Agenda Notes for the 15th meeting of Executive Committee of National CAMPA on 20th October, 2021 at 11.00 AM Through video Conferencing

List of Agenda Items for 15th meeting of the Executive Committee of the National Authority through VC

Sl. No.	Agenda Item
Agenda Item No. 1:	Confirmation of Minutes of 14th meeting of the Executive Committee of the National Authority.
Agenda Item No. 2:	Action Taken on 14th meeting of the Executive Committee.
Agenda Item No.	Additional APO for the year 2021-22 of **Himachal Pradesh** State

3:	Authority.
Agenda Item No. 4:	Supplementary APO for the year 2021-22 of **Rajasthan State** Authority.
Agenda Item No. 5:	The proposal submitted by Wildlife Division for "**the establishment of National Centre for Wildlife Forensics (NCWF) at WII."**
Agenda Item No. 6:	Proposal submitted by Project Elephant Division on **"Assessment of Existing and Modeling of Potential Elephant Movement Corridors for Conservation Planning and Management in West Bengal."**
Agenda Item No. 7:	Proposal of WII submitted by Wildlife Division of WII for **"the Nationwide Elephant Population Estimation (Census) 2022."**
Agenda Item No. 8:	Proposal submitted by submitted by Wetlands Division on "**Development of Ex-Situ conservation of endemic tree species and plantation of different taxa including forestry species in eight forest types, 8 phytogeographic regions and 21 thematic sections at Botanic Garden of Indian Republic, MoEF&CC, NOIDA".**
Agenda Item No. 9:	**"Land Degradation Project"** submitted by Desertification Cell for setting up of Center of Excellence at ICFRE
Agenda Item No. 10:	Project proposal submitted by RT Division on **"Management of *Lantana camera* through utilization for improving livelihood of people in forest fringe villages of India."**
Agenda Item No. 11:	**Proposals from States/UTs with regard to facilitating scientific, technological and other assistance** (A) Proposal submitted by Goa State Authority on **"Study of short and long-term impact of Climate Change on Biodiversity of Protected area in Goa by setting up of Automatic Weather Stations".** (B) Proposal for facilitating scientific, technological and other assistance under wildlife wing of State CAMPA, Assam
Agenda Item No. 12:	Deployment of three additional post at ROHQ under the NICSI project' Yearly Maintenance, Enhancement and up-Gradation of Forest Clearance module of PARIVESH.
Agenda Item No.	Update on progress of Projects undertaken under National Fund

13:	by various Institutes
Agenda Item No. 14:	Any other matter with the permission of the chair.

Agenda Item No. 1:

Confirmation of Minutes of 14th meeting of Executive Committee of National Authority

Minutes of the 14th Meeting of Executive Committee of National Authority circulated vide OM of even No. dated **19.08.2021** is placed before Executive Committee for Confirmation.

Agenda Item No. 2:

Action Taken on 14th meeting of the Executive Committee

Para No.	Subject	Action taken Report
1	**Decision:** The action taken report on the decision of the 13th meeting of the EC of the National Authority, held on 7thJune, 2021 was discussed. **Agenda Item No: 3. Approval of Annual Plan of Operation (APO) 2021-22 of Assam State Authority** **Decision:** Assam State Authority has submitted the Annual Plan of Operation for the financial year 2021-22 to the National Authority having a proposed outlay of Rs.97.68 Crores only for the year 2021-22. The Executive Committee, NA has approved Rs.88.13Crore and deferred Rs.9.55Crore out of proposed outlay of Rs.97.68 Crores. With regard to the APO, the following observation was made: **Brahmaputra Rejuvenation Program:** The DPR being	Decision of 14th Executive Committee meeting was conveyed/circulated through letter of even number dated the 19.08.2021.

	prepared by ICFRE is due for implementation. Brahmaputra being a major river and due to recurrent floods, token provision of Rs. 20 lakhs is approved "in-principle", so that preliminary activities can be initiated. State may write to release more funds subject to implementation schedule and progress report. **Survey Demarcation and Geo-referencing of forest boundary using DGPS/ETS in Reserve Forest:** An amount of 3.60 crores (50%) is approved as first instalment. On submission of progress report, remaining amount shall be considered. **Staff amenities for frontline staff/field personnel including in 24 nos. of Biodiversity parks:** State clarified that this activity includes two components: Amenities (40L) and Solar Lights (24L). Only costs of basic amenities i.e 40 Lakhs is approved. **Procurement of satellite phones**: State had submitted problems of no/poor connectivity especially in the interior forest and WL areas including border areas. CEO National Authority, CAMPA enquired whether necessary approval from competent authority like MHA etc is obtained. This proposal may be considered if when necessary approvals from competent authority are obtained by state authority. **Procurement of smart phones:** State clarified that these are required for GPS survey, tracking, monitoring and uploading of data and will be in compliance to the approved software applications of WL tracking, fire warnings and FSI polygon uploading on e-Green watch amongst others. The proposal may be considered subject to the condition that the expenses are non-recurring in nature. An amount of 0.075 crores is approved as first instalment. The phones specification may get vetted from FSI, and the phones shall not be replaced before minimum period specified by the Government **Publicity and Awareness and celebration of Van Mahotsav:** Amount is being reduced to 0.25 Crores (50%) with condition specified in para 2(iii). **<u>Agenda Item No.4: Approval of Annual Plan of Operation (APO) 2021-22 of Delhi State Authority</u>** **Decision:** New Delhi State Authority has submitted	

	the Annual Plan of Operation for the financial year 2021-22 to the National Authority having a proposed outlay of Rs.17.18 crores only for the year 2021-22. The Executive Committee approved Rs. 15.82 crores out of proposed outlay of Rs. 17.18 Crores. **Agenda Item No. 5: Approval of Annual Plan of Operation (APO) 2021-22 of Karnataka State Authority** **Decision:** Karnataka State Authority has submitted the Annual Plan of Operation for the financial year 2021-22 to the National Authority having a proposed outlay of Rs.321.09 Crores only for the year 2021-22. The Executive Committee approved Rs.235.56 crores out of proposed outlay of Rs.377.56 crores. **Agenda Item No. 6 (i-xxv): Approval of remaining Activities in the APO for the year 2021-22 of State Authorities** **Decision:** The Executive Committee discussed APOs of States in detail and approved activities under CAF 2018 rules. The approved activities of APOs and their details States/UT-wise in the 14th EC meeting are annexed at (Annexure B). **Agenda Item No.7 (I): Annual Plan of Operation (APO) 2020-21 obtaining budget sanction for completion of incomplete works (Spill over works) of Chhattisgarh State Authority.** State Authority to provide confirmation from State Finance Department that fund will be released in time this year. The spill over APO and additional APO was approved with this condition. **Agenda Item No.7 (II): Spill over APO of year 2020-21** **Additional APO for the year 2021-22 of Telangana State Authority:** The EC asked State Authority to provide confirmation from State Finance Department that fund will be released in time this year. The spill over and additional APO of Telangana State Authority was approved with this condition. **Agenda Item No. 8: Approval of Funds for the CPC**	

	Green (PARIVESH 2.0) from "CAMPA" has been submitted by IA division. **Decision:** The Executive Committee went through the details furnished in the Agenda Item. It was submitted by AS (IA Division) and his team that EC clearance in the forest area is interlinked with FC clearances as well as wildlife clearances in Protected Areas/ ESZ with the overall aim to conserve forest, ecology, biodiversity and environment. There is a need to have an integrated platform/mechanism for online access, filing of data, management and monitoring of cases through a single window portal of the proposed Parivesh 2.0. This platform when operational will lead to ease of doing responsible business by facilitating the project proponents/applicants to make one comprehensive application for various clearances through a single window and also expedite processing and monitoring of various stages of the application by concerned officers/ authorities. The amount to be released in quarterly installments every year as per demand raised by the program division. Further, in order to rationalize the cost, the project division is to constitute technical monitoring committee as an oversight mechanism to assess and examine the stage of development of the system and also whether the demanded software and hardware are actually required. **Agenda Item No. 9: Approval of a Pilot Project on 'Seed Ball Plantation" to be taken up in the states in collaboration with ICFRE** **Decision:** The Executive Committee deliberated on the details furnished in the agenda item proposed by ICFRE through the NAEB division. The project is to be implemented in 20 states for two years starting from 2021-22 with an objective of deploying low cost innovative technology for complementing massive greening exercise in order to achieve the various National and International green commitments. The Proposed scheme is to be taken up in the states in	

	collaboration with ICFRE. The EC recommended the proposal for approval at a total cost of Rs. 904 lakhs, by the Governing Body of National Authority. **Agenda Item No. 10: Approval of Project proposal on 'Pan India assessment and monitoring of endangered species covered under the 'Integrated Development of Wildlife Habitats' (IDWH) scheme of MoEF&CC Government of India.** **Decision:** The Executive Committee deliberated the details furnished in the agenda item proposed by Wildlife Institute of India (WII) through the Wildlife Division. The aim of the proposal is to fill this data gap with active involvements of State Forest Departments and other relevant agencies for a period of two years, to develop methodological protocol, assess and monitor the population of the species covered under DWH. Cost will also include the capacity building of concerned frontline staff The EC recommended the project proposal for approval at a total cost of Rs.19.05 crores by the Governing Body of National Authority. **Agenda Item No. 11: Approval of Strengthening of CAMPA Office** The CEO, National Authority apprised the EC that strengthening and improvement of the Administrative structure of National Authority of CAMPA is urgently required for smooth functioning. Presently a very skeletal structure is available to carry out all works. This requires creation of posts, appointment of consultant and other officials to man various operations on National Authority. National Authority of CAMPA has become effective with coming into force of CAF Act, 2016 but so far appropriate initiative has not been done to ensure engagement of suitable manpower support for the Authority. National Authority, CAMPA office is presently functioning with bare minimum infrastructure. The office space available at CGO Complex at Block No 03, 4thfloor is very small; cramped accommodation and	

	can't be expanded due to space constraints. There is no proper room for CEO, Jt. CEO, Dy.CEO, AIGFs, Technical Consultant, Finance and Accounting officials and other contractual staffs. There is acute shortage of IT equipment like Desktop and Laptop computers, Xerox machines, printers, scanners etc. It was informed by CEO National Authority that despite these huge shortcomings, lack of minimum required manpower, CAMPA office is trying its best to attend very important following matters/ activities on top priority, but efficiency is badly affected: - **Meeting of Governing Body of CAMPA** As per the CAF Act, 2016, the governing body of National Authority of CAMPA is required to meet once in six months. Last meeting was last held in Nov, 2019. The governing body approves all the schemes recommended by Executive Committee. *Action has been initiated after due approval of HMEFCC to invite nominations for non-official members of the GB. A total of 131 applications have been received as on date. The applications received are being shortlisted and scrutinized for final selection of the members.* **Reconciliation of funds deposited in CAMPA** Reconciliation of funds is done to verify the amount deposited by user agency in lieu of the diversion of forest land. This facilitates calculation of the share of State Authority and National Authority so that the share of State Authority can be transferred to them. There is no account functionary at present to handle this task, resulting in difficulties in timely reconciliation. *Efforts are being made to appoint Account functionary. Reconciliation of accounts currently under progress.* **Confirmation of Amount deposited by User Agency** The amount deposited by user agency in CAMPA is required to be confirmed to facilitate grant of Stage II clearance under FC Act. A large number of such confirmations are pending in CAMPA due to	

	insufficient number of staffs to handle the work. *Efforts are being made for real-time update of confirmation of amounts deposited by User Agencies. This includes proposals received under SBI & PARIVESH 2.0.* **Audit of CAMPA** No audit of CAMPA, both internal and external, has been initiated so far, which needs to be taken up on top priority. The report is to be placed before Governing Body. *Action has been initiated for Auditing of accounts of previous years. (Status to be placed in EC Meeting). A Chartered Accountant has been engaged for this work.* **Payment mechanism** An online payment mechanism with involvement of Reserve Bank of India, CAG and State Authority is proposed to be developed so that the fund deposited by user agency is credited in both State and National Authority in 90:10 ratio. In order to functionalize this, additional staff like financial adviser and adequate equipment are required. *An updated proposal from RBI has been circulated to all concerned for comments/inputs on payment mechanism. Further, a proposal has also been received from SBI after detailed discussions on real-time confirmation of deposits of compensatory levies from User Agencies. The last approved project on PARIVESH 2.0 has included features to monitor and update progress on payment mechanisn and confirmations.* **Approval of APOs** Follow up with states is required to ensure that States/UTs submit APOs in time. Proper scrutinizing and examination of APOs submitted by States is required. The appraisal of APOs of all States takes lot of time in view of very few officials available with National CAMPA. *All pending APOs of all State CAMPA Authorities have been approved for the year 2021-22. The statement of*	

	the progress made placed before the 15th EC. **Approval of schemes** Several scheme recommended by EC needs to be processed on time from CAMPA office. *All approved Schemes have been processed and has been approved by HMEFCC as chairman of the GB of National CAMPA. Further, the Schemes are in different stages of processing for final concurrence of IFD and release of funds through issuing of the respective sanction orders.* Monitoring of implementation of approved State APOs by the States. *State Authorities have submitted an updated list of the progress made in M&E of activities undertaken under CAMPA. The statement will be placed before the 15th EC for discussion and review.* **Decision:** After detail deliberations on the requirements submitted by CEO, National Authority**,** the Executive Committee agreed in principle to the proposal of the National Authority as mentioned in the agenda item regarding strengthening of Office of NA including that of the CEO, Jt. CEO, Dy. CEO, AIGFs, Consultants and Section along with measures to delegate financial powers to NA for meeting demands of increasing workload. The EC decided that the appropriate proposal may be moved to IFD for consideration. *A Sr. Consultant for Monitoring and an Financial Advisor have been appointed after due approval of Competent Authorities for supporting works of the office of NA.* **Additional Agenda item NO. 12: With Permission of the Chairman, Executive Committee** **Dolphin Project Submitted through WL Division:** The proposal submitted by WL Division for range-wide enumeration of River Dolphin populations in India under CAMPA mentioning that the budget is prepared, keeping in mind the resource required for each range state, as well as Wildlife Institute of India	

	and the state budgets may require validation from respective states. The Executive Committee agreed "in principle" to the proposal of WL Division subject to submission of detailed proposal. WL Division to submit revised proposal. **Land Degradation Project submitted by Desertification Cell for setting up of Centre of Excellence at ICFRE** The proposal was deferred. The EC sought further details from the project proponent. Further, EC observed that the costing for infrastructure and manpower may be explored from other sources and also if any existing facilities of ICFRE are being included/utilized. EC was also of the opinion that the funding, if at all from National CAMPA, should be one-time and non-recurring. The SS&FA desired that option of AFRI as location of the Centre should be explored. The PD was asked to explore funding from other sources and submit a revised proposal for consideration before the next EC. **iii. Reassessment Study for modification of Management Plan Sustainable Mining (MPSM) in Saranda and Chaibasa Forest Division in West Singbhum District of Jharkhand submitted by FC Division.** The proposal was submitted by FC Division stating that in pursuance to decision taken in the meeting dated 04.02.2019 (held between Secretary, EF&CC and officials of the Government of Jharkhand and inter-ministerial meeting dated 26.08.2019 held between Hon'ble Minister, EF&CC, Hon'ble Minister, Mines, Hon'ble Minister, Steel, and Hon'ble CM of Jharkhand), the MoEF&CC has assigned a re-assessment study of MPSM to ICFRE. As per the proposal, said Study will be led by the ICFRE with WII, ISM Dhanbad and IIT Kharagpur as member organization. The cost of the proposed study is Rs 3.54 crores, as communicated by ICFRE. This	

	matter is being reviewed at various levels in the Ministry wherein, it was desired that ICFRE, at their own cost, may initiate the short term table top exercise using the available information for this re-assessment study while the detailed assessment may be taken up subsequently by the ICFRE. The ICFRE, in turn, has requested for release of an amount of Rs. 30,29,500/- so that it may initiate the table top study as per ToR approved by the Ministry. The Executive Committee deliberated the details furnished in the agenda item proposed by Forest Conservation division MoEF&CC and recommended the project proposal at the total cost of Rs.3.54 crores by Governing Body of National Authority. The EC further desired that a status report on all the studies & projects undertaken by ICFRE, IIFM, WII and any other premier institutes funded by the National CAMPA should be placed in the next meeting.	

Agenda Item No. 3

File No.NA-15/19/2020-NA

Additional APO for the year 2021-22 of Himachal Pradesh State CAMPA

An additional Annual Plan of Operation for the year 2021-22 with an outlay of Rs 11.00 crores has been received from the PCCF (HoFF), Himachal Pradesh vide his letter No.Ft.CAMPA/2012/Adhoc-CAMPA/APOs/Vol.VI dated 06th October, 2021 after the approval of the Steering Committee of Himachal Pradesh CAMPA in its 4th meeting held on 22.09.2021.

2. The Himachal Pradesh State CAMPA initially submitted APO for the year 2021-22 for activities amounting to Rs.138.10 crores. This was approved by the National Authority and sanction was also issued.

3. The proposed outlay of various forestry activities included in the additional APO (2021-22) are as under:

CAF Rules	**Activity**	**Physical Target (Area in Ha./No.)**	**Financial Target (Rs. in Crores)**	**Remarks**
1.	**Activities as per Rule 5 (2)**			
5(2)(g)	Development of Ponds/trenches/water & snow harvesting structures	44 Nos.	11.00	Details not furnished
	Grand Total		**11.00**	

4. The additional APO of Himachal Pradesh State CAMPA for 2021-22 is placed for consideration before the 15th Executive Committee of the National Authority.

Agenda Item No. 4

File No.NA-15/23/2020-NA

Additional APO for Wildlife Management under CAMPA for the year 2021-22 of **Rajasthan State CAMPA**

An additional Annual Plan of Operation for the year 2021-22 with a proposed outlay of Rs. 2.66 crores have been received from the CEO, Rajasthan State CAMPA vide her letter No. F.14(2)/CAMPA/APCCF/2020-21/4933 dated 24.08.2021. It is pertinent to mention here that the National Authority had approved the additional APO for 2020-21 for Rs 2.75 crores for carrying out GIB conservation works in Desert National Park, Jaisalmer. However, activities amounting to Rs 9.22 lakhs could be completed during 2020-21 due to late release of funds for this purpose by the Government of Rajasthan. Hence, the State CAMPA has sought the approval for carrying out remaining work during current financial year. It is also noted that before submitting the additional APO to the National Authority, fresh approval of the Steering Committee of the State CAMPA has not been sought.

2. The Rajasthan State CAMPA initially submitted APO for the year 2021-22 for activities amounting to Rs 284.92 crores. The National Authority approved the APO for the outlay of Rs. 284.05 crores and sanction was also issued.

3. The proposed outlay of various activities included in the additional APO (2021-22) are as under:

CAF Rule	**Activity**	**Phy. Targets**	**Financial Target (Rs. in Crores)**	**Remarks**
5(2)(i)	Creating predator proof Enclosure in Desert National Park, Jaisalmer at Sudasari RKVY Cluster of Closures (GIB Conservation Work)	LS	2.66	Received without the approval of Steering Committee of the State CAMPA
	Total		2.66	

4. The additional APO of Rajasthan State CAMPA for 2021-22 is placed for consideration before the 15th Executive Committee of the National Authority.

Agenda Item No. 5:

The proposal submitted by Wildlife Division for "**the establishment of National Centre for Wildlife Forensics (NCWF) at WII."**

Wildlife Division of MoEF&CC has submitted a funding proposal amounting to **Rs.82.83 Crores** for "**the establishment of National Centre for Wildlife Forensics (NCWF) at WII**" along with justification regarding seeking funding from the National fund. The period of project is four years. The brief details about the project, budget estimates, justification from Wildlife division and comments/ recommendations of National Authority are given below.

BACKGROUND:

Worldwide illegal exploitation of wildlife and its derivatives strongly influence the levels of attrition of biodiversity. Over the years, illicit wildlife trade has emerged as a form of organized transnational crime that has threatened several wild species across the globe. In 1995, the Wildlife Institute of India (WII) initiated in a modest way through a collaborative project with the U.S. Fish & Wildlife Service (USFWS) to develop protocols for identification of the wild species parts and products for assisting the examination of wildlife crime cases in India and over the years developed a basic research facility supporting decisions in legal cases related to wildlife forensics.

In the present scenario of crime investigation, species identification is an important aspect, but other part of crime investigation has not been addressed, which may help in expanding the vision of investigating teams. Preparation of well-documented repository requires the full support from all zoo park and all state forest departments for collection of the known carcass of the naturally dead animal species. These issues can be addressed by establishing a dedicated state-of-the-art center. Hence, to fulfill the 38Z(v) of the Wildlife Protection Act, 1972, and actionable point No. 1.9 of the theme 'Control of Poaching and Illegal Trade in Wildlife' of the National Wildlife Action Plan (NWAP) 2017-31 of MoEF&CC, WII proposes to establish a 'National Centre for Wildlife Forensics' (NCWF) in collaboration with the WCCB in WII campus.

2. OBJECTIVES OF NCWF:

The aims and objective of NCWF is to fill the gaps in forensic capabilities related to wildlife crimes by developing protocols for dealing with all aspects of criminal science. Finally, established protocols would be disseminated to

crime investigation laboratories in the form of Standard Operating Procedure (SOP). The broad focus area of NCWF is given below:

a. To create the complete repository for Indian wildlife- which is the main gap in dealing with wildlife forensics.

b. To prepare a plan for the advancement of wildlife forensics India

c. To create the required infrastructure (workspace, storage facility, and database) for dealing with all aspects of criminal sciences.

d. To establish working relationships with a national and international institution of repute in the areas of wildlife conservation, zoological research, and wildlife forensics

e. To develop the complete schedule-wise database (as per WPA, 1972) for all protected Indian species.

f. To develop the proficiency for toxicology, morphology, pathology, genetics and ballistic science for dealing with a variety of wildlife offenses

g. To disseminate the acquired knowledge to users through training and manuals

Through NCWF, following dedicated facilities will be created for wildlife forensic investigation India:

i. Morphological Division

ii. Analytical and Ballistic Division

iii. Genetics Division

iv. Toxicological Division

v. Pathology Division

vi. Marine and Invertebrate Division

vii. Botanical Division

viii. Database & Dissemination Cell

3. Annual budgetary outlay (in Lakhs)

S. No.	**Head**	**Ist Year (Rs. in Lakhs)**	**IInd Year (Rs. in Lakhs)**	**IIIrd Year (Rs. in Lakhs)**	**IVth Year (Rs. in Lakhs)**	**Total**
1	Non-recurring (Equipment and Centre)	6718	-	-	-	6718
2	Recurring	-	521.8	521.6	521.6	1564.8

	(Manpower & Consumables)					
3	**Total (Rs. in Lakhs)**	**6718**	**521.8**	**521.6**	**521.6**	**8282.8**

The objectives of the proposal fall within the provisions contained in section 5(b) (iii) of the CAF Act 2016.

Agenda Item No. 6:

File No: NA-13/20/2021-NA

Project Proposal submitted by Project Elephant Division on **"Assessment of Existing and Modelling of Potential Elephant Movement Corridors for Conservation Planning and Management in West Bengal"**

Project Elephant Division of MoEF&CC has submitted a funding proposal amounting to Rs.1.70 crores for Project on "Assessment of Existing and Modelling of Potential Elephant Movement Corridors for Conservation Planning and Management in West Bengal" along with justification regarding seeking funding from the National fund. The project period is of three years. The brief details about the project, budget estimates, justification from Project Elephant Division and comments/ recommendations of National Authority are given below.

Introduction: The negative effects of habitat fragmentation threaten many species today and strategies to reduce their impact have been widely discussed. A proposed method for moderating the negative effects of habitat isolation is the preservation and restoration of linear landscape elements (corridors that structurally link otherwise isolated habitat remnants). These corridors are meant to increase landscape connectivity by facilitating movement of organisms between habitat fragments and thus minimize the risk of inbreeding and extinction, increase local and regional population persistence and facilitate colonization.

Asian elephants are long ranging species with extensive habitat and nutritional requirements. Furthermore, the population biology and genetics of the species require fairly unhindered gene flows across populations to ensure long term viability. In the fragmented, human-transformed landscapes that typify most elephant habitats in Asia today, corridors thus ensure that nutritional, demographic and genetic needs are met. In these kinds of landscapes, corridors are likely to be surrounded by human

settlements.

2. Objectives:

Assessment (present status and change detection) of the of existing elephant corridors in West Bengal.

Identification and mapping of potential elephant corridors in West Bengal using telemetry and other movement data.

Drafting of conservation plan of elephant corridors in West Bengal.

3. Methodology:

Objective 1: The status of the existing elephant corridors in West Bengal will be assessed by doing change detection in the last 20 years and habitat assessment.

Objective 2: Elephant movement will be analysed and pockets in the landscape outside PAs will be identified where they were spending a considerable amount of time while dispersing or exploring using liner time density analysis.

Objective 3: Data from filed about the presence of elephants and other wildlife species, habitat quality and anthropogenic pressure will help us formulate a conservation plan for the identified elephant corridors in the West Bengal.

4. Expected Outcomes:

Present status of existing elephant corridors in West Bengal and the change that is happened over the years.

New corridors based on telemetry and other elephant movement data in the landscape.

Management plan of elephant corridors of Southern and Northern West Bengal

5. Budget Details:

Head	**Component 1**	**Component 2**	**Component 3**
3X Project Associate-I @31,000/- Pm + 16% HRA + medical	13,69,560	13,69,560/-	0

3X Project Associate-II @35,000/- Pm + 16% HRA + medical	0	0	15,36,600/-
3X field staff (Field Assistants/Interns/Volunteers) @15,000/- Pm	5,40,000/-	5,40,000/-	5,40,000/-
Base camp	3,00,000/-	3,00,000/-	3,00,000/-
Hiring of Vehicle for field work @40,000/- Pm with 5 % increase every year	5,60,000/-	5,88,000/-	6,17,400/
PoL	2,00,000/-	2,00,000/-	2,00,000/-
Travel of PI and Project Staff	3,00,000/-	3,00,000/-	3,00,000/-
Field equipment's GPS/Binoculars/ Work station/Data Storage etc.	10,00,000/-	5,00,000/-	0
Satellite data cost	10,00,000/-	0	0
Conservation and management planning workshops	0	0	10,00,000/-
Miscellaneous	1,50,000/-	1,50,000/-	1,50,000/-
Contingency	1,00,000/-	1,00,000/-	1,00,000/-
Subtotal (A)	55,19,560/-	40,47,560/-	47,44,000/-
5% inflation cost	0	2,02,378/-	2,37,200/-
Subtotal (B)	55,19,560/-	42,49,938/-	49,81,200/-
Institution charges (15%)	8,27,934/-	6,37,491/-	7,47,180/-
Grand Total	**63,47,494/-**	**48,87,429**	**57,28,380/-**

Total required budget for the project is Rs.1,69,63,303/- (1.70 crores)

6. Component Details:

Component 1(Duration 1 year)

This can be initiated any time independent of any other component.

Assessment (present status and change detection) of the existing elephant corridors in West Bengal.

Component 2 (Duration 1 year)

This can be initiated any time after receiving telemetry and other movement and conflict data from the West Bengal forest department.

Identification and mapping of potential elephant corridors in West Bengal using telemetry and other movement data.

Component 3 (Duration 1 year)

This can only be initiated once the first two components are completed.

7. The objectives of the proposal fall within the provisions contained in section 5(b) (iii) of the CAF Act 2016.

Agenda Item No. 7:

File No: NA-13/22/2021-NA

Proposal of WII submitted by Wildlife Division for **"the Nationwide Elephant Population Estimation (Census) 2022."**

Wildlife Division of MoEF&CC has submitted proposal amounting to **Rs**.**7.24** crores for the project "the Nationwide Elephant Population Estimation (Census) 2022" received from WII along justification regarding seeking the funds from the CAMPA fund. The brief details about project, budgetary estimates, justification from wildlife division and comments/ recommendations of National CAMPA Authority are given below.

Nationwide Census of Elephant Population in the country-regarding.

As a part of the National Tiger status assessment, data is being recorded on elephant occupancy and relative abundance through the MSTrIPES Ecological application. These include a) Elephant sigh survey in each beat with three replicate walks of 5 Km each in an occupancy framework, b) dung plots to estimate elephant dung density on 2x20m plots on 2-4 Km transects every 400m interval in each beat, c) Distance sampling on a 2-4 Km transect in each forest beat.

The above data provides the basic information on distribution of elephants after correcting for detection probability in an occupancy framework. Distance sampling has not given the desired results for estimating elephant

absolute density because of the dangers associated with close approach to an elephant on a foot sampled line transect.

2. Field sampling protocol for elephant absolute density estimation:
As part of the on-going National Tiger estimation, Polygon search method is being employed for estimation of animal population densities and thereby abundances. This method will be further modified for elephants in certain sites. This will ensure that with the current effort of field sampling being carried out for the tigers and co-predators we will simultaneously be able to apply the same methods for elephants. For ease of sampling and to minimize errors in data collection, the polygon search app, an android app on the lines of the MSTrIPES Ecological module app, will be used. Fresh dung samples of elephant encountered during the polygon survey will be sampled for genetic analysis. First, the diameter of the bolus will be measured so as to be able to sampled for genetic analysis. First the diameter of the bolus will be measured so as to be able to categorize them post-priori into broad age classes (Tyson ET al.2002). About 10-20 gm of the freshest part of the dung, which is not in contact with other boli, will be collected in silica gel. Location information (GPS) of each sample collected will be noted.

3. Laboratory Analysis: DNA extraction from drug samples followed. Fernando et al. (2003), with reagent controls in a spartially segregated room dedicated to low copy DNA extraction. For assigning each drug sample to individual elephants, a select panel of microsatellite markers characterized for Asian elephants (as mentioned above), will be amplified. Subsequently, the probability of identity which provides a relative measure of the degree of match in any random pair of multilocus genotype will be estimated. Multiple tube microsatellite genotyping will be used to determine consensus genotypes and calculate error rates.

4. Analysis: After individual identification from genetic analysis, information on individuals and their distribution in space will be obtained. This data on captures and recaptures of elephant individual across space will be used in a spartially explicit capture re-capture framework to estimate densities.

5. Budget: Most of the Peninsular and Northern India is covered and North-east is partly covered. The area which is not covered under Tiger States need to be funded by PE for elephant estimation. For Phase I money need to be allocated to states (Table 1) and for Phase III money need to be allocated to WII (Table 2)

Table 1: Budget for States

(Amount in Lakh)

State	**Amount**
Arunachal Pradesh	1,42,31,000
Manipur	60,76,000
Meghalaya	55,79,000

Mizoram	56,91,000
Nagaland	39,62,000
Tripura	30,03,000
West Bengal	38,01,000
Total	**42,343,000**

Table 2: Budget for WII

(Amount in Lakh)

SNo.	**Budget Head**	**Details**	**Amount**
1	Genetic Analysis	Chemicals for genetic analysis of dung samples from 20 sampling blocks of varied density gradients	Rs. 2,24,00,000
2.	Man Power	8 research biologists (Salaries, HRA, Insurance, Medical Reimbursements)	Rs. 38,40,000
3.	Equipment	Freezers etc.	Rs. 8,00,000
4	Field Sampling	Field logistics for sampling, chemicals for storage and transportation and field genetic kits	Rs. 2,50,000
5.	Total		Rs. 2,72,90,000
6.	10% Institutional Overhead charges		Rs. 27,29,000
7.	**Grand Total**		Rs. 3,00,19,000

Total Budget required 7,23,62,000 lakhs (7.24 crores)

6. The objectives of the proposal fall within the provisions contained in section 5(b) (iii) of the CAF Act 2016.

Agenda Item No. 8:

Project submitted by Wetlands Division on "**Development of Ex-Situ conservation of endemic tree species and plantation of different taxa including forestry species in eight forest types, 8 phyto-geographic regions and 21 thematic sections at Botanic Garden of Indian Republic (BGIR), MoEF&CC, NOIDA".**

Wetland Division of MoEF&CC has submitted a proposal amounting to **Rs.**2.00 **crores** for the project "the Nationwide Elephant Population Estimation (Census) 2022" along with notes and justification regarding seeking funding from the National fund. The period of project is three years. The brief details about project, budget estimates, justification from NEAB and comments/ recommendations of National CAMPA Authority are given below.

BACKGROUND

The importance of afforestation has been realized in the present scenario of climate change and global warming. Various governments, NGOs and people at community level are now exploring ways to increase the tree cover and restore the degraded ecosystems. Afforestation has multipronged benefits – the most important being the increase of carbon sink and holistic improvement in soil quality to combat desertification. And when the newly created tree cover is with economically important species, it will certainly add to the local economy and livelihood. Several institutes and agencies are engaged in R & D for developing afforestation procedures, which of course is the need of hour. We must also look to develop models which would address the holistic development of tree cover as well as to create microclimatic zones to improve fertility, quality and moisture retaining capacity of the soil. Several factors need to be looked into for developing such models. These include selection of site, analysis of environmental factors like climate, soil, local vegetation, anthropogenic activities etc. and finally, selection of plant species, plantation procedure and establishment of nutrient cycle.

With this background, present project has been proposed to develop such a model at BGIR, Noida which would definitely help people to go for ecosystem restoration and increase of carbon sink.

2. SCOPE OF THE WORK

The master landscape plan of BGIR, Noida has been approved by the Ministry of Environment, Forest and Climate Change, Government of India. Through this master plan, the ministry plans to set up within 164 acres, eight forest types representing different phytogeographic regions, 21

thematic sections, taxonomic gardens, tropical and temperate conservatories including hi-tech green houses for Orchids, Ferns, Cacti and other succulents. The scope of work under the proposed project include large scale plantation of indigenous tree species and develop a model afforestation site with holistic improvement of soil quality. Microclimatic conditions will be established by planting the associated floristic elements for creating a nutrition chain.

3. OBJECTIVES:

To develop a model afforestation site which would address gross improvement of tree cover, soil quality and establish a nutrient chain.

4. GOALS/ VISION:

Promoting nature conservation through Research and Development, training and environmental education.

Serving as center of excellence for conservation research and training.

Improvement of Carbon Sink through sustainable afforestation and establish community – forest linkage.

Re-establishing the traditional system of maintaining soil fertility and quality.

5. ACTIVITIES UNDER THE PROPOSED WORK WITH METHODOLOGY (YEAR WISE)

First year

Activities/ Deliverable	**Methodology**
Selection of site and recording of environmental parameters including soil quality	The approved Master Plan of BGIR, Noida has designated areas representing eight forest types and phyto-climatic zones. These eight identified areas will be selected for this project. The primary environmental parameters will be noted which include rainfall, atmospheric temperature, pressure, soil quality, fertility and moisture retaining capacity.
Selection of species and associated vegetation	At least 50 tree species will be selected for each phytogeographic regions and forest types with a multiple of at least 1000 seedlings for each species. The associated vegetation for every selected species will be recorded in natural condition and their seeds/ planting materials will be collected for simulation of such association in

	ex-situ condition.
Collection and development of planting material	The planting materials will be collected from all phyto-geographical regions of India through field tours and procurements from respective regional centers of Botanical Survey of India. Planting materials will also be raised in the nurseries through seeds, cuttings and other effective methods.
Preparation of plantation beds and/ or pits	Plantation beds and pits will be prepared as per the standard methods depending on the nature of species.
Development of infrastructure for improvement of soil quality; augmentation of irrigation facility	Soil and moisture conservation work (Soil layering, soil mulching (organic and inorganic mulching) Drip irrigation work, sprinklers, foggers Vermi-composting/ Organic and inorganic manuring Setting up of nursery blocks for plant multiplication. Laying of water channels from centrally located water source for setting up aquatic plants garden, Hedge Fencing, Nature trail/ Pathway. Setting up of three Hi-Tech conservatoires for cactus & succulents, Orchids and ferns. Establishment of tube wells
Plantation of seedlings and maintenance	Seedlings and planting materials will be planted in the designated beds or pits. Regular maintenance and up keeping will be done by watering, manuring, installation of tree guards and removal of weeds.
Periodical recording of soil health	Recording of data pertaining to soil temperature, pH, salinity, humus/ organic matter content, moisture and water retaining capacity will be done at six-months interval. All the data will be correlated with the initial information recorded at the beginning and also with a control plot where no plantation done.
Recording of survival percentage	All the planted seedlings will be monitored for finding the survival percentage in six-month interval. Flowering and fruiting behavior will also be recorded to establish their adaptability.
Establishing the microclimatic zones and mini-ecosystems	Germplasm of native associated vegetation will be planted alongside the tree species. Leguminous species will be planted to maintain the nitrogen cycle.

	Grasses and sedges with clustered and fibrous roots will also be planted to increase humus and organic matter. Organic composts and FYM will be applied for replenishment of microorganisms. Natural water reservoirs will be established for recharge and maintenance of ground water table.

Second year

Activities/ Deliverable	**Methodology**
Collection and development of planting material	The activities of first year will be continued.
Preparation of plantation beds and/ or pits	The activities of first year will be continued.
Development of infrastructure for improvement of soil quality; augmentation of irrigation facility	The activities of first year will be continued.
Plantation of seedlings and maintenance	The activities of first year will be continued.
Periodical recording of soil health	The activities of first year will be continued.
Recording of survival percentage	The activities of first year will be continued.
Establishing the microclimatic zones and mini-ecosystems	The activities of first year will be continued.

Third year

Activities/ Deliverable	**Methodology**
Collection and development of planting material	The activities of first year will be continued.
Preparation of plantation beds and/ or pits	The activities of first year will be continued.
Development of infrastructure for improvement of soil quality; augmentation of irrigation facility	The activities of first year will be continued.
Plantation of seedlings and maintenance	The activities of first year will be continued.
Periodical recording of soil health	The activities of first year will be continued.
Recording of survival percentage	The activities of first year will be continued.
Establishing the microclimatic zones and mini-ecosystems	The activities of first year will be continued.

Documentation and technology transfer	The planted species will be digitized, labeled with signage and provided with unique barcode ID. The entire process of afforestation and the model for sustainable maintenance of soil quality will be documented. The know-how will be shared with the common people through workshops and environmental education campaigns.

6. Introduction about the area where the activities are to be undertaken

BGIR was established by Botanical Survey of India under the Ministry of Environment, Forest and Climate Change, Govt. of India in April, 2002. BGIR is being developed on land measuring 164.85 acres which would serve as a nodal Centre for ex-situ conservation research and environmental education. It also aspires to develop into one of the most uniquely landscaped Botanic Garden of modern times and as a Centre of Excellence for conservation and research. At present the garden is having about 7215 fully grown tress of 180 species and also maintains herbarium under the acronym 'BGIR' with nearly 1500 specimens of angiosperms collected from BGIR and NCR.

