraceae	Shaora	Serut tree	do	do
Syzgium firmum Thw.	Myrtaceae	Dhaki jam		Myrtales	do
Eucalyptus camaldulensis Dehnh.	Myrtaceae	Eucalyptus	River red gum	Myrtales	Rosids
Syzygium jambos (L.) Alston	Myrtaceae	Golap jam	Pomarrosa	do	do
Syzygium cacuminis (Craib) Chantaran. & J.Parn.	Myrtaceae	Kalo jam	-----	do	Magnoliopsida
Syzygium fruticosum (Roxb.) DC.	Myrtaceae	Khudi jam	Sabri	do	do
Syzygium formosanum (Hayata) Mor.	Myrtaceae	Pani jam		do	do
Averrhoa bilimbi L.	Oxalidaceae	Belam	bilimbi	Oxalidales	Rosids
Zizyphus oenoplea (L.) Mill.	Rhamnaceae	Bonboroi	wild jujube	Rosales	do
Bruguiera gymnorrhiza	Rhizophoraceae	Lal kakra	Black mangrove	Malpighiales	do
Anthocephalus chinensis (Lam.) A. Rich ex Walp.	Rubiaceae	Bon kadam	Burflower-tree	Gentianales	Asterids
Neonauclea sessilifolia (Roxb.) Merr.	Rubiaceae	Guti kadam	Bosser	Gentianales	Equisetopsida
Adina cordifolia (Roxb.) Hook. f.	Rubiaceae	Holdu	Karma	Gentianales	Asterids
Citrus limon (L.) Osbeck	Rutaceae	Guralebu	Lemon	Sapindales	do
Citrus maxima (Burm.) Merr.	Rutaceae	Jambura	Pomelo	do	do
Lepisanthes rubiginosa (Roxb.) Leenh.	Sapindaceae	Chagalnadi	Kalayo	do	do
Sterculia villosa Roxb	Sterculiaceae	Janli badam	Elephant rope tree	Malvales	do
Sterculia colorata Roxb.	Sterculiaceae	Udal	Bonfire tree	do	do
Schima wallichii Choisy	Theaceae	Kanak	cheloni	Ericales	do
Aquilaria malaccensis Lamk.	Thymeleaceae	Agar	Agarwood	Malvales	do
Gmelina arborea Roxb.	Verbenaceae	Gamar	Beechwood	Lamiales	do

Appendix L: Questionnaire on Invasive Alien Species

(This questionnaire from the Secretariat of CBD to the Contact Person, Ministry of Environment and Forests, Government of People's Republic of Bangladesh)

a. Controlling measure of Invasive Alien Species

1. What is the relative priority afforded to implementation of this Article and the associated decisions by the Government of Bangladesh?							
a) High	-	b) Medium	-	c) Low	X		
2. To what extent are the resources available adequate for meeting the obligations and recommendations made?							
a) Good	-	b) Adequate	-	c) Limiting	-	d) Severely limiting	X
3. Has Bangladesh identified alien species introduced?							
a) no						X	
b) only major species of concern						-	
c) a comprehensive system tracks introductions						-	
4. Has Bangladesh developed national policies for addressing issues related to alien invasive species?							
a) no						X	
b) yes – as part of a national biodiversity strategy (please give details below)						-	
c) yes – as a separate strategy (please give details below)						-	
5. Has Bangladesh assessed the risks posed to ecosystems, habitats or species by the introduction of these alien species?							
a) no						X	
b) only some alien species of concern have been assessed						-	
c) most alien species have been assessed						-	
6. Has Bangladesh undertaken measures to prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species?							
a) no measures						X	
b) some measures in place						-	
c) potential measures under review						-	
d) comprehensive measures in place						-	

a. Decision IV/1 Report and recommendations of the third meeting of Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA)