BGIR is situated at 28°33'27" N to 28°34'00" N latitudes and 77°19'16" E to 77°20'13" E longitudes, with altitude ranging from 197 to 202 m above MSL. The Garden is located in flood plain of river Yamuna having alluvial soil known as khaddar, which represents fairly coarse sand with very fine texture on surface soil (grayish-brownish to grey) depending upon depth. Soil is deficient in nitrogen, humus and phosphoric acid. However, it contains high percentage of soluble salts of sodium, calcium and magnesium as pH of soil is alkaline and moisture content is very-very low during most part of the year. Before establishment of this garden land area was under cultivation of cereals/ vegetables. The garden is being developed for ex-situ conservation, with plant specimens collected from all over the country in different seasons. The collected specimens are put under nursery care for acclimatization before being released for plantation in the respective designated zones.

The garden has been working as a repository of live plants and has been acting as a hub for ex-situ conservation and environmental education. It has high footfalls as tourists, students, visitors, enthusiasts and amateurs. It also provides opportunity for doing research in various aspects of plant biology like propagation of threatened and endemic species, maintenance and conservation of their germplasm, hybridization for horticulture purposes. BGIR aims to develop major forest types of India, phyto-diversity region of the India, 21 thematic sections (Trellis garden, curious garden, sacred garden, Rosery, Bonsai Garden, Discover Garden, Evolutionary Garden, Garden of smell and touch, Insectivorous plant section, Cacti and

succulents, etc.), Taxonomic Garden which will show case the major objective of ex-situ conservation for native plant resources of India. In addition to above, BGIR also aims to conserve the soil and moisture level of the present soil physiography of the locality, with various organic and inorganic soil amendments methods, vermin-composting, drip irrigation, and sprinkler.

7. TIME SCHEDULE & COST ESTIMATES

Sl.No.	Activities	1st Year	Financial Output/Deliverable in lakhs (A)	2nd year	Financial Output/Deliverable in lakhs (B)
1	Plantation: Plants collection Nursery development Vegetative prorogation /Net House/Nurseries Organic fencing/Hedging Grassing Avenue plantation	1. About 500 Endemic plant species of about 10,000 plant saplings will be collected from different part of India and conserved in 8 Phyto-diversity Sections, Taxonomic Garden, Forest Types and 21 thematic sections. In addition to above Hedges, climbers, avenue Trees, ornamental grasses will also be collected for plantation and beautification 2. Nursery block will be prepared in an area of 5 acres. The plants propagation, multiplication work	Rs. ~ 50,00,000/- Collection and transportation charges from BSI NRC, AZRC, SRC, WRC, DRC, APRC, ASSAM, CRC, CSIR-NBRI, CMAP, Forest nurseries, to BGIR, BSI, NOIDA, which includes saplings from different seasons. Plants will also be collected from forest dept-Nurseries of India and transported to BGIR Noida. ~ 20,00,000/- 5 acres = ~20,000 m2 cost of developing 1m2 nursery block = Rs. 100/m2	1. Plantations of already collected plants in respective forest types/Arboretum /Phytodiversity regions/ thematic sections. 2. Hedge & Avenue planation along the sections/zones 3. Grassing in the sections with Niligiri grass/Bermuda grass/Selection-1 4. Hi-Tech Nurseries/Net Houses for conservation of Cactus & Succulents, Orchids, Ferns, plants collected.	Rs. 3, 00,000/- Labour charges of 30 malis 10,000 per month for 3 months of rainy season Rs. 17,00,000 (Annex II for details)
2	Soil and Moisture conservation Soil layering Organic fertilizer In- organic fertilizer Water	1. Phyio-chemical analysis of Soil and water. 2. Application of forest soil from nearby forests rich in humus. 3. Application of	~ Rs. 1,00,000/- Rs. 8000/ sample for soil at IARI Pusa Soil division unit Rs. 2000/ sample for	1. Water Channelization as per the approved master landscape plan. 2. Laying of underground network of Drip	Rs. 30,00, 000/- (1) Rs. 32,00,000/- (2, 3) Rs. 62,00,000/- Details below Fogger discharge range: -7.0 LPH, Operating

	Channelization Drip irrigation Sprinkler irrigation Tube wells	FYM, inorganic fertilizers to improve the soil physiochemical status. 4. Setting up of Tube wells at different locations of the Botanic Garden.	water at Faridabad institute. Rs. 2,00,000/- Labor and transportation charges ~ Rs. 2, 00,000 Rs. 12, 00,000/- for 5 bore wells of 11 hP each Costing: upto above 200 feet- 100 rupees plus taxes and pipe cost is total about 25000/- plus Rs. 55,000 equipment cost plus Rs. 10,000 labour cost each	Irrigation system in Forest Types, PD Regions 3. Installation of Sprinklers in Horticulture sections. 4. Purchase of HDPE/LDPE sheets.	Pressure: -4.0 bar, Density of one fogger: -4.0 m, Mister /Fogger Make :- NANDAN (Israel) / Netafim (Israel) Head Control Unit- The same head control to be used for humidity & irrigation. Microfogging / Micromisting :- Installation with leakage prevention device (LPD) fogger does not drip during the function. Working pressure: - 4 bar at this pressure, the average droplet size:- 50 to 100 µm. Density :- One fogger to 0.3 m – 0.4 m^2 for propagation. Patten: - four way nozzle, hanging type. Pipe Imported; - 16 mm LLDPE (10 kg/cm^2) color BLACK . Motor:- 1 HP monoblock pump (Crompton/ servo) :- 1 No. Filter (Screen) :- Kelba (ISI) Pressure meter:- 10 bar one. Return gutter, control valve assembly Tank:- 500 litres PVC pipe :- 32 mm/ 25mm. Rs. 7,00,000/- Rs. 70 / meter, Min order 500 meters Total 10000 meters
3	Operational work Setting up of	1. Setting up of Vermi-compost units (Collection	~ Rs. 9,00, 000/- (HPDE Organic	1. Laying of nature trail/pathways	Rs. 15,00,000/- Synthetic Herculan track

	Vermicompost unit Plant boards/ label Image processing and digitization of endemic plant wealth of BGIR Noida Bar-coding in each trees. Nature trail/pathways Image processing and digitization of BGIR endemic plants	of earthworms, FYM, Enzymes Composting Machine/OWC) 2. Labels/Plant tags for each plant planted as well as existing plants. 3. Bar coding systems.	Vermi compost Bed 12 ft X 4 Ft X 2 Ft HQM => Rs. 1,846/- X 30 nos = 55,380/- ; 1 KG Earth worm = Rs. 449/- 100 Kgs X 449 = 44900/-; Composting Machine (ECOBOT Fully automatic organic waste convertors, Daily procession capacity 1000 Kgs, Size 15.2 X 4.7 X 6.9 ft., Power kW 31 = Rs 6,00,000/- (Inclusive of taxes and AMC) ~Rs. 3,00,000/ Rs. 30/- per tag/ labels for 10,000 plant accessions Rs. 1, 00,000/- I5, 7 generations, Intel Pentium core processor computer (Rs. 65,000/-) and Barcode printer for commercial purpose (Rs 35,000/- including AMC)	in an area of 4750 sq feet area in the Forest types of Botanic Garden. 2. Labeling of plants through Bar code 3. Image processing and digitization of all plant species in BGIR and generating meta bar-coding data for all the plants	floring @ Rs 290/ square feet Rs. 1, 00,000/- Rs 5 per lable for 10,000 plant saplings new + 6000 old plants+ nylon tags Rs. 2, 00, 000/- Low light processing camera along with software Nikon D 5300 (Rs. 1 Lakhs) along with one Computer dedicated for Metabarcoding work (Rs. 75,000) Electricity backup Invertor and UPS (Rs. 25000)
		Total	**Rs. 91,00,000 (A)**	**Total**	**1,09,00,000/- (B)**
GRAND TOTAL A+B => 91,00,000 + 1,09,00,000 = 2,00,00, 000 (Two Cr. rupees)					

8. POTENTIAL BENEFITS/SIGNIFICANCE

Climate change has emerged as one of the greatest challenges faced by human society, and the urgency of this challenge continues to grow as the climate continues to warm. Botanical gardens have a special role to play in investigating climate change because they have large collections of living plants that can be used for scientific investigations, they have botanical expertise, and they are places where the public comes to learn about plants. Their impacts on climate change research and climate change have already

been substantial. New technologies and initiatives at botanical gardens around the world are providing new research opportunities. We encourage botanical garden staff, researchers, and science communicators to continue to work together to advance climate change-related science, conservation, and public engagement. Further, Botanic Gardens are the major reservoir of ex-situ conservation of extinct, threatened and endemic plants of the country under a condition when there is a threat to plants wealth. In addition of ex situ conservation of plants an Environment education and awareness is the another benefit which can be availed from Botanic Garden sustainability via plant, soil and moisture conservation in long term.

Measurable Outcomes/Benefits

1 Integrated plant conservation (in situ-ex situ)

2 Environmental impact assessment

3 Horticulture training and research

4 Implementation of CBD in general measures for conservation and sustainable use, identification and monitoring, suitable use of components of biological diversity

5 Research Training, national and international workshop and seminars

6 Public education and environmental awareness

7 Technical and scientific cooperation

8 Seed banks, herbaria

9. MONITORING AND EVALUATION

Ministry of Environment, Forest & Climate Change has already constituted a Steering Committee to oversee the development of BGIR Noida, therefore the Steering committee will be fully responsible to monitor the progress of work under the project.

10. The objectives of the proposal fall within the provisions contained in section 5(b) (iii) of the CAF Act 2016.

Agenda Item No. 9:

"Land Degradation Project"

submitted by Desertification Cell for setting up of Centre of Excellence at ICFRE, Dehradun

This proposal was placed before the 14th EC meeting and discussed by the committee in detail. However, the proposal was deferred as the Committee desired that more detail information needs to be submitted by the Desertification Cell.

Desertification Cell has submitted a revised proposal amounting to **Rs.66.44 crores (**period of 5 years**)** for setting up of Centre for Excellence (CoE) at ICFRE, Dehradun. The background detail about CoE, budget estimates, justification from Desertification Cell and comments/ recommendations of National Authority in this regard are given as below:

Brief on Centre of Excellence

This is regarding the proposal of setting -up of a Centre of Excellence on Sustainable Land Management and South-South Cooperation at Indian Council of Forestry Research and Education, Dehradun.

2. As per the Desertification and Land Degradation Atlas of India, 2016, the current extent of land degradation is estimated to be 96.4 million hectares covering 29.3% of the geographic area of the India. Ministry of Environment, Forest and Climate Change, Government of India has planned to support an initiative to enhance South-South Cooperation by developing a Centre of Excellence at Indian Council of Forestry Research and Education (ICFRE) in order to develop scientific approach, facilitate induction of technology and knowledge sharing for addressing land degradation issues.

3. The proposed Centre of Excellence is being setup at ICFRE, Dehradun keeping in view the expertise and experiences of the Council in implementing national programme and project on sustainable land management.

4. In this context, it may be mentioned here that the objectives and coverage of the Centre of Excellence on Sustainable Land Management and South-South Cooperation will not overlap with projects/ schemes being implemented by the same or another agency.

5. Department of Expenditure, Ministry of Finance has also given in-principle approval in this regard with the following conditions:

i) The announcement does not envisage formation of a new body;

(ii) Any costs for the body shall be met by offsetting savings in the budget of the Ministry. No additional funds will be provided.

2. Background /Context:

The Hon'ble Prime Minister of India on 9th September 2019, while addressing the High-Level Segment of Fourteenth Conference of Parties (COP 14) to United Nations Convention to Combat Desertification (UNCCD) held in Delhi made an announcement to set up a Centre of Excellence at Indian Council of Forestry Research and Education (ICFRE) in order to further develop scientific approach and facilitate induction of technology on land degradation issues. The main role of the Centre would be to share knowledge and technology amongst developing countries Parties of UNCCD to arrest further land degradation and restoration of degraded lands.

3. Objectives

i. The Centre of Excellence shall provide technical support to National and the sub- national (state) level in India and other developing country parties of UNCCD under south-south cooperation for sustainable land management and achieving land degradation neutrality target by 2030.

ii. Providing technical support to Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India in achieving the LDN targets.

iii. Facilitating MoEF&CC in implementation and monitoring of transformative pilot projects.

iv. Providing training to stakeholders for targeting their ongoing interventions in degraded land and uploading related information in online Tracking Mechanism.

v. Networking of national and international institutions working on sustainable land and ecosystem management for knowledge sharing and exchange

vi. Providing technical support to country parties in interpretation of land degradation processes classification system and detailed land degradation mapping from satellite images with the help of National Remote Sensing Centre, Space Application Centre, Indian Institute of Remote Sensing, Forest Survey of India and National Bureau of Soil Survey and Land Using Planning etc.

vii. Facilitating MoEF&CC in periodic reporting to UNCCD Secretariat through UNCCD PRAIS portal.

viii. Development and standardization of protocols for monitoring of land productivity and carbon stocks.

ix. Research and mapping/ documentation of ongoing SLM schemes and programmes related to sustainable land management

x. Research on Gender mainstreaming in implementation of sustainable land and ecosystem management programmes/ projects/ schemes for achieving LDN targets

xi. Developing Knowledge dissemination hub related to sustainable land management

xii. Technical support in working out of financial solutions for implementation of sustainable land and ecosystem management programmes/ projects/ schemes of for achieving LDN

xiii. Academic programmes including online courses related to sustainable land management

xiv. Provide technical support to the Ministry of Environment, Forest and Climate Change, Government of India in implementation of Convention (UNCCD)

xv. Monitoring of the LDN targets achievements through interactive portal development.

xvi. Shall contribute to transfer technology in achieving LDN targets and land restoration under South-South cooperation

4. Indicative Outcome:

i. Formulation of Policies, Strategies and Sustainable Land Management (SLM) Frameworks in relation to Sustainable Development Goals (SDGs), land tenure management and related land rights issues.

ii. Monitoring and assessment of land based indicators identified by United Nations Convention to Combat Desertification (UNCCD) and associate reporting to UNCCD through the online Performance Review Assessment of the Implementation System (PRAIS) portal.

iii. Assessment of land degradation status, land degradation neutrality (LDN) targets, drought risk and early warning systems, sand and dust storms, land degradation induce force migration and displacement and gender mainstreaming, good governance of land tenure and land rights.

iv. Publication of articles, journals, research papers and books related to sustainable land management.

v. Availability of information related to best practices on indigenous knowledge for combating desertification, restoring degraded land, mitigating drought, soil and water conservation, carbon sequestration, livelihood improvement, gender empowerment, poverty eradication etc.

vi. Certificate, diploma, degree, doctoral and post-doctoral courses. In subjects related to sustainable land management through

vii. Collaborate with international agencies for effective knowledge exchange related to assessment of land degradation status, LDN targets, SLM practices, drought risk and early warning system, sand and dust storms, land degradation induce force migration and displacement, gender mainstreaming, good governance of land tenure and land rights, land induced climate change and bio-diversity loss.

viii. Dissemination training and knowledge to international stakeholders on above issues in line with understanding and achievement of SDGs.

ix. Availability of compiled information on best practices of sustainable land and ecosystem management worldwide and dissemination to the international stakeholders.

5. Target Beneficiaries:

The Centre of Excellence on Sustainable Land Management and South-South Cooperation shall have national mandate; however, it will provide necessary technical and capacity building supports to the developing countries Parties of UNCCD on land degradation issues under South-South Cooperation.

6. Manpower Requirement:

S. No.	**Profile/ Division**	**Senior Consultant**	**Junior Consultant (A)**	**Junior Consultant (B)**	**Total number of positions**
Functional Divisions					
1	Land Resources Division	01	01	02	04
2	Climate Change Division	01	01	01	03
3	Biodiversity Division	01	01	01	03
4	IT and Knowledge Management Division GIS & RS Services Division	01	02	-	03
5	International Cooperation Division	01		01	02
6	Communication and Outreach Division		01	01	02
Support Services					
7	Administration & Procurement, Stores & Infrastructure		01	02	03
8	Accounts			02	02
Total					22

All the Functional Divisions will be headed by the regular staff (either on position or to be engaged on deputation from its sanctioned strength) of ICFRE

i. Senior Consultant: Contractual engagement @Rs.80,000/- per month (consolidated) with 0% to 8% increase in every year based on the performance.

ii. Junior Consultant (A): Contractual engagement @Rs.60,000/- per month (consolidated) with 0% to 8% increase in every year based on the performance.

iii. Junior Consultant (B): Contractual engagement @Rs.40,000/- per month (consolidated) with 0% to 8% increase in every year based on the performance.

7. Budget requirement:

Year wise cost estimates along with a break-up of non-recurring and recurring expenses for Phase I of Setting up of Centre of Excellence on Sustainable Land Management and South-South Cooperation and its operationalization are as under:

S. No.	**Particulars**	**Budget Requirements for Phase I (Rs. in Crore)**					
Recurring Expenses		Year 1	Year 2	Year 3	Year 4	Year 5	Total
1	Hiring of individual consultants and salary etc.	1.5	1.6	1.75	1.85	2.00	8.70
2	Capacity building programmes including workshops/seminar /training	0.2	0.44	0.48	0.48	0.48	2.08
Total Recurring Expenses		1.7	2.04	2.23	2.33	2.48	10.78
Non-Recurring Expenses		Year1	Year2	Year 3	Year 4	Year 5	Total
Refurbishing of existing building Total area 10,000 (Sq.Ft) Costs @ 2500/Sq.ft		2.50	-	-	-	-	2.50
Laboratory Total area 20,000 (Sq.Ft) Costs @3500/Sq.ft plus Electrical and furniture cost @1150/sq.ft		-	3.00	4.00	2.30	-	9.30
Training facilities Total area 30,000 (Sq.Ft) Costs @ 3500/sq.f plus Electrical and furniture cost @1150/sq.ft		-	5.00	5.00	3.95	-	13.95
Equipment for laboratory and its		10.91	-	5.00	4.00	-	19.91

consumables, spares and other related issues including maintenance; Computers, laptops, Plotters etc and Books for Library including digital library						
IT infrastructure including Networking set up, productivity Software and other soft wares	1.00	5.00	3.00	-	-	9.00
Roof top solar system Total area 17,000 (Sq.Ft) 1KV required/100Sq.ft @80,000/-	-	-	-	1.00	-	1.00
Total for Non-Recurring	14.41	13.00	17.00	11.25	-	55.66
Total	**16.11**	**15.04**	**19.23**	**13.58**	**2.48**	**66.44**

8. Justifications:

Recurring Expenditure:

i. It includes hiring of manpower. It will be done on contractual basis and the remuneration has been taken as per the Ministry's guidelines. These contractual employees will be working under the regular staff of ICFRE in every department.

ii. Capacity Building, being it's one of the core mandate, the Centre of Excellence is required to be supported in the 1st phase for a period of 5 years and thereafter it will be self-sustainable.

Non-recurring Expenditure:

i. To begin with the renovation of Building as well as well as Classroom is required. Keeping in view the international standard in mind Hostel accommodation for the international students, faculties etc. needs to be refurbished.

ii. The Centre of Excellence should have a state of the art laboratory infrastructure having all the laboratory equipment of the relevant field and the Laboratory should also have a demonstrative area having world class facilities. The office as well as classrooms are required to be housed with proper furniture and overall infrastructure are required to be developed.

iii. Lab equipment and Office equipment is required for practical training and research.

iv. IT infrastructure is required keeping in view to enhance the capability of training rooms and other allied works including the requirement of hardware and software and development of a state of the art knowledge system.

Budget Requirements for Phase I
(Rs. in Crore)

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Recurring Expenses	1.7	2.04	2.23	2.33	2.48	10.78
Non-Recurring Expenses	14.41	13.00	17.00	11.25	-	55.66
Total	**16.11**	**15.04**	**19.23**	**13.58**	**2.48**	**66.44**

The objectives of the proposal fall within the provisions contained in section 5(b) (iii) of the CAF Act 2016.

Agenda Item No. 10:

Project proposal submitted by RT Division on **"Management of *Lantana camera* through utilization for improving livelihood of people in forest fringe villages of India."**

RT Division of MoEF&CC has submitted a proposal amounting to Rs.43.26 crores for the project "Management of *Lantana camera* through utilization for improving livelihood of people in forest fringe villages of India" along with notes and justification regarding seeking funding from the National fund. The period of project is five years. The brief details about project, budget estimates, justification from RT and comments/ recommendations of National CAMPA Authority are given below.

Lantana camara L., an invasive terrestrial weed of South and Central American origin has huge impact on the native composition of terrestrial ecosystem. It has now naturalized in approximately 60 countries and is regarded as the world's 100 worst notorious weeds. At present it is considered to be extremely adaptable and prolific. Global efforts are being made to control this invasive species as this is considered to pose significant threats that are difficult to reverse. Effective management of Lantana require an integrated comprehensive approach covering development of technique for assessing the spatial extent of Lantana invasion, eradicating the Lantana and restoring the invaded area with the participation of various stakeholders and utilization of the eradicated biomass for improving the livelihood of the people. Hence, the present comprehensive project proposal is grouped into the following three components (objectives);

1. Component: A: Spatial spread of Lantana and other Invasive Alien Plants

2. Component: B: Eradication and restoration of Lantana invaded areas
3. Component: C: Utilization of Lantana for improving the livelihood of people

This project will focus on socio - economic benefits to the local community in terms of their livelihood concerns and scale utilization for industrial usage of lantana bio - resource and minimizing the negative ecological impacts of its removal.

The total cost of the project is Rs. 4326.44 lakhs. The duration of the project is 5 years.

Organizations involved in the project proposal:

a. ICFRE and its institutes

i. Institute of Forest Genetics and Tree Breeding, Coimbatore

ii. Forest Research Institute, Dehradun

iii. Rain Forest Research Institute, Jorhat

iv. Himalayan Forest Research Institute, Shimla

v. Institute of Forest Productivity, Ranchi

vi. Institute of Wood Science and Technology, Bengaluru

vii. Tropical Forest Research Institute, Jabalpur

viii. Institute of Forest Biodiversity, Hyderabad

ix. Arid Forest Research Institute, Jodhpur

b. Wildlife Institute of India, Dehradun

c. Indian Plywood Industries Research & Training Institute (IPIRTI), Bengaluru

d. Indian Institute of Forest Management, Bhopal

e. National Remote Sensing Centre, Hyderabad

f. CSIR - Indian Institute of Petroleum, Dehradun

g. State Forest Departments (Himachal Pradesh, Madhya Pradesh, Jharkhand, Odisha, Telangana, Kerala, Rajasthan, Assam, Mizoram, Arunachal Pradesh and Tripura

Budget break-up

Head of Expenditure	**1st Year**	**2nd Year**	**3rd Year**	**4th Year**	**5th Year**	**Total (Rs. in lakhs)**

Project Scientist (03 years; Rs. 56,000/month + HRA (16%) JRF (First two years, Rs. 31,000/month + HRA (16%), 3rd year Rs.35,000/ month + HRA (16%)	154.31	154.31	160.82	45.91	45.91	561.25
*PA (Rs. 18,000/Month)	40.58	40.58	39.58	10.80	10.80	142.34
Consumables	40.95	38.57	34.78	6.50	6.00	126.80
Travel &Training cost** for 8-10 no. oftrainees in each training	76.70	78.60	65.30	8.00	7.00	235.60
Contingency	69.50	58.64	62.02	9.00	8.00	207.16
Non - Recurring : Permanent Equipment	273.00	49.00	2.50	1.00	1.00	326.50
Institutional Charges 20%	90.37	59.79	52.64	12.18	11.81	226.79
Total	**745.41**	**479.49**	**417.64**	**93.39**	**90.52**	**1826.44**
SFD Eradication of Lantana/restoration	**1625**	**575.00**	**150.00**	**75.00**	**75.00**	2500.00
Grand Total (Sum of Components A+ B+ C)	**2370.41**	**1054.49**	**567.64**	**168.39**	**165.52**	**4326.44**

The objectives of the proposal fall within the provisions contained in section 5(b) (iii) of the CAF Act 2016.

Agenda Item No. 11:

Proposals from States/UTs with regard to facilitating scientific, technological and other assistance (A: Goa; B: Assam)

Agenda Item No. 11 (A):

Project submitted by Goa State Authority on **"Study of short and long-term impact of Climate Change on Biodiversity of Protected area in Goa by**

setting up of Automatic Weather Stations".

Goa State Authority has submitted a funding proposal through Statistical Cell of MoEF&CC vide latter No. 2-76-WL-2021-Vol.I-FD/2017 dated 12.08.2021 amounting to Rs.65 Lakhs for Study of the short and long term impact of weather and climate change on Biodiversity of Protected Area in Goa by setting up of Automatic Weather Stations.

2. Introduction

Goa is located on the West Coast of India between 15^{O} 48' and 14^{0} 53' North latitude and 74^{0} 20' and 73^{0} 40' East longitude with geographical area of 3702 sq. km.

As per the State of the Forest Report published by the Forest Survey of India, the forest cover of Goa is 2,219 sq km, which is 60.04% if the State's geographical areas.

3. Forest and wildlife of Goa:

The forests of Goa are typical of the Western Ghats (Southern Maharashtra and Karnataka).

There is diversity in the forests due to the variation in altitude, aspect, soil characters, slope etc. As per Champion and Seth (1968) Classification of Forest types of India, the forests of Goa fall in the following types: -

i. Estuarine vegetation consisting of mangrove species along narrow muddy banks of rivers [4 B/TS1 and 4B/TS2]

ii. Strand vegetation along the coastal belts

iii. Plateau vegetation confined especially to the low altitude

iv. Open scrub jungle(5.E7)

v. Moist mixed deciduous forests[3B/C2]

vi. Secondary moist mixed deciduous forests [3B/C2/2SI)

vii. Sub-tropical Hill forests [8A/C2]

viii. Semi-evergreen and evergreen forest.

ix. Semi-evergreen forests [2A/C2]

x. Lateritic Semi-evergreen forests [2E4]

xi. Evergreen forests [IA/C4]

Goa presents a diversity of endemic species, habitats and ecosystems.

Goa is under the influence of two global biomes- the marine biome or the Arabian sea and the terrestrial forest biome of the Western Ghats. Within this geographical canvas are a wide range of ecosystem and habitats e.g. forests, Ghats, alluvial plains, coasts, rivers, estuaries, mangroves, wetlands etc.

The ecophysiology of the habitats is governed by complex ecological and meteorological conditions. There are normal habitats and extreme habitats (like the rock pools and the salt pans).

There are microhabitats which are equally important-e.g. the termite mounds which play a significant role in the decomposition of plant litter. The status of biodiversity in each of these habitats varies, depending naturally on a variety of genetic and environmental factor, each habitats faces its own peculiar mix of pressure on its biodiversity.

The typical flora and fauna of the State is attached at Appendix-I.

4. Protected Area Network of Goa

i. With 20% of its geographical area dedicated for the proliferation of wildlife, the state of Goa has 6 Wildlife Sanctuaries and 1 National Park. These protected areas are provided with complete protection to the fauna & flora to conserve the unique biodiversity of the states.

ii. These are:

Name of the protected area	**Area (ha)**	**Location**
Bhagwan Mahavir National Park	107	Sanguem, Dhrbandora
Cotigao Wildlife Sanctuary	86	Canacona
Bondla Wildlife Sanctuary	8	Ponda, Sattari, Dharbandora
Dr. Slaim Ali Bird Sanctuary	1.8	Tiswadi
Madei Wildlife Sanctuary	208.48	Sattari
Natravali Wildlife Sanctuary	211.05	Sanguem
Total	**755.31**	

5. Stakeholders:

i. The stakeholders of this project/work will be Forest Department, India Meteorological Department, Goa University, Researchers from various Institutions and others.

6. Objective of the project:

i. To ensure real time mapping and monitoring of various weather parameters including temperature, humidity, wind speed, rainfall etc. through Automatic Weather station, Rain Gauges for scientific management of Forest and Wildlife areas in Goa.

ii. To ascertain impact of climate change on biodiversity of forests in Goa.

7. Benefits:

i. Forest Department will get real time weather data which will be used for scientific management of forest and wildlife areas and to ascertain and study impact of climate change on Biodiversity.

ii. The study will enable the department to have a clear idea of the water deficient areas in the forest and will provide invaluable data for resolving the problems like availability of water throughout the year for wildlife/ soil and moisture conservation.

iii. Real-time weather data may be input to expert systems, management models or simple applications to support the decisions for scientific management of forest and wildlife areas.

iv. Weather/Climate data collected over a long period may be used to assess probability and risk of extreme events and to compute statistics of the relevant weather events.

v. In many cases, weather data collected for specialized studies which may provide information related to pest management, and fire danger rating systems etc.

vi. Short and long term data may be shared with specialized Institutions/ Organization for specific studies.

8. Component of the project:

The following are the requirement and standards for Automatic Weather Stations and all the stations will be operating in remote forest regions of Goa.

Telecommunications. GSM/GPRS networks will be used wherever they are available whereas satellite communications (such as IRIDIUM or ORBCOMM) may be used where GSM/GPRS networks are unavailable.

Power. Solar panels with backup batteries are a useful power source for AWS at remote areas.

AWS equipment. The cost of the data loggers and communication devices which can work over in extreme environments e.g., temperature and prolonged time with high humidity values.

AWS enclosure. These enclosures are small rooms made of suitable material like laterite stone or properly shielded pre-cast cabins so that inside temperature does not increase considerably, causing malfunction to the electronic equipment or batteries. High rainfall rates can cause water infiltration, so the connector and core hitches exposure to the environment must be minimal.

Earthing. AWS equipment is often damaged by lightning strikes. Appropriate conventional or maintenance-free earthing, could be very effective in the long run.

Calibration of sensors and maintenance of stations. Though AWS are generally unmanned by design, regular visits to a site are required to check its security, exposure conditions and for performing preventive maintenance. The costs of maintenance, calibration and running expenses for an operating AWS network. Calibration of sensors would be performed at least once or twice per year.

Safety. In remote regions, security of AWS equipment has become a major concern. It is quite common that there are many thefts of solar panels and batteries from the AWS sites. Hence watch and ward are required to be employed.

9. Working Area:

The weather station will be located at five locations in forests areas. The following are the ranges that are proposed for the stations:

	Name of the Protected Area	GPS location of Station
1.	Bhagwan Mahaveer Wildlife Sanctuary and National Park	15* 22' 39.2" N 74* 13" 48.4" E
2.	Bondla Wildlife Sanctuary	15* 26' 20.6" N 74* 06" 09.6" E
3.	Cotigao Wildlife Sanctuary	14*12' 57.89" N 74*13" 54.94" E
4.	Mhadei Wildlife Sanctuary	15*35' 13.9"N 74* 11" 23.9 E
5.	Netravali Wildlife Sanctuary	14* 58' 39" N 74* 07" 59"E

The working areas selected for the station are open areas where there are no obstacles for accurate readings of weather conditions.

10. Financial Implications:

The project will be implemented by the Goa forest Department.

The following are the financial requirements for the Automatic Weather Station Project:

Sl. No	**Particulars**	**Quantity**	**Amount (in Rs lakh)**
1	Telecommunications		
	GSM/GPRS network establishment expenses	5	1.00
2.	Power		
	Solar panels and storage battery	5	5.00
3.	AWS equipment		
	Data loggers and devices	5	40.00
4.	AWS enclosures		
	Construction of cabin	5	10.00
5.	Earthing		
	Lighting arresters	5	5.00
6.	Calibration and sensors		
	Computers for data collection	5	2.00
7.	Safety		

	Fencing, fire equipment	5	2.00
	Total		65.00

The objectives of the proposal fall within the provisions contained in section 5(b) (iii) of the CAF Act 2016.

Agenda Item No. 11 (B):

(ii) Proposal State submitted by Assam State CAMPA for **facilitating scientific, technological and other assistance under wildlife wing**

Assam State has submitted a funding proposal vide latter No. FD/WL/D/CAMPA/Pt-II/2014-15 dated 6th August, 2021 amounting Rs.3.59 Crores.

Sl. No.	**Item**	**Quantity**	**Unit Rate (in Rs. lakhs)**	**Amount (In Rs. lakhs)**
	Unmanned Aerial vehicles with Infra-red camera	15	4	60
	GSM based Camera Traps	50	0.4	20
	Camera traps	500	0.25	125
	Range Finders	200	0.18	36
	Compass for line transect sampling	200	0.09	18
	Mobile phones for M.STrIPES application	100	0.20	20
	Nigh vision devices/FLIR (Forward looking infra-red)	20	4	80
Grand total				**359 (Rupees three crore, fifty nine lakhs only)**

The objectives of the proposal fall within the provisions contained in section 5(b) (iii) of the CAF Act 2016.

Agenda Item No. 12:

Deployment of three additional post at ROHQ under the NICSI project' Yearly Maintenance, Enhancement and Up-Gradation of Forest Clearance module of **PARIVESH**.

This in reference to the yearly Maintenance, Enhancement and Up-Gradation of Forest Clearance module of PARIVESH through NICSI with a total cost of ₹2,31,96,128/- for the duration from April, 2021 to 31 st March, 2022. The National Authority of CAMPA has approved the project and released a sanction letter of ₹2,09,16,247/- (after deducting the unspent balance of ₹22,79,881/-) to NICSI dated on 07/05/2021.

The FC Division was requested to deployment of three (3 Nos.) additional Manpower through NICSI at Ministry RO(HQ) for the coordination with various IRO's for the implementation of FC module of PARIVESH in the ministry as well as various IROs to the Technical Director NIC.

As per the request of FC Division the technical Director has submitted following financial estimate of three additional manpower in the existing ongoing project.

Budget:

S. No	**Manpower Details**	**Nos**	**Place of Posting (Nos.)**	**Cost per person per month (Rs.)**	**Deploying period (months)**	**Date of deployment (From / To)**	**Tentative User Rate (Rs.) Total cost for 9/7 months (inclusive of NICSI, Service Tax etc.)**
1	Office Assistance Support Graduate (6 years & above relevant experience)	1	MoEFCC RO HQ , New Delhi	50,875/-	9	01.07.2021 to 31.03.2021	50,875 X 9 = 4,57,875/-
2	Office Assistance Support Graduate (2 to less than 4 years relevant experience)	1	MoEFCC RO HQ , New Delhi	43,547/-	7	01.09.2021 to 31.03.2021	42,547 X 7 = 3,04,829/-
3	Office Assistance Support Graduate (0 to less than 2 years relevant experience)	1	MoEFCC RO HQ , New Delhi	40,306/-	7	01.09.2021 to 31.03.2021	40,306 X 7 = 2,82,142/-
Total							**10,44,828/- (Inclusive of GST and NICSI charges)**

The objectives of the proposal fall within the provisions contained in section 5(b) (iii) of the CAF Act 2016. It is recommended that the project proposal for providing financial assistance may be considered for approval as per section

15 (ii) of CAF Act, 2016.

Agenda Item No. 13:

Update on progress of Projects undertaken under National Fund by various Institutes

As decided at the 14th EC, a status report on all the studies & projects undertaken by ICFRE, IIFM, WII and any other premier institutes funded by the National CAMPA placed before the 15th EC for review. Concerned PI/Head of the Project to make a brief comprehensive PPT.

Agenda Item No. 14:

Any other matter with the permission of **the chair**.

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ESTABLISHMENT OF THE 'NATIONAL CENTRE FOR WILDLIFE FORENSICS' (NCWF)

WILDLIFE INSTITUTE OF INDIA
DEHRADUN

Proposal for the

Establishment of the 'National Centre for Wildlife Forensics' (NCWF)

Subject:	**Wildlife Sciences**
Sub-area:	**Wildlife Forensic Science**
Estimated cost:	**Rs. 8282.8 Lakhs (~ Rs. 82.83 Crores)**
Proposed for:	**Strengthening wildlife forensic capacity in India**
To be established at:	**Wildlife Institute of India** **Dehradun, Uttrakhand**
Collaborator:	**Wildlife Crime Control Bureau (WCCB)** **New Delhi**
Funding Agency:	**Ministry of Environment, Forest and Climate Change (MoEF&CC),** **Government of India**

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

Establishment of the 'National Centre for Wildlife Forensics' (NCWF)

Worldwide illegal exploitation of wildlife and its derivatives strongly influence the levels of attrition of biodiversity. Over the years, illicit wildlife trade has emerged as a form of organized transnational crime that has threatened several wild species across the globe. Illegal trade on wildlife is the third-largest category of crime for illegal revenue generation after narcotics and illegal arms supply (www.renctas.org.br). There are "wildlife trade hotspots," where wildlife trade is intense. They include China's international borders, trade hubs in East/Southern Africa and South-east Asia, the eastern borders of the European Union, some markets in Mexico, parts of the Caribbean, parts of Indonesia and New Guinea, and the Solomon Islands. India has four internationally recognized hotspots of biodiversity i.e., Western Ghats, Eastern Himalayas, Indo-Burma, and Sundaland (http://moef.nic.in/downloads/public-information/in-nr-04.pdf). India's native wildlife is exploited for a product derived from them, which includes mongoose hair; snake skins; rhino horn; tiger and leopard claws, bones, skins, whiskers; elephant tusks; deer antlers; shahtoosh shawl; turtle shells; musk pods; bear bile; a wide variety of medicinal plants; timber and caged birds such as parakeets, mynas, munias; butterflies, moths and beetles (http://www.traffic.org). INTERPOL's recorded trade on tiger products and derivatives over 10 years indicates that poaching of 1069-1220 tigers has probably taken place, and in 481 cases, materials were seized from various countries holding the tiger population (http://www.traffic.org/seizures/).

The products derived from the body part of poached animals are used either in traditional Chinese medicine or the preparation of ornamental products. Trade-in over 1800 species of wild animals, plants, and their derivative is prohibited under the Wildlife (Protection) Act, 1972 of India; therefore, it becomes essential to develop expertise in identifying the part and products derived from protected flora and fauna species.

The wildlife trade monitoring network 'TRAFFIC' is a joint program of World Wildlife Fund (WWF) and International Union for Conservation of Nature (IUCN). The TRAFFIC is involved in arranging training programs for the enforcement agencies to control wildlife offense. However, it does not have any role in the legal implication of the wildlife protection laws. India is a member of the Convention on International Trade in Endangered Species (CITES) since 1976, and therefore, it is obliged to conform to the guidelines and recommendations it makes.

In India, Additional Director General (Wildlife), MoEF&CC is the CITES management authority, and the Regional Deputy Director, Wildlife Crime Control Bureau (WCCB) are the Assistant Management Authority (CITES). Additional Director, WCCB, is the Enforcement Authority to ensure the CITES in India.

It becomes essential to build capacity with in the country to identify parts and products derived from all Indian wild species, which would help in the proper enforcement of the Wildlife (Protection) Act, 1972.

In 1995, the Wildlife Institute of India (WII) initiated in a modest way through a collaborative project with the U.S. Fish & Wildlife Service (USFWS) to develop protocols for identification of the wild species parts and products for assisting the examination of wildlife crime cases in India and over the years developed a basic research facility supporting decisions in legal cases related to wildlife forensics.

Establishment of Wildlife Crime Control Bureau (WCCB) for Wildlife Law Enforcement:

Wildlife Crime Control Bureau (WCCB) was established by the Government of India under the MoEF&CC through amendment in the Wild Life (Protection) Act, 1972 (WPA) of India (38Z) to combat organized wildlife crime in the country that became operational in the year 2008. Afterward, WCCB has been a leading central government agency in wildlife law enforcement in India. It provides field support to the State Forest Department, Police Department, Customs, and other Government agencies and coordinating with multi agencies for the effective implementation of the Wild Life (Protection) Act, 1972 (WPA) of India and CITES prohibited species. It is also involved in preparing and maintaining the database for wildlife offenders to share with the field level enforcement agencies. WCCB is also playing a key role in coordination with the South Asian country's enforcement agency to prevent transnational wildlife crime and illegal trade through the South Asia Wildlife Enforcement Network (SAWEN). One of the mandates of the WCCB is to develop infrastructure and capacity building for a scientific and professional investigation into wildlife crimes and assist State Governments in ensuring success in prosecutions related to wildlife crimes. Since its establishment, WCCB has played a vital role in the control of wildlife crime and illegal trade across the country. As per the provision of the act (WPA, 1972) in section 38Z (v), WCCB shall take measures to 'develop infrastructure and capacity building for scientific and professional investigation into wildlife crime and assist State Government to ensure success in the prosecutions related to wildlife crime'. Hence the proposed National Centre for Wildlife Forensics

(NCWF) will help in fulfilling the requirement of WPA 38Z (v). Therefore, NCWF will be in constant coordination with the WCCB in its activities and provide necessary support and seek guidance.

World's leading Wildlife Forensic Centre as a model lab:

One of the best wildlife forensic facilities of the world exists in the **National Fish and Wildlife Forensics Laboratory, Ashland, Oregon, USA**, which was established by U.S. Fish & Wildlife Service (USFWS). The role of this lab is to examine, identify, and compare evidence using a wide range of scientific procedures and instruments, in the attempt to link suspect, victim, and crime scene with physical evidence. USFWS has one of the best expertise in all disciplines of criminal science to deal with wildlife offense cases. It is for this reason that the present proposal draws heavily from the structure, set up and functioning of this lab. It is, therefore essential to understand further the facilities and capabilities of this lab.

National Fish and Wildlife Forensics Laboratory provides forensic assistance to the Office of Law Enforcement of the Fish and Wildlife Service (FWS). Office of Law Enforcement is composed of Special Agents and Wildlife Inspectors who enforce the criminal laws and U.S. Statutes that protect threatened and endangered species.

The Office of Law Enforcement of the Fish and Wildlife Service is primarily focused on compliance with criminal law that deals with crimes and their punishments. The lab seldom works on non-federal cases such as state poaching violations, or non-wildlife cases like animal abuse or food contamination.

The analytical assistance provided by the staff at the National Fish and Wildlife Forensic Laboratory can be grouped into four major categories:

1. Crime scene investigations
2. Cause of death determinations
3. Class character analysis (such as species identification or chemical analysis)
4. Individualization analysis

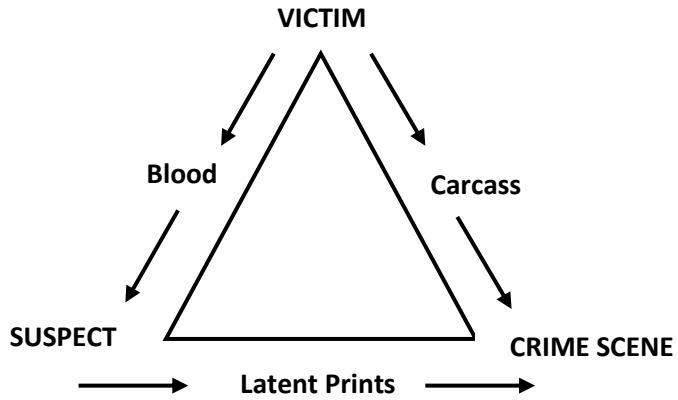
In many wildlife crime investigations, class category analysis provides the needed proof that a violation has occurred; for example, by documenting the presence of a protected species or a prohibited chemical. However, in some cases, further individualization analysis is required.

Individualization analysis:

The endpoint of many Office of Law Enforcement cases is to connect a suspect with the crime scene and the victim. For example, suppose

- **the victim (wild animal) is found dead at the crime scene** (links victim and crime scene)
- **a suspect's fingerprints are found at the crime scene** (links suspect and crime scene)
- **the victim's blood has stained the suspect's clothes** (links suspect and victim)

Therefore, individual characters (DNA extracted from blood and latent prints recovered at the scene) provide the basis for identity and linkage between victim suspects and the crime scene. While class character analysis can demonstrate that the victim is a tiger (*Panthera tigris*), individualization analysis is needed to prove that the blood of this particular tiger (the victim) is on the suspect's clothes.



This diagram shows the relationship between the victim, suspect, and crime scene. The victim is linked to the suspect via blood, the suspect to the crime scene via latent prints, and the crime scene to the victim via the carcass. USFWS has set an example, how a wildlife forensics laboratory should proceed for crime investigation by the use of multidisciplinary approaches.

ESTABLISHMENT OF WILDLIFE FORENSIC CAPABILITY IN INDIA

Wildlife Forensics in India-Background

In the case of wildlife crime, offenders caught with biological material (evidence) may not be sufficient for successful prosecution, until unless the court-defensible species-specific determination of the evidence provided. Forensic laboratories in the country have not paid attention to wildlife-related offenses, investigative and analytical procedures. In the late 1980s, it was felt that enforcement of the Indian Wildlife (Protection) Act, 1972, is often hampered due to the lack of

reference material and methods necessary to identify the animal and plant species used/affected in various wildlife offense cases. A strong need was felt to develop Wildlife Forensic capabilities for identifying parts and products derived from Indian wildlife for efficient implementation of the Indian wildlife laws and in controlling the illegal wildlife trade.

In order to overcome this long due vital requirement of wildlife law enforcement, the Wildlife Institute took an initiative way back in 1995. An Indo-US collaborative project entitled "Establishment of a wildlife forensic capacity at the Wildlife Institute of India" between U.S. Fish and Wildlife Services (USFWS), Ashland, Oregon, USA and WII was initiated in October 1995 with a sole aim to establish the Wildlife forensic capability at WII through research and development and ultimately disseminating the knowledge to the various law enforcement agencies. The project was funded under the US-Indian Fund (USIF). The project objectives included preparation of a perspective plan for wildlife forensics in the country, development of morphometric protocols for species identification, and create a repository of known species and tissue samples.

The Wildlife Institute of India provided the logistic support as well as the workspace for the forensic lab, while the infrastructure was developed through the collaborative project.

On completion of the major collaborative project, the Institute decided to establish a Wildlife Forensic Cell (WFC) at WII in 1999 with the support from Grant-in-Aid from the Ministry of Environment and Forests (MoEF&CC) for further research and development required for a functional wildlife forensic facility.

Initiatives - Other Agencies

In the year 1998, the Centre for Cellular and Molecular Biology (CCMB), Hyderabad initiated a DBT funded project entitled "Laboratory for the Conservation of Endangered Species (LaCONES)". The mandate of LaCONES was to establish a germplasm repository of Indian endangered animals and to develop a protocol for the assisted reproduction for them. Subsequently, CCMB-LaCONES started a DNA typing service for species identification of wild animals. However, the contribution by LaCONES is mainly restricted to DNA based approach to species identification for wildlife forensics. Concurrently, forensic laboratories also made an effort to contribute wildlife forensics by undertaking DNA based research viz. CFSL, Kolkata; Forensic Laboratory at Gandhi Nagar, Gujarat and CDFD, Hyderabad. Zoological Survey of India (ZSI), Kolkata, Biological Survey of India (BSI), Kolkata, and CMFRI, Kochi, has established a collection of the animal and plant

specimens of the country. The Veterinary Institute and Universities are also contributing substantially in the analysis of histological and toxicological samples.

Wildlife Forensic and Conservation Genetics (WFCG) Cell- Achievements and contributions

After initiation of the WII-USFWS collaborative project in 1995 and the establishment of Wildlife Forensic Cell in 1999, the cell has done significant projects in the field of wildlife Forensics that is evident from its accomplishment and contribution. Wildlife Forensic and Conservation Genetics (WFCG) Cell was formed by merging the Wildlife Forensic and Conservation Genetics Laboratories in 2014.

Following are significant achievements and contribution of WFCG Cell:

(A) Achievements

Over the period, more than 4000 legal cases (Fig. 1) have been forwarded to WFCG Cell pertaining to crime against wildlife species. The majority of the cases were sent from various forest departments (Fig. 2). WFCG Cell has developed the protocols for the identification of selected parts and products derived from Indian wild species and generated the repository for a few wild animals of India. Based on research and development carried out at WFC, various scientific protocols have been published, including more than 10 research articles, one computer-assisted hair identification program and two identification manuals (one for identification of Shahtoosh shawl and another for identification of species from the morphological feature of hairs).

Subsequently, WFCG Cell has set-up a state-of-art facility for DNA analysis for dealing with the cases related to the wildlife products, where identification of species will not be possible by morphometric analysis.

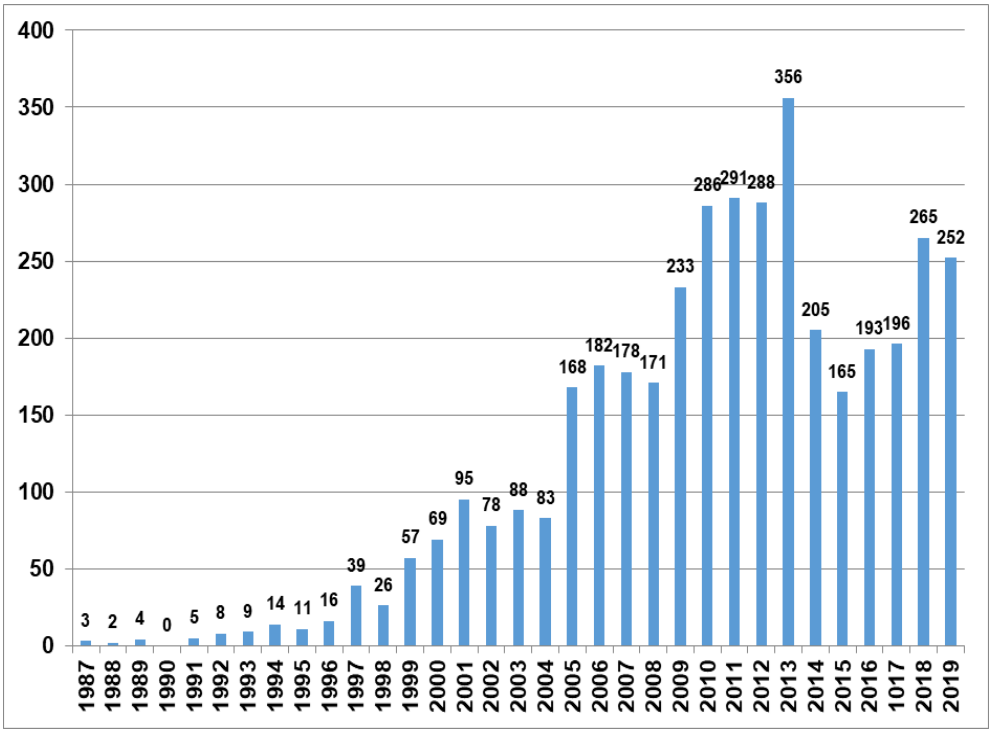


Figure 1. Year-wise offense cases received at WFCG Cell (N=4036).

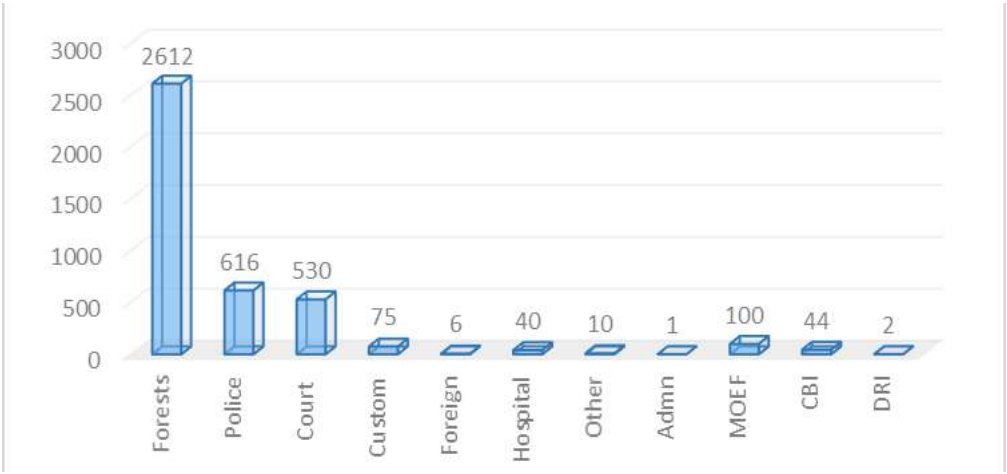


Figure 2. Involvement of enforcement agencies in the seizure of wildlife various objects.

(B) Contribution

So far, about 3500 wildlife forensic cases have been addressed by the WFCG Cell. Approximately 63 % of cases can be solved based on the DNA and remaining by the morphometric protocols (Fig. 3).

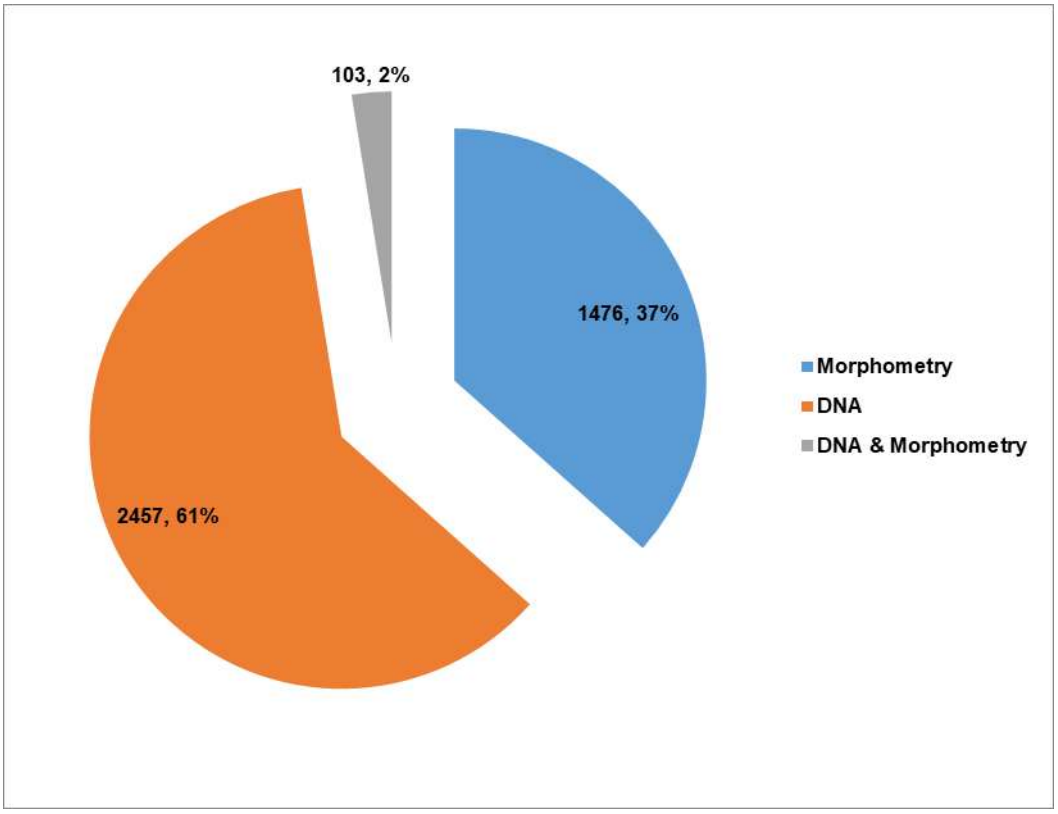


Figure 3. Involvement of DNA and Morphometry analysis in wildlife crime investigation for species identification in India (based on WII case records).

Identified Gaps

Although WII has established a basic facility to identify various parts and products of select Indian wild animals, certain limitations while developing further protocols and supporting wildlife crime investigation were felt.

Due to limited existing infrastructure, the cell is not able to expand the facility for creating a much-demanded repository of known specimens. A complete repository could not be developed on Indian wildlife species for want of required space and funds. At the present stage, we are able to support wildlife crime investigation only for species identification. WFCG Cell has developed the partial repository for only selected and commonly traded animals, which need to be expanding for a complete repository for all protected wildlife of India.

JUSTIFICATION FOR ESTABLISHMENT OF THE NATIONAL CENTRE FOR WILDLIFE FORENSICS (NCWF)

In the present scenario of crime investigation species identification is an important aspect, but other part of crime investigation has not been addressed, which may help in expanding the vision of investigating teams. Preparation of well-documented repository requires the full support from all zoo park and all state forest departments for collection of the known carcass of the naturally dead animal species. These issues can be addressed by establishing a dedicated state-of-the-art center.

Hence, to fulfill the 38Z(v) of WPA, and actionable point No. 1.9 of the theme 'Control of Poaching and Illegal Trade in Wildlife' of the National Wildlife Action Plan (NWAP) 2017-31 of MoEF&CC, we propose to establish a 'National Centre for Wildlife Forensics' (NCWF) in collaboration with the WCCB in WII campus.

OBJECTIVES OF NCWF

The aims and objective of NCWF will be to fill the gaps in forensic capabilities related to wildlife crimes by developing protocols for dealing with all aspects of criminal science. Finally, established protocols would be disseminated to crime investigation laboratories in the form of Standard Operating Procedure (SOP). The broad focus area of NCWF is given below:

1. To create the complete repository for Indian wildlife- which is the main gap in dealing with wildlife forensics.
2. To prepare a plan for the advancement of wildlife forensics India
3. To create the required infrastructure (workspace, storage facility, and database) for dealing with all aspects of criminal sciences.
4. To establish working relationships with a national and international institution of repute in the areas of wildlife conservation, zoological research, and wildlife forensics
5. To develop the complete schedule-wise database (as per WPA, 1972) for all protected Indian species.
6. To develop the proficiency for toxicology, morphology, pathology, genetics and ballistic science for dealing with a variety of wildlife offenses
7. To disseminate the acquired knowledge to users through training and manuals

Up-gradation of Forensic Capability at WII under NCWF

A variety of wildlife crime invites the use of specific protocols. The following are the dedicated units required for dealing with all aspects of wildlife crime investigation.

1. Morphological Division

The laboratory for Morphology analysis uses the classic techniques of comparative morphology and anatomy to identify animal remains to species. "Identifying the victim species" is an essential first step in wildlife crime investigations. Identification of animal remains must be established to determine which, if any, laws have been violated.

A Rhino Horn

A dedicated morphology unit for dealing with the identification of part and product of wild animals based on morphologic features is required, which can solve around 40% of the total wildlife crimes based on WII's forensic records. This unit should be equipped with the basic equipment for measuring the morphological feature, which may include a high-end microscope, digital calipers, and more importantly, a dedicated repository for different wildlife species. The repository consists of every body part of the entire animal along with a complete set of the skeleton, hide, and tissue sample for DNA analysis.

The morphologists are routinely asked to answer questions like these:

- Is this carving made from ivory or the bone of permitted animals?
- Is this fur coat derived from protected species?
- Are these feathers from protected bird species?

To answer the questions, the Forensics Lab need to develop expertise in three taxonomically-based disciplines:

- Herpetology: reptiles and amphibians
- Ornithology: birds
- Mammalogy: mammals

The recurring and non-recurring budget for the morphological division is explained below:

Non-recurring Expenditure

S. No.	Equipment/Objects	No. of unit	Application/Use	Estimated Cost (Rs. in Lakhs)
1	Hitachi Compact SU1510 VPSEM	1	Fine surface analysis under various morphological study	50
2	X-ray diffraction (XRD) unit	1	For examination of 3D structure of molecules	50
3	MS-MS spectroscopy	1	For elemental analysis	100
4	GC-MS	1	For elemental analysis	50
5	SEM Electron Microscopy	1	For fine scale microscopy of biological surfaces	50
6	X-ray exposure	1	Analysis of Fine structure of Bones, claws etc.	5
7	Miscellaneous equipment	1	For associated uses	15
			Total (Rs. in Lakhs)	**320**

Recurring Expenditure

S. No.	Categories of personnel	No of personal	Annual Remuneration (Rs. in Lakhs)	Remuneration for three years (Rs. in Lakhs)	Job responsibility
1	Consultant or Project Scientist @80,000/ month	2	19.2	57.6	Two dedicated consultant/ faculty may require to look after the facility
2	R A or PDF @60,000/ month	2	14.4	43.2	R&D and forensic support in each department. Looking at present trends two RA would be required in each i.e. morphology and Genetics unit.

3	Project Assistant @35,000/month	3	12.6	37.8	Each RA may be supported by one PA. Looking at present trends two PA would be required in each RA at morphology and Genetics unit.
4	Supporting staff @12,000/ month	10	14.4	43.2	Supporting staff will helped in day to day research activity and all activity of NCWF
5	Consumable Items		20	60	Purchase of chemical and wares
6	AMC for Equipments		3.00	9	Equipments maintenance
Total (Rs. in Lakhs)			83.6	250.8	

2. Analytical and Ballistic Division

The activities of the Analytical unit will be focused on casework for the elucidation of molecules that assist in answering questions concerning the cause of death and species identifications. It also takes up the research and investigation of the ballistic analysis. While the approaches to molecular elucidations are as varied as the molecules under investigation, many methods incorporate mass spectrometry as a vital component of the analyses performed. As such, the analytical unit requires equipments used in molecular characterizations along with a diverse array of mass spectrometers that include:

Analytical unit will assist in cause of the death determinations, which can focus on the identification of a particular agricultural poison (organophosphates or carbamates); a specific mammalian pest control agent (strychnine, anticoagulants, or sodium fluoroacetate); an avian pest control agent such as 4-aminopyridine; or the identification of petroleum hydrocarbons found on/in “oiled” birds. Support in the area of species identifications encompasses characterization of heme proteins from blood and tissue samples, characterization of bile acids from gall bladders and Asian medicinal products, or characterization of keratins from products made of rhino horn or tortoise shell.

Since the analytical unit will also be supporting the activity of other divisions, it will require the following essential equipments. The recurring and non-recurring budget for the morphological division is explained below:

Non-recurring Expenditure

S. No.	Equipment/Objects	No. of unit	Application/Use	Estimated Cost (Rs. in Lakhs)
1	Nexsus 470 FT-IR by Nicolet	1	For molecular inferences analysis	10
2	Energy dispersive X-ray spectrometry (EDX)	1	For X-Ray Fractionation analysis	10
3	*Agilent 6890N* gas chromatograph equipped with a *5975B* mass select detector.	1	Chemical analysis of compounds	100
4	*Varian CP-3800* gas chromatograph equipped with a *Saturn 2200* ion-trap mass spectrometer and associated *CTCAnalytics COMBIPAL* automated injector with solid phase microextraction (SPME) capacity	1	Chemical analysis of compounds	150
5	*ThermoFinnigan LCQ DecaXP* ion-trap mass spectrometer	1	Chemical analysis of compounds	100
6	*Applied Biosystems Voyager-DE PRO* MALDI mass spectrometer	1	Chemical analysis of compounds	100
7	*Ion Spec* Fourier Transform mass spectrometer equipped with a 7.0T magnet	1	Chemical analysis of compounds	100
8	*Agilent 1200 Series* capillary high performance liquid chromatograph	1	Chemical analysis of compounds	100
9	*ThermoNicolet NEXUS 470* Fourier transform infrared spectrometer equipped with a *Centaurus* microscope	1	Chemical analysis of compounds	100
10	*EDAX Eagle II* x-ray fluorescence spectrometer	1	Chemical analysis of compounds	100
11	Ballistic testing tank	1	Determining that a projectile was fired from the suspects	1
12	Ballistic fire unit	1 set	Determining that a projectile was fired from the suspects	5
13	Leeds comparison microscope	1	Determining that a projectile was fired from the suspects	10
14	Reichert comparison microscope	1	Determining that a projectile was fired from the suspects	15
15	Tescan Vega electron scanning microscope with a dual comparison stage	1	Determining that a projectile was fired from the suspects	15
			Total (Rs. in Lakhs)	**916**

Recurring Expenditure

S. No.	Categories of personnel	No of personal	Annual Remuneration (Rs. in Lakhs)	Remuneration for three years (Rs. in Lakhs)	Job responsibility
1	Consultant or Project Scientist @80,000/ month	2	19.2	57.6	Two dedicated consultant/ faculty may require to look after the facility
2	R A or PDF @ 60,000/ month	2	14.4	43.2	R&D and forensic support in each department. Looking at present trends two RA would be required in each i.e. morphology and Genetics unit.
3	Project Assistant @ 35,000/month	4	16.8	50.4	Each RA may be supported by one PA. Looking at present trends two PA would be required in each RA at morphology and Genetics unit.
4	Supporting staff @ 12,000/ month	5	7.2	21.6	Specialized consultant may help in initial set up of specialized disciplines for Wildlife offence.
5	Consumable Items		20	60	Purchase of chemical and wares
6	AMC for Equipments		3	9	Equipments maintenance
Total (Rs. in Lakhs)			**80.6**	**241.8**	

3. Genetics Division

The importance of genetic techniques has been proven worldwide and these are vastly applied as tools. The modern forensic approach is revolving around this tool. Genetic analysis has proven to be a great asset in dealing with various complicated and intricate judicial cases, including wildlife crimes (Gupta *et al.* 2005, 2006, 2011a, 2011b, 2018). The genetics section uses the modern techniques of molecular genetics for the identification of wildlife evidence. Plant and animal remains and products need to be identified to determine those conservation regulations that may apply. Identifications include determining the taxonomic family,

species, sub-species, population origin, individual origin, gender origin and parentage of questioned evidence.

Nucleotide sequence analysis of mitochondrial, chloroplast and nuclear DNA identifies variants that are diagnostic markers for the taxonomic family, species, sub-species and population origin of questioned evidence. For the successful application of this tool, a vast DNA sequence repository of known Indian wildlife need to be prepared. Schedule wise collection of biological samples and generation of DNA database is compulsory for dealing with all the listed animals in Wildlife (Protection) Act, 1972 of India. Since a minimum of 60% of wildlife crime cases requires DNA analysis, therefore; such a database can be used in matching the DNA profile of unknown case samples with known victim species (Gupta *et al*. 2005). The developed infrastructure will also help in the development of the latest molecular markers and protocols for dealing with forensic cases and the development of the next-generation forensic approach.

The nuclear DNA of animals contains short tandem repeats (STR) comprised of 2-6 base pair units that are scattered along the autosomal and sex chromosomes. STR loci display high levels of polymorphism that are detected as length polymorphism by PCR amplification with locus-specific primers. The amplified DNA is analyzed by direct sizing with capillary electrophoresis. If two evidence samples exhibit the same alleles at a suite of different loci, the probability of the samples originating from the same individual is inferred from the frequency distribution of the observed alleles in a database of the species of interest. The genetics section performs STR analysis for purposes of individual identification, assignment of the population of origin, parentage determination (Gupta *et al*. 2011), and species identification. The genetics section also uses PCR amplification of the sex chromosome loci.

Skin of *Varanus species* used for making bag

Since the genetic unit will work on the development of next-generation analytical protocols, it will require the following essential equipments. The recurring and non-recurring budget for the genetic division is explained below:

Non-recurring Expenditure

S. No.	Equipment/Objects	No. of unit	Application/Use	Estimated Cost (Rs. in Lakhs)
1	PAC Bio	1	For sequencing of whole genome of wildlife of India	800
2	Alumina NovaSeq (NGS Platform with accessories)	1	For Next Generation DNA Sequencing	700
3	3730 Genetic analyzer	1	For sequencing of short DNA fragment	100
4	Liquid Nitrogen Unit	1	For preparation of Liquid N_2	50
5	Setup of animal cell culture facility	1	Study of functional genomics of wild animals	50
6	Setup of cold room facility	2	Preservation of samples and reagents	80
7	Setup of BSL IV facility	1	Handling of air born infectious agent	100
8	Gradient Thermal Cycler	3	For PCR amplification optimization	15
9	High throughput robotic liquid handling system	1	For sample preparation	75
10	Karyotyping unit	1	For karyotyping of wild animals	75
11	Bio-safety class-II laminar cabinets	3	For culture work in various dedicated facility	15
12	Laminar hoods	2	For media preparation	8
13	Incubator	3	For culture work in various dedicated facility	9
14	CO_2 Incubator	1	For cell culture lab	4
15	Incubator Shaker	2	Each for Cell culture and microbial culture lab	7
16	Vertical rotors	5	For all dedicated facility	2
17	Hybridization chamber	2	For Genetic unit	6
18	Various size Gel Electrophoresis unit	10	For Genetic unit	5
19	-20°C deep fridge	5	For all dedicated facility	4
12	-80°C deep fridge	5	For all dedicated facility	25
13	Autoclave	2	For sterilization of equipments	5
14	Drier Chamber	2	One for drying the sterilized equipments and second for drying biological samples	4
15	Oxford Nanophor (Minion)	1	For high read length DNA seq.	3
			Total (Rs. in Lakhs)	**2142**

Recurring Expenditure

S. No.	Categories of personnel	No of personal	Annual Remuneration (Rs. in Lakhs)	Remuneration for three years (Rs. in Lakhs)	Job responsibility
1	Consultant or Project Scientist @8 0,000/ month	2	19.2	57.6	Two dedicated consultant/ faculty may require to look after the facility
2	R A or PDF @ 60,000/ month	2	14.4	43.2	R&D and forensic support in each department. Looking at present trends two RA would be required in each i.e. morphology and Genetics unit.
3	Project Assistant @ 35,000/month	4	16.8	50.4	Each RA may be supported by one PA. Looking at present trends two PA would be required in each RA at morphology and Genetics unit.
4	Supporting staff @ 12,000/ month	5	7.2	21.6	

5	Consumable Items		40	120	Purchase of chemical and wares
6	AMC for Equipments		7	21	Equipments maintenance
Total (Rs. in Lakhs)			**104.6**	**313.8**	

4. Toxicological Division

Forensic toxicology is the use of toxicology and other disciplines such as analytical chemistry, pharmacology and clinical chemistry to aid medical or legal investigation of death, poisoning, and drug use. The primary concern for forensic toxicology is not the legal outcome of the toxicological investigation or the technology utilized, but rather the obtaining and interpreting of the results. Toxicological analysis can be done to various kinds of samples.

A forensic toxicologist must consider the context of an investigation, in particular, any physical symptoms recorded, and any evidence collected at a crime scene that may narrow the search, such as pill bottles, powders, trace residue, and any available chemicals. Provided with this information and samples with which to work, the forensic toxicologist must determine which toxic substances are present, in what concentrations, and the probable effect of those chemicals on the individual.

Determining the substance ingested is often complicated by the body's natural processes, as it is rare for a chemical to remain in its original form once in the body.

In many suspected wildlife crime cases, it is desirable to conduct the toxicological test from the gut of animals and match with the same toxic substance in the premises of the accused. Such a study requires a dedicated infrastructure of toxicological division along with the well-established chemical unit.

Since the toxicology unit will be supported by analytical division for equipments, it will may not requires any dedicated equipments. Therefore, non-recurring budget for the toxicological division is explained below:

Recurring Expenditure

S. No.	Categories of personnel	No of personal	Annual Remuneration (Rs. in Lakhs)	Remuneration for three years (Rs. in Lakhs)	Job responsibility
1	Consultant or Project Scientist @80,000/ month	1	9.6	28.8	One dedicated consultant/ faculty may require to look after the facility
2	R A or PDF @60,000/ month	1	7.2	21.6	R&D and forensic support in each department. Looking at present trends two RA would be required in each i.e. morphology and Genetics unit.
3	Project Assistant @35,000/month	1	4.2	12.6	To assist the RA & consultant for analysis
4	Specialized contractual consultant @80,000/ month	1	9.6	28.8	Specialized consultant may help in initial set up of specialized disciplines for Wildlife offence.
5	Consumable Items		15	45	Purchase of chemical and wares
Total (Rs. in Lakhs)			**45.6**	**136.8**	

5. Pathology Division

The objective of pathological evaluation of a carcass of an animal is to determine the cause of death, which for most pathologists, means providing a diagnosis. As we know, multiple diagnoses may be applied to any pathology report depending on the level of investigation, which is directly related to the post mortem condition of the carcass. In legal circles, we refer to the cause, manner, and mechanism of death, and we may also list contributory and incidental findings.

The medical examiner is expected to determine a "cause" of death, meaning the disease, injury or abnormality that alone or in combination is responsible for initiating the sequence of functional disturbances that ends in death. This is different than the "mechanism" of death, which infers more of the physiological consequence of the injury or disease. The "manner" of death relates more to the circumstances around the factors that initiated the cause of death with special reference to the social relationship and personal causation. As the investigating pathologist and an expert witness, you may be asked to explain your opinion on the above designations for the case at hand.

Other objectives that must be considered in a forensic evaluation include the recovery of trace evidence, reconstruction and documentation of the sequence of events where possible, and an estimation of the time of death. Trace evidence may include bullets or bullet fragments, tissue or organ samples, stomach and crop contents, carrion feeding insects, hair, etc. Proper procedures to document the association of the trace evidence items with the original carcass and appropriate preservation and packaging of the trace evidence are also the responsibility of the pathologist. A chain of custody must be established for each trace evidence item removed from the original carcass. Photo documentation of the items recovered to demonstrate the origin of the sample or item is an effective way to establish the connection between the carcass and the new trace evidence sample.

For example, a bullet might be photographed in situ with a pointer demonstrating a wound path before removing the bullet. Skin samples around a suspected bullet wound which are removed to illustrate lead residue or duration of the wound should be photographed before and after removal to establish the relationship of the "trace" evidence or sub-item to the original sample. Radiographs (x-rays) are an excellent way to document the presence of bullets, bullet fragments, and pellets. However, field radiographs of large animals are rarely practical. Metal detectors may be used to demonstrate and recover bullets from carcasses in the field.

Since the pathology unit will be supported by the equipments available at the analytical division and morphology division, it may not require any dedicated equipments. Therefore, non-recurring budget for the toxicological division is explained below:

Recurring Expenditure

S. No.	Categories of personnel	No of personal	Annual Remuneration (Rs. in Lakhs)	Remuneration for three years (Rs. in Lakhs)	Job responsibility
1	Consultant or Project Scientist @80,000/ month	1	9.6	28.8	One dedicated consultant/ faculty may require to look after the facility
2	R A or PDF @60,000/ month	1	7.2	21.6	R&D and forensic support in each department. Looking at present trends two RA would be required in each i.e. morphology and Genetics unit.

3	Project Assistant @35,000/month	1	4.2	12.6	To assist the RA & consultant for analysis
4	Specialized contractual consultant @80,000/ month	1	9.6	28.8	Specialized consultant may help in initial set up of specialized disciplines for Wildlife offence.
5	Consumable Items		15	45	Purchase of chemical and wares
Total (Rs. in Lakhs)			**45.6**	**136.8**	

6. Marine and Invertebrate Division

Marine animals and invertebrates are also extensively involved in the illegal trade. These include Arthropod, Mollusc, Echinodermata, shark and turtle species. A dedicated Marine and Invertebrate Division in NWFC would establish a database and develop a protocol for the identification of the part and products derived from the invertebrates and marine animals. The analytical support to this division would be provided by the other division; however, a dedicated team of scientific personnel would be required to take up the analysis and investigation.

Recurring Expenditure

S. No.	Categories of personnel	No of personal	Annual Remuneration (Rs. in Lakhs)	Remuneration for three years (Rs. in Lakhs)	Job responsibility
1	Consultant or Project Scientist @80,000/ month	2	19.2	57.6	Two dedicated consultant/ faculty may require to look after the facility
2	R A or PDF @ 60,000/ month	2	14.4	43.2	R&D and forensic support in each department. Looking at present trends two RA would be required in each i.e. morphology and Genetics unit.
3	Project Assistant @ 35,000/month	4	16.8	50.4	Each RA may be supported by one PA. Looking at present trends two PA would be required in each RA at morphology and Genetics unit.
4	Supporting staff @ 12,000/ month	5	7.2	21.6	Specialized consultant may help in initial set up of specialized disciplines for Wildlife offence.
5	Consumable Items		20	60	Purchase of chemical and wares
6	AMC for Equipments		3	9	Equipments maintenance
Total (Rs. in Lakhs)			**80.6**	**241.8**	

7. Botanical Division

The establishment of this division will fill one of the essential lacunas in forensic investigation. Many rare and endangered plant species are being illegally overexploited worldwide. There is no proper protocol available so far to establish the identity from part and product derived from rare and endangered plants. This division will utilize the expertise of genetic and analytical unit to develop the protocols for the identification of endangered medicinal and aromatic plant species from part and products. One database will also be established from all endangered plant species with a known repository. This database and repository would be the basis for the development of plant forensic sciences at India.

The botanical unit will be supported by the equipments available at the analytical division, genetic division and morphology division; therefore, it may not require any dedicated equipments. Thus, non-recurring budget for the botanical unit is explained below:

Recurring Expenditure

S. No.	Categories of personnel	No of personal	Annual Remuneration (Rs. in Lakhs)	Remuneration for three years (Rs. in Lakhs)	Job responsibility
1	Consultant or Project Scientist @80,000/ month	1	9.6	28.8	One dedicated consultant/ faculty may require to look after the facility
2	R A or PDF @60,000/ month	1	7.2	21.6	R&D and forensic support in each department. Looking at present trends two RA would be required in each i.e. morphology and Genetics unit.
3	Project Assistant @35,000/month	1	4.2	12.6	To assist the RA & consultant for analysis
4	Consumable Items		5	15	Purchase of chemical and wares
Total (Rs. in Lakhs)			**26**	**78**	

8. Database & Dissemination Cell

Dissemination of the tools and techniques by means of teaching and training will be the main asset from NWFRF. This cell will establish close linkages between prospective forensic laboratories to disseminate the appropriate knowledge to the user lab. This cell will regularly conduct the workshop and seminars in recent development on wildlife forensic capabilities. It will also involve in the training field staff of the forest department for the collection and forwarding of the samples and organizing a workshop for the Judiciary, Staff of WCCB, Police Department, staff od DRI and other enforcement agencies.