7. Is Bangladesh collaborating in the development of projects at national, regional, sub-regional and international levels to address the issue of alien species?	
a) little or no action	X
b) discussion on potential projects under way	-
c) active development of new projects	-
8. Does your national strategy and action plan address the issue of alien species?	
a) no	Not applicable
b) yes – limited extent	-
c) yes – significant extent	-

b. Case-studies

9. Has Bangladesh submitted case-studies on the prevention of introduction, control, and eradication of alien species that threaten ecosystems, habitats or species, in response to the call by the fourth meeting of SBSTTA?	
a) no – please indicate below whether this is due to a lack of available case-studies or for other reasons	X - lack of available case studies
b) yes – please give below any views you may have on the usefulness of the preparation of case-studies for developing a better biological understanding of the problem and/or better management responses.	-
10. How many case-studies are available that could be used to gain a better understanding of the issues surrounding alien species in Bangladesh?	
a) none	-
b) 1-2 – limited understanding	X
c) >2 – significant information available	-

c. Transboundary issues

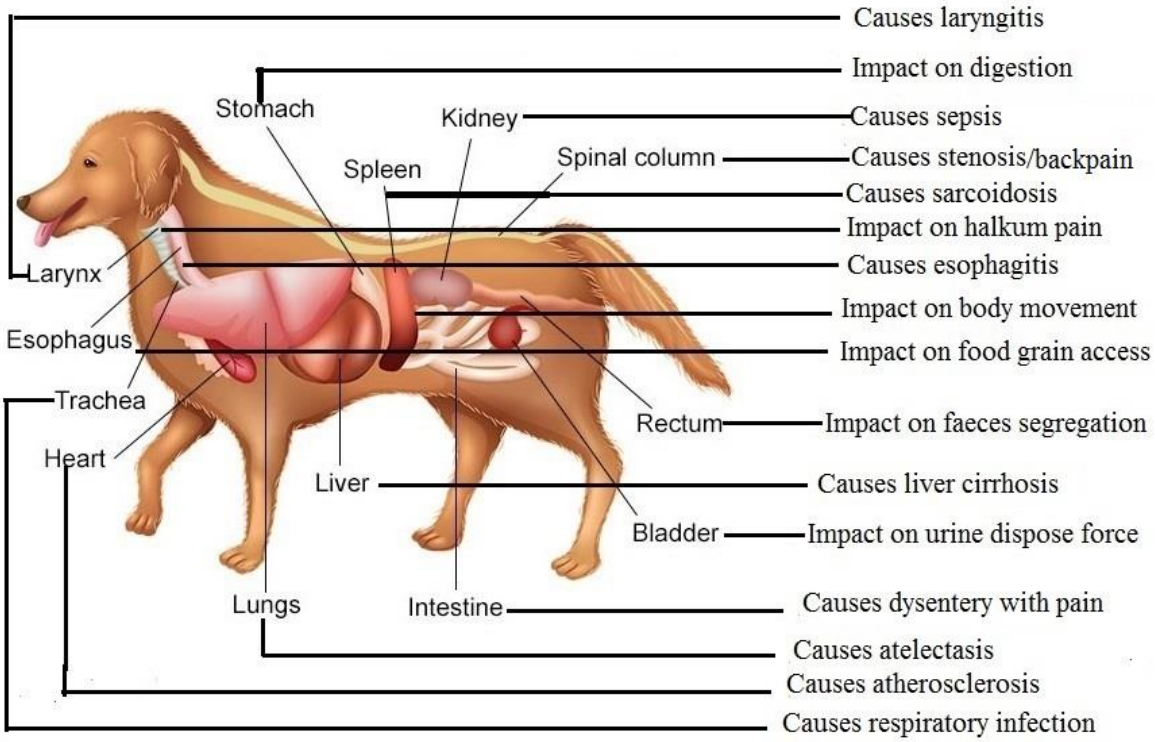
11. Are known alien invasive species in Bangladesh also a problem in neighbouring or biogeographically-similar countries?	
a) not known	X
b) none	-
c) a few – but in general alien invasive species problems are specific	-
d) more than a few - in general we share common problems with other countries	-
12. Is Bangladesh collaborating in the development of policies and programmes at regional, sub-regional or international levels to harmonise measures for prevention and control of alien invasive species?	
a) little or no action	X
b) discussion on potential collaboration underway	-
c) development of collaborative approaches for a limited number of species	-
d) consistent approach and strategy used for all common problems	-