Database Dissemination Cell will be supported by the equipments available at the analytical division, genetic division and morphology division; However, it will requires following equipment for storage and discrimination of data and informations:

Non-recurring Expenditure

S. No.	Facilities	No. of unit	Application/Use	Estimated Cost (Rs. in Lakhs)
1	High end sever system	2	To store the data and records of the centre	50
2	Workstation desktopes	4	To work with the large size data	20
3	CCTV survilance network system	1 set	To monitor the security of the centre	50
4	Desktop PC	20	For the user of the centre	10
5	High end color Printer	1	For color imaging	1.5
6	Xerox machine	1	For the user of the centre	1.5
7	Laser printers	4	For the user of the centre	2
8	Big screen for traning room	1	For training & teaching clases	4
9	Power point projector	2	For training & teaching clases	1
			Tota (Rs. in Lakhs)l	**140**

Recurring Expenditure

S. No.	Categories of personnel	No of personal	Annual Remuneration (Rs. in Lakhs)	Remuneration for three years (Rs. in Lakhs)	Job responsibility
1	Consultant or Project Scientist @80,000/ month	1	9.6	28.8	One dedicated consultant/ faculty may require to look after the facility
2	R A or PDF @60,000/ month	1	7.2	21.6	R&D and forensic support in each department. Looking at present trends two RA would be required in each i.e. morphology and Genetics unit.
3	Project Assistant @35,000/month	1	4.2	12.6	Specialized consultant working in public relation matter may help in this activity
4	Workshop and Seminars	2/year	30	90	To disseminate the knowledge
5	Consumable Items		4	12	Purchase of chemical and wares
	Total (Rs. in Lakhs)		**55**	**165**	

After completion of three functional years, the recurring expenditure of Rs. 521.8 Lakhs per year may be provided through a special grant to support the smooth functioning of the established NCWF facility.

9. Creation of a State-of-the-art Centre

The first and most important need is for one dedicated center with appropriate space for accommodating all the above units. Each unit requires one instrumentation room, one researcher's room and one working space. In addition to this, morphology and the genetic unit requires additional space for the storage of known repository. One DNA preparation room with controlled negative pressure will be required for the genetic unit. Three numbers of 4° C storage rooms (each with 400 square feet ground area and 10 feet in height) with modular self attach to the walls would be required for storage of case property. One -20° C strong room (400 square feet ground area and 10 feet in height) with modular self attach to the walls would be required for the storage of tissue and meat samples. One normal temperature strong room (600 square feet ground area and 10 feet in height) with modular self attach to the walls and with regulated negative pressure required for storage of dried case and reference samples. One dedicated repository preparation room will be required for the collection of various body parts from the carcass of the animal. One dedicated facility for cell culture lab with controlled negative pressure and to deal day to day activity of karyotyping unit along with media preparation room. One dedicated fumigation room will be required for handling the putrefied and bad-smelling samples. One planned flesh-eating beetle (family *Dermestidae*) room requires preparation of the skeleton from the carcass of the animal. One dedicated washing and sterilization room will be set for taking care of all the basic needs of the building. One dedicated generator room and central AC plant will be attached to this building. The base of the building will be a minimum of 800 sq. m and will be constructed by CCU. The land for the location of this building within the Institute's campus in Chandrabani, Dehradun, is already available, for which no cost is to be paid. Therefore, non-recurring budget for the creation of the State-of-the-art centre is explained below:

Non-recurring Expenditure

S. No.	Facilities	No. of unit	Application/Use	Estimated Cost (Rs. in Lakhs)
1	Creation of a New Centre	1	To house various facilities of the NCWF	800
2	Automated management of cryopreserved tissue samples	1	For easy and accurate access of the long term presrved samples	800
3	Movable (motarized) metal racks and space optimizer	1	For space economic and safe storage of case properties and files	300
4	Electronics & equipment safe network of fire extiguser	1	For fire safety of the centre	300
5	Furning of facility to house BSL IV lab	1	Handling of air born infectious agent	300
6	Furning of negative pressure lab	2	For contamination free DNA isolation and sample preparation	300
7	Furning of positive pressure lab	2	Post PCR handling of samples	200
8	Furnishing of training centre with isolated equipments	1	For delivery of hands on training	160
9	Set up of 50 KV Digi Set	1	For power Backup	40
			Total (Rs. in Lakhs)	**3200**

Total Budget

1. Morphology Division	Cost (Rs. in Lakhs)
Equipment	320
Manpower & Consumables	250.8
2. Analytical and Ballistic Division	
Equipment	916
Manpower & Consumables	241.8
3. Genetics Division	
Equipment	2142
Manpower & Consumables	313.8
4. Toxicological Division	
Equipment	0
Manpower & Consumables	136.8
5. Pathology Division	
Equipment	0
Manpower & Consumables	136.8
6. Marine and Invertebrate Division	
Equipment	0
Manpower & Consumables	241.8
7. Botanical Division	
Equipment	0
Manpower & Consumables	78
8. Database & Dissemination Cell	
Equipment	140
Manpower & Consumables	165
9. Creation of a State-of-the-art Centre	3200
Grand Total (Rs. in Lakhs)	**8282.8**

Budgetary outlay (in Lakhs)

S. No.	Head	Ist Year (Rs. in Lakhs)	IInd Year (Rs. in Lakhs)	IIIrd Year (Rs. in Lakhs)	IVth Year (Rs. in Lakhs)	Total
1	**Non-recurring** (Equipment and Centre)	6718	-	-	-	6718
2	**Recurring** (Manpower & Consumables)	-	521.8	521.6	521.6	1564.8
3	**Total (Rs. in Lakhs)**	**6718**	**521.8**	**521.6**	**521.6**	**8282.8**

Potential Target Species of NCWF

NCWF will establish a protocol and SOP's for all the Mammalian species listed in WPA and other highly traded non-mammalian and marine species. NCWF would also prioritize the target species for urgent development of the protocol in consultation with the WCCB to meet the immediate requirement of the investigation.

Scope of NCWF and Responsibility

Though WII's NCWF will be a focal agency for undertaking research and development work for strengthening wildlife forensics, it will also be dissemination/sharing developed/validated SOP/database and methodologies with the various forensic science laboratories across the country. It will work in collaboration with the WCCB, New Delhi, to assist in wildlife crime investigation. This center will be involved in developing easy-to-use protocols in the field for the identification of parts and products of the highly traded species for taking immediate action. Such a protocol will assist in taking on the spot decisions regarding the confiscation of the material. This center will serve as a comprehensive 'Wildlife Forensic Investigation Centre' in India, and based on funding support, three regional centers in Northeast, Western, and Southern/Central may be established under the NCWF in the future. It will also collaborate with the various veterinary research centers to bring expertise and SOP's in place for wildlife crime investigation. This center will collaborate with the laboratories working at the regional level e.g., ZSI, BSI, CCMB-LaCONES, CMFRI, Gandhinagar Forensic University, to disseminate the synchronized protocol through the regular workshop and to provide the secure access to the DNA data bank available in NWFC for casework. All the regional laboratories working in the country for wildlife crime investigation will be associated with the NWFC through the Memorandum of Understanding (MoU). Thorough MoUs, all the laboratories will be linked with the NCWF, and the protocol and resources available at this center will be legally accessible to them for forensic casework. NCWF would also relink with the USFWS, Oregon, the USA for the technology transfer and to develop new technology in wildlife crime investigation.

Role of other Centres working for Wildlife Crime analysis

The regional laboratories working in solving the wildlife offense case would transfer an aliquot (part) of the case property as a reference repository of the case that will act as a 'safe

wildlife forensic repository' and standard samples, which can be revalidated at NCWF whenever required. Each laboratory working in the region would primarily establish a 'Species Identification Centre' and 'Report Section' so that the earliest response could be provided to the enforcement team that will avoid the delay in the availability of the forensic report for legal procedure.

Government of West Bengal
Department of Forests,
Aranya Bhavan, Block-LA-10A, Sector-III, Saltlake City
Kolkata-700 106

Dt.: 12/08/2021

From: Shri R. Biswas, WBCS (Exe)
Deputy Secretary to the Government of West Bengal

To: The Inspector General of Forest, (Project Elephant)
Government of India
Ministry of Environment, Forest & Climate Change
Indira Paryavaran Bhavan.
Aliganj Jor Bagh Road,
New Delhi-110003

Sub: Submission of Project Proposal for the "Assessment of existing and modelling of potential elephant corridor for Conservation Planning and Management of West Bengal" under Centrally Sponsored Scheme "CSS-Project Elephant" in WB for the year 2021-22.

Sir,

With reference to above, I am directed to send herewith Project "Assessment of existing and modelling of potential elephant corridor for Conservation Planning and Management of West Bengal" with estimated cost of Rs. 1,69,63,303 while duration of project is 3 years. Project may be considered for approval and release of fund during 2021-22.

Enclo: As mentioned.

Yours faithfully

Deputy Secretary

Dt.: 12/08/2021

Copy forwarded for information and necessary action to

The PCCF (WL) & CWW, WB

Deputy Secretary

Government of West Bengal
Directorate of Forests
Office of the Principal Chief Conservator of Forests, Wildlife
& Chief Wildlife Warden, West Bengal.
Bikash Bhavan, North Block, Third Floor, Saltlake City, Kolkata-700 091.
Tel.No.2334-6900/2358-3208, Fax.91-033-23345946 e-mail< pccfwloffice.fd-wb@bangla.gov.in>
Website www.wildbengal.com

No.1437/WL/4Q-28/2021 **Dated: 28.07.2021**

To:
The Addl Chief Secretary to the Dept of Forests,
Govt of West Bengal

Sub: Project Proposal for the Assessment of existing and modeling of potential elephant corridor for conservation planning and management in West Bengal.

Ref: Wildlife Institute of India File No. WII/AE&CB/BH/WB_Elephant/2021/01 dt.16th July 2021.

Enclosed please find herewith Technical and Financial Project Proposal on the Assessment of existing and modeling of potential elephant corridor for conservation planning and management in West Bengal-a collaborative Project between Wildlife Institute of India and Forest Department of Govt of West Bengal.

The Project consists of 3 components namely, 1. Assessment of the existing elephant corridors in West Bengal, 2. Identification and mapping of potential elephant corridors in West Bengal using telemetry and other elephant movement data. 3. Drafting of conservation plan of elephant corridors in West Bengal for effective conservation and management.

The financiai proposal involves total cost of Rs. 1,69,63,303.00 of which Rs. 63,47,494 for component 1, Rs.48,87,429 for component 2 and Rs.57,28,380 for component 3. The Duration of the Project is 2 to 3 years.

You are requested to send the proposal to the Project Elephant Division , MoEF&CC for providing the fund under CSS-Project Elephant so that a comprehensive project can be prepared..

Principal Chief Conservator of Forests, Wildlife
& Chief Wildlife Warden, West Bengal

No.1437/WL/4Q-28/2021(2) **Dated: 28.07.2021**

Copy forwarded for information to the
1.The Principal Chief Conservator of Forests & HoFF, West Bengal
2. The Director, Project Elephant, MoEF&CC, GoI.

Principal Chief Conservator of Forests, Wildlife
& Chief Wildlife Warden, West Bengal

File No: WII/ AE&CB/BH/WB_Elephant/2021/01

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

Date: 16th July 2021

To

Principal Chief Conservator of Forests, Wildlife
& Chief Wildlife Warden, West Bengal
Bikash Bhawan, North Block, 3rd Floor,
Salk Lake City, Kolkata 700091.
Email: pccfwi-wb@nic.in, wbwildlife@gmail.com

Cover Pic: Avijan Saha

Sub.: Submission of project proposal for the study "Assessment of existing and modelling of potential elephant movement corridors for conservation planning and management in West Bengal" – reg.

Ref.: Letter from PCCF(WI)&CWLW, West Bengal No 1271/WL/1E-8/2021 dated 07.07.2021

Dear Sir,

We are in receipt of your letter as mentioned above. As per your request to conduct assessment of previously identified elephant corridors, and mapping of new telemetry based potential elephant corridors in North Bengal and South Bengal, we do hereby propose a study divided into 3 components/ phases:

1. Assessment (present status and change detection) of the existing elephant corridors in West Bengal,
2. Identification and mapping of potential elephant corridors in West Bengal using telemetry and other elephant movement data,
3. Drafting of conservation plan of elephant corridors in West Bengal for effective conservation and management.

We do hereby submit component-wise technical and financial proposal of the study for your perusal and kind approval.

Thanking You,

Yours faithfully,

14/07

Dr. Dhananjai Mohan, IFS
Director

Enclosed: Project proposal (Technical and Financial)

WILDLIFE INSTITUTE OF INDIA • CHANDRABANI, DEHRADUN •

पत्रपेटी सं. 18, चन्द्रबनी, देहरादून - 248001, उत्तराखण्ड, भारत
Post Box No. 18, Chandrabani, Dehradun- 248001, Uttarakhand, INDIA
ई.पी.ए.बी.एक्स : +91-135-2640111 से 2640115, फैक्स : 0135-2640117
EPABX : +91-135-2640111 to 2640115; Fax : 0135-2640117
ई-मेल/Email : wii@wii.gov.in; वेब/website : www.wii.gov.in

Project Title:	**ASSESSMENT OF EXISTING AND MODELLING OF POTENTIAL ELEPHANT MOVEMENT CORRIDORS FOR CONSERVATION PLANNING AND MANAGAMENT IN WEST BENGAL**
Project Lead:	**Dr. Dhananjai Mohan, Director WII** **Sh. V. K. Yadav, IFS, CWLW, WB**
Principal Investigator(s):	**Dr. Bilal Habib** **Head/Scientist - E** Dept. of Animal Ecology & Conservation Biology Wildlife Institute of India, Govt. of India Chandrabani, Dehradun, Uttarakhand – 248 001 Tel; 0135 – 2640111 – 2640115 Ext: 283 (0) Cell: 09410992233, E- mail: bh@wii.gov.in
Co- Investigators:	**Dr. (Capt). Parag Nigam** Department of Wildlife Health Management Wildlife Institute of India, Govt. of India Chandrabani, Dehradun, Uttarakhand – 248 001 Tel; 0135 – 2640111 – 2640115 Ext: 219 (0) E- mail: nigamp@wii.gov.in **Dr. Indranil Mondal** Wildlife Institute of India, Govt. of India Chandrabani, Dehradun, Uttarakhand – 248 001 E- mail: indranil@wii.gov.in
Funding Support:	**West Bengal Forest Department**
Duration:	**2 - 3 Years**
Submission:	**JULY 2021**
Budget:	**Rs. 1,69,63,303.00**

Component 1	Component 2	Component 3	Total
63,47,494	48,87,429	57,28,380	1,69,63,303

ASSESSMENT OF EXISTING AND MODELLING OF POTENTIAL ELEPHANT MOVEMENT CORRIDORS FOR CONSERVATION PLANNING AND MANAGAMENT IN WEST BENGAL

Introduction

The negative effects of habitat fragmentation threaten many species today and strategies to reduce their impact have been widely discussed (Saunders et al., 1991; Huxel and Hastings, 1999). A proposed method for moderating the negative effects of habitat isolation is the preservation and restoration of linear landscape elements (corridors that structurally link otherwise isolated habitat remnants) (Saunders and Hobbs, 1991). These corridors are meant to increase landscape connectivity by facilitating movement of organisms between habitat fragments and thus minimise the risk of inbreeding and extinction, increase local and regional population persistence and facilitate colonisation (Doak and Mills, 1994; Fahrig and Merriam, 1994; Sjorgen, 1991; Simberloff, 1988).

Connectivity depends on the characteristics of the habitat patches and the distance between patches (Ewers and Didham 2006) but also on the suitability and permeability of the matrix (Powney et al., 2011; Vergara, 2011). Landscape connectivity is also dependent on some landscape characteristics, which modify interspecific relationships (Ewers and Didham, 2006; Wakano et al., 2011) and mortality risks (Tischendorf & Fahrig, 2000a). Thus, species success or failure depends on features of landscape patches and landscape characteristics that need to be taken into account when estimating connectivity (Kadoya, 2009; Sawyer et al., 2011). Using movement data to estimate connectivity within a species' territory requires very important logistical and economical resources (Zeller et al., 2012), which become even more important when multi-species connectivity is considered. Goodwin & Fahrig (2002) showed that landscape structure was strongly correlated to connectivity, especially habitat area and inter-patch distance.

Asian elephants are long ranging species with extensive habitat and nutritional requirements. Furthermore, the population biology and genetics of the species require fairly unhindered gene flows across populations to ensure long-term viability. In the fragmented, human-transformed landscapes that typify most elephant habitats in Asia today, corridors thus ensure that nutritional, demographic and genetic needs are met. In these kinds of landscapes, corridors are likely to be surrounded by human settlements. The usage of corridors by elephants may thereby lead to human-elephant conflict through a multitude of mechanisms. Besides, in the human dominated landscape of West Bengal, the elephant population has increased by 69% in the last 6 years. Therefore, elephant conservation in India solely depends on identification of structural and functional dispersal corridors and on mitigation of conflicts with humans along these.

Study area

Southern West Bengal

The districts of Purulia, Bankura, and West Midnapore are situated in the southwestern part of the state of West Bengal, bounded by the state of Jharkhand on the Northern and Western side, Burdwan,

Hooghly, Howrah and East Midnapore districts of West Bengal on the Eastern side, and the state of Odisha on the southern side (Anon 2013). The western part of the study area is hilly and undulating being an extension of Chota Nagpur plateau, while the eastern part consists of flat Gangetic plains. Geologically, the western part of the Southwest Bengal has the oldest rocks, the granites, and schist from Precambrian age (Dasgupta 1989). The area comprises of 13 forest divisions namely, Kharagpur, Medinipur, Jhargram, Rupnarayan, Panchet, Bankura South, Bankura North, Kangsabati South, Kangsabati North, Purulia, Durgapur, Burdwan, and Birbhum. The Mayurjharna ER is located at the tri-junction of the districts of West Medinipur, Purulia and Bankura between 23° 27' N and 22° 23' N and 86° 27' E and 87° 32' E bordering Jharkhand. The area comprises of Belpahari, Banspahari, and Bhulabheda forest ranges of Jhargram Forest Division, and Bandwan-I, Bandwan-II, Manbazar-II and Jamuna forest ranges of Kangsabati (South) Forest Division; and Jhilimili, Fulkusma, Ranibandh, and Motgoda forest ranges of Bankura (South) Division totaling to 473.23 km^2.

Northern West Bengal

North Bengal region comprising of three districts (administrative units) viz., Darjeeling, Jalpaiguri, and Coochbehar that are spread across an area of ca. 12,700 km^2. The region is dissected north-south by swift flowing rivers and alluvial floodplains that drain into the Brahmaputra-Gangetic delta. The major rivers of the northern Bengal region from the west are the Mechi, Teesta, Jaldhaka, Torsa and Sankosh. The Torsa river flowing between the Jaldapara Wildlife Sanctuary and Buxa Tiger Reserve is the boundary between Eastern Dooars and Western Dooars, while the Sankosh river is the border between West Bengal and Assam. The major rivers of this region are Teesta, Mechi, Torsa, Rydak and Sankosh. Most of these rivers are flood prone and some of the rivers change their course regularly, resulting in large area under alluvial floodplains. An average of (300–700) persons per km^2 inhabit this region (Census of India 2011) with the primary occupation being agriculture, livestock rearing and tea estate workers. This region receives an annual rainfall of 3160 mm.

This region is characterized by moist tropical and sub-tropical forests along foothills of the Eastern Himalaya and includes 3 National Parks and 2 Wildlife Sanctuaries. These include Buxa National Park and Tiger Reserve (761 km^2), Jaldapara National Park (217 km^2), Gorumara National Park (80 km^2), Chapramari Wildlife Sanctuary (9.5 km^2) and Mahananda Wildlife Sanctuary (158 km^2). The other protected areas such as Neora Valley National Park, Singalila National Park and Senchal, Jorepokhri Wildlife Sanctuaries are located beyond 1000 meters altitude in the higher reaches of the Eastern Himalayan region. This entire stretch of forests along the foothills of North Bengal from the Indo-Nepal border with Mechi river in the west to the Sankosh river in the east bordering Assam is believed to be a historically contiguous elephant range. The major mammalian fauna of this region are the endangered one-horned rhinoceros (*Rhinoceros unicornis*), gaur (*Bos gaurus*), sambar (*Rusa unicolor*), chital (*Axis axis*), rhesus macaque (*Macaca mullata*) and a host of diverse fauna and flora with leopard being the apex predator and only large carnivore present (Bhattacharjee and Parthasarathy, 2013). Apart from elephants, this region also experiences one of the highest human-leopard conflicts in India (Naha et al, 2018).

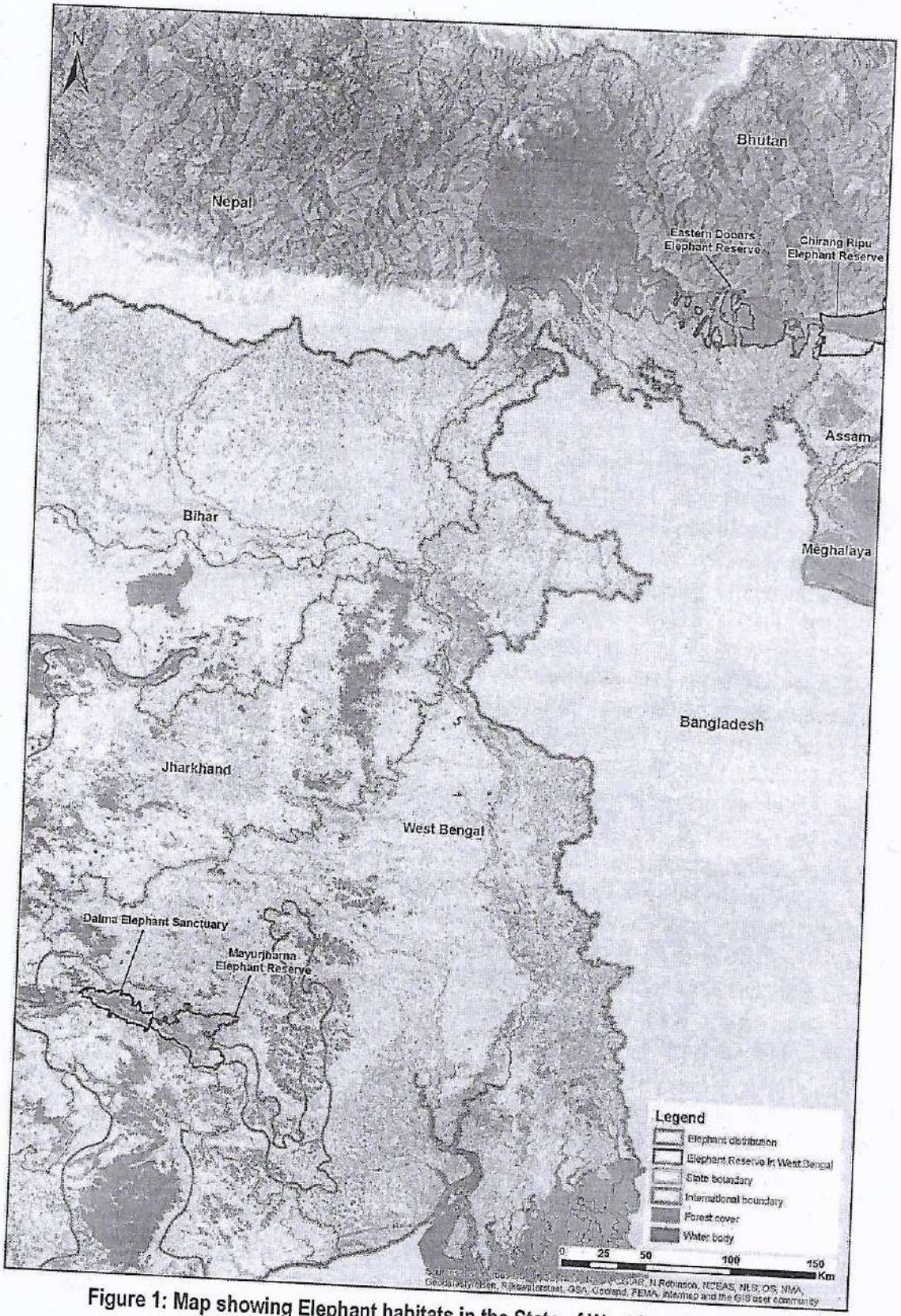


Figure 1: Map showing Elephant habitats in the State of West Bengal, India.

Objectives:

1. Assessment (present status and change detection) of the of existing elephant corridors in West Bengal.

2. Identification and mapping of potential elephant corridors in West Bengal using telemetry and other movement data.

3. Drafting of conservation plan of elephant corridors in West Bengal for effective conservation and management.

Methodology

Objective 1: The status of the existing elephant corridors in West Bengal will be assessed by doing change detection in the last 20 years and habitat assessment.

Change detection will be done using high resolution satellite imagery, whereby we will look at change in land use and vegetation cover over the last 20 years. Habitat assessment will be done via sign surveys to assess presence of other wildlife species and vegetation sampling to assess the floral diversity. Anthropogenic pressure will also be assessed by recording human disturbance in the form of cutting, lopping, grazing and other direct/ indirect signs or by using remote-sensing data.

Objective 2: Elephant movement data will be analysed and pockets in the landscape outside PAs will be identified where they were spending a considerable amount of time while dispersing or exploring using Liner Time Density Analysis (Wall et al., 2013). The eco-geographical characteristics of these pockets will be extracted and based on this information it will be extrapolated to other areas of the landscape to derive a model of habitat permeability for the movement of elephants in the landscape outside PAs. The habitat permeability surface was used in Circuit Theory framework (McRae, 2006; McRae and Beier, 2007; McRae et al., 2008; Shah and McRae, 2008) to model elephant corridors.

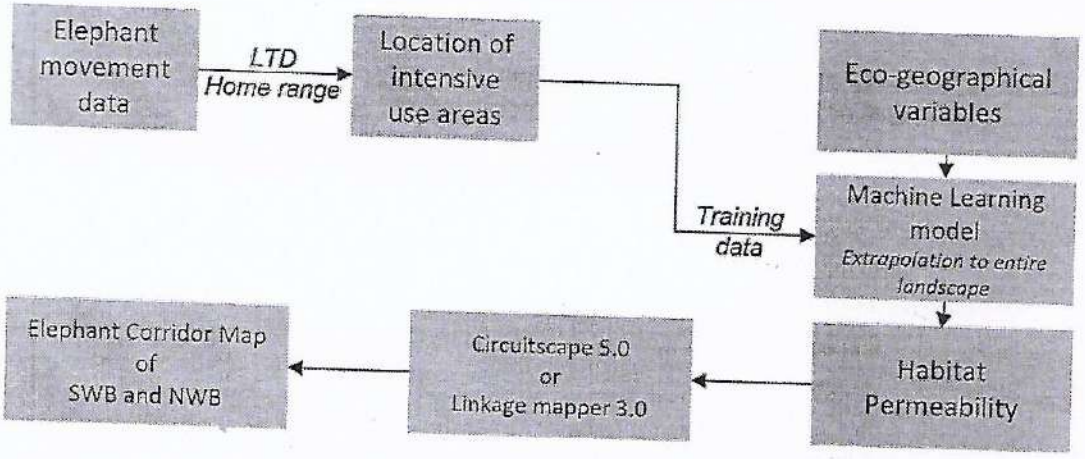


Figure 2: Flowchart of methodology for objective 2 *(SWB = Southern West Bengal, NWB = Northern West Bengal)*

Elephant movement data is to be provided by the Forest Department of West Bengal for this analysis. As soon as we receive movement data, we shall initiate the analysis for this objective.

Objective 3: Data from field about the presence of elephants and other wildlife species, habitat quality and anthropogenic pressure will help us formulate a conservation plan for the identified elephant corridors in West Bengal. That will include habitat management, review of protection strategies and regulation of human activities. Once the baseline information about the status of the corridors is established, a yearly monitoring plan will be envisioned which will keep track of the trends in use by elephants and change in habitat quality which will further help in the management of these corridors. Regular workshops conducted with the Forest Department staff and other stakeholders to keep them abreast of the findings of this study and help them implement conservation strategies in these corridors.

Once the elephant corridors are identified in the landscape, they will be ranked to find out the optimal candidate corridor to be implemented on the ground. The ranking will be based on the importance of the corridor (Linkage Priority), cost of implementation (land ownership in the identified corridors), amount of livelihood that is going to be affected etc. The selection process will be a weighing between ecological importance and the cost of implementation. Using Circuit Theory gives us an advantage over conventional least cost path (LCP) corridor identification, as Circuit Theory Corridors provides us several option on the ground as against a single optimal pathway by LCP. Once the final selection is made, the corridor will be demarcated on the ground based on village boundaries and forest compartment boundaries. That will give us an opportunity to identify the stakeholder who will be called into a consultation meeting. At such meetings the social and environmental safeguards/risk will be identified and mitigation measure and adaptation strategies will be formulated.

Expected outcomes:

1. **Present status of existing elephant corridors in West Bengal and the change that is happened over the years.**
2. **New corridors based on telemetry and other elephant movement data in the landscape.**
3. **Management plan of elephant corridors of Southern and Northern West Bengal.**

Budget Details:

Head	Component - 1	Component - 2	Component - 3
3 X Project Associate - I @31,000 pm + 16 % HRA + medical	13,69,560	13,69,560	0
3 X Project Associate - II @35,000 pm + 16 % HRA + medical	0	0	15,36,600
3 X Field Staff (Field Assistants/ Interns/ Volunteers) @ 15,000 pm	5,40,000	5,40,000	5,40,000
Basecamp	3,00,000	3,00,000	3,00,000
Hiring of vehicle for field work @40,000 pm with 5% increase every year	5,60,000	5,88,000	6,17,400
PoL	2,00,000	2,00,000	2,00,000
Travel of PI and Project Staff	3,00,000	3,00,000	3,00,000
Field Equipments GPS/ Binoculars/ Workstation/ Data Storage etc	10,00,000	5,00,000	0
Satellite Data Cost	10,00,000	0	0
Conservation and Management Planning Workshops	0	0	10,00,000
Miscellaneous	1,50,000	1,50,000	1,50,000
Contingency	1,00,000	1,00,000	1,00,000
Sub Total (A)	55,19,560	40,47,560	47,44,000
5% Inflation Cost	0	2,02,378	2,37,200
Sub Total (B)	55,19,560	42,49,938	49,81,200
Institution Charges (15%)	8,27,934	6,37,491	7,47,180
Grand Total	**63,47,494**	**48,87,429**	**57,28,380**

Component Details:

Component 1 (Duration 1 year) *This can be initiated any time independent of any other component.*	*Assessment (present status and change detection) of the of existing elephant corridors in West Bengal.*
Component 2 (Duration 1 year) *This can be initiated any time after receiving telemetry and other movement and conflict data from the West Bengal Forest Department.*	*Identification and mapping of potential elephant corridors in West Bengal using telemetry and other movement data.*
Component 3 (Duration 1 year) *This can only be initiated once the first two components are completed.*	*Drafting of conservation plan of elephant corridors in West Bengal for effective conservation and management.*

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F. No. 7-1/2021 -PE
Government of India
Ministry of Environment, Forests & Climate Change
(Project Elephant Division)
****

Indira Paryavaran Bhawan,
Jor Bagh Road, Aliganj,
New Delhi-110003

Dated 24th August, 2021

OFFICE MEMORANDUM

Sub: Proceedings of the Meeting of the committee constituted to identify and conduct ground-truthing of 101 elephant corridors in India held at 15:30 hrs on Friday, 23rd July, 2021 at the Ministry of Environment, Forests and Climate Change-reg.

The undersigned is enclosing herewith the approved Proceedings of the Meeting of the committee constituted to identify and conduct ground-truthing of 101 elephant corridors in India held at 15:30 hrs on Friday, 23rd July, 2021 at the Ministry of Environment, Forests and Climate Change (MoEF&CC) under the Chairmanship of Inspector General of Forests & Director, Project Elephant.

2. This issue with the approval of the Inspector General of Forests & Director, Project Elephant, Ministry of Environment, Forests & Climate Change.

Encls: as above

(Dr. K. Muthamizh Selvan)
Scientist 'D' (Project Elephant)
Email id: km.selvan@gov.in
Telephone No. 011-24695067

Distributon:

- As per list enclosed.

Copy to :

1. Dr. K. M. Selvan, Scientist D, Project Elephant Division, MoEF&CC.
2. PPS to Inspector General of Forests (Project Elephant), MoEF&CC.
3. Dr. Prajna P. Panda, National Coordinator, Elephant Cell, MoEF&CC.

Proceedings of the Meeting of the committee constituted to identify and conduct ground-truthing of 101 elephant corridors in India held at 15:30 hrs on Friday, 23rd July, 2021 at the Ministry of Environment, Forests and Climate Change

The virtual meeting of the committee constituted to identify and conduct ground-truthing of 101 elephant corridors was held at 15:30 hrs on Friday, 23rd July, 2021 under the Chairmanship of Shri Brijendra Swaroop, IGF & Director (PE), MoEF&CC. List of participants is annexed.

2. Shri Brijendra Swaroop, IGF (PE) welcomed all the participants and requested Dr. Sandeep Kumar Tiwari to present on the methodology adopted in the identification and ground-truthing of elephant corridor in India.

3. Dr. Sandeep Kumar Tiwari presented on the methodology adopted in identification and ground-truthing of elephant corridors. He also informed that a corridor evolves due to topography of the area, settlements and agricultural and developmental activities in the area. Elephant corridor should not connect sources with sinks that could escalate conflict levels. Therefore, corridor restoration should not focus on habitat improvement.

4. The Chair remarked that prior to notifying of elephant corridors and giving them legal status, it is important to get the sympathy of communities. It is first important to identify the elephant corridors.

5. CWLW Assam informed that Assam has large amount of disconnected land and the intensity of conflict is very high. The State Forest Department is working with local communities and sensitizing them not to disturb elephants in their natural migratory routes as the Government shall be providing the compensation to the amount of Rs. 7000/bigha through the purchase of standing crops.

In Assam corridors are divided based into two categories- structural and functional corridors (during floods wild animals come out anywhere). The elephant corridors can be identified and minimal habitat improvement may be done for the free passage of elephants and not for elephants to become residential in the area.

State Govt. of Assam is keen to fund for elephant corridors but prior to that the elephant corridors needs to properly identified based on the usage by elephants. The Committee should come up with a check list that can be given to the front line staff to identify elephant corridors.

Use of honey bee sounds and promoting crops like tea, rubber, citronella, chilly is detrimental as the elephants might cause more damage if no food is available during their movement across human landscapes. Instead, the State FD should compensate the villagers adequately to gain their good will and support. Addressing HEC, a village in Nagaon have started growing paddy in a large area for elephants restricting the movement of elephant in the area.

6. Dr. Anil Kumar Singh informed that terrain and frequency of elephant movement in elephant corridors is very important. Even if there is a regular seasonal movement of a corridor, the corridors should be maintained. If connectivity of the corridors is lost, then two populations gets separated. Regular monitoring of elephant corridors is very important.

7. APCCF (WL), Karnataka informed that corridors are dynamic in nature and the usage of elephant corridors varies.

He suggested Ministry to define what an elephant corridor is. Ministry should provide training to field staff on what is a corridor and on protocols of data collection.

National CAMPA funds should be used for securing elephant corridors. Land acquisition should be invoked. Declaring elephant corridors as eco-senstive zone will not serve any purpose. A proper approach is needed to protect elephant corridors.

8. Mr. Manoj Kumar, CCF informed that Karnataka Forest Department has already started work on elephant corridors in Nagarhole and proper study should be undertaken to find out the minimum area required to declare an elephant corridor instead of declaring the entire area as elephant corridor.

9. APCCF, Uttarakhand informed that the state has a viable population of 2100 elephants and also facing the issue of HEC. The state receives funds from Disaster Management Department and is able to give compensation to victims.

WTI had identified 10 elephant corridors but at the same time Uttarakhand has diverted 50,000 hectares of land for developmental purposes.

Cooperation of local people is critical. In recently concluded Kumbh Mela, all steps were taken by the State FD to ensure no accidents happen during the Mela.

With cooperation of WWF-India, a monitoring system has put in place to prevent death of elephants due to train hits.

10. Shri Bikash Das, Odisha informed that WTI has identified 9 corridors in 2005 and 12 elephant corridors in 2017. ANCF has also identified new elephant movement paths. There is a need to institute proper study on the long term movement of elephants.

The following decisions were taken in the meeting:

1. Dr. Sandeep Kumar Tiwari and Dr. Anil Kumar Singh shall send a note to this Ministry by 1st week of September, 2021 on the parameters to be considered for categorizing an area as an elephant corridor.
2. Identification and ground truthing of elephant corridors shall be done involving the State Forest Departments of elephant range states.
3. Regional consultation meetings on redrawing of elephant corridors shall be organized to finalize the list of elephant corridors.
4. A proposal shall be prepared for funding from National CAMPA to secure and stregthen elephant corridors.

The meeting ended with thanks to the Chair.

List of participants:

1. Shri Brijendra Swaroop, IGF & Director, Project Elephant, MoEF&CC
2. Shri M. K. Yadav, CWLW, Assam
3. Shri J. S. Suhag, CWLW, Uttarakhand
4. Dr. Sandeep Kumar Tiwari, Program Manager, AsESG
5. Dr. Anil Kumar Singh, WWF-India
6. Shri Subhash Malkhede, APCCF (WL), Karnataka
7. Shri Ranjan Mishra, APCCF (WL), Uttarakhand
8. Shri Manoj Kumar, CCF, Karnataka
9. Shri Bikas Das, CF, Odisha
10. Dr. K. M. Selvan, Scientist D, Project Elephant Division, MoEF&CC
11. Dr. Prajna P. Panda, National Coordinator, Elephant Cell, MoEF&CC

F. No. 7-1/2021-PE
Government of India
Ministry of Environment, Forests & Climate Change
(Project Elephant Division)
****

Indira Paryavaran Bhawan,
Aliganj, Jor Bagh Road,
New Delhi-110003

Dated 13th April, 2021

OFFICE MEMORANDUM

Sub: Constitution of Committee to identify and conduct the ground truthing of 101 elephant corridors identified by the Wildlife Trust of India in consultation with State Forest Departments –reg.

A committee to identify and conduct the ground truthing of the 101 elephant corridors identified by the Wildlife Trust of India in consultation with State Forest Departments is constituted. The composition of the Committee is as follows:

(i) Inspector General of Forests & Director (Project Elephant)- Chairman
(ii) Dr. Sandeep Kumar Tiwari- Program Manager, IUCN AsESG & EMT, WTI- Member
(iii) Dr. Anil Kumar Singh- WWF- India - Member
(iv) Dr. K. M. Selvan- Scientist D, Project Elephant Division - Member
(v) Dr. Prajna P. Panda- National Coordinator, Elephant Cell - Member
(vi) CWLW, Karnataka or Nodal Officer, Project Elephant Division, Karnataka - Member
(vii) CWLW Odisha or representative, Odisha - Member
(viii) CWLW or representative, Assam - Member
(ix) CWLW or representative, Uttarakhand - Member

2. The Committee shall have the following Terms of References:

(i) To collate the information on the existing elephant corridors from the State Forest Departments.
(ii) To submit the plan for groundtruthing of the elephant corridors identified by the State FDs.
(iii) Conduct consultative workshops with State Forest Departments to finalize the list of identified elephant corridors.
(iv) To prepare the document on the identified elephant corridors of the country and submit to the Ministry within the time limit prescribed.

3. The travelling allowance, daily allowance etc. will be payable to Non- official members of the Committee through RTGS as per SR-190 after submission of original bills of Airlines, Taxi etc. whereas official members will get TA/DA from their respective organizations.

4. The term of the Committee shall be for two years from the date of constitution.

5. All the expenditure related to meetings and consultative workshops with SFDs will be met by the Elephant Cell of Wildlife Institute of India, Dehradun.

6. This issues with the approval of the competent authority.

(Dr. K. Muthamizh Selvan)
Scientist 'D' (Project Elephant)
Email id: km.selvan@gov.in
Telephone No. 011-24695067

Distribution:

- All the members of the Committee.

Copy to:

- PPS to DGF&SS, MoEF&CC
- PPS to Addl. DGF (WL),MoEF&CC

Note # 1

F. No. 1-2/2021-PE
Government of India
Ministry of Environment, Forest and Climate Change
Project Elephant Division

Subject: Submission of Project Proposal for the "Assessment of existing and modelling of potential elephant corridor for conservation planning and management of West Bengal" under CSS-Project Elephant in West Bengal for the year 2021-22.

2. FR **(page No. 1-12/cor)** is a communication received from Shri. R. Biswas, Deputy Secretary, Government of West Bengal regarding financial assistance to the Project Proposal submitted by Wildlife Institute of India, titled "Assessment of existing and modelling of potential elephant corridor for conservation planning and management of West Bengal"

3. Objectives of the proposal ;

i. Assessment (Present status and Change detection) of the existing elephant corridors in West Bengal.
ii. Identification and mapping of potential elephant corridors in West Bengal using telemetry and other movement area.
iii. Drafting of conservation plan of elephant corridors in West Bengal for effective conservation and management.

4. Expected outcome

i. Present status of existing elephant corridors in West Bengal and the change that is happened over the years.
ii. New corridors based on telemetry and other elephant movement data in that landscape.
iii. Management plan of elephant corridors of southern and northern west Bengal.

5. The total cost of project is Rs. 1,69,63,303/- in three years. He has requested to provide financial assistance under the CSS Project elephant, MoEF & CC.

6. The Government of West Bengal has submitted the APO of Rs. Rs.320.50 lakhs and is currently under process in the division. Therefore, the present proposal may be forward to CAMPA Authority for funding support from Central or state CAMPA.

7. Submitted for kind consideration and approval please.

18/08/2021 10:12 AM

K MUTHAMIZH SELVAN
(SCIENTIST D)

Note # 2

The note supra may be perused. The proposal submitted by WII to WB Forest Department need financial support, as has been requested by WB Govt, which can not give from PE, as elaborated above. However, there is a possibility that the project may be funded by CAMPA fund, keeping in view the significance of the

project which will help in understanding the elephant corridors and their conservation. Therefore, may like to take a view and forward the proposal to CAMPA for financial support please.

21/08/2021 1:17 PM

RAMESH KUMAR PANDEY
(INSPECTOR GENERALS OF FORESTS)

Page: 1

Note # 3

23/08/2021 9:50 AM

SOUMITRA DASGUPTA
(ADDITIONAL DIRECTOR GENERALS OF FORESTS)

Note # 4

23/08/2021 2:20 PM

RAMESH KUMAR PANDEY
(INSPECTOR GENERALS OF FORESTS)

Note # 5

Has there not been similar studies on the subject for other State(s)?

23/08/2021 8:13 PM

SUBHASH CHANDRA
(CEO)

Note # 6

23/08/2021 8:44 PM

RAMESH KUMAR PANDEY
(INSPECTOR GENERALS OF FORESTS)

Note # 7

Page: 2

Attention needed for note no # 5. Please coordinate with states and put up.

24/08/2021 11:24 AM

K MUTHAMIZH SELVAN
(SCIENTIST D)

Note # 8

1. In reference to the Note#5 , it is to mention that the elephant corridors of West Bengal has been studied in 2005 where upon the identification of 13 elephant corridors in West Bengal, 1 interstate corridor between West Bengal and Assam and 4 inter state elephant corridors between West Bengal and Jharkhand have been done in 2005. These elephant corridors are also reported in the Right of Passage edition of 2005 as well as in the Gajah Task Force Report of the Ministry in 2010.

2. Further the elephant corridors of West Bengal were assessed by Wildlife Trust of India and stakeholder consultation were held with West Bengal FD in 2017 and the same number (13 in West Bengal and 5 interstate) of elephant corridors

were identified and groundtruthed after over a decade. The change in the corridor habitat status, forest/land use, extent of threats, list of corridor villages, corridor dependent villages, level of HEC and the conservation actions needed to be taken to protect these corridors were outlined in the Right of Passage second edition in 2017 which was released by the Hon'ble MEF in 2017.

3. A Committee has also been constituted by the Ministry to identify and groundtruth all elephant corridors of India in 2021 (placed at page 17-18/cor) and the first meeting for the same has already been convened on 23.07.2021 under the Chairmanship of ADG (WL). The minutes of the meeting are placed at page 13-16/cor where it has been decided by the Ministry that the identification and groundtruthing of all elephant corridors shall be done involving the SFDs of all elephant range states. Ministry shall also be conducting regional and state level consultations with all elephant range states to finalise the list of elephant corridors with due validation of the SFDs (placed at page 15/cor).

4. West Bengal FD was already involved on the identification of elephant corridors both in 2005 and 2017. Based on the information available with the SFD, the state may now draft the conservation action plan of the critical elepahnt corridors. The Committee of the Ministry constituted for identification and groundtruthing of elephant corridors shall also be working with SFD in the matter.

Submitted please.

24/08/2021 3:25 PM

PRAJNA PARMITA PANDA
(NATIONAL COORDINATOR ELEPHANT CELL)

Note # 9

Reference to Note#8 ,

1. The identification of elephant corridors in India including West Bengal has been done in 2005 and 2017.Ministry has also constituted a Committee for identification and groundtruthing of elephant corridors across the country in 2020.

2. As indicated by DGF&SS in Note 5 , radio collaring of elephant to monitor the movement of elephants is at present undergoing in Chhattisgarh.

3. The proposed study submitted by West Bengal FD and WII aims to assess the existing elephant corridors identified in the state of West Bengal and identify the potential corridors using telemetry. As HEC is a major conservation issue in the State of West Bengal where 950 humans have been killed by elephant attacks in last 10 years, it is important to draft a conservation plan of elephant corridors for management and conservation of elephants in the state.

3. Since management of human-elephant conflict is a priority mandate of the Project Elephant Division, MoEF&CC needs to be involved in the overall functioning of the project. Therefore, the IGF(PE) and Director, Project elephant should also be the Project Lead and the National Coordinator, Elephant Cell should be included as the Co-PI of the project.

4. In view of the above, we may recommend the proposal to National CAMPA for consideration for funding the proposal.

Page: 3

09/09/2021 2:17 PM

K MUTHAMIZH SELVAN
(SCIENTIST D)

Note # 10

The Note #5 of the DG&SS/CEO Campa may kind be perused.
There are similar works being done in Chhatisgarh.
As mentioned in the aforementioned note #9 (except para-3), the project is worth consideration keeping in view the West Bengal being an important Elephant Range State affected with Human-Elephant negative interfaces.
May like to approve the proposal and extend the financial assistance solicited.

09/09/2021 3:45 PM

RAMESH KUMAR PANDEY
(INSPECTOR GENERALS OF FORESTS)

Note # 11

Proposal be placed in next EC Meeting.

09/09/2021 4:32 PM

SUBHASH CHANDRA
(CEO)

Note # 12

09/09/2021 4:47 PM

RAMESH KUMAR PANDEY
(INSPECTOR GENERALS OF FORESTS)

Note # 13

Page: 4

15/09/2021 10:16 AM

SANJAY KUMAR OJHA
(JOINT CEO)

Note # 14

15/09/2021 10:27 AM

PRIYA RANJAN
(DY INSPECTOR GENERAL OF FOREST)

Note # 15

Please put up for including in next EC meeting.

22/09/2021 4:48 PM

SIAM KHAN MUAN GUITE
(ASSISTANT INSPECTOR GENERAL FOREST)

F. No. 7-1/2021-PE
Government of India
Ministry of Environment, Forests & Climate Change
(Project Elephant Division)
****

Indira Paryavaran Bhawan,
Aliganj, Jor Bagh Road,
New Delhi-110003

Dated 13th April, 2021

OFFICE MEMORANDUM

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(iv) Dr. K. M. Selvan- Scientist D, Project Elephant Division - Member
(v) Dr. Prajna P. Panda- National Coordinator, Elephant Cell - Member
(vi) CWLW, Karnataka or Nodal Officer, Project Elephant Division, Karnataka - Member
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6. This issues with the approval of the competent authority.

(Dr. K. Muthamizh Selvan)
Scientist 'D' (Project Elephant)
Email id: km.selvan@gov.in
Telephone No. 011-24695067

Distribution:

- All the members of the Committee.

Copy to:

- PPS to DGF&SS, MoEF&CC
- PPS to Addl. DGF (WL),MoEF&CC

Elephant Status and Abundance Estimation Across India

As part of the National Tiger Status assessment, data is being recorded on elephant occupancy and relative abundance through the MSTrIPES Ecological application. These include a) elephant sigh survey in each beat with three replicate walks of 5 km each in an occupancy framework, b) dung plots to estimate elephant dung density on 2x20m plots on 2-4km transects every 400m interval in each beat, c) Distance sampling on a 2-4km transect in each forest beat.

The above data provides the basic information on distribution of elephants after correcting for detection probability in an occupancy framework. Distance sampling has not given the desired results for estimating elephant absolute density because of the dangers associated with close approach to an elephant on a foot sampled line transect. To circumvent this problem the following approach is proposed for obtaining absolute density from 30-40 sampling sites of 250-400 km^2 size blocks varying in elephant relative abundance categories in a double sampling (Pollock et al. 2002) framework with relative abundance indices and environmental covariates sampled across all elephant bearing forests.

Field sampling protocol for elephant absolute density estimation

As part of the on-going National tiger estimation, Polygon search method (Efford, 2011) is being employed for estimation of animal population densities and thereby abundances. This method will be further modified for elephants in certain sites. This will ensure that with the current effort of field sampling being carried out for tigers and co-predators, we will simultaneously be able to apply the same methods for elephants. For ease of sampling and to minimize errors in data collection, the polygon search app, an android app on the lines of the MSTrIPES Ecological module app, will be used. Fresh dung samples of elephant encountered during the polygon survey will be sampled for genetic analysis. First, the diameter of the bolus will be measured so as to be able to categorise them post-priori into broad age classes (Tyson et al.2002). About 10-20 gm of the freshest part of the dung, which is not in contact with other boli will be collected in silica gel. Location information (GPS) of each sample collected will be noted.

Elephant demography in many places is skewed due to poaching of tuskers, thus it is important to record sex and age of herds. Two days will be spent in each beat, to record age and sex of

animals, as part of Phase I. Appropriate field guide will be circulated, and training imparted to field staff for this estimation.

Laboratory Analysis

DNA extraction from dung samples followed Fernando et al. (2003), with reagent controls in a spatially segregated room dedicated to low-copy DNA extraction. For assigning each dung sample to individual elephants, a select panel of microsatellite markers characterized for Asian elephants (as mentioned above), will be amplified. Subsequently, the Probability of Identity (Pid), which provides a relative measure of the degree of match in any random pair of multilocus genotype will be estimated. Multiple tube microsatellite genotyping will be used to determine consensus genotypes and calculate error rates (Navidi et al. 1992). Several PCR replications with negative controls will be conducted per sample and loci to construct a consensus genotype. Before performing downstream population and kinship analyses, microsatellite markers will be tested for heterozygote deficiencies, indicative of scoring errors due to stuttering, large-allele dropout and null alleles. Error prone loci will either be re-amplified or removed from analysis.

Analysis

After individual identification from genetic analyses, information on individuals and their distribution in space will be obtained. This data on captures and recaptures of elephant individuals across space will be used in a spatially explicit capture re-capture framework to estimate densities.

Budget

Most of the Peninsular and Northern India is covered and Nort-East is partly covered. The area which is not covered under Tiger States need to be funded by PE for elephant estimation. For Phase I money need to be allocated to states (Table 1) and for Phase III money need to be allocated to WII (Table 1).

Table 1. Budget for States

State	Amount
Arunachal	14231000
Manipur	6076000
Meghalaya	5579000
Mizoram	5691000
Nagaland	3962000
Tripura	3003000
West bengal	3801000
	4,23,43,000

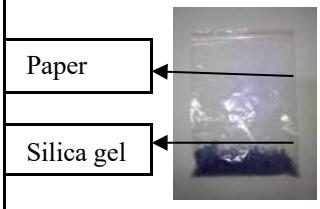
Table 2Budget for WII

Sno	Budget Head	Details	Amount
1	Genetic analysis	Chemicals for genetic analysis of dung samples from 20 sampling blocks of varied density gradients	₹ 2,24,00,000
2	Man power	8 Research biologists (Salaries, HRA, Insurance, Medical Reimbursements)	₹ 38,40,000
3	Equipmet	Freezers etc	₹ 8,00,000
4	Field sampling	Field logistics for sampling, chemicals for storage and transportation & field genetic kits	₹ 2,50,000
5	Total		₹ 2,72,90,000
6	10% Instituional Overhead Charge		₹ 27,29,000
7	**Grand Total**		**₹ 3,00,19,000**

Protocol of dung collection

Collect dung of large herbivores (*), as and when encountered in field according to the following protocol.

1. Carry zip lock bags whenever you go to field.
2. When you encounter a large number of dung samples in one area, chose to sample 30% of these dung bolus. Choose the bolus which are not touching each other. Sample from the middle of the dung bolus, and not from the edges.
3. Break the dung pile with a stick or stone around, or an inverted zip lock bag and sample about 25 gm.
4. Only collect if you get very fresh, fresh or old dung samples. Do not collect from very old and dry samples.
5. When you encounter a dung sample, collect a part of it in the ziplock bag as mentioned below.

Use an empty ziplock bag. Invert it to sample the middle part of the bolus, and take about 25gm of the part with most moisture, and where the surface still has some moisture. Do not touch the dung directly with your hand. If you are not comfortable using a zip lock directly, use a leaf/twig to a stone to break the dung pile and put the dung sample into the zip lock	
Fill approximately 1/5th of the ziplock with silica gel.	
Seal tightly after removing any air.	

6. Write details of Sample ID (Of users choice, but generally includes name of PA, for eg. Sample first sample collected in Bandipur on 23May 2019 would be BND23052019_1), species, GPS location, place, collectors name and date of collection on the ziplock bags.
7. Fill in the datasheet without fail.
8. If you come across the carcass of any dead animal, collect 5-10 gm of tissue for reference. This can be collected in ziplocks with silica gel, and later transferred to vials with ethanol.
9. Finally, send ziplocks, paper bags and/or vials with tissue samples, along with data sheet without any delay by post/courier to: **Dr YV Jhala, Wildlife Institute of India, Chandrabani, Dehradun – 24800**

Datasheet 5A

Dung collection (Genetics)

Observer:…….. Protected Area:……..

S.No.	Date	Sample ID	GPS co-ordinate						Potential Species**	Range/Beat	Forest type	Terrain type	Dung condition*	Remarks
			Latitude			Longitude								
			Deg	Min	Sec	Deg	Min	Sec						
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														

*Scat condition- Very fresh, fresh, old, very old

* dung of gaur, elephant, wild buffalo and rhinoceros.

References

- Efford, Murray G. (2011). "Estimation of population density by spatially explicit capture–recapture analysis of data from area searches." Ecology 92.12: 2202-2207.
- Fernando P, Vidya TNC, Rajapakse C, Dangolla A, Melnick DJ. (2003). "Reliable non-invasive genotyping: fantasy or reality?" Journal of Heredity 94:115–12.
- Navidi, W., Arnheim, N. and Waterman, M.S. (1992)." A multiple-tubes approach for accurate genotyping of very small DNA samples by using PCR: statistical considerations". American Journal of Human Genetics, 50: 347.
- Pollock, K. H., Nichols, J. D., Simons, T. R., Farnsworth, G. L., Bailey, L. L., & Sauer, J. R. (2002). Large scale wildlife monitoring studies: statistical methods for design and analysis. Environmetrics: The official journal of the International Environmetrics Society, 13(2), 105-119.
- Tyson M, Hedges S, Sitompul AF. (2002). "WCS-Indonesia Program Sumatran elephant project: six-month report January–June 2002". Unpublished report to the Wildlife Conservation Society, New York

Reminder-I

Government of India
Ministry of Environment Forest and Climate Change
(RT-Division)

Indira Paryavaran Bhawan,
4th Floor, Agni Wing, Ali Ganj,
Jor Bagh Road, New Delhi-110003
Dated: 20, September, 2021

OFFICE MEMORANDUM

Subject: Project on "Management of Lantana Camara through utilization for improving livelihood of people –regarding.

The undersigned is refer to RT-Division's O.M. of even number dated 02.08.2021 vide which project proposal on **"Management of Lantana camara through utilization for improving livelihood of people in forest fringe villages in India"** has been submitted to CAMPA for funding.

2. In this context, it is requested to furnish current status of the aforesaid proposal, so that the same could be apprised to ICFRE, Dehradun.

Encl : As above

(Suveena Thakur)
Asst. Inspector General of Forests (RT)
Tel: - 011-24652173
E-mail: hp199.ifs@nic.in

To

AIGF (CAMPA)
Old CBI Building, CGO Complex,
Lodhi Road, New Delhi - 110003

Copy for information to :-
(i) The Director General, Indian Council of Forestry Research and Education, PO New Forest, Dehradun – 248006 Uttarakhand.

Government of India
Ministry of Environment Forest and Climate Change
(RT-Division)

Indira Paryavaran Bhawan,
4th Floor, Agni Wing, Ali Ganj,
Jor Bagh Road, New Delhi-110003
Dated: 02,August, 2021

OFFICE MEMORANDUM

Subject: Project on "Management of Lantana Camara through utilization for improving livelihood of people –regarding.

The undersigned is directed to forward herewith a copy of the ICFRE's letter No. 3-11/ICFRE(R)/RP/L.Camara/484 dated 27.07.2021 along with project proposal on **"Management of Lantana camara through utilization for improving livelihood of people in forest fringe villages in India"** submitted by ICFRE, Dehradun. The duration of the project is 05 years and the total outlay is of Rs. 43.2644 Crores.

2. This issues with the approval of the DGF&SS, MoEF&CC.

(Suveena Thakur)
Asst. Inspector General of Forests (RT)
Tel: - 011-24652173
E-mail: hp199.ifs@nic.in

To

The Chief Executive Officer (CEO)
CAMPA
Old CBI Building, CGO Complex,
Lodhi Road, New Delhi - 110003

Copy for information to :-

(i) The Director General, Indian Council of Forestry Research and Education, PO New Forest, Dehradun – 248006 Uttarakhand.

सं. 3–11 / भा.वा.अ.शि.प. (आर) / आर.पी / *L. camara*/ 484
अनुसंधान निदेशालय / Directorate of Research
भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद्
Indian Council of Forestry Research and Education (ICFRE)
पो. ओ. न्यू फॉरेस्ट, देहरादून – 248 006 / P.O. New Forest, Dehradun- 248 006

Dated: 27 July 2021

To,

DIG (RT)
Research and Training Division
Ministry of Environment, Forests and Climate Change
5th Floor, Vayu Block, Indira Paryavaran Bhawan,
Jor Bagh Road, Aliganj, New Delhi- 110 003

(Attention: Ms. Suveena Thakur, Asstt. Inspector General of Forests (RT), MoEF&CC, New Delhi)

Sub: Project on Management of Lantana camera through utilization for improving livelihood of people - reg.

Ref: Office letter No. 1-6/2021-RT dated: 12-07-2021 sent through email dated: 27-07-2021

Sir,

With reference to the letter and your email cited above, please find attached herewith a project proposal on **"Management of *Lantana camara* through utilization for improving livelihood of people in forest fringe villages of India"** received from Director, IFGTB, Coimbatore prepared in collaboration with IPRITI, Bengaluru; CSIR-IIP, Dehradun; IIFM, Bhopal, WII, Dehradun and other ICFRE institutes (AFRI, Jodhpur; HFRI, Shimla; IFB, Hyderabad; RFRI, Jorhat; TFRI, Jabalpur). The duration of the project is 05 years for the total outlay is of Rs. 43.2644 crores.

In this regard, it is to inform you that the project details from NRSC, Hyderabad are still awaited due to the pending internal approval of the project from ISRO, NRSC, Hyderabad. However, the tentative budget of NRSC has been incorporated. Further, it is brought to your attention that IIFM, Bhopal has given some clauses in their proposal on terms and conditions and potential risks and management which have been included in the proposal.

The project proposal is submitted for your information and further necessary directions.

Thanking you,

Yours faithfully,

27/7

(S.D. Sharma)
DDG (Research)
ICFRE, Dehradun

Encl.: As above.

Copy for information to:

1. Director, IFGTB, Coimbatore
2. PS to DG, ICFRE for information of DG, ICFRE

Management of *Lantana camara* through utilization for improving livelihood of people in forest fringe villages of India

A Collaborative project proposal

Submitted for funding under CAMPA

July 2021

Indian Plywood Industries Research & Training Institute

प्रगतेः मूलं प्रकृतिः

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

75 Years of CSIR Touching Lives

1. Preamble:

Lantana camera L., invasiveness resulted in serious ecological and economic repercussion such as altered native composition, ecological degradation, fire facilitation to areas it invades and particularly to ecologically rich and diverse regions such as protected areas. A recent study predicted that Lantana invaded 86,806 km^2 forests (38.8%) in India. However, the actual extent of Lantana invasion in various biodiversity rich areas especially Protected Areas (PA) of the country is unavailable. Further, though various control measures employed to curb *L. camara* infestations in India, still we could not be able to completely curtail its invasion, Cut Root-Stock (CRS) method is gaining significant attention nowadays, as it has proven its visible superiority over existing methods of Lantana removal. The Cut Root-Stock method has been practiced in some of the selected protected areas with varying level of success of restoration of invaded areas. Hence it is important that the various successful Lantana management approaches available in the country should be collated and disseminated to various frontline staffs for effective management of this Invasive Alien Plant Species (IAPS) of global importance. Further, monitoring the impact of Lantana removal on the ecosystem structure and function in the eradicated sites are vital for improving the productivity of the Indian forests.

The management of this weed species by utilization is gaining momentum in different parts of the world as Lantana could be used as source for various products. Recent studies reported that Small experiments with regard to utilization of Lantana for furniture making, charcoal production, fencing material, aromatic oil, wood polymer composites, particle boards, cement bonded particle board, polymer matrix composite, Lantana epoxy composite, have been attempted but none has been scaled up to economical utility till date. With a view to address the glaring lack of viable large-scale industrial options for Lantana utilization, this study attempts to develop socio-economically, and ecologically sustainable Lantana based business models in different geographic regions/ forest types of the country. Recognizing the need for developing research- industry linkages and also for bringing together the research experiences and learnings from the existing field Analysis of value chains and business viability of Lantana utilization interventions while seeking to address the policy loopholes, the project also proposes to create a knowledge platform to facilitate science-policy-practice linkages for promoting sustainable Lantana management solutions.

2. Introduction

Lantana camara L., an invasive terrestrial weed of South and Central American origin has huge impact on the native composition of terrestrial ecosystem. It has now naturalized in approximately 60 countries and is regarded as the world's 100 worst notorious weeds (Lowe, 2007; GISD, 2010; Lüi, 2011). At present it is considered to be extremely adaptable and prolific. Thus, it has its indiscriminate spread and presence in almost all regions of India including farm (Bhatt et al., 1994; Saha, 2002), pasture (Hakimuddin, 1929; Batianoff and Butler, 2003), fallow land (Sharma and Raghubanshi, 2006) and forest (ISSG, 2008) except the Thar Desert and its surroundings (Dogra et al., 2009). Its invasion is implicated in widespread loss of native species diversity via recruitment, limitation, competition, and alteration of ecosystem structure and function (Bhatt et al., 1994; Fensham et al., 1994; Swarbrick et al., 1995; Gentle and Duggin, 1998; Sharma et al., 2005; Kohli et al., 2006; Dobhal et al., 2009). Not only is the geographic range of *Lantana camara* escalating in various regions, but the density of infestations within its range is mounting and has been acknowledged and recognized as a potential threat (Sharma and Raghubanshi, 2006; Kimothy et al., 2010; Lüi, 2011). Therefore global efforts are being made to control this invasive species as this is considered to pose significant threats that are difficult to reverse.

2.1. Spatial mapping and modelling the spread of invasion

Information on the spatial extent of Lantana invasion in various biodiversity rich areas especially Protected Areas (PA) and non-forest areas of the country is unavailable. The challenges encountered in spatial mapping of *Lantana camara* include the problem of similarity in the spectral signatures of the species with other surrounding plant species, which leads to a low classification accuracy. Further, mapping of invasive species such as *Lantana camara, Chromolaena odorata, Ulex europaeus, Mimosa* spp, *Ageratum conyzoides, Ageratina adenophora* etc., which occur in the understory vegetation is a challenge. The spatial spread of the species has been mapped in different parts of the world using various multi-spectral, multi-temporal and hyper spectral satellite images with varying level of accuracy. A combination of remote sensing techniques, information on the landscape characteristics and GIS and expert knowledge may help in accurate mapping of the species and identifying the potential hot spots of invasion. Though, the spatial spread of the species has been assessed for few species in selected forests patches of the country with varying accuracy, comprehensive information on the extent of the Invasive Alien Plant Species in various forests especially the

Protected Areas, habitats which are vulnerable and regions which hot spots of invasion in the country is unavailable.

Another approach, Species Distribution Models (SDMs) provides us with a reliable tool for prediction of spatial and temporal distribution of the species in current as well as in future scenarios (Araujo and Peterson, 2012). Among the various modelling approaches, application of MaxEnt model (Phillips et al., 2006) in particular have been done extensively compared to the other approaches. Mungi et al., (2020) used occurrence points collected from various tiger reserves of selected states of the country to model the habitat suitability of Lantana (Figure 1). However, occurrence points from the Himalayan, North-Eastern states and non-forested areas in various parts of the country is expected to provide accurate information on the spatial spread of Lantana in the country. Hence one of the components of this comprehensive project proposal, proposes to develop techniques for finer scale mapping of Lantana in various landscapes of the country including the non-forested areas to comprehend the spatial spread of Lantana (Figure 2).

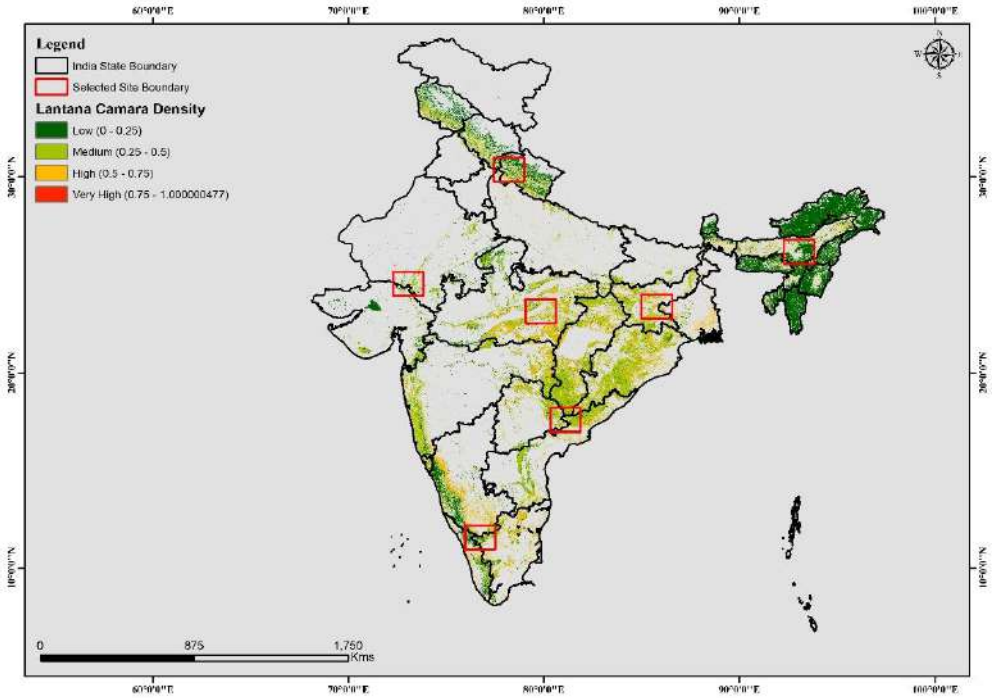


Figure 1. *Lantana camara* density and selected study sites in the country (Source: Mungi et al 2020)

Most of the available literature from India has mapped on the selective basis either for single species or just for a smaller forest area. Further, information on the current distribution, extent of spread, habitats vulnerable for invasion and forests areas which are hot spots of invasion by many Invasive Alien Plant Species in the country are not available.

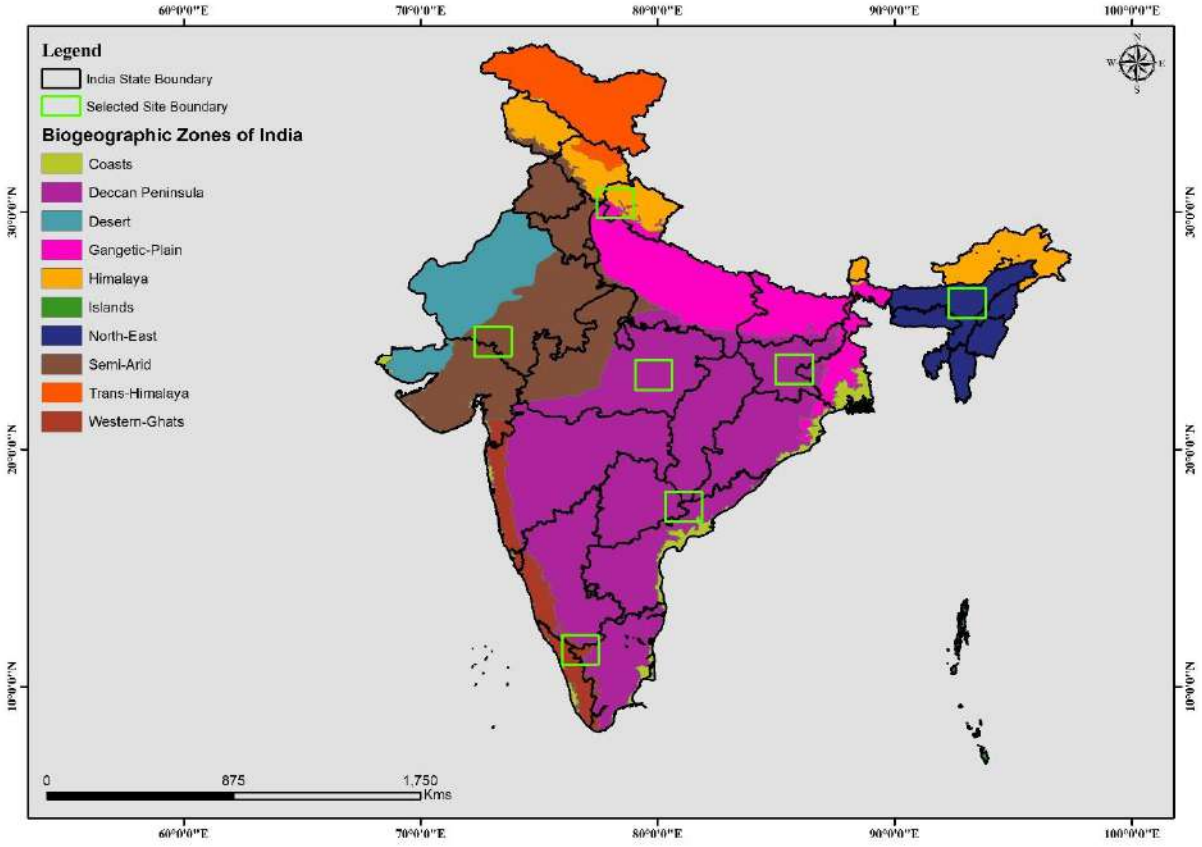


Figure 2. Proposed study sites in different biogeographic zones of the country

2.2. Eradication and restoration of Lantana affected areas

Though various control measures employed to curb *Lantana camara* infestations in India could not be able to completely curtail its invasion, Cut root stock method is gaining significant attention nowadays, as it has proven its visible superiority over existing methods of Lantana removal (Babu et al., 2009). However removal alone would not allow ecosystems to recover because some invaders alter the habitat conditions as a result it becomes unsuitable for native species (Zavaleta et al., 2001; Rai, 2013). Therefore integration of removal along with holistic assessment and followed by additional site restoration process will help safeguard against accidental adverse effects on native ecosystems (Zavaleta et al., 2001; Rai, 2013). Developing restoration models for invaded landscapes can play a crucial role in controlling the invasive plants and restoring the native vegetation.

In India, few attempts have been made to remove the Lantana from the forests and the areas has been restored using various native species (Babu et al., 2009; Ishwar Singh (2012); Geetha *et. al.*, 2014; Venkatraman 2015; Hiremath et al., 2018; Prasad et al 2018;). However, these restoration attempts have been made in smaller areas and they are very meagre as compared to

the scale of affected area and the rate of invasion of this species. Further, information on the impact of Lantana removal on the ecosystem structure and function in the eradicated sites are not available.

Need for participation of stakeholders: Despite several management interventions our country is still not able to successfully control Lantana spread. Reasons for this may include lack of coordination and inadequate awareness and capacity among regional government and local communities, lack of human as well as logistics funds within the government system to execute the regulation and lack of coordination, and motivation among stakeholders. Currently there is a serious concern for Lantana invasion and removal among people and government since long. In order to control further spread of Lantana in Indian Forest lands and protected areas, an integrated approach is required through the involvement of various stakeholders.

The review of literature clearly showed that the control and management measure undertaken so far are very meagre when compared to the extent of spread and participation of various stakeholders are essentially required for effective management of Lantana.

2.3. Utilization of Lantana biomass for improving the livelihood of people

The wide spread distribution of the species can be a source of biomass. It is estimated that net primary productivity of lantana is about 10-28 tonnes/ha/year for the subtropical and temperate forests (Singh and Singh 1987) and about 70-80% of this is woody biomass (Vasudev and Jain 1991). Since there is lot of emphasis on eradication of this weed species and physical removal of the lantana stems is one of the practiced methods. The extraction of lantana stems provides an opportunity of its utilization of value-added products. A number of researchers have explored utilization of lantana biomass for variety of products. Essential oils from lantana biomass has been reported to be useful as perfume ingredient, insecticide, mosquito repellent, antiseptic, etc. Antimicrobial efficacy of the plant (flavonoids, crude alkaloids, leaf extract, and essential oil) has been well documented against various microorganisms (Begum et al. 2004, Ventataswamy et al., 2010; Kurade et al., 2010; Sharma & Kumar, 2009).

Being the lignocellulosic material, lantana stems can be used as source of energy (fuel wood), pulpwood, furniture, bio-composites, etc. The use of lantana stems of suitable sizes for furniture has been well studied and is considered as a substitution of cane. The furniture made out of lantana is found to be cheaper and at par in strength with cane furniture. In addition, the

furniture made by lantana was reported termite resistant. Soligas, the tribal artisans of South India are indigenously utilizing Lantana, as a substitute for rattan and converting it into value added products such as furniture, toys and articles of household utility (Kannan et al. 2008). Currently, nearly 50 replicas of cane furniture and 25 designs of toys produced by these artisans from Lantana. Studies were also conducted to explore the chemical constituent present in different parts of lantana. However, furniture making from lantana requires specific size of stems and therefore large amount of biomass cannot be used effectively.

Naithani and Pandey (2009) evaluated pulp and paper making properties of lantana and found that the pulp possesses adequate strength properties and suggested that it can be used for production of variety of papers. The stems were characterized with 66% holocellulose, 26.93% lignin and 2.3 ash content which is suitable for paper making. However, industrial scale adoption of lantana for pulp and paper making has not been studied. Lantana biomass is also a good source of energy as it has 18.53 MJ energy kg^{-1}, it yields 118 ltr biogas 1000 kg^{-1} and 56 ltr methane 1000 kg^{-1} dried biomass (Negi et al. 2019). It is already being used as fuel wood and can be an effective substitution of woody biomass of other species used as fuel wood. Institute of Wood Science and Technology has worked on utilizing lantana as a partial substitute of biomass in briquetting. Similarly, FRI Dehradun and IFTGB Coimbatore explored utilization of lantana for value added products from lantana.

In this backdrop, it is essential to identify utilization potential of Lantana which are extracted from the forest/non-forest areas in order to give an economic value to the biomass. The technical and commercial feasibility of such products also need to be evaluated.