Appendix M: Misuse of Digital Technology on Nature Conservation

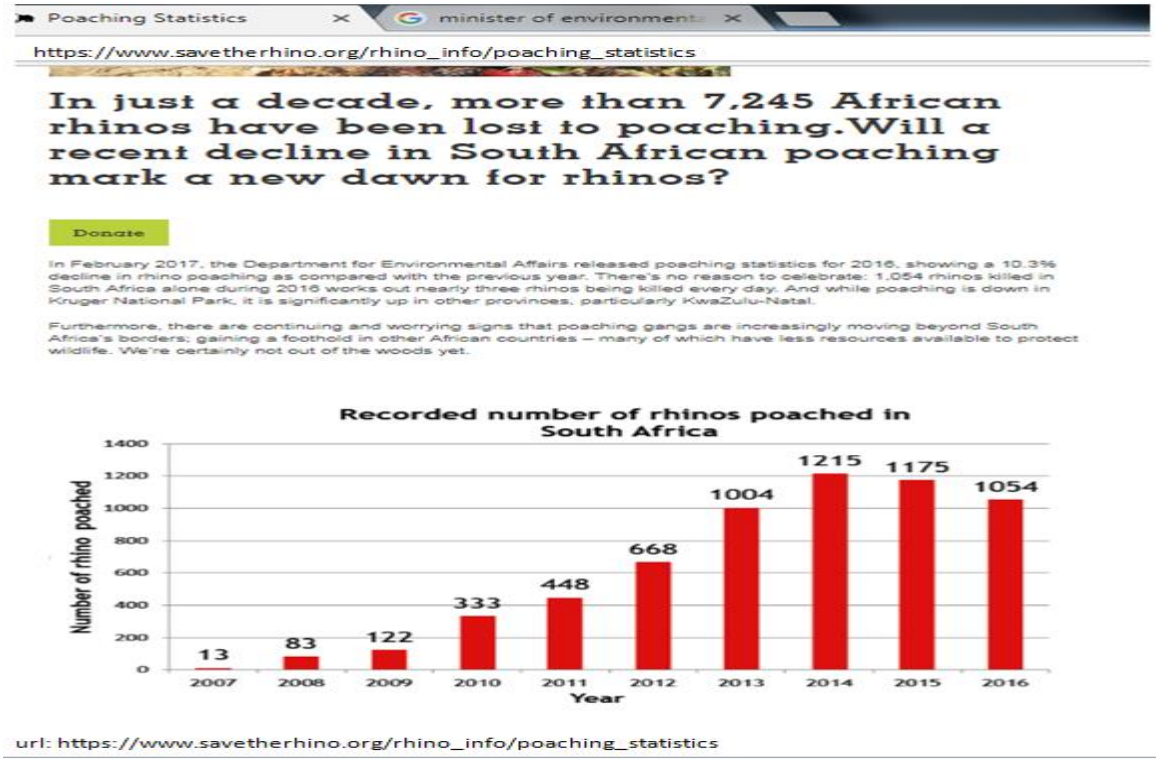
a. Misuse options

i. False Interfacing
ii. Phishing
iii. Pharming
iv. Bouncing
v. Scamming
vi. Blocking
vii. Digital killing (for example: Telematics Software)

b. Global Example: Impact of Sensor Network on Dogs



c. Global News: Impact of Sensor Network on Rhinos



Appendix N: Management Effectiveness of National Park

Management Effectiveness Scores by Assessment Issues of Lawachara National Park (LNP)