2.4. Need for comprehensive collaborative studies

Effective management of Lantana require an integrated comprehensive approach covering development of technique for assessing the spatial extent of Lantana invasion, eradicating the Lantana and restoring the invaded area with the participation of various stakeholders and utilization of the eradicated biomass for improving the livelihood of the people. Hence, the present comprehensive project proposal is grouped into the following three components;

Component: A: Spatial spread of Lantana and other Invasive Alien Plants

Component: B: Eradication and restoration of Lantana invaded areas

Component: C: Utilization of Lantana for improving the livelihood of people

3. Objectives of the study

Component: A: Spatial spread of Lantana and other Invasive Alien Plants

i) Modelling the potential distribution zones of Lantana and other selected Invasive Alien Plant Species spread using Species Distribution Models

ii) Assessment of the spatial spread of Lantana and other Invasive Alien Plant Species in various forests of the country

iii) Comprehend the landscape characteristics and scale of Lantana and other Invasive Alien Plant Species invasion in various forests of the country

iv) Identification of regions/areas under high infestation conditions (invasion Hotspots) for effective management of forests/Protected Areas in the country

Component: B: Eradication and restoration of Lantana invaded areas

i) To coordinate /facilitate the exchange of knowledge on managing Lantana at national/international levels

ii) Creating awareness and encouraging key stakeholders to participate in Lantana eradication.

iii) Assess the baseline status of Lantana invasion and removal of Lantana in selected forests/Protected Areas of the country

iv) To comprehend relevant restoration models for Lantana affected areas in selected forests

v) Long term monitoring of the holistic impacts of removal of Lantana in selected forests

Component: C: Utilization of Lantana for improving the livelihood of people

i) Development of sustainable value added products such as (a) lantana composites; (b) lantana briquettes (c) handmade paper and (d) bio-compost & insect repellent

ii) Assessment of technical characteristics viz., physical & mechanical properties and durability of developed value added products

iii) Processing and evaluation of *Lantana camara* for reconstituted wood and handmade papermaking

iv) Skill development on reconstituted wood and handmade papermaking and value addition from *Lantana camara*.

v) Design the suitable tools for the pelletisation and their applications as solid fuels/raw material for pyrolysis process

vi) Design and development of mobile pyrolysis unit (0.5 ton per day) to produce lantana-based value-added products.

vii) Application of biochar for soil amendment to enhance the agricultural productivity.

viii) Analyzing the value chains and business models for the existing uses of Lantana and to estimate the threshold levels of each business model for its economic/financial viability for the given business/technology cycle

ix) Establishment of demonstration units and transfer of technology to the relevant stakeholder

4. Brief review of the status of research on the subjects

4.1. Spatial mapping of Lantana using satellite images

Despite the alarming effects of *Lantana camara* on the environment, the rate at which it is spreading into new areas has been poorly documented. Remote sensing technologies proved to be useful in mapping and monitoring invasive species overtime. Previous studies used medium spatial resolution satellite imagery for mapping the spatial distribution of *Lantana camara*. For example, Taylor et al. (2011) compared the accuracy results for mapping *L.camara* using Quick Bird, Landsat TM and SPOT 5, and to evaluate the cost- effectiveness of the images. Landsat TM and Aster images have been used to map and monitor Lantana invasion in three land tenure systems in Zimbabwe (Dhau 2008). The potential of Linear Imaging Self-Scanning Sensor Cartosat and (LISS) IV data for detecting of Lantana in forest ecosystems of India has also been explored (Kimothi and Dasari, 2010). The accuracy and cost-effectiveness of Quick Bird, Landsat TM and SPOT- 5 images or mapping *L. camara* have also been compared (Taylor et al., 2011). The usefulness of Worldview-2 and SPOT 5 imagery in mapping *L. camara* in South Africa was assessed with satisfactory accuracies of 78.22% and 84.74% using random forest algorithm due to improved spatial resolution (Lawrence et al., 2006). Attempts have been made to map the precise extent and density of Lantana invasion in Indian forests using various types of multispectral satellite data and modelling (Kimothi et al. 2010, Niphadkar, Ficetola et al. 2016). Study by Kandwal et al. (2009) attempted to understand the appropriate band combination using Landsat data and generating vegetation indices in order to extract Lantana patches in an accurate manner. Twenty nine different vegetation indices were analyzed for their effectiveness in differentiating Lantana from other classes. The study showed that SAVI (Soil Adjusted Vegetation Index) is most favorable in discriminating Lantana. In a community grazing land in KwaZulu-Natal, South Africa, Oumar (2016) assessed the potential of the SPOT 6 multispectral sensor and two broadband vegetation indices (NDVI and SR) for detecting and mapping *Lantana camara*. Therefore it is essential to study the effectiveness of different vegetation indices for mapping and differentiation Lantana from other vegetation.

Lantana being an understorey species, therefore it is difficult to detect from satellite imagery. For mapping the understorey invasive shrub Lantana in a tropical mixed forest habitat in the Western Ghats biodiversity hotspot in India, Madhura *et al.*, (2017) compared a pixel-based and object-based classification method and suggested using measures like texture and vegetation indices proved effective in separating out Lantana from other cover types. Khare *et al.*, (2019) suggested an increase in predictive accuracy of Lantana within forest areas along

with increase in the spatial resolution for the same Landsat-8 imagery. In semiarid rangeland ecosystems of South Africa Dube, *et al.*, (2020) demonstrated the first comparative assessment of Landsat 8 Operational Land Imager (OLI) and Sentinel-2 Multispectral Instrument (MSI) satellite data in detecting and mapping of invasive *Lantana camara* from other land cover types (i.e., built up, fields/bare patches, grassland, and shrub). However in India such comparative studies are lacking and technique for spatial mapping of Lantana in different landscapes of the country is yet to be standardized.

4.2. Habitat suitability Modelling using MAXENT

For constructing effective control and eradication strategies for Lantana and other Invasive Alien Plant Species, firstly it is very important to have information on current and future spread of these species in India. One such powerful method is SDMs which provide modelling of distribution to discover the potential areas of spread of invasive species.

Using the Maximum entropy (MAXENT) approach Zang et al., (2016) predicted an overall expansion of *L. camara* and showed that regions with consistently favorable environments for *L. camara* were located mainly in southern U.S. states, large parts of Central America, and east-central South America. Other suitable regions included Africa (eastern edges, parts of western regions) as well as eastern Madagascar, southern China, north-eastern India, parts of Southeast Asia, coastal areas of eastern Australia, and Pacific Island regions. In southern African savannah ecosystems Ncube *et. al.*, (2020) predicted the potential effects of climate change on the future distribution of *Lantana camara* using ensemble modelling consisting of three Species Distribution Models (SDMs). On average, the habitat suitability of *Lantana camara* was projected to increase by 5892 km^2, which was about 65% of the total area of southern Zimbabwe. In India Mondal et al., (2020) predicted the distribution of *Lantana camara* using Ecological Niche Modelling (ENM) in MaxEnt software for Rajaji- Corbett landscape in the lower Shivalik region of the state of Uttarakhand, India. Further a most recent study conducted by Mungi et al., (2020) predicted that Lantana invaded 86,806 km^2 forests (38.8%) of India, particularly degraded forests of hot and humid areas and the expansion in its invaded range was found to be correlated with its increased tolerance to higher temperatures, lower fertility and denser canopy cover as compared to its native range. However, accurate information on the current distribution, extent of spread and mapping of Lantana invaded areas in the country is not available.

4.3. Restoration of Lantana affected areas

Soil seed bank characteristics can constrain the suitability of restoration techniques therefore understanding the impact of habitat degradation on the soil seed bank is important from a conservation perspective. From a restoration perspective, determining the contribution of an invasive species' propagules to the seed bank can help assess the local persistence of the species (Gioria et al. 2014), while quantifying the abundance and composition of indigenous species within the seed bank provides an indication of the potential for the original (i.e. pre-invasion) species to re-establish. Gardener *et.al.* (2010) reviewed 30 plant eradication projects covering 23 potentially invasive species with limited distributions on four of the Galapagos Islands.

In India, Babu et al., (2009) successfully eradicated and restored two Lantana-invaded sites in Corbett Tiger Reserve, India using knowledge about its ecology, and, subsequently, weed-free landscapes were restored to productive grasslands and mixed woodlands using native species. The restoration of these areas to grassland communities has successfully prevented secondary invasions by lantana and other weeds and has enhanced the habitat quality for herbivores whose populations are vital for the survival of top carnivores. Ishwar Singh (2012) initiated Control of Lantana and Restoration of Biodiversity in Reserve Forests of Chandigarh. A three-pronged strategy was adopted to control the proliferation of lantana in Sukhna Wildlife Sanctuary.

Geetha *et. al.,* (2014) quantified re-colonisation of lantana at sites that were either managed only once or for two consecutive years in Rajaji National Park, Uttarakhand. Rapid re-colonisation and recruitment was occurring from seed dispersal from surrounding lantana populations, soil seed banks and vegetative regeneration.

Hiremath et al., (2018) tested the effectiveness of two Lantana removal techniques (cutting and burning, and uprooting) to restore *Lantana camara* invaded Tropical deciduous forest and concluded that no Lantana removal is likely to be effective without post-removal monitoring and weeding. More efforts on restoration of invaded landscapes for mitigating negative impacts of other invasive species need to be considered for implementation in India.

Prasad, et al., (2018) observed rainfall influenced both eradication effort and outcomes. Drier forest had lower starting levels of invader biomass, requiring less initial eradication effort, as well as lower subsequent Lantana re-invasion (from seed and rootstock) whereas wetter forest typically had greater starting levels of invader biomass, requiring considerably greater initial

eradication effort, and greater Lantana re-invasion. With regard to removal method, uprooting, followed by regular weeding of germinating Lantana and secondary invaders, was crucial to long-term Lantana eradication success.

Sanjay *et. al.,* (2018) identified native species having potential for restoration of *Lantana camara* invaded forest communities in Kundam, Bargi and Patan Range of Jabalpur forest division of Madhya Pradesh. Negi, . *et al*., (2019) reviewed the current knowledge on *L. camara* with particular focus on its ecological attributes such as biomass productivity, reproductive biology, invasiveness, allelopathy, control measures and economic uses reported from India. The review of literature clearly showed that the control and management measure undertaken so far are very meagre when compared to the extent of spread and participation of various stakeholders are essentially required for effective management of Lantana.

4.4.Utilization of Lantana

In many areas, the sheer size of the infestations coupled with low land values makes conventional control not feasible. However mechanical clearing and hand pulling are suitable for small areas and fire can be used over large areas. Also there are several control chemicals which are most effective when applied to re-growth following other treatments. Given the limited success of bio-control till date in most areas, it is therefore important for planners and managers to develop strategies aimed at best utilization of the species. This may include planning to use the species as means of generating livelihood opportunities through briquetting for fuel wood / biofuel, creating market for herbal medicine, insect repellents and floor cleaning agents and compost for nurseries through involvement of community. These practices will likely not only curb the invasion but simultaneously make people aware of the consequences of plant invasion.

Small experiments with regard to utilization of lantana for furniture making (FRI, An NGO, The Shola Trust & Tamil Nadu Forest Department, ATREE), charcoal production, fencing material, aromatic oil (SIDHI), wood polymer composites (IWST), particle boards (Thanigai et al, IPIRTI, 2017), cement bonded particle board (Manish Ranjan et al, FRI, 2017), polymer matrix composite (Aniash Agarwal et al, 2014, Chitta Ranjan Deo, 2010), Lantana epoxy composite (Anil Kumar et al, 2017) etc, have been attempted but none has been scaled up to economical utility till date. Bio-composites from Lantana is cutting edge scientific technology for effective utilization of weed species as a substitute raw material for industrial production

of wood composites. Bio Composites can be used as cost-effective and eco-friendly alternatives for variety of applications – from the construction of panels, wall cladding, false ceiling, acoustics, window frames, doors, flooring and decks to making household items like furniture and foot mats. Social and economic livelihood of local people/tribal can be improved by promoting this bio-composite technology.

5. Current status of the Composite technology

A bio-composite is a composite material formed by a matrix or resin and a reinforcement of natural fibers. Environmental concern and cost of synthetic fibres have led the foundation of using natural fibre as reinforcement in polymeric composites. The matrix phase is formed by polymers derived from renewable and non-renewable resources. The matrix is important to protect the fibers from environmental degradation and mechanical damage, to hold the fibers together and to transfer the loads on it. In addition, bio-fibers are the principal components of bio-composites, which are derived from biological origins, for example fibers from agro waste, bamboo, kenaf, jute, coir, crops (cotton, flax or hemp), recycled wood, waste paper, crop processing by-products or regenerated cellulose fiber (viscose/rayon). The interest in bio-composites is rapidly growing in terms of industrial applications (automobiles, railway coach, aerospace, military applications, construction, and packaging) and fundamental research, due to its numerous benefits such as renewable, cheap, recyclable, and biodegradable.

A matrix in the composites provides the overall durability, including surface appearance, shape, and environmental tolerance. Another function of the matrix is to efficiently bind the fibres to transfer load between them. These matrices depending on the processing technique and type of bonding present in them can be classified into thermoplastic and thermosets. Apart from these binding systems lime and cement are two well established binding systems.

5.1. Thermoset resin systems:

During the past 50-60 years, the use of adhesives in the production of bonded-wood products has in- creased substantially. The increased use of adhesives after World War II is largely due to the availability of low-cost, highly durable synthetic adhesives that could be produced from petrochemicals no longer needed to support the war effort. Highly durable synthetic adhesives allow efficient and economical utilization of diverse and changing wood resources. Adhesives allow the manufacture of useful products from residues and waste wood; the manufacture of stronger, more efficient structures by removing or minimizing natural defects; the re- assembly

of smaller forms of wood such as veneer, flakes, particles and fibers into efficiently engineered shapes and products; and the manufacture of a variety of new composites by blending wood with non-wood materials such as plastics and cement. Amino resins, phenolic resins, and iso-cyanates are the three most important thermosetting adhesive systems used by the wood products industry.

5.2. **Cement/Lime bonding systems:**

Recently the research on cement binded particle board (CBPB) has increased dramatically throughout the world, especially for housing construction and furniture manufacturing (Youngquist, 1999; Sellers, 2000). However, the developing countries are more focused on commercial manufacture of cement-bonded composites from wood residue and agriculture due to its utilization in low-cost housing projects. These boards possess the advantage of inorganic as well as organic materials. Other desirable characteristics include fire resistance and durability in warm-humid climate where decay by termites, fungus, mould is a major concern (DeSouza et al., 2004). The cement binder provides a durable surface as well as embossed easily. It can coloured with a range of processing methods to provide a variety of products that are easily machined with conventional wood working tools.

CBPB has gained favour throughout the industries due to its extended applications compare to plywood, resin-bonded particle board and other allied products (Eusebio, 2003). It has been found to be a good substitute for concrete hollow blocks, plywood, particle board and other resin bonded boards. It is a very versatile material that can be used as ceiling, partition wall, exterior wall, flooring, cladding and even roofing provided that proper coating is applied. Cost wise, wood wool boards or CBPB are much cheaper than solid wood or other panel bonded with adhesives. They possess favorable physical properties such as low thermal conductivity, superior sound absorptions; adequate strength and excellent working qualities (Ahn and Moslemi, 1980). Wood wool boards are classified as class- I fire resistant materials based on surface spread of flame test (Simatupang and Geimer, 1990). Though, it is an excellent low-cost housing material very few firms are manufacturing CBPB in India. Furthermore, these firms are mainly using poplar as their lignocellulosic material, but the lantana are not reported anywhere. Thus, working with lantana particles and cement combination may give better properties with low cost.

IIT Hyderabad (2019) has made a precursory study on Bio- ricks which clearly suggested that the manufacturing technology of so-called 'hempcrete' can be modified best to suit the agro-waste generated in India. The study suggested lime-based slurry shall be used as binder in preparing Bio- Bricks with slake lime, binder, stone dust and water. However, no specific study was made using alkali activated binder systems with lantana in bio-composites. CSIR-CBRI (2018) has made efforts in converting hemp hurds (shivs) into hemp crete blocks using lime-based binder systems. Mechanical properties and dimensional stability of the blocks were studied. Recommendations are made towards the development of blocks from hemp shuvs for making bricks and blocks for load bearing and non-load bearing structures.

5.3. **Geo-polymer binding system:**

In the last few years, there has been spectacular technological progress in the development of geopolymeric applications. Davidovits (1994) developed high-tech geopolymer binders that meet the standard applications in all fields of industry, whether used as pure materials, with fillers, or reinforced. These applications are to be found in the automotive and aerospace industries, non-ferrous foundries and metallurgy, civil engineering, cements and concretes, ceramic and plastics industries, waste management, art and decoration, and retrofit of buildings. According to Davidovits (1994) alkali-activated alumino-silicate binders (cements) have the potential to become the best and in many cases the most economical binder for routine construction and may evolve into a new generation of building materials. Their unique properties which include high compressive and flexural strength, low shrinkage, freeze-thaw resistance, sulphate and corrosion resistance, heat and electrical resistance make them ideal for various applications of geo-polymer technology.

The first applications involving wood with geo-polymer technology were building products developed in the period 1973 to 1976 (Davidovits 2008). These were fire-resistant particle-board panels, comprised of a wooden core faced with two geo-polymer nano-composite coatings, in which the entire panel was manufactured in a one-step process. Simatupang and Geimer (1990) reported that, depending on the raw material selection and processing conditions, inorganic-bonded wood composite can exhibit a wide variety of properties and characteristics, including compressive strength, dimensional stability, fire and acid resistance, and thermal conductivity. His results revealed the interaction between inorganic binder and woody material. Acceptable properties of an inorganic bonded wood composite can be obtained only when the wood particles are fully encased with the binder. Jorge *et al.* (2004) noted that

properties of inorganic-bonded wood composite are influenced by (i) wood element characteristics; species, size, geometry, chemical compositions, (ii) binder type, (iii) wood-binder ratio, (iv) environmental temperature and (v) cure time. Davidovits (2008) mentioned that geo-polymers have three main properties that make them superior to ceramic-matrix composites, plastics and organic composites materials. First, geo-polymers are very easy to make, as they handle easily and do not require high heat; second, geo-polymeric composites have a higher heat tolerance than organic composites. Tests conducted on geo-polymer carbon-composites showed that they will not burn at all, no matter how many times ignition might be attempted; Third, the mechanical properties of geo-polymer composites are as good as those of organic composites.

Gouny *et al.* (2013) studied the mechanical behaviour of laboratory assemblies of wood, geo-material binder and two different types of earth brick. They found that the adhesion mechanism between geo-polymer binder and wood are not well defined, however the mechanical interlocking adhesion and chemical bonding were considered to be effective compared to conventional binders for wood. Alomayri *et al.* (2013) studied the characterization of cotton fiber-reinforced geo-polymer composites and found that the appropriate addition of cotton fibers can improve the mechanical properties of geo-polymer composites. Chen *et al.* (2014) investigated the mechanical properties of reinforcement fly-ash based geo-polymer with alkali-pre-treated sweet sorghum fiber. They found the unconfined compressive strength, the splitting tensile, and flexural strengths, as well as the post-peak toughness are increased. Ruy A. Sa Ribeiro et al. (2016) produced geo-polymer bamboo composite using potassium - sodium geo-ploymer reinforcing bamboo fibers and strips and suggested the same as a sustainable construction building material. Laurent Arnaud et al (2012) attempted to utilize plant particles as natural building material aggregate. Hemp shiv (Particles) is used as aggregates for the manufacture of building materials called hemp concrete which was one of the most widely studied bio-based concretes. Hempcrete was constituted of hemp shivs and lime-based binder. The success of hempcrete lies in the fact that it is carbon negative due to its agricultural origin and the use of lime and other industrial wastes as the mineral binders. It was found that every kilogram of hemp shivs sequesters about 1.6 to 1.8 kg of carbon dioxide. International studies and results strongly indicate that alkali activator binding systems are a binder of the future and it has been well established for the following reasons: no high temperature, no CO_2 emissions from reactions and primarily materials are obtained from wastes. Binders from alkali-activated materials are an alternative to organic/inorganic binders. Concrete and bricks made from geo-

polymer binders has been well established in building materials and these technologies are in applications.

5.4. **Handmade paper:**

The Indian handmade paper industry has been identified as one of the village industries and the industry has seen significant growth in last one decade because of improved demand not only on national level but also at the international arena. The profits India stands to gain from its handmade paper industry which today spans over 4,000 units across the country generating revenue of over Rs 700 crore. The Indian handmade paper industry had grown remarkably in the recent past wherein the production of handmade paper industry has achieved many milestones. Across the country, today, places such as Sanganer in Rajasthan, Kalpi in Uttar Pradesh and Auroville in Pondicherry emerged as lucrative export hubs (Deulgaonkar, 2015). Due to increased literacy, industrialization and modernization, the per capita consumption of the paper and paper board has increased remarkably from 4.5 kg in the year 2000 to nearly 13.0 Kg in the recent past. This industry provides employment to about 15,000 people and most of them are situated in the rural areas (Kumar et al., 2013 b).The government of India took up the initiative for the development of handmade paper industry from 1953 onwards as an important village industry to generate employment and income in the rural areas with low capital investment. The Khadi and Village Industry Commission (KVIC) set up under the Ministry of Industry was given the responsibility to provide support for the development of the handmade paper industry. The KVIC has been encouraging entrepreneurs in rural areas to start such industries that would employ semi-skilled labour and provide employment. The industrial policy of the Government of India and the state governments extended full support and provided incentives for the growth and development to this industry (United Nations Industrial Development Organization, 1997).

In India, a project co-ordinated by KVIC under the Ministry of Industry with financial support from the United Nations Development Programme (UNDP) on strengthening the handmade paper industry in India, was embarked in 1990 with the aim to strengthen the handmade paper industry in India by establishing a centre with the capacity to develop and transfer technology and to provide services to the industry to increase productivity and improve quality and marketability of handmade paper products. Under this project, the outputs to establish a testing laboratory for pulp and paper, a papermaking demonstration plant with new technologies

developed, a cell to provide consultancy services to the handmade paper industry, and training courses were satisfactorily met (United Nations Industrial Development Organization, 1997).

The demand of handmade paper at international level is on the spurge due to increasing environmental awareness. Countries like Philippines, Japan, Korea etc. are producing handmade paper in different varieties on the basis of colors, shades, thickness, smoothness, size etc. Although the demand for handmade paper is increasing day by day globally, but not much attention has been paved on development of handmade paper sector across the globe. Conventional practices for preparation of handmade paper are still in practice due to lack of sufficient research and development activities. Literature study also reveals that significant developmental activities needs to be undertaken for augmentation of handmade paper sector at international front as well.

5.5. **Biomass briquettes**

Briquetting is the process of conversion of loose, high volume, low density mass to compact, low volume and high density lumps by compression. Briquettes can be produced with a density of 1.2 g/cm³ from loose biomass of bulk density 0.1 to 0.2 g /cm³ Having a high combustion rate, briquettes are the suitable substitute for coal in most applications and in boilers. Briquettes are cheaper than coal and combustion is more uniform compared to coal. Biomass briquettes have a higher practical thermal value and much lower ash content (2-10% as compared to 20-40% in coal). The demand of fuel briquettes is increasing and people becoming aware of its availability and advantages. The major users are tea processing industries, textile industry, chemical processing industry, hotel industry etc. However, there are many factors to be considered before a biomass qualifies as feedstock for briquetting. Apart from its availability in large quantities, it should have some desirable characteristics such as low moisture content (10-15%), low ash content, high fixed carbon content.

L. camara is available in huge quantity both inside and outside forest. Being invasive in nature they cause more damage to the forest then good. Many methods were tried for the removal of this species, but almost all the strategies remain unsuccessful. Similarly, *Prosopis juliflora* is also a fiercely competitive species which grows as shrub or small tree. It is native to Mexico, South America and the Caribbean. *P. juliflora* grows in most soils and water condition including; sandy, rocky, poor and saline soils. It has deep taproots which help to access sub-surface waters. There are several use reported from *P. juliflora*. The pods are used as food and

medicinal supplement for man and animal. The alkaloids obtained from leaves of *P. juliflora* are reported to have antifungal properties. The wood of this species used as firewood, charcoal and activated carbon production. *L. camara* and *P. juliflora* are widely available weed species and are reported to as potential biomass sources. The woody nature of these weeds allows its utilization for energy conversion through thermochemical conversion process. Both *L. camara* and *P. juliflora* have low moisture content, low ash content and high calorific value and high fixed carbon content. They are best material for high pressure briquetting because they contain higher lignin content.

At present almost all available biomass residue (agriculture) is used for making briquettes. Briquetting industries are using groundnut shell, rice husk, wheat husk, cotton stalk, tamarind husk, coffee husk etc. All such feedstock contain high amount of ash and pose serious problem to the boilers. Even the ash composition of such biomass is not favorable for boilers as they contain large amount of alkaline minerals. Many users are complaining that the briquettes are made using sand in it, because there boilers are filled with silica. However, the main problem is the use of raw material having higher ash content. In this project we propose to make high quality briquettes using of *L. camara* and *P. juliflora* biomass. The quality of the briquettes will further be enhanced by using charcoal of the same species in ratios for making briquettes. We also propose to involve village forest communities and give them full training for making and marketing good quality briquettes.

Technological/Economical and Social Gap: Lantana weed invasion is a serious matter as it has a significant impact on biodiversity and there is an urgent need for habitat-oriented management, biodiversity monitoring and restoration-oriented studies to safeguard India's forest. Eradicating lantana is being practiced in many protected and others areas and several methodologies like uprooting, burning and planting the cleaned area with grass and other fast-growing species have been restored too. These efforts have very meagre as compared to the scale of affected area and the rate of invasion of this species. The exercise is also highly uneconomical. Further the long term and holistic impacts of such eradication have not been fully comprehended yet.

Small experiments with regard to utilization of lantana for furniture making (FRI, An NGO, The Shola Trust & Tamil Nadu Forest Department, ATREE), charcoal production, fencing material, aromatic oil (SIDHI), wood polymer composites (IWST), particle boards (Thanigai et al, IPIRTI, 2017), cement bonded particle board (Ranjan et al, FRI, 2017), polymer matrix

composite (Agarwal et al, 2014, Deo et al, 2010), *Lantana* epoxy composite (Kumar et al, 2017), etc., have been attempted but none has been scaled up to economical utility till date.

Bio-composites from Lantana is cutting edge scientific technology for effective utilization of weed species as a substitute raw material for industrial production of wood composites. Lantana composites can be used as cost-effective and eco-friendly alternatives for variety of applications – from the construction of panels, wall cladding, false ceiling, acoustics, window frames, doors, flooring and decks to making household items like furniture and foot mats. Social and economic livelihood of local people/tribal can be improved by promoting this bio-composite technology. Though, a number of applications have been suggested for utilization of lantana biomass but their industrial viability has not been evaluated. Therefore, it is necessary to standardize processes and products which are industrially amenable with medium to small scale operations. The products also need to be economically competitive with the existing composites.

The growing Indian board and handmade paper industry has made a big impression in the international market because the Indian products have made a quantum jump. According to an estimate, value added products have the share of more than 70% of total exports (Univision, 2014). For the last two decades the handmade paper industry has been exporting certain exclusive varieties like deckle edge stationery drawing paper, marble paper, mottle paper made from jute, wool, algae, straw, grass etc. and recorded significant growth in the export sector. Countries like Indonesia, Malaysia and Philippines have already emerged as `handmade paper giants'; India is being looked upon as the country with the maximum growth potential. The country is almost self-sufficient in manufacture of most varieties of handmade papers. There has been phenomenal growth in the export market for Indian handmade paper and its products, especially in the developed countries like the United States of America that helped in increasing the foreign exchange of the country. Foreign buyers like US, Germany, UK, Canada, Italy, Sweden, Australia, Singapore and Hong Kong are purchasing handmade paper from India because handmade paper production in India by all means is as low priced as compared to the other handmade paper producing nations. This production can further be improved by exploring new and underutilized lignocellulosic biomass for this purpose and development of skilled manpower for handmade paper through hands-on trainings or practices.

5.6.**Bioenergy**

Invasive terrestrial species like *Lantana camara* can be used for the production of energy/ electricity by converting it into pellets/ briquettes. These pellets can also be converted into bio-oil and bio-char using a mobile pyrolyser unit if available in larger quantities at a particular location. The pyrolysis process is well established and needs minimal amount of optimisation before it can be directly deployed on field. The bio-oil fraction can be used for energy applications and the bio-char fraction is very valuable. It can be used for enhancing the soil fertility and proven studies are available to show the increased yields of crops after the application of bio-char on fields. Both these processes help in using the whole biomass as such without eliminating any part of the Lantana plant.

6. Novelty/Innovation/Justification

The project would provide an opportunity for various scientists and researchers to collaborate and work towards a common goal on effective management of Lantana in various parts of the country. Apart from estimating the extent of present invasion status, the study also aims to identify areas vulnerable for invasion and to forecast possible impacts of future climate change scenarios on the distribution of IAPS using various Species Distribution Models (SDM). Lantana will be eradicated from selected landscapes and various restoration models will be developed depending on the landscape characteristics.

Utilization of Lantana weed as particle/filler/reinforcement in composite production has not well established till date. Technology development for industrial utilization of locally available lantana into Bio - Composites such as Particle Boards, Bio-composite Bricks and Lantana Laminate using different binder systems (Synthetic/Bio- Adhesives, Lime, Cement and Geo - Polymer Binders) are proposed in this proposal. Thus, this can result as a substitute raw material for wood and wood based products and also reduce the pressure from the forest by conserving the ecological bio-diversity.

With the developing drift of environmental responsiveness, demand of value-added products made out of natural fibers is continuously growing. Moreover, the increasing cost of traditionally used cellulosic raw materials being used in reconstituted wood and handmade papermaking is also pushing the industry to search for additional alternative sustainable cellulosic raw materials for production of handmade paper and board. This should help in providing more opportunities for cost effective, locally available lingo-cellulosic biomass like

Lantana there by addressing the problem of raw material crisis and environment in a right perspective. The product offers possibilities for use as a substitute for solid wood where directional strength properties are the main requirement as in structural timbers. It may be used for furniture, doors and window frames, beams and many loads bearing structure.

Utilization of Lantana as for large scale industrial use as briquettes has not well established till date. Since, biomass briquetting quality is affected by process variables such as feedstock composition (lignin, hemicellulose, and extractives), types of feedstock, fraction of the same feedstock, feedstock particle size and moisture content, percentage of fines, temperature, and pressure etc. In one of our earlier study we have optimized the process condition (moisture content, particle size, temperature etc.) for producing high quality briquettes from lantana biomass. This exercise will focus on socio - economic benefits to the local community in terms of their livelihood concerns and scale utilization for industrial usage of lantana bio - resource and minimizing the negative ecological impacts of its removal. In this project we propose to involve forest department and give them training on production of good quality briquettes from waste forest biomass.

This exercise will focus on socio - economic benefits to the local community in terms of their livelihood concerns and scale utilization for industrial usage of lantana bio - resource and minimizing the negative ecological impacts of its removal.

7. Organizations to be involved in the research in collaboration with SFD's

a) ICFRE and its institutes
   - Institute of Forest Genetics and Tree Breeding, Coimbatore
   - Forest Research Institute, Dehradun
   - Rain Forest Research Institute, Jorhat
   - Himalayan Forest Research Institute, Shimla
   - Institute of Forest Productivity, Ranchi
   - Institute of Wood Science and Technology, Bengaluru
   - Tropical Forest Research Institute, Jabalpur
   - Institute of Forest Biodiversity, Hyderabad
   - Arid Forest Research Institute, Jodhpur

b) Wildlife Institute of India, Dehradun

c) Indian Plywood Industries Research & Training Institute (IPIRTI), Bengaluru

d) Indian Institute of Forest Management, Bhopal

e) National Remote Sensing Centre, Hyderabad

f) CSIR - Indian Institute of Petroleum, Dehradun

g) State Forest Departments (Himachal Pradesh, Madhya Pradesh, Jharkhand, Odisha, Telengana, Kerala, Rajasthan, Assam, Mizoram, Arunachal Pradesh and Tripura)

The Component B: This component Eradication and restoration of Lantana invaded areas will be implemented by the selected State Forest Departments and various regional institutes of ICFRE. The scientific inputs for Lantana removal, restoration protocols for Lantana invaded areas and Long term monitoring of the holistic impacts of removal of Lantana in selected forests/Protected Areas of the country will be undertaken by various regional institutes of ICFRE while the Lantana removal and restoration activities will be undertaken by the concerned State Forest Departments in 100 ha area (40 ha in High density, 30 ha each in Medium and Low Lantana density). Arunachal Pradesh and Tripura State Forest Departments will carry out the activities in 50 ha area each (20 ha in High density, 15 ha each in Medium and Low Lantana density).

8. Methodology

Component: A: Spatial spread of Lantana invasion

8.1. Landscape characteristics and scale of Lantana and other Invasive Alien Plant Species invasion

In order to systematize data collection on the presence of invasive alien plant species, grid based survey (5 * 5km) will be followed. The study will be limited to forested areas, therefore the area under forest within each grid will be computed. For this, the latest forest cover map from Survey of India (Indian State of Forest 2019) will be used, wherein the categories of scrub land, open forest, moderately dense forest, and dense forest will be combined as 'forests'. Stratified random sampling in 5*5km grids with nested quadrats, based on the probability of proportions to size, will be performed covering forest type and biogeographic zones. The forested grids will be sampled by laying 1 to 5 transects of 2 km length in each of these grids. On these transects, at every 400 m nested quadrats 5 m for shrub species and 1m for herb species will be sampled. Within each sub-quadrat, the invasive species will be enumerated as the number of clumps as individuals may not be unambiguously identified, so the numbers of clumps will be counted. Further, within each survey plot all vascular plant species including the selected IAPS will be recorded and assigned a cover abundance score using a modified six-point Braun-Blanquet scale (Poore 1955) as shown below;

Score	Cover abundance
0	Taxa absent
1	Rare, few individuals present (three or less) and Cover <5%;
2	Common and cover <5%;
3	Very Abundant and Cover nearing 5% OR Cover from 5% to <25%;
4	Cover from 25% to less than 50%;
5	Cover from 50% to less than 75%;
6	Cover 75% or more

IAPS invasion is known to be facilitated by human disturbances (Hiremath and Sundaram, 2010; Mungi et al., 2018), so in each quadrat, information on the number of trees lopped/cut, details livestock-human foot trails, fire occurrences etc. will also be collected. Fire can burn nearby area or degrade it by spreading ashes and smoke that can support Lantana invasion (Hiremath and Sundaram, 2005). Hence, information on fire occurrence from the Fire Information for Resource Management System (FIRMS) database, which consist of daily MODIS hotspots and Visible Infrared Imaging Radiometer Suite (VIIRS) will be used for the study for the period of 2000–2020 will be used for the study. The distance from the fire prone areas and occurrences of invasive alien plants will be analysed.

8.2. **Scale of Lantana and other Invasive Alien Plant Species invasion**

The spatial extent of Lantana will be initially assessed in selected landscapes for standardization of technique for accurate mapping of Lantana and other of IAPS. Since accurate mapping of Lantana is a challenge, various multi-temporal, multi-spectral, higher spatial resolution and hyper spectral satellite images (Landsat/Sentinel 2/LISS-III, will be used in the proposed study depending the need. Similarly various algorithms such as maximum likelihood, Support Vector Machine, random Forest will also be used for accurate mapping of Lantana and other of IAPS. In addition, important indices like Normalized Difference Vegetation Indices (NDVI), Enhanced Vegetation Indices (EVI), distance from road and river will be sued for mapping the species. Various approaches will have to be used for assessing the spatial spread in open forests, moderate dense and very dense forests and also similarly in various forest types.

Field data collection and pre-processing: IAPS location will be recorded using a handheld Global Positioning System (GPS). Since invasive plants are generally not uniformly distributed in natural ecosystems; therefore, purposive sampling will be used to identify invasion patches

of selected IAPS and other land-cover types (i.e. Invaded areas, Uninvaded areas, Wasteland areas, Water body and Built-up areas etc.), and in the process locational data will be recorded. For each sampled location, a distance of 100 m between sampled points will be maintained to avoid overlaps when superimposed on the satellite images. The collected GPS locations will be converted into a point map using a common Geographic Information System (GIS) tool.

Image classification and accuracy assessment: Field data collection points will be overlaid on the satellite images in Arc Map 10.3, where the study area will also extracted. All bands that offer a significant discrimination of *Lantana camara* and other selected IAPS from other land-cover types will be employed to map the spatial distribution of IAPS, using the supervised classification.

Stratified random sampling will be used in splitting the collected data (i.e. 70% will be used for training of the classification, whereas 30% will be used for validation purposes). The chosen land-cover classes will be cross-tabulated in a confusion matrix against the land-cover classes for determining classification accuracy. Agreement between classification results and ground truth data will be measured using the producer accuracy (PA), user accuracy (UA) and overall accuracy (OA) generated from the confusion matrices. The techniques standardized for accurate mapping of Lantana in various landscape will be replicated in similar landscapes in other areas of the country.

8.3. Modelling the Invasive alien plant species spread using Species Distribution model

The invasion data of all IAPS occur in the area will be captured using a Global Positioning System (GPS). The occurrence data for selected IAPS will also be collected from Global Biodiversity Information Facility (https://www.gbif.org/) and India biodiversity portal (https://indiabiodiversity.org/). Occurrence records will be screened for duplicates and will be spatially rarefied to minimize the model over-fitting towards environmental and sampling biases.

Environmental and Human Variable Predictors:

Climatic Variables: To predict the potentially suitable habitats for selected IAPS in the country, we downloaded the nineteen standards bioclimatic variables of the current climate

(1970–2000) and future (2050 and 2070) from the WorldClim website at a spatial resolution of 2.5 arc-minutes (~5 km*5 km at the equator).

Edaphic Variables: Apart from climatic variables other important variables representing the soil physical and chemical properties will downloaded from the ISRIC-World Soil Information database (soilgrids.org) at spatial resolution of 30 arc seconds and Soil Cation Exchange Capacity (CEC) will be downloaded from the Global Harmonized Soil Index as an index of soil fertility (Mungi et al., 2020).

Human Influence Variable: The Global Human Influence Index (HII) Dataset of the Last of the Wild Project is a global dataset of 1-km grid cells created from nine global data layers covering human population pressure, human land use, and infrastructure (land use/land cover, built-up areas and night time lights), and human access (roads, railroads, coastlines, and navigable rivers) will be downloaded from SEDAC website (https://sedac.ciesin.columbia.edu/data/set/wildareas-v3-2009-human-footprint)

Testing Multicollinearity: Multicollinearity analysis of the environmental predictors will be done to avoid over fitting of models, poor model performance, and misleading interpretations. Variance inflation factor (VIF) will be used to detect collinearity between the variables using '*usdm*' R package (Babak, 2017) in R statistical software.

Species distribution modelling method: Maximum entropy modelling software (MaxEnt, version 3.4.1) will be selected for projecting current and future distribution of IAPS (Phillips et al. 2006). MaxEnt a highly appropriate method for modelling the distribution of alien and invasive species as these species tend to establish and expand their range to new areas outside their native distribution (Elith et al. 2011). Moreover, its simplicity of use has made MaxEnt the most broadly used SDM algorithm. It is Presence-only modelling method which predicts the probability distribution of a species on the basis of a given set of predictors for example topography, climate, soil, biogeography etc. together with known occurrences (Phillips et al. 2004; Phillips and Dudik 2008).

Model Performance and Evaluation: The area under the curve (AUC) values of the receiver operating characteristic (ROC), helped us to compare the performance of the three models. The AUC is usually commonly used in evaluating multiple MaxEnt models. An AUC value closer

to 1 indicates better model performance (Phillips et al., 2006). Jack-knife tests and permutation importance approach will be used to evaluate the efficiency or predictive power and the relative importance of predictors (Phillips et al., 2006). The response curves will be used to show how environmental variables affect the prediction of invasion suitability. The curves show how the predicted probability of presence (invasion suitability) changes as each environmental variable is changed, keeping all the other environmental variables at their average values (Phillips et al., 2011).

Future distribution map: The effect of global climate change on potential habitat suitability of selected IAPS will be modelled for the projected HADCM3 A2a and B2a 2050 and 2080 climate change scenarios. The current and future potential distribution will be modelled with occurrence data, and significant bioclimatic environmental predictors using a novel approach based on maximum entropy gain.

Risk Zonation map: Species distribution models describe the potential niches of the concerned species therefore they can be used for delineating/prioritizing risk zones at national or state level.

8.4. Identify invasion Hotspots for effective management of IAPS

The hotspots of alien plant invasion will be identified by intersecting the areas climatically suitable for multiple IAPS with the Eco regions (Schmitt et al 2009) and anthropogenic biomes (Ellis and Ramankutty, 2008) as per Adhikari et al., (2015). The Eco regions with more than 50 percent of their area climatically suitable with a 'high' consensus level for introduction, establishment, and persistence of multiple invasive alien plant species and contain at least three anthropogenic biome types, will be considered as 'invasion hotspots'. Thus, the consensus zone of the ecoregions, anthropogenic biomes, and areas with high climatic suitability for multiple alien invasive plant species will be represented as a hotspot.

8.5. Exchange of knowledge on managing Lantana

Various successful management strategies of Lantana at national and international level will be compiled and disseminated. This includes success stories from various state forest Departments, R&D institutes, and other organisations in India and international level. Suitable

management measures with respect to sites, and landscape considering the physico-chemical properties of the soil, climatic conditions, geography and Eco/agro climatic zones will be identified.

Consultative workshops with respect to Lantana management by inviting experts from various organisation at national and international level to develop suitable strategies to eradicate the lantana invasion in forest and other areas will be organised. The consultative workshop would lead to establish Lantana Eradication Group (LEG). This will also facilitate to share and exchange knowledge on managing lantana in the country. Based on the consultative workshop and deliberations with various stakeholders (most importantly state forest departments), the species suitable to restore the Lantana cleared sites will be identified and restoration of the sites will be ascertained. Natural resilience of Native plant basis to be the basis of restoration action.

8.6. Creating awareness and encouraging key stakeholders to participate in Lantana removal

Preparation and dissemination of various awareness materials (booklet/ Brochure/ Video materials/ etc.) with respect to areas of invasion both in forested and non-forested areas and management protocol, utilisation, suitable species for restoration etc. is the top priority. It also includes to encourage various stakeholders such as state forest departments, forest dwellers/communities, farmers, and others to participate in Lantana removal programme. Demonstration of Cut Root-Stock method to key stakeholders in pilot plots of selected sites, monitoring of pilot experimental plots to ascertain its efficacy will also be part of this programme. A multi-stakeholder consultative decision-making process will be made in order to set priorities in different areas, and to decide on strategies and activities for prevention, clearance and rehabilitation for those areas. Raising awareness among local communities living in invaded areas on the negative and positive impacts of Lantana and how it can be controlled. Training will be given to local government staff members working in areas where Lantana has invaded or is at risk of invasion, about the negative impacts of Lantana and actions that can be taken. Therefore different awareness activities will be carried out and different communication channels will be used to reach different stakeholders. It includes dissemination of messages through different channels of communication, through village leaders, through websites, mass media, and posters e.g., at points of entry/exit from Lantana-invaded areas, information brochure, identification guides, public talks and face-to-face meetings.

8.7. Baseline status of Lantana invasion and Eradication of Lantana affected landscapes

Field survey in the selected landscapes will be carried out to assess the baseline status of Lantana invasion, floristic diversity and soil physico chemical properties. In each selected landscape, a total area of 0.5 ha will be sampled using 10 m × 10 m quadrats spread randomly across the habitat and Lantana abundance and other plant species growing in the area will be collected. Soil samples in different depths will also be collected to assess the soil physico-chemical properties before initiation of eradication activities.

8.8. Removal of Lantana using cut root stock method in selected landscape

Eradication of Lantana using Cut Root-Stock method in selected landscape will be employed. A total of 1000 ha will be selected for this study with 400ha (low dense areas); 300ha each for moderate and highly dense areas. Eradication in low and moderate density areas will be done first so that the rate of restoration will be faster and it will give more insights for handling High density areas (Experiences from Bandipur NP). Rehabilitation will start from Low Intensity Infestation areas and to progress towards areas with Heavy Infestation. Eradication will be initiated during the non-flowering season of Lantana i.e. winter season.

Steps involved in the eradication of *Lantana*

- Chop the main tap root just 3 – 5 cm below the ground surface by standing close to the clump, with a few hits using a kudaal having a long handle (cut rootstock method).Lift the clump and place it upside down for drying.
- Uproot seedlings of *Lantana if any, by hand, after removing the clump.*
- Locate perching trees and remove the saplings under the canopy of perching trees and along the surface run off originating from the perching trees.
- Continuous surveillance for *Lantana in the area from where Lantana has been* eradicated

8.9. Restoration of invaded landscapes with native plant species:

Various stakeholders will be engaged for planning the restoration activities followed by identification of model habitat and plant species suitable for restoration activities. Collection of seeds from natural sources and raising of seedlings in nursery for restoration and maintenances activities will be made. Natural native seedlings will be given priority and

protection of grass patches (Water harvesting structures, increasing moisture etc.). Based on the discussion with various stakeholders a combination of following successful approaches followed in Corbett and Bandipur National parks and other areas will be used for restoration of Lantana affected areas

- **Selection of suitable native plant species and creating green cover**: Grass is the best species for restoration of lantana removed areas. Therefore Grass cover will be created using natural means i.e. expansion of existing grass cover to the lantana removed areas by synchronizing the activity with the monsoons, and by manual propagation of grass by transplantation of grass clumps from nearby areas. Attempts will also be made for broadcasting of grass seeds. Additionally, discussion will be carried out with stakeholders, forest staffs and local people for selection of indigenous species.
- **Broadcasting of seeds** of grasses/herbs/shrubs and planting of native shrub/tree seedlings will be made.

- **Seed balls:** The seed balls of selected native plant species based on the prioritization by the stakeholders will be prepared and used for restoration activities.
- **Sapling planting and support to natural native saplings:** Saplings planting will be done for native species based on the landscapes type. On removed plots, number of native saplings exists, either underneath the removed lantana bushes or in-between. Water harvesting trenches will be made for the native saplings in order to help improve water and moisture availability for the saplings, enabling them to grow faster. This method had already been piloted successfully in the literature.

- **Plantation of Bamboo based on experiences from Karnataka Forest Department** Only local grass and bamboo has the ability to suppress the weed after initial support. The programme is as follows.
  - **0 - Year:** Collection, storage of local grass seeds to be used in the next monsoon.
  - **1st Year:** Uprooting lantana and other weeds after onset of monsoon and followed by broadcasting of collected grass, bamboo seeds mixed with sand. Use of grass slips where seed collection is difficult. Uprooting of regrowing weeds at the end of monsoon. Collection of grass seeds for next monsoon.

- **2nd Year:** Uprooting once again the regrowing weeds and followed by broadcasting of collected grass, bamboo seeds mixed with sand. Use of grass slips where seed collection is difficult. Uprooting of regrowing weeds at the end of monsoon. Collection of grass seeds for next monsoon.
- **3rd Year:** Once again uprooting of left over weeds and followed by broadcasting of collected grass, bamboo seeds mixed with sand. Use of grass slips where seed collection is difficult. Uprooting of regrowing weeds at the end of monsoon. These operations are required because lantana seeds have viability of more than one year and keeps on germinating. We have been implementing it in protected area since last two years.

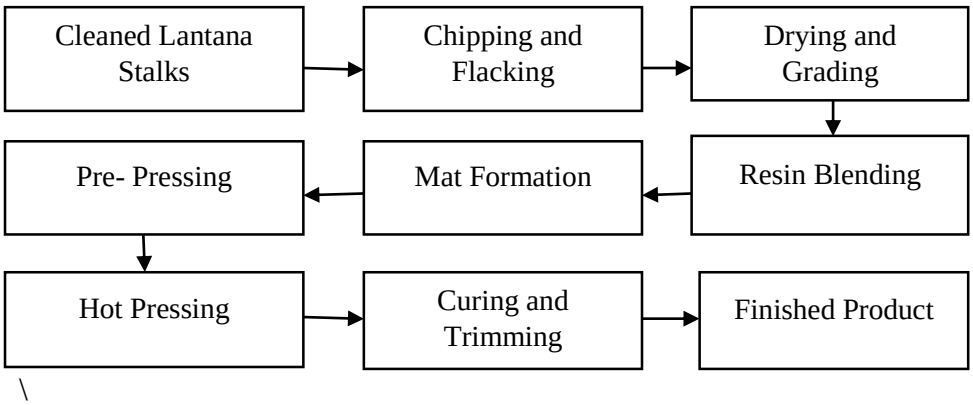
For continuous protection of restoration site fertilizers like bio-boosters, VAM fungi, pest management, protection from grazing and browsing will be done. **De-weeding**: Periodic de-weeding will also be done, where growth of any invasive plants is seen.

8.10. Long term monitoring of the holistic impacts of removal of Lantana in selected landscapes

Monitoring will be done regarding the progress of implementation, efficiency, effectiveness and appropriateness of the Lantana Management Strategy and actions undertaken, in reducing Lantana spread and removing from and rehabilitating the invaded land. The holistic impacts of removal of Lantana on the plant diversity, regeneration and the soil physico-chemical properties in restored areas will be regularly monitored. The changes in density and abundance of Invasive Alien Plant and native species will be monitored through quadrat sampling. The changes in soil physico chemical properties will be monitored through soil sampling in random areas. Regular monitoring will be done and update information will be updated on Lantana distribution (expansion and reduction) including GIS mapping, at a national and regional levels.

8.11. Utilization of Lantana for value added products

8.11.1. **Particle Board Manufacture** (IPRITI, Bengaluru)



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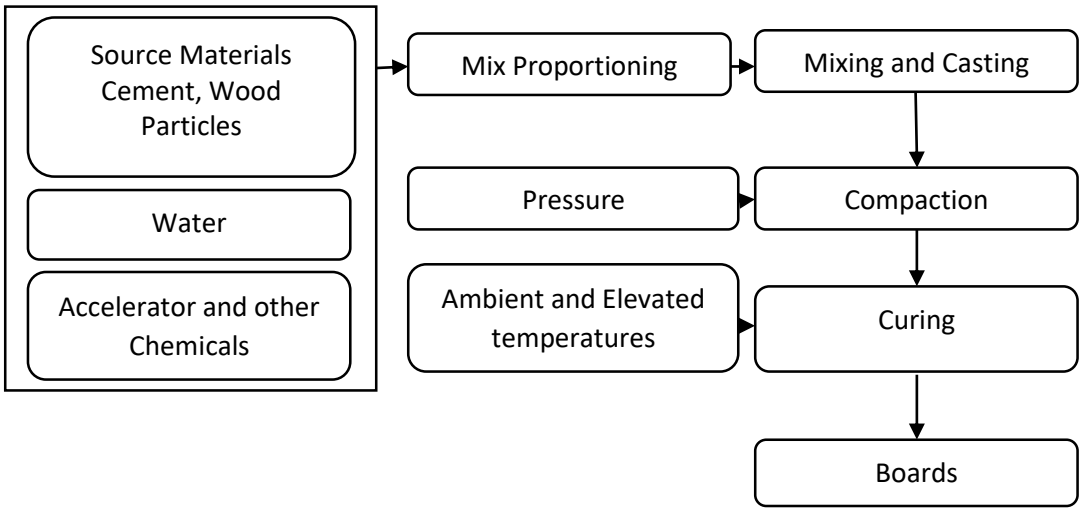
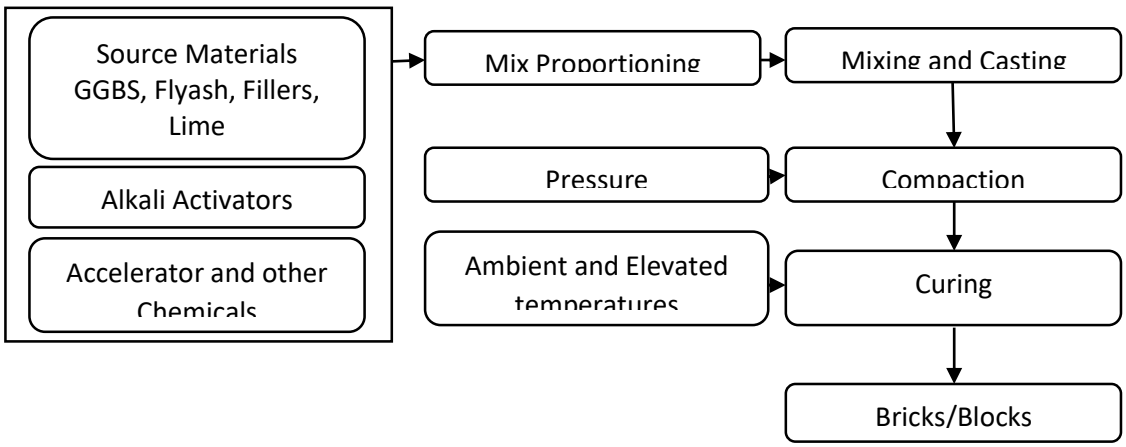
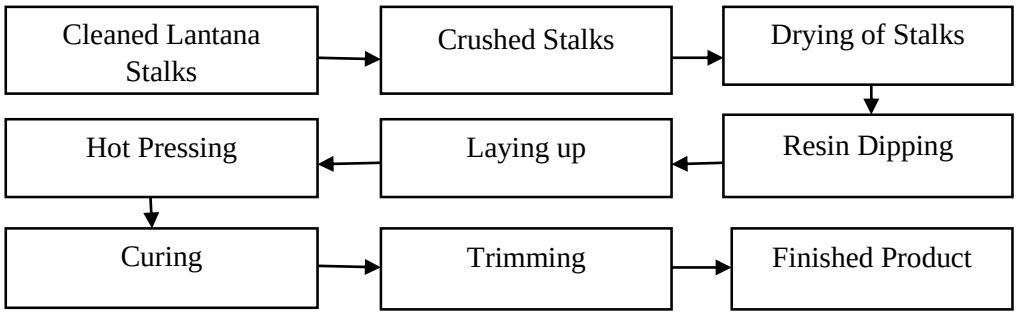
8.11.2. **Cement Bonded Particle Board Manufacture** (IPRITI, Bengaluru)



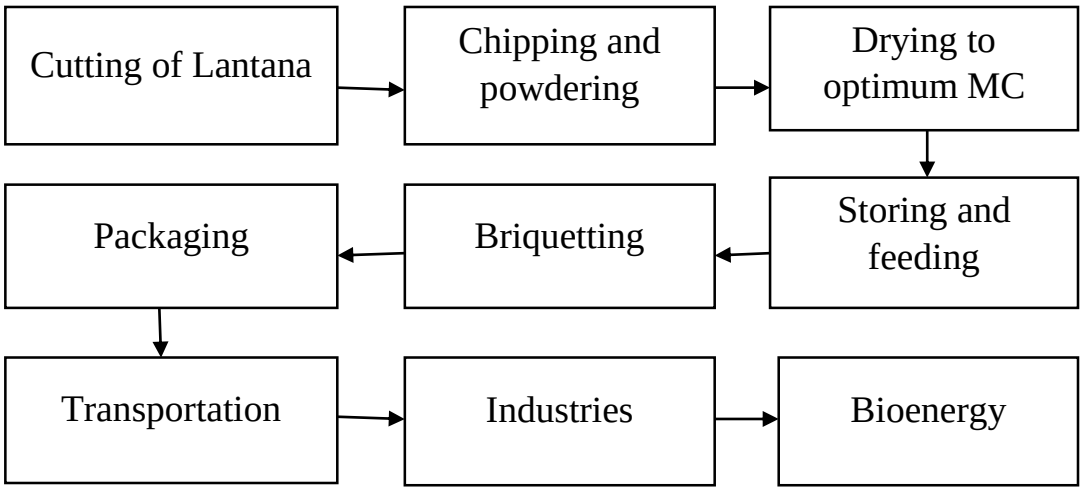
8.11.3. Bio - Composite Brick Manufacture (IPRITI, Bengaluru)



8.11.4. Lantana Laminate Manufacture (IPRITI, Bengaluru)



8.11.5. Briquettes Production (IWST)



8.11.6. Handmade paper (FRI, Dehradun)

Proximate chemical analysis

Chemical parameters of the procured raw material with respect to extractives content, Klason lignin content, holocellulose content, 0.1 N NaOH solubility, alpha cellulose content, ash content, hot and cold water solubility, etc. will be done.

I.b. Training on handmade paper from Lantana

Each training component of the project will mainly comprise the following major steps:

Introduction for Pulp and Paper making: Theoretical sessions on basics of pulp and paper and handmade paper making will be conducted.

- *Processing of raw material:* Lantana will be subjected towards chipping followed by screening. The screened chips having adequate chip size will be processed for pulping process.

- *Pulping of Lantana for pulp production:* Lantana will be subjected to chemical and/or mechanical pulping process for production of pulp.

- *Washing and screening of pulp:* Pulps produced from different pulping processes will be subjected to washing sequentially followed by screening for removal of impurities.

- *Evaluation and beating of pulp:* Pulp obtained after pulping of Lantana will be assessed for total pulp yield, Kappa no. determination. Pulp of Lantana will be subjected to beating for enhancement of degree of fibrillation and quality of the end product for value addition.

- *Handmade paper making from Lantana Pulp:* Beaten pulps produced from Lantana will be subjected to handmade paper manufacturing through a series of sequential steps viz. pulp vat preparation, sizing, couching, pressing, drying, calendaring and cutting.

- *Blending of Lantana pulp with other fibre resources for handmade paper making:* Studies on blending of Lantana pulp with other fibre resources will be conducted. Lantana pulp will be blended with some other available fibre resources for preparation of handmade paper.

II. Training on reconstituted wood from Lantana

Each training component of the project will mainly comprise the following major steps: Theoretical sessions on basics of wood materials and restructured wood making using lantana will be conducted.

- *Processing of raw material*

– Hands-on training for the collection and processing of Lantana over counter revolving rollers.
– Importance of uniform crushing and fiber alignment stability.
– Treatments and operations of Lantana with resins.
– Drying and pressing techniques for lantana wood.
– Conditioning and finishing techniques.

The study will be conducted in *Lantana camara* growing areas in various districts, Tamil Nadu both in forested and non-forested areas. *L. camara* (whole plant) will be uprooted and brought to the community center in the respective district for further experimental analysis. The stem, twigs and roots will be separated from leaves and flowers. Fruits will be discarded. The parts are considered as raw material for further study.

8.11.7. Compost manufacture (IFGTB, Coimbatore)

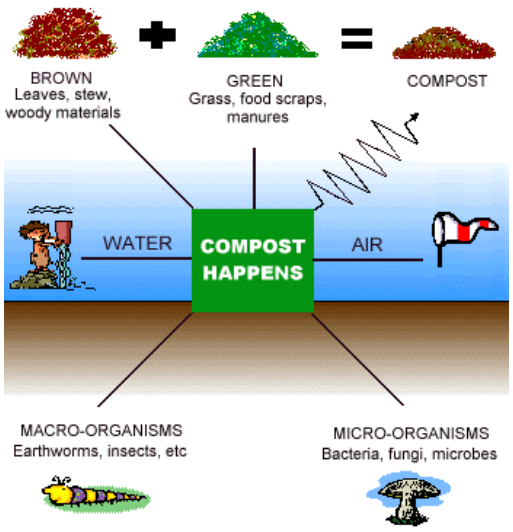
Raw material: The raw material such as lantana weeds - flowers, stalks, stems, fallen leaves, pruning's and leftover will be collected and stacked in a pile. Green materials, which are soft and succulent, are allowed to wilt for two to three days to remove excess moisture before stacking; they tend to pack closely if they are stacked in the fresh state. The mixture of material residues ensures a more efficient decomposition. While stacking, each type of material is spread in layers about 15 cm thick until the heap is about one and a half metres high. The heap

is mixed with cow dung, cow urine and urine soil then next day the mixture will be taken to the pits where the composting is to be done.

Site and pit dimension: The site selected for the compost pit should be at high level so that no rainwater gets in during the monsoon season; it should be near to the cattle shed and a water source. The pit should be about 1 m deep, 1.5-2 m wide and of any suitable length.

Filling the pit: The material mixture is spread evenly in the pit in layers of 10-15 cm. On each layer is spread a slurry made with 4.5 kg dung, 3.5 kg urine-earth and 4.5 kg of inoculum taken from a 15 day-old composting pit. Sufficient quantity of water is sprinkled over the material in the pit to wet it. The pit is filled in this way, layer by layer, and it should not take longer than one week to fill. Care should be taken to avoid compacting the material in any way.

Turning: The material is turned three times during the whole period of composting; the first time 15 days after filling the pit, the second after another 15 days and the third after another month. At each turning, the material is mixed thoroughly, moistened with water and replaced in the pit. The compost will be evaluated for raising nursery.



8.11.8. Insect repellent and floor cleaning agent manufacture

a) Put the vinegar and dried lantana leaves into large glass jar.
b) Seal tightly and shake well each day for 2-3 weeks.
c) After 2-3 weeks, strain the herbs out and store in spray bottles or tincture bottles, preferably in fridge.
d) To use, dilute to half with water in a spray bottle and use as needed.
e) Use whenever you need serious insect control!

The extracts will be subjected to bioassay studies on insects. *L. camara* leaves will be collected air dried and the air dried leaves will be used for the preparation of repellent and floor cleaning agents. The essential oils will be extracted by hydro-distillation method using clevenger apparatus and the oil will be evaluated for insect repellent activity.

8.11.9. Pelletisation

The biomass pelletisation process consists of multiple steps including raw material pre-treatment, pelletisation and post-treatment. In the pre-treatment, unwanted materials like stone will be removed and shredded to 2-3 mm particle size, and then feed to pelletiser, where biomass is compressed through a die consists of holes. The exudates will be collected and cooled down to room temperature and will be packed in different sizes.

The pellets may directly used for burning purpose to produce energy/ electricity. In cases where the biomass is available in large quantities (minimum 1.6 TPD), the pellets are loaded into the continuous feeding mobile pyrolyser unit and the products such as bio-oil and bio-char can be obtained. The bio-char can be used for soil applications as enhancers/ amendment purpose.

8.11.10. Value chains and business models (IIFM, Bhopal)

Data collection involves field visits to these sites and interactions with stakeholders (local communities, artisans, forest department, industries, NGOs, sellers and consumers) to understand the different steps of the value chain starting from collection of Lantana in forests to manufacturing of the final product and their marketing to end-consumers. To supplement the primary data, available secondary data on the production, sales and other relevant parameters will be collected from the concerned enterprises.

The proposed methodology is detailed objective -wise below-

1) Identify and document the existing utilization/uses of Lantana

The study will be initiated with an extensive review of literate to glean information on the latest research in Lantana utilization and screen the existing utilization models for further analysis. Consultations will be held with organizations and research institutes involved in Lantana based enterprises to analyze models for economic / financial viability. Based on the available information on models that are currently operational, the following are tentatively suggested for value chain mapping and analysis of scalability and sustainability:

i. Furniture and craft making enterprises facilitated by ATREE, Junglescapes and the Shola Trust in Karnataka and Tamil Nadu and by HESCO in Dehradun
ii. Bio-composites (particle boards and bio-bricks) developed by IPIRTI, Bangalore
iii. Briquette and charcoal making units in Central India and South India

In phase 1 (first year of the project), the extant Lantana utilization models will be analyzed, while in years 2 and 3, depending on the availability of the required data on other Lantana utilization possibilities from institutions involved in research and development, a few additional options could be selected for further analysis to estimate threshold levels for economic viability and to explore possible business models. Spatial data on extent of different varieties of lantana (expected to be generated by WWI-NRSA) will also be crucial for working out the possible business models, based on availability of raw material with desired characteristics for each utilization method.

2) Analyze the value chains and business models of each of the existing uses of Lantana and to estimate the threshold levels of each business models for its economic/financial viability for the given business/technology cycle

Value chain analysis of each business will investigate the following aspects

- Lantana resource availability: Volume, legal aspects, access etc.
- Collection practices: Methods, labour, effort and time involved and seasonality
- Transport of material: form of raw material, mode of transport, time taken etc.
- Primary processing: Seasoning, treatment, etc.

- Product manufacturing: Types of products, manufacturing methods and processing stages - design, machinery and infrastructure, other materials needed etc.
- Product marketing - Key Markets & consumers, institutional support, Prices, Volumes, Stakeholders, Benefit sharing
- Financial, techno-commercial, market and socio-economic feasibility and ecological compatibility

The various aspects of the existing business models/mechanism adopted for the different uses of Lantana will be studied. This may include the organizational structure, ownership, management, key drivers, products resources, markets, customers, competitors, delivery channels and other relevant variables. The variable wise analysis may be undertaken as the commercial activities for lantana are on a low scale and it may be difficult to delineate identified business models. In case of hybrids, the various aspects mentioned above are analyzed rather than an integrated holistic model.

The financial aspects will cover the cost structure, the revenue flows, cash flow management, break-even analysis and profitability of the existing models/mechanism. The threshold levels for financial viability will be determined taking into consideration the financial and operational cost structure and the increase in levels of operating leverage with adoption of various technological up gradation, capital expenditure for value addition of the products. The factors on the revenue side like the demand and sales forecast, pricing variability and its impact on sales and profitability, volume variability, competitive market and substitute products will also be factored-in to determine the levels of capacity utilization required for business to be sustainable and profitable.

3. Assess the social-ecological sustainability of economically feasible models

Stakeholder workshops involving forest department officials, local community members, industry, local organizations and consumers etc., will be conducted for participatory sustainability assessment of viable enterprises to understand the social and ecological impacts and stakeholder preferences. Multi-criteria analyses using ecological (impacts on resources, biodiversity etc.), social (impacts on labour participation, gender, health, collective action etc.) and economic (income, profitability etc.,) indicators will be employed for sustainability assessment

4. **Explore the potential uses of Lantana based on inputs/learnings from other expert institutions / business organizations / Government Departments etc. (Outside MoEF&CC / ICFRE**)

   The value chains and business model possibilities for each of the potential utilization options will be assessed in the same manner as mentioned under objective 2 above.

5. **Promote knowledge synthesis and exchange for sustainable Lantana management solutions by creating a science-policy-practice hub**

   Considering the highly fragmented status of knowledge on Lantana management and its socio-economic, ecological, technological and policy dimensions, the knowledge hub is envisioned as a platform for networking of stakeholders from diverse sectors to collaboratively work towards sustainable Lantana management solutions. The hub will focus on synthesizing, exchanging, and disseminating research outputs and experiences from field level interventions on Lantana utilization with a view to inform policy deliberations and practice. An online forum will be created in the first year of the project and stakeholders will be invited to join the forum. The forum will hold periodic meetings online and at least two physical meetings to promote active discussions on Lantana management and utilization. A website for the hub will host a comprehensive data base with interactive maps and infographics on Lantana management options, Lantana based enterprises and products to provide a constantly updated picture of the 'Lantanascape' of the country. The hub will also play an advisory role to facilitate linkages of research institutions with entrepreneurs and industries.

9. Action plan:

9.1. Component: A: Spatial spread of Lantana and other Invasive Alien Plants

Activities	Year 1				Year 2				Year 3			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Landscape characteristics and scale of Invasive Alien Plant Species invasion												
Activity 1.1. Collection of data on invasion in different forest areas (All institutions)	■	■	■	■			■	■				
Activity 1.2. Collection of data on anthropogenic disturbances (All institutions)	■	■	■	■			■	■				
Activity 1.3. Downloading data on fire occurrences and other anthropogenic variables (IFGTB, FRI, IFP, RFRI, FSI, NRSC, WII)			■	■					■			
Activity 1.4. Assess Landscape characteristics and scale of Invasive Alien Plant Species invasion (IFGTB, FRI, IFP, RFRI, FSI, NRSC, WII)					■	■			■			
Assessing the spatial spread of Lantana and other of IAPS												
Activity 2.1. Collection of data on invasion in different forest areas (All institutions)	■	■	■	■								
Activity 2.2. Downloading/Purchase of Satellite images and pre-processing (IFGTB, FRI, IFP, RFRI, FSI, NRSC, WII)			■	■								
Activity 2.3. Standardization of methodology for mapping various IAPS in selected areas (IFGTB, FRI, IFP, RFRI, FSI, NRSC, WII)				■	■	■						
Activity 2.4. Accuracy assessment of classification (IFGTB, FRI, IFP, RFRI, FSI, NRSC, WII)						■						
Activity 2.5. Satellite image processing and classification for other forest areas (IFGTB, FRI, IFP, RFRI, FSI, NRSC, WII)							■	■	■	■	■	
Activity 2.6. Accuracy assessment of classification of satellite images for										■	■	

other forest areas (IFGTB, FRI, IFP, RFRI, FSI, NRSC, WII)												
Activity 2.7. GIS analysis of invasion (IFGTB, FRI, IFP, RFRI, FSI, NRSC, WII)												
Modelling the Invasive alien plant species spread using Species Distribution model												
Activity 3.1. Field survey and occurrence data collection. (All institutions)												
Activity 3.2. Bioclimatic data processing (IFGTB, FRI, IFP, RFRI, FSI, NRSC, WII)												
Activity 3.3. Environmental and Human Variable Predictors processing (IFGTB, FRI, IFP, RFRI, FSI, NRSC, WII)												
Activity 3.4. Multi-collinearity testing and variable selection (IFGTB, FRI, IFP, RFRI, FSI, NRSC, WII)												
Activity 3.4. Model validation and evaluation (IFGTB, FRI, IFP, RFRI, FSI, NRSC, WII)												
Activity 3.5. Probable Distribution Map Generation (IFGTB, FRI, IFP, RFRI, FSI, NRSC, WII)												
Identify invasion Hotspots for effective management of IAPS												
Activity 4.1. Downloading and processing of Anthropogenic biomes, Ecoregions, biogeographic zones, Protected Area shape file etc. (IFGTB, FRI, IFP, RFRI, FSI, NRSC, WII)												
Activity 4.2. Assessing the extent of invasion in various forests/Protected Areas (IFGTB, FRI, IFP, RFRI, FSI, NRSC, WII)												
Activity 4.3. Identification of regions/areas under high infestation conditions (IFGTB, FRI, IFP, RFRI, FSI, NRSC, WII)												
Report preparation (All institutions)												

9.2.Component: B: Eradication and restoration of Lantana invaded areas

Activities	Year 1				Year 2				Year 3				Year 4				Year 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Facilitate the exchange of knowledge on managing Lantana																				
Activity 1.1. Compilation of various successful management strategies of Lantana																				
Activity 1.2. Organization of Lantana experts National workshops (2 nos)																				
Activity 1.3. Organization of Lantana experts International workshops (1 no)																				
Activity 1.4. Deliberate and identify plant species suitable for restoration activities																				
Creating awareness and encouraging key stakeholders to participate in Lantana removal																				
Activity 2.1. Preparation and dissemination of various awareness materials (booklet/ Brochure/ Video materials/ etc)																				
Activity 2.2. Encouraging various stakeholders to participate in Lantana removal																				
Activity 2.3. Demonstration of cut root stock method to key stakeholders in pilot plots of selected sites																				

Activity 2.4. Monitoring of pilot experimental plots																				
Activity 2.5. Shortlist plant species suitable for restoration																				
Assess baseline Lantana invasion status and eradicate Lantana affected selected forests/Protected Areas of the country																				
Activity 3.1.Select sites for management and restoration																				
Activity 3.1. Assess the baseline status of Lantana invasion and soil characteristics in the selected sites to be restored and video graphing of the areas																				
Activity 3.2. Designing/Purchase of Gudlis or Axes and other tools																				
Activity 3.3. Identify areas of High, medium and low density of Lantana invasion																				
Activity 3.4. Removal of Lantana using cut root stock method in larger areas of selected landscape																				
Activity 3.5. Transport /controlled burning /utilization of eradicated Lantana																				
Activity 3.6. Regular weeding and removal of seedlings of Lantana																				
Restoration models for Lantana affected areas in selected forests																				

Activity 4.1. Engaging stakeholders and planning the restoration activities																			
Activity 4.2. Identification of model habitat and plant species suitable for restoration																			
Activity 4.3. Collection of seeds/raising of seedlings for restoration and maintenances																			
Activity 4.4. Support to natural native seedlings and protection of grass patches (Water harvesting structures, increasing moisture etc)																			
Activity 4.5. Broadcasting of seeds of grasses/herbs/shrubs and seed balls																			
Activity 4.6. Planting of native shrub/tree seedlings																			
Long term monitoring of the holistic impacts of removal of Lantana in selected forests																			
Activity 5.1. Assessing the plant diversity, regeneration in restored areas through quadrat study																			
Activity 5.2. Assessing the soil physic-chemical characteristics in restored areas																			
Activity 5.3. Publication/sharing of lessons learned																			
Data analysis Report preparation																			

9.3.Component: C: Utilization of Lantana for improving the livelihood of people

Time line	**1st year**				**2nd Year**				**3rd Year**			
Milestone and work elements	1st Q	2nd Q	3rd Q	4th Q	5th Q	6th Q	7th Q	8thQ	9st Q	10th Q	11th Q	12th Q
IPRITI, Bengaluru												
Procurement of source materials												
Procurement equipment's												
Characterization of ingredients												
Development of mix propositions												
Manufacturing of Bio-composite												
Evaluation of physical and mechanical properties												
Design and Product development												
Technology Promotion												
IWST, Bengaluru												
Site selection with Forest Department												
Procurement and establishment of unit at selected site												
Analysis of properties of biomass material												
Cutting and removal of lantana												
Chipping and powder making												
Production of briquettes												
Analysis of properties and industrial use												
Technology Promotion												
IFGTB, Coimbatore												
Recruitment of staff												
Permission to be accorded from State Forest Department												

Collection and process of *L. camara*.											
Initiation of process for biocomposting											
Collection and process of *L. camara*.											
Lantana based biocomposting											
Estimation of carbon, nitrogen and phosphorous in biocompost											
Evaluation of allopathic effect of biocompost											
Extraction of essential oil from lantana											
Bioassay studies with insects/microbes											
Development of repellent and floor cleaning agent											
Evaluation and work out economics of value added product											
Data analysis											
Report Preparation											
FRI, Dehradun											
Proximate chemical analysis											
Three Trainings (five days each) on handmade paper making and three trainings (five days each) on reconstituted wood will be organized.											
Four Trainings (five days each) on handmade paper making and four trainings on reconstituted wood (five days each) will be organized.											
CSIR- IIP, Dehradun											
Procurement of feedstock and pyrolysis studies at CSIR-IIP for understanding the products, decomposition mechanisms through											

extensive characterization												
Preliminary studies and design/preparation of specifications for procurement of equipment proposed												
Procurement of pelletiser, mobile pyrolysis unit												
Optimisation of process using Lantana feedstock												
Deployment on field at the targeted location												
Possibilities to replicate the model at other places where large quantities of Lantana are observed												
Report writing and submission												
Design of scaled up models, techno-economics, skill development												
IIFM, Bhopal												
Project staff recruitment												
Literature review												
Selection of business models for analysis												
Study launch workshop												
Finalizing the design and methods												
Piloting the methods												
Field visits for primary data collection												
Secondary data collection												
Workshops with different stakeholders including industries, forest department, NGOs, and local communities												
Selection of more utilization models for analysis (Phase -2) depending on the availability of data from other research institutes												

and field visits for data collection on these models									
Data analysis									
Preparing the draft report									
Dissemination workshops									
Final report									

Work plan (IIFM, Bhopal)

The project is planned for a duration of 30 months (2.5 years) from the date of release of the first instalment of the grant. The work pertaining to value chain analysis, scalability and sustainability of the extant business models (phase-1) shall be completed in the first year. Year 2 will be used for phase 2- ie. feasibility analysis of any utilization models for which technology will be developed and demonstrated by the research institutions in the consortium in the meantime. The last 6 months (year 3) will be used for knowledge synthesis and advising incubation centres initiated by other research institutes in the consortium on forging industry linkages. If the data required for phase-2 is not made available from the research partners of the consortium, the project could be completed in two years.

Potential risks and management (IIFM, Bhopal)

- In case of non-availability of the required data for phase 2 on other possible utilization models from collaborating institutions, the analysis will be confined to the existing models identified at the start of the project.
- In case of any unforeseen events (natural calamity, law and order situation in field sites, pandemics etc.), MoEFCC and IIFM will discuss and decide the future course based on mutually agreed terms.

Terms and conditions (IIFM, Bhopal)

i. The duration of this study will be 30 months from the date of receipt of the first instalment. In case of any eventuality, extension of the duration will be on mutually agreed terms and conditions.
ii. IIFM will be free to share the academic outputs generated from this project internally or in academic journals and other platforms.
iii. This study will close once the final report is submitted by IIFM and the final instalment is released from MoEFCC.
iv. After submission of the final report, IIFM will not appear in court or defend the report in any other forum or proceedings which is linked to this assignment.

10. Major applications of the proposed technology (IPRITI, Bengaluru)

This proposed technology shall open up opportunities for converting lantana (weed) as an alternative raw material for making value added building materials for applications in panel products, building walls, interior designing, furniture making, wall fillings and acoustic wall panels. Due its less weight and low density these bio - composite helps in maintaining thermal comfort of the buildings, making the building comfortable which suits for hot-humid climate like India. This is extremely beneficial for high rise structures as the overall load on the frame structure will be much lower compared to traditional walls. Thus, this can result in designing lighter frame structure, thereby reducing the use of conventional blocks and lowering the construction cost.

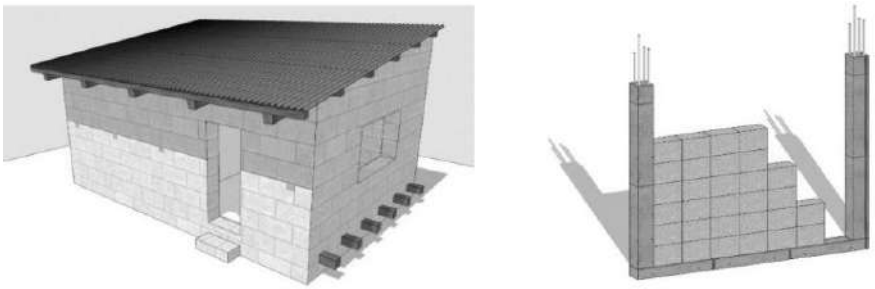


Figure. 3 Low cost housing using bio – composite bricks.

Various advantages found in bio – composite from alkali activator binders are dimensional stability, longevity, weather resistant, better fire resistant, low maintenance, non-toxic, low flame spread, no emission etc., Alkali activated binder systems for wood or other lingo – cellulosic waste materials in composite manufacturing would result in a potentially important class of formaldehyde-free type of composites.

Post Project Further Works Required for Commercial Exploitation of Technology (IPRITI, Bengaluru)

Following steps could help in proper development of bio-composites from *Lantana*

1. Continuous Research & Development should be focused on developing durable building materials from *Lantana camara*.
2. Government initiative, incentives and new standards are required to promote and propagate the new bio – composites materials in construction sector.

3. Large scale awareness campaigns and training programs for tribal people/ local people, masons and builders for production and promotion of bio-composites.
4. Campaigns that are directed at informing target users (e.g. tribal, the farmers, NGO) by showcasing how the conversion of weed into value added products.
5. Showcasing how bio – composites can become a major impact in improving the livelihood of rural people and industrial promotion.