Sl.	Parameter	Assessment Score				Obtained score
		3	2	1	0	
1.	Constitutional Status for Biodiversity Protection	√	-	-	-	3
2.	National Park Regulations	√	-	-	-	3
3.	Law Enforcement for National Park	-	√	-	-	2
4.	National Park's Objectives for Biodiversity	√	-	-	-	3
5.	Update National Park's Management Plan	-	√	-	-	2
6.	National Park Conservation Area Design	-	-	√	-	1
7.	National Park Area Boundary/ Demarcation	-	-	√	-	1
8.	Regular Work Plan of National Park	-	√	-	-	2
9.	National Park Resource Inventory	-	√	-	-	2
10.	National Park Digital Conservation & BCHM	-	-	-	√	0
11.	Co-management System for National Park	√	-	-	-	3
12.	National Park Security System for Protection	-	-	√	-	1
13.	National Park's Biodiversity Research	-	√	-	-	2
14.	National Park Resource Management	-	√	-	-	2
15.	National Park Service Staff Training	-	√	-	-	2
16.	Park Management of Budget(Long-medium-short)	-	√	-	-	2
17.	Equipment and Maintenance for Park Management	-	-	√	-	1
18.	Environmental Education and Awareness at Park	-	-	√	-	1
19.	Biodiversity Strategic Planning for National Park	√	-	-	-	3
20.	Access to Benefit Sharing within National Park	-	-	√	-	1
21.	Participation of Indigenous People in Park	-	√	-	-	2
22.	Involvement of Local Community in Park	-	√	-	-	2
23.	National Park Monitoring and Evaluation	-	-	√	-	1
24.	Park Visitors' Facilities (National & Foreigners)	-	-	√	-	1
25.	National Park Entry Fees for visitors	√	-	-	-	3
26.	National Park Connected with WDPA	-	-	√	-	1
27.	National Park connection with IUCN Green Lists	-	-	-	√	0
28.	Removal of IAS Plan from National Park	-	-	√	-	1
29.	Management of Flagship Species of Park	-	-	√	-	1
30.	Develop Systematic Conservation Plan	-	-	√	-	1
31.	Regular Afforestation/Reforestation Programme	-	-	√	-	1
	Total Assessment Score out of 93	18	20	13	0	51
	Management Effectiveness in percentage					(54.88%)

* BCHM means Biodiversity Clearing House Mechanism

Appendix O: Glossary (*ibid*)

National Park: National Park means comparatively large area of outstanding scenic and natural beauty with the primary object of providing public education, research and recreation and managed for preservation of natural state of flora and fauna and outstanding charming scenery and which is an area declared as such through official gazette notification under Section 17 of the Wildlife Conservation and Security Act 2012.

Biodiversity: Biodiversity means the variety and variability of life on Earth at all its level, from genes to ecosystems, and the ecological and evolutionary purposes that sustain it.

Community: Community is a group of plants, animals and organism that occupy a shared environment and interact each other.

*Corridor:*Corridor is a strip of vegetation or other habitat that connects fragmented areas, which may have been historically connected to enable movement between the two fragments.

*Ecological process:*Ecological process is the interaction between organisms, between communities, and between organisms and abiotic resources.

*Ecosystem:*Ecosystem is an assemblage of organisms and the physical environment in which it exchanges energy and matter.

*Endemism:*When an organism is native to, or found, only in one area, is called endemism.

Flagship species
Animals or plants that generate a large amount of popular interest, often used in conservation to protect charismatic species that share habitat with the flagship species.

*Gap analysis:*An effort to use mapping to uncover areas that are not being protected through existing conservation efforts.

*Indicator species:*A species whose well-being is taken to be reflective on the condition of some more general ecological or environmental condition / process.

*Network:*Network is a group of protected areas that are linked each other (for example: WDPA).

*Species diversity:*A measure of the species richness, but weighted to express abundance either based on the number of individuals or biomass of each species.

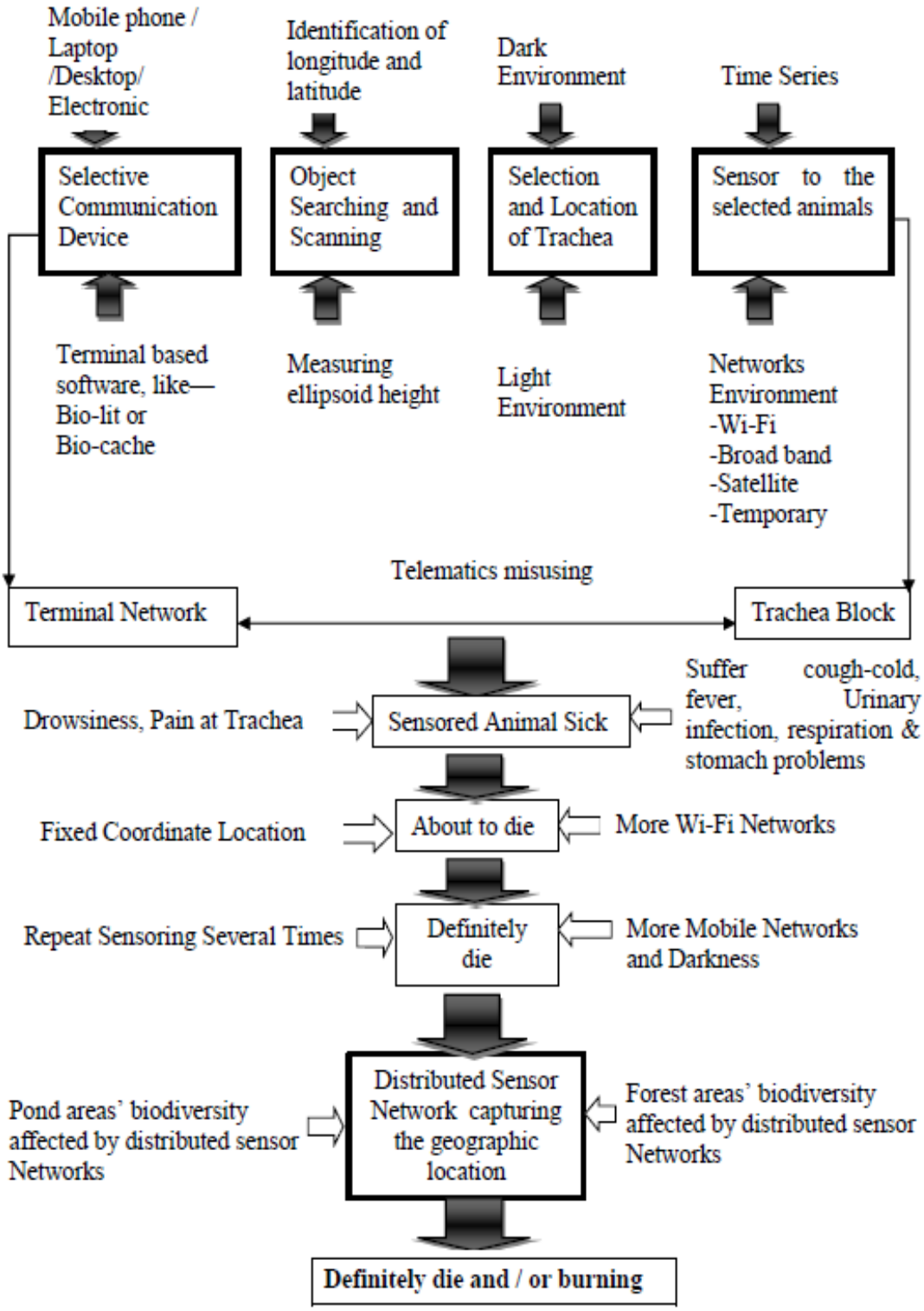
*Stakeholder:*Stakeholder is a person or group of people with an interest in any impact that an action might have.

*Umbrella species:*A species whose protection will also provide protection for other species, usually through habitat preservation.

*Zone:*Zones are the areas within a national park that have different levels of protection.

Conservation Instrument: Conservation instrument is the tool, which enhances the assessment of existing biodiversity status.

Appendix P: Misuse Technological Process towards Animals



Appendix Q: General Model of Environmental Psychology for stimulating conservation of biodiversity