Technology Demonstration/Outreach Plan (IPRITI, Bengaluru)

Milestones	**Activities**	**Timeline**
Product development and demonstration of technology -Awareness among industries, govt. & other stake holders	1. Production of bio- composite. 2. Demonstration of performance of the lantana-composites to stakeholders through interactive meets, exhibitions/conference, etc. 3. Development of product profiles, leaflets, etc.	11^{th} Q
Transfer of Technology and promotion	1. Promotion through websites, social media platforms of the institute, MSME, MoEF & CC. 2. Workshop/Conference to explore potential partners to establish commercial pilot scale plant.	12^{th} Q

11. Outcome and deliverables

Following are the expected comes of the proposed project

Component: A: Spatial spread of Lantana and other Invasive Alien Plants

- Standardized techniques for spatial extent mapping of IAPS
- Spatial extent map of invasion of IAPS
- Predicted future distribution of IAPS and sites vulnerable for IAPS
- Identification of sites having higher population of IAPS

Component: B: Eradication and restoration of Lantana invaded areas

- Booklet on existing successful management strategies for Lantana
- Knowledge exchange on managing Lantana
- Demonstration of cut root stock method to key stakeholders
- Eradication of Lantana using cut root stock method in selected forested landscape
- Standardized restoration protocols for various Lantana invaded areas
- Technique for long term monitoring of the holistic impacts of removal of Lantana
- Compendium on management strategies for Lantana

Component: C: Utilization of Lantana for improving the livelihood of people

- Lantana composites (Particle board, bio-composite bricks and Lantana laminate) – Design and Development

- Bio- Composites standards for lantana products (Standardization)
- Demonstration of technology by applications
- Value addition for lantana weed for new bio-composite products
- Promotion of industrialization from lantana with the support of local people
- Briquettes from lantana may benefit the society as a whole through controlling the spread and management of the noxious weed
- Industrial-fired boilers and industrial kilns (Gasifier industries, direct combustion units, ceramic industry, textile, food processing, brick industry etc)
- Lantana based value added products such as biocompost for farmers, Forest Departments and corporation for raising nurseries.
- Insect repellent and floor cleaning agents are for larger sections of the society.
- Development of Technology for small scale industrial products from Lantana
- Promotion of industrialization from Lantana with the support of local people.

CSIR-IIP

- Design of pelletiser and production of Lantana pellets
- Mobile pyrolysis unit (0.5 TPD) for production of bio-char using Lantana pellets
- Understanding the decomposition behavior and compositional changes during pyrolysis of Lantana
- Extensive characterization of bio-char and modification for soil amendment purposes
- Training and skill development programmes to create human resource

12. Cost of the project (in Rs Lakhs): 4326.44 (tentative)

Head of Expenditure	1st Year	2nd Year	3rd Year	4th Year	5th Year	Total
Project Scientist (03 years; Rs 56,000/month + HRA (16%) JRF (First two years, Rs 31,000/month + HRA (16%), 3rd year Rs.35,000/month + HRA (16%)	154.31	154.31	160.82	45.91	45.91	561.25
*PA (Rs. 18,000/Month)	40.58	40.58	39.58	10.80	10.80	142.34
Consumables	40.95	38.57	34.78	6.50	6.00	126.80
Travel &Training cost** for 8-10 no. of trainees in each training	76.70	78.60	65.30	8.00	7.00	235.60
Contingency	69.50	58.64	62.02	9.00	8.00	207.16
Non - Recurring : Permanent Equipment	273.00	49.00	2.50	1.00	1.00	326.50
Institutional Charges 20%	90.37	59.79	52.64	12.18	11.81	226.79
Total	**745.41**	**479.49**	**417.64**	**93.39**	**90.52**	**1826.44**
SFD Eradication of Lantana/restoration	**1625**	**575**	**150**	**75**	**75**	2500.00
Grand Total (Sum of Components A+ B+ C)	**2370.41**	**1054.49**	**567.64**	**168.39**	**165.52**	**4326.44**

12.1Breakup of the project:

Component: A: Spatial spread of Lantana and other Invasive Alien Plants

Head of Expenditure	1st Year	2nd Year	3rd Year	Total
Project Scientists, JRFs, Field Assistants	83.44	83.44	91.44	**258.32**
Project Assistants	19.78	19.78	19.78	**59.34**
Consumables	7.65	7.35	6.08	**21.09**
Travel	30.00	27.50	24.00	**81.50**
Contingencies & Forest Research Expenses (FRE)	24.00	16.14	12.52	**52.66**
Non-Recurring Equipment & Accessories Workstations Satellite Images	101.20	8.00	2.00	**111.20**
Institutional Charges (15 %)	35.27	21.10	20.09	**76.46**
Grand Total	**301.34**	**183.31**	**175.92**	**660.57**

Component- B (B1+B2): Eradication and restoration of Lantana invaded areas

Budget for B1: ICFRE institutions:

Head of Expenditure	1st Year	2nd Year	3rd Year	4th Year	5th Year	Total
Fellowship (RA, SRF, JRF, SPA, JPA, FA, PA)	40.63	40.63	45.91	45.91	45.91	**218.99**
*PA (Rs. 18,000/Month)	10.80	10.80	10.80	10.80	10.80	**54.00**
Consumables	11.10	9.52	7.50	6.50	6.00	**40.62**
Travel	23.00	22.50	19.20	8.00	7.00	**79.70**
Contingencies & Forest Research Expenses (FRE)	23.00	21.50	17.00	9.00	8.00	**78.50**
Non-Recurring Equipment & Accessories Workstations Satellite Images	18.00	1.00	0.50	1.00	1.00	**21.50**
Institutional Charges (15 %)	18.98	15.89	15.14	12.18	11.81	**74.00**
Grand Total	**145.50**	**121.84**	**116.05**	**93.39**	**90.52**	**567.30**

Budget for B2: State Forest Departments

(Himachal Pradesh, Madhya Pradesh, Jharkhand, Odisha, Telengana, Kerala, Rajasthan, Assam, Mizoram, Arunachal Pradesh and Tripura)

Activity	1st Year	2nd Year	3rd Year	4th YEAR	5th Year	Total (In lakhs)
Eradication of Lantana and restoration activities in 1000 ha for all the selected ten states*	**1625**	**575**	**150**	**75**	**75**	**2500**

*Note: The budget is calculated based on average labour wages of Rs 500/day. However, the exact cost will vary depending on the prevailing labour wages in the selected location. The tentative manpower, labour wages and approximate cost required for 100 ha in each states is given below;

Activity	Man days/ha	Approximate Labour wages (Rs.500/day)	Extent (ha)*	Total in Lakhs
1st Year				
Eradication of Lantana	125	62500	100	62.50
Advanced work (Nursery mother bed, collection of grasses, seeds, watering, dibbling, weeding, manuring	75	37500	100	37.50
Pitting	75	37500	100	37.50
Soil work	50	25000	100	25.00
Subtotal Ist year	325	162500		162.50
II nd year				
Establishment work	30	15000	100	15.00
Maintenance of nursery stock till planting	10	5000	100	5.00
Planting of seeds, broadcasting of grasses, planting of seedlings, Bamboo etc	50	25000	100	25.00
Weeding /uprooting of seedlings	25	12500	100	12.50
Subtotal IInd year	115	57500		57.50

IIIrd year				
Casualty replacement	10	5000	100	5.00
Weeding /uprooting of seedlings	20	10000	100	10.00
Subtotal IIIrd year	30	15000		15.00
IVth year				
Maintenance (Weeding /uprooting of seedlings etc)	15	7500	100	7.50
Subtotal IVth year	15	7500		7.50
Vth year				
Maintenance (Weeding /uprooting of seedlings etc)	15	7500	100	7.50
Subtotal Vth year	15	7500		7.50
Total	500	250000		250.00

*Note: The Lantana eradication will be done in 100 ha area in each state which may further split into 40 ha in High density, 30 ha each in medium and low Lantana density area. Arunachal Pradesh and Tripura State Forest Departments will carry out the activities in 50 ha area each (20 ha in High density, 15 ha each in Medium and Low Lantana density).

Component: C: Utilization of Lantana for improving the livelihood of people

Head of Expenditure	**1st Year**	**2nd Year**	**3rd Year**	**Total**
Recurring :Manpower*	30.24	30.24	23.46	**83.94**
Project Assistants	10.00	10.00	9.00	**29.00**
Consumables	22.20	21.70	21.20	**65.10**
Travel &Training cost** for 8-10 no. of trainees in each training	23.70	28.60	22.10	**74.40**
Contingency	22.50	21.00	32.50	**76.00**
Non - Recurring : Permanent Equipment	153.80	40.00	0.00	**193.80**
Institutional Charges	36.12	22.80	17.41	**76.33**
Total	**298.56**	**174.34**	**125.67**	**598.57**

Institution wise budget

Component: A: Spatial spread of Lantana and other Invasive Alien Plants

AFRI, Jodhpur

Head of Expenditure	**1st Year**	**2nd Year**	**3rd Year**	**Total**
Recurring: Fellowship JRF (First two years Rs 31,000/month +16% HRA, 3rd Year Rs. 35,000/month + 16%HRA): 2 Nos.	8.63	8.63	9.74	**27.00**
PA (Rs. 18,000/Month): 2	4.32	4.32	4.32	**12.96**
Consumables	0.50	0.50	0.30	**1.30**
Travel	2.00	2.00	2.00	**6.00**
Contingencies	1.00	1.00	1.00	**3.00**
Non-Recurring: Equipment & Accessories GPS, Workstation	3.00	0.00	0.00	**3.00**
Sub Total	19.45	16.45	17.36	**53.26**
Institutional charges (15%)	2.92	2.47	2.60	7.99
Total	**22.37**	**18.92**	**19.96**	**61.25**

HFRI, Shimla

Head of Expenditure	**1st Year**	**2nd Year**	**3rd Year**	**Total**
Recurring::Fellowship JRF (First two years Rs 31,000/month +8% HRA, 3rd Year Rs. 35,000/month + 8% HRA): 2 Nos.	8.04	8.04	9.07	**25.14**
*PA (Rs. 19,000/Month): Two	4.32	4.32	4.32	**12.96**
Consumables	1.00	1.00	1.00	**3.00**
Travel	2.50	2.50	2.00	**7.00**
Contingencies	2.00	2.00	1.00	**5.00**
Non-Recurring Equipment & Accessories GPS, Printer, Harddisk	2.40	0.00	0.00	**2.40**
Sub Total	20.26	17.86	17.39	**55.50**
Institutional Charges (15 %)	3.04	2.68	2.61	**8.33**
Total	**23.29**	**20.53**	**20.00**	**63.83**

IFP, Ranchi

Head of Expenditure	**1st Year**	**2nd Year**	**3rd Year**	**Total**
Recurring::Fellowship JRF (First two years Rs 31,000/month + HRA, 3rd Year Rs. 35,000/month + HRA): 2 Nos.	8.63	8.63	9.74	**27.00**
*PA (Rs. 18,000/Month)	0.00	0.00	0.00	**0.00**
Consumables	0.50	0.50	0.43	**1.43**
Travel	2.00	2.00	1.50	**5.50**
Contingencies	1.00	1.00	1.00	**3.00**
Non-Recurring Equipment & Accessories Workstations, Satellite Images	6.00	0.00	0.00	**6.00**
Sub Total	18.13	12.13	12.67	**42.93**
Institutional Charges (15 %)	2.72	1.82	1.90	**6.44**
Total	**20.85**	**13.95**	**14.57**	**49.37**

IFB, Hyderabad

Head of Expenditure	**1st Year**	**2nd Year**	**3rd Year**	**Total**
Recurring:: PA fellowship (Rs. 18,000/Month)	2.16	2.16	2.16	**6.48**
Consumables	0.40	0.10	0.10	**0.60**
Travel	8.00	4.00	4.00	**16.00**
Contingencies & Forest Research Expenses (FRE)	1.16	0.60	0.60	**2.36**
Non-Recurring Equipment & Accessories Workstations, GPS	1.30	0.00	0.00	**1.30**
Sub Total	13.02	6.86	6.86	**26.74**
Institutional Charges (15 %)	1.95	1.03	1.03	**4.01**
Total	**14.97**	**7.89**	**7.89**	**30.75**

RFRI, Jorhat

Head of Expenditure	**1st Year**	**2nd Year**	**3rd Year**	**Total**
Recurring::Fellowship JRF (First two years Rs 31,000/month + HRA, 3rd Year Rs. 35,000/month + HRA): 2 Nos.	8.04	8.04	9.07	**25.14**
*PA (Rs. 18,000/Month)	0.00	0.00	0.00	**0.00**
Consumables	0.15	0.15	0.15	**0.45**
Travel	3.00	4.50	4.50	**12.00**
Contingencies &Forest Research Expenses (FRE)	0.30	0.30	0.30	**0.90**
Non-Recurring Equipment & Accessories Satellite Images, Software, maps	15.00	0.00	0.00	**15.00**
Sub Total	26.49	12.99	14.02	**53.49**
Institutional Charges (15 %)	3.97	1.95	2.10	**8.02**
Total	**30.46**	**14.93**	**16.13**	**61.52**

TFRI, Jabalpur

Head of Expenditure	1st Year	2nd Year	3rd Year	Total
Recurring::Fellowship PA (Rs. 18,000/Month): 1	2.16	2.16	2.16	**6.48**
Consumables	0.60	0.60	0.60	**1.80**
Travel	2.50	2.50	1.50	**6.50**
Contingencies & Forest Research Expenses (FRE)	2.00	1.00	1.00	**4.00**
Non-Recurring Equipment & Accessories Computer, printer, camera	1.50	0.00	0.00	**1.50**
Sub Total	8.76	6.26	5.26	**20.28**
Institutional Charges (15 %)	1.31	0.94	0.79	**3.04**
Total	**10.07**	**7.20**	**6.05**	**23.32**

IFGTB, Coimbatore

Head of Expenditure	1st Year	2nd Year	3rd Year	Total
Recurring::Fellowship JRF (First two years Rs 31,000/month + HRA, 3rd Year Rs. 35,000/month + HRA): 2 Nos.	8.63	8.63	9.74	**27.00**
*PA (Rs. 18,000/Month):2 PAs	4.32	4.32	4.32	**12.96**
Consumables	2.00	2.00	2.00	**6.00**
Travel	4.00	3.00	3.00	**10.00**
Contingencies & Forest Research Expenses (FRE) (wages for CDL)	4.00	2.44	2.00	**8.44**
Non-Recurring Equipment & Accessories Workstations 2, Printer, Satellite Images, Softwares, GPS, Camera lens	26.00	2.00	0.00	**28.00**
Sub Total	48.95	22.39	21.06	**92.40**
Institutional Charges (15 %)	7.34	3.36	3.16	**13.86**
Total	**56.29**	**25.75**	**24.22**	**106.26**

FRI, Dehradun

Head of Expenditure	1st Year	2nd Year	3rd Year	Total
Recurring: Recurring::Fellowship JRF (First two years Rs 31,000/month + HRA, 3rd Year Rs. 35,000/month + HRA): 2 Nos.	8.63	8.63	9.74	**27.00**
PA (Rs. 18,000/Month)	0.00	0.00	0.00	**0.00**
Consumables	0.5	0.5	0.5	**1.50**
Travel	3	3	2.5	**8.50**
Contingencies & Forest Research Expenses (FRE)	1	1	1	**3.00**
Non-Recurring GPS, software, satellite images / desktop, etc	8.00	0.00	0.00	**8.00**
Sub Total	21.13	13.13	13.74	48.00
Institutional / overhead Charges	3.17	1.97	2.06	7.20
Total	**24.30**	**15.10**	**15.80**	**55.20**

Wildlife Institute of India, Dehradun

Head of Expenditure	1st Year	2nd Year	3rd Year	Total
Project Scientist (03 years; Rs 56,000/month + HRA (16%) - 1 No. JRF (First two years, Rs 31,000/month + HRA (16%)- , 3rd year Rs.35,000/month + HRA (16%) - No.	12.11	12.11	12.66	**36.88**
*PA (Rs. 18,000/Month):1 PA	2.50	2.50	2.50	**7.50**
Consumables	2.00	2.00	1.00	**5.00**
Travel	2.00	3.00	2.00	**7.00**
Contingencies & Forest Research Expenses (FRE)	2.00	2.00	2.00	**6.00**
Non-Recurring Equipment & Accessories Workstations, Satellite Images	8.00	6.00	2.00	**16.00**
Sub Total	28.61	27.61	22.16	**78.38**
Institutional Charges (15 %)	4.29	4.14	3.32	**11.76**
Total	**32.90**	**31.75**	**25.48**	**90.14**

NRSC, Hyderabad

Head of Expenditure	1st Year	2nd Year	3rd Year	Total
2 SE grade 15 days, 2 SG grade: 15 days: 30 days in a year)	4.65	4.65	4.65	**13.95**
*PA (Rs. 18,000/Month)	0.00	0.00	0.00	**0.00**
Consumables	0.00	0.00	0.00	**0.01**
Travel	1.00	1.00	1.00	**3.00**
Contingencies & Forest Research Expenses (FRE)	9.54	4.80	2.62	**16.96**
Non-Recurring Equipment & Accessories Workstations, Satellite Images	30.00	0.00	0.00	**30.00**
Sub Total	45.19	10.45	8.27	**63.92**
Institutional / overhead Charges	4.55	0.75	0.51	**5.82**
Total	**49.75**	**11.20**	**8.78**	**69.73**

NRSC-ICFRE*

Head of Expenditure	1st Year	2nd Year	3rd Year	Total
ICFRE PA/JRF/SRF salary (@31000 p.m. per 2 years; 35000 p.m. for one year) (2 JRFs) + ICFRE 26% HRA for two JRFs + ICFRE Project Scientist-I (@56,000 p.m.)	16.09	16.09	17.03	**49.21**

*Note: The manpower will be jointly used by NRSC and ICFRE

Component: B: Eradication and restoration of Lantana invaded areas

B1: ICFRE Institutions

AFRI, Jodhpur

Head of Expenditure	1st Year	2nd Year	3rd Year	4th Year	5th Year	Total
Recurring: Fellowship JRF (First two years Rs 31,000/month + HRA, from 3rd Year Rs. 35,000/month + HRA): Three	8.63	8.63	9.74	9.74	9.74	**46.48**
*PA (Rs. 18,000/Month): Five	2.16	2.16	2.16	2.16	2.16	**10.80**
Consumables	2.50	2.00	1.50	1.00	1.00	**8.00**
Travel	3.00	3.00	2.50	1.00	1.00	**10.50**
Contingencies	5.00	5.00	2.00	1.00	1.00	**14.00**
Non-Recurring Equipment & Accessories Workstations, Camera, Printer, GPS	5.00	0.00	0.00	0.00	0.00	**5.00**
Sub Total	26.29	20.79	17.90	14.90	14.90	**94.78**
Institutional Charges (15 %)	3.94	3.12	2.69	2.24	2.24	**14.22**
Total	**30.23**	**23.91**	**20.59**	**17.14**	**17.14**	**109.00**

HFRI, Shimla

Head of Expenditure	1st Year	2nd Year	3rd Year	4th Year	5th Year	Total
Recurring: Fellowship JRF (First two years Rs 31,000/month + HRA, from 3rd year Rs.35,000/month + HRA	8.04	8.04	9.07	9.07	9.07	**43.29**
PA	2.16	2.16	2.16	2.16	2.16	**10.80**
Consumables	1.00	1.00	1.00	1.00	1.00	**5.00**
Travel	2.00	2.00	2.20	1.00	1.00	**8.20**
Contingencies (Contingencies & FRE)	1.50	1.50	2.00	1.00	1.00	**7.00**
Non-Recurring Equipment & Accessories Printer, GPS, agricultural tools	2.00	1.00	0.50	1.00	1.00	**5.50**
Sub Total	16.70	15.70	16.93	15.23	15.23	**79.79**
Institutional charges (15%)	2.50	2.35	2.54	2.28	2.28	**11.97**
Total	**19.20**	**18.05**	**19.47**	**17.52**	**17.52**	**91.75**

IFP, Ranchi

Head of Expenditure	1st Year	2nd Year	3rd Year	4th Year	5th Year	Total
Recurring: Fellowship JRF (First two years Rs 31,000/ month + HRA, from 3rd Year Rs. 35,000/month + HRA): 2	8.63	8.63	9.74	9.74	9.74	46.48
Consumables	3.00	2.00	2.00	1.00	1.00	9.00
Travel	3.00	3.00	2.00	1.00	1.00	10.00
Contingencies	4.50	4.00	3.00	1.00	1.00	13.50
Non-Recurring Equipment & Accessories	0.00	0.00	0.00	0.00	0.00	0.00
Sub Total	19.13	17.63	16.74	12.74	12.74	78.98
Institutional Charges (15 %)	2.87	2.64	2.51	1.91	1.91	11.85
Total	**22.00**	**20.27**	**19.25**	**14.65**	**14.65**	90.83

IFB, Hyderabad

Head of Expenditure	1st Year	2nd Year	3rd Year	4th Year	5th Year	Total
Fellowship (FA, PA)	2.98	2.98	3.42	3.42	3.42	**16.22**
Consumables	1.10	1.00	0.50	1.00	0.50	**4.10**
Travel	6.00	4.00	3.00	1.00	1.00	**15.00**
Contingencies & Forest Research Expenses (FRE)	6.50	2.50	2.00	2.00	2.00	**15.00**
Non-Recurring Equipment & Accessories Workstations, agricultural tools etc	1.00	0.00	0.00	0.00	0.00	**1.00**
Sub Total	17.58	10.48	8.92	7.42	6.92	**51.32**
Institutional Charges (15 %)	2.64	1.57	1.34	1.11	1.04	**7.70**
Total	**20.22**	**12.05**	**10.26**	**8.53**	**7.96**	**59.02**

RFRI, Jorhat

Head of Expenditure	1st Year	2nd Year	3rd Year	4th Year	5th Year	Total
Recurring: Fellowship JRF (First two years Rs 31,000/month + HRA, from 3rd Year Rs. 35,000/month + HRA): 2 Nos.	8.04	8.04	9.07	9.07	9.07	**43.29**
PA (Rs. 18,000/Month): 1 PA	2.16	2.16	2.16	2.16	2.16	**10.80**
Consumables	0.50	0.52	0.50	0.50	0.50	**2.52**
Travel	3.00	4.50	4.50	2.00	1.00	**15.00**
Contingencies &Forest Research Expenses (FRE)	1.50	4.50	4.50	1.00	1.00	**12.50**
Non-Recurring Equipment & Accessories Workstations, agricultural tools etc	5.00	0.00	0.00	0.00	0.00	**5.00**
Sub Total	20.20	19.72	20.73	14.73	13.73	**89.11**
Institutional Charges (15 %)	3.03	2.96	3.11	2.21	2.06	**13.37**
Total	**23.23**	**22.68**	**23.84**	**16.94**	**15.79**	**102.48**

TFRI, Jabalpur

Head of Expenditure	1st Year	2nd Year	3rd Year	4th Year	5th Year	Total
1 Project Assistant @ Rs. 18,000 per month	2.16	2.16	2.16	2.16	2.16	**10.80**
Consumables	1.00	1.00	1.00	1.00	1.00	**5.00**
Travel	3.00	3.00	2.00	1.00	1.00	**10.00**
Contingencies	2.00	2.00	1.50	1.00	1.00	**7.50**
Non-Recurring Equipment & Accessories Workstations, agricultural tools etc	3.00	0.00	0.00	0.00	0.00	**3.00**
Sub Total	11.16	8.16	6.66	5.16	5.16	**36.30**
Institutional Charges (15 %)	1.67	1.22	1.00	0.77	0.77	**5.45**
Total	**12.83**	**9.38**	**7.66**	**5.93**	**5.93**	**41.75**

IFGTB, Coimbatore

Head of Expenditure	1st Year	2nd Year	3rd Year	4th Year	5th Year	Total
Recurring: Fellowship JRF (First two years Rs 31,000/ month + HRA, from 3rd Year Rs. 35,000/month + HRA):1 No	4.31	4.31	4.87	4.87	4.87	**23.23**
*PA (Rs. 18,000/Month):1 PAs	2.16	2.16	2.16	2.16	2.16	**10.80**
Consumables	2.00	2.00	1.00	1.00	1.00	**7.00**
Travel	3.00	3.00	3.00	1.00	1.00	**11.00**
Contingencies & Forest Research Expenses (FRE)	2.00	2.00	2.00	2.00	1.00	**9.00**
Non-Recurring Equipment & Accessories Workstations, agricultural tools etc	2.00	0.00	0.00	0.00	0.00	**2.00**
Sub Total	15.47	13.47	13.03	11.03	10.03	**63.03**
Institutional Charges (15 %)	2.32	2.02	1.95	1.65	1.50	**9.45**
Total	**17.79**	**15.49**	**14.98**	**12.68**	**11.53**	**72.48**

Component: C: Utilization of Lantana for improving the livelihood of people

IPIRTI, Bengaluru

Head of Expenditure	**1st Year**	**2nd Year**	**3rd Year**	**Total**
Manpower	6.64	6.64	6.64	**19.92**
PA s	0.00	0.00	0.00	**0.00**
Consumables	5.00	5.00	3.00	**13.00**
Travel	1.00	2.00	1.50	**4.50**
Contingency* & FRE **& Technology promotion &Extension***	9.00	8.50	20.50	**38.00**
Non - Recurring Permanent Equipment #	45.00	20.00	0.00	**65.00**
Institutional Charges 20%	13.33	8.43	6.33	**28.08**
Total	**79.97**	**50.57**	**37.97**	**168.50**

(*including unskilled/semiskilled labour, plant running cost, maintenance, product demonstration, etc.; **FRE (Field Research Expenses) including field work, outsourced work, Fabrication charges (but not the fabricated equipment) & Testing charges etc; # Hydraulic Press (1 ft × 1 ft), Pan Mixer, Vibrating Table, Isothermal *calorimeter and other need equipment's*. *** including conferences, workshop, patent applications, development of movies, website & other promotion activities)

IWST, Bengaluru

Head of Expenditure	**1st Year**	**2nd Year**	**3rd Year**	**Total**
Recurring Manpower	4.00	4.00	4.00	**12.00**
Project Assistants	0.00	0.00	0.00	**0.00**
Consumables	0.50	0.00	0.50	**1.00**
Travel	1.00	2.00	2.00	**5.00**
Contingency* & FRE	4.00	4.00	4.00	**12.00**
Institutional Charges 20%	1.90	2.00	2.10	**6.00**
Total	**11.40**	**12.00**	**12.60**	**36.00**

(*, including unskilled/semiskilled labour, plant running cost, maintenance, product demonstration, etc.;)

IFGTB, Coimbatore

Head of Expenditure	**1st Year**	**2nd Year**	**3rd Year**	**Total**
*Recurring "Fellowships: Manpower: JPF (01)	5.20	5.20	5.62	**16.02**
Project Assistants	0.00	0.00	0.00	**0.00**
Consumables	1.50	1.50	1.00	**4.00**
Travel	1.50	2.00	2.00	**5.50**
Contingency	1.50	1.50	1.00	**4.00**
Non - Recurring Permanent Equipment	0.00	0.00	0.00	**0.00**
Institutional Charges 20%	1.94	2.04	1.92	**5.90**
Total	**11.64**	**12.24**	**11.54**	**35.42**

(*, including JPF and skilled assistant. etc.)

FRI, Dehradun

Head of Expenditure	1st Year	2nd Year	3rd Year	Total
Recurring :Manpower*	0.00	0.00	0.00	**0.00**
Project Assistants	0.00	0.00	0.00	**0.00**
Consumables	1.50	1.50	1.50	**4.50**
Training cost** for 8-10 no. of trainees in each training	7.20	9.60	9.60	**26.40**
Contingency *	3.00	3.00	3.00	**9.00**
Non - Recurring : Permanent Equipment #	5.00	0.00	0.00	**5.00**
Institutional Charges 20%	3.34	2.82	2.82	**8.98**
Total	**20.04**	**16.92**	**16.92**	**53.88**

(**including Boarding, lodging, food charges, travel etc.; *including skilled labour, honorarium costs of resource person, maintenance, etc.; #Sheet Press, Calendaring Machine, Digester.

CSIR-IIP, Dehradun

Head of Expenditure	1st Year	2nd Year	3rd Year	Total
Project Assistants (2 Nos)	8.00	8.00	8.00	**24.00**
Consumables	10.00	10.00	5.00	**25.00**
Travel	3.00	3.00	2.00	**8.00**
Contingency	4.00	3.00	3.00	**10.00**
Non - Recurring : Permanent Equipment #	100.00	20.00	0.00	**120.00**
Institutional Charges 10%	12.50	4.40	1.80	**18.70**
Total	**137.50**	**48.40**	**19.80**	**205.70**

The mobile pyrolysis unit and the pelletiser unit will be on the field and not retained by CSIR-IIP. Hence, it will help the self-help groups or the farmers/local govt, who will be benefitted by this process.

IIFM, Bhopal

Head of Expenditure	1st Year	2nd Year	3rd Year	Total
Recurring :Manpower* SRA-2 Monthly 60000, 3rd year (6 months)	14.40	14.40	7.20	**36.00**
Field enumerators for data collection (2 people for approx. 2 months in each site @ Rs. 25000/month)	2.00	2.00	1.00	**5.00**
Consumables	3.70	3.70	10.20	**17.60**
Travel	10.00	10.00	5.00	**25.00**
Contingency	1.00	1.00	1.00	**3.00**
Non - Recurring : Permanent Equipment Laptop, Digital camera, Hard drive, Website & social media for the knowledge hub	3.80	0.00	0.00	**3.80**
Institutional Charges 10%	3.11	3.11	2.44	**8.66**
Total	**38.01**	**34.21**	**26.84**	**99.06**

13. Details of Research team

Project Investigator and Project Co-Investigators:

National Project Coordinator: Dr. A. Rajasekaran, Scientist –'F', IFGTB, Coimbatore

Component A: Spatial Mapping - Coordinator: Dr. A. Rajasekaran, Scientist –'F', IFGTB, Coimbatore

S.No	Name of the Institute	Name/ address of Project Investigators	Name/ address of Project Co-Investigators
1.	IFGTB, Coimbatore	Dr. A. Rajasekaran, Scientist –'F' FECC Division, Email: rajasekarana@icfre.org; a.rajsekaran@gmail.com Contact : 0422-2484155, 9489402805	Mr Mohamad Ali Noushad Scientist – B, FECC Division, Email: m_ali@icfre.org
2.	AFRI Jodhpur	Dr. Sachin Sharma, Scientist-B FE & CC Division, AFRI, Jodhpur Email: ssharma@icfre.org	Smt. Seema Kumar, Scientist E & HOD S & FM Division, Email: seemakumar@icfre.org Sh. B. V. Jayant, CTO, S & FM Division Email : bvjayant@icfre.org
3.	HFRI, Shimla	Dr. Ranjeet Kumar Scientist-'E Email:ranjeet@icfre.org	Dr Vaneet Jishtu Scientist-E Email: jishtuv@icfre.org
4.	IFP, Ranchi	Dr. Sharad Tiwari,Scientist - 'F' Email : tiwaris@icfre.org sharadtiwari8@gmail.com Contact : +91-651-2526142, 9431766404	Dr. S.N. Mishra Email : mishrasn@icfre.org shambhu5365@gmail.com
5.	IFB, Hyderabad	Smt. Asha Kumari CTO Email: rashakumari@icfre.org	Smt. Bharti Patel Email; bpatel@icfre.org
6.	RFRI, Jorhat	Dr. Dhruba J. Das, Scientist E Email : dasdj@icfre.org Contact : 0376-2305119, 9435742252	Mr. Dinesh Kumar Meena, Scientist C Email : meenad@icfre.org Mr. Ajoy Debbarma, Scientist C Email : ajoybarma@icfre.org
7.	TFRI, Jabalpur	Dr. S. Saravanan, Scientist-F TFRI, Jabalpur	Dr. S. C. Biswas, Scientist-D Email : scbiswas@icfre.org

		Email Id : sarvanans@icfre.org Contact : 0761-2840627	
8.	Wildlife Institute of India, Dehradun	Dr. Amit Kumar, Scientist-C Dept. of Protected Area Network, Wildlife Management and Conservation Education, Wildlife Institute of India Dehradun 248002 Uttarakhand, India Email: amit@wii.gov.in Contact: 9012701362	Dr. Gautam Talukdar, Scientist-E Dept. of Protected Area Network, Wildlife Management and Conservation Education, Wildlife Institute of India Dehradun 248002 Uttarakhand, Email: gautam@wii.gov.in Contact: 9456178697 Dr. Navendu Page, Scientist-C Dept. of Habitat Ecology Wildlife Institute of India, Dehradun 248002 Uttarakhand, India Email: navendu@wii.gov.in Contact: 9611053510
9.	NRSC	Dr Sudhakara Reddy Head, Forest Biodiversity & Ecology Division National Remote Sensing Centre Balanagar, Hyderabad -. 500 625 Andhra Pradesh, India Telephone:040-23884219(O);27954732 (R) E-mail: drsudhakarreddy@gmail.com	G. Rajashekar Forestry and Ecology Group, Email : grajashekar@gmail.com

Component B: Eradication and Restoration - Coordinator: Dr. A. Rajasekaran, Scientist –'F', IFGTB, Coimbatore

S.No.	Name of the Institute	Name/ address of Project Investigators	Name/ address of Project Co-Investigators
1.	AFRI Jodhpur	Smt. Seema Kumar,Scientist E & HOD S & FM Division, (AICRP-7) Email : seemakumar@icfre.org Contact : 291-2729195	Dr. Sachin Sharma, Scientist-B, FE & CC Division, Email : ssharma@icfre.org Shri B. V. Jayant, CTO, S & FM Division AFRI,Jodhpur (AICRP-7) Email : bvjayant@icfre.org

2.	HFRI, Shimla	Dr. Ranjeet Kumar,Scientist-E Himalayan Forest Research Institute Shimla-171013 Email : ranjeet@icfre.org Contact : 0177- 2816109, 8988378338	Dr. Pawan Rana,Scientist-E Himalayan Forest Research Institute Shimla-171013 Email: kumarp@icfre.org
3.	IFP, Ranchi	Dr. Yogeswar Mishra, Head,Silviculture Email " mishray@icfre.org Contact : +91-651-2526148 (O) 7909065526 (M) Sanjeev Kumar, Head, Ecology Email : bhatiask@icfr.org	Dr Anshuman Das, Scientist B Email : das_a@icfr.org Shri Ravishankar, CTO
4.	IFB, Hyderabad	Smt. Asha Kumari CTO Email: rashakumari@icfre.org	Smt. Bharti Patel Email; bpatel@icfre.org
5.	RFRI, Jorhat	Dr. Dhruba J. Das, Scientist E Email : dasdj@icfre.org Contact : 0376-2305119, 9435742252	Dr. R.K.Borah, Scientist G Email : borahb@icfre.org Mr. Sandip Yadav, Scientist C Email : yadavs@icfre.org
6.	TFRI, Jabalpur	Dr. S. Saravanan, Scientist-F TFRI, Jabalpur Email : sarvanans@icfre.org Contact : 0761-2840627	Dr. S. C. Biswas, Scientist-D TFRI, Jabalpur Email : scbiswas@icfre.org
7.	IFGTB, Coimbatore	Dr. A. Rajasekaran, Scientist –'F' FECC Division, IFGTB, Coimbatore Email:rajasekarana@icfre.org Contact : 0422-2484155, 9489402805	

Component B: Utilization - Coordinator: Dr. Shakti Singh Chauhan, Director, IPIRTI,

S.No.	Name of the Institute	Name/ address of Project Investigators	Name/ address of Project Co-Investigators
1.	IFGTB, Coimbatore	Dr. N. Senthil Kumar, Scientist –'F' & Head, Chemistry and Bioprospecting Division, IFGTB, Coimbatore Email: senthilnk@icfre.org	
2.	IPIRTI, Bengaluru	Shri Thanigai K, Scientist Email : kthanigai@ipirti.gov.in	Shri Ramkumar V R, Scientist, PASD & Extension Email : vrramkumar@ipirti.gov.in Dr Manish Ranjan, Scientist CBD Email : manishr@ipirti.gov.in Ms. Sujatha, Scientist HoD, Chemistry (Adhesive Technology) Email : dsujatha@ipirti.gov.in Mr. Prakash V., Scientist PDES Email : prakashv@ipirti.gov.in Mr. Kiran M.C., Scientist CENTEC Email : kiranmc@ipirti.gov.in IPIRTI, Bengaluru
3.	IWST, Bengaluru	Mr. Ritesh D Ram, Scientist 'E' Email : ritesh@icfre.org, riteshdavid@gmail.com Contact : 080-22190178, 91-9449056230	Dr. Ritesh Tailor Email id: rtailor@icfre.org Contact : 080- 22190199
4.	FRI, Dehradun	Sh. D.P. Khali (PI – Reconstituted wood) Email id : khalidp@icfre.org Dr. Vikas Rana (PI-Handmade paper)	Sh. Raj Kishore Email id : kraj@icfre.org

		Email : ranav@icfre.org	
5.	IIFM, Bhopal	Dr. Manmohan Yadav Professor & Dean Marketing management Email : manmohan@iifm.ac.in Contact : +91-755-2775335	Dr. Sandeep Tambe Technical forestry Email : stambe@iifm.ac.in Contact : +91-755-2775463 Dr. Ashutosh Verma Financial management Email : ashutosh@iifm.ac.in Contact : +91-755-2775370 Dr. Jayashree Dubey Marketing management Email : jayashree@iifm.ac.in Contact : +91-755-2775452 Dr. Dhanya Bhaskar Ecosystem and environment management Email : dhanyab@iifm.ac.in Contact : +91-755-2775443
6.	CSIR-Indian Institute of Petroleum, Dehradun	Dr. Thallada Bhaskar, HoD Material Resource Efficiency Division, Email :tbhaskar@iip.res.in Contact : 0135-2525820	Dr. Bhavya B Krishna bhavya@iip.res.in, Contact : 0135-2525820 Dr.Y Sudhakar Reddy Email: ysreddy@iip.res.in, Contact : 0135-2525824 Mr. Jitendra Kumar Email: jeetu@iip.res.in, Contact : 0135-2525824

The Project monitoring Team:

- Sh. Sanjay Kumar, IFS
  Director General of Forest & Special Secretary
  Ministry of Environment, Forest and Climate Change
  Indira Paryavaran Bhawan
  Jorbagh Road New Delhi – 110 003
  INDIA.
  Email: dgfindia@nic.in

- Sh.A.S. Rawat, IFS
  Director General
  Indian Council of Forestry Research & Education,
  P.O. New Forest,
  Dehra Dun - 248 006.
  Email: dg@icfre.org

- Sh. SD Sharma, IFS
  Deputy Director General
  Indian Council of Forestry Research & Education,
  P.O. New Forest,
  Dehra Dun - 248 006.
  Email: ddg_res@icfre.org

- Mr.Suneesh Buxy, IFS
  Inspector General of Forest
  Ministry of Environment, Forest and Climate Change
  Indira Paryavaran Bhawan
  Jorbagh Road New Delhi – 110 003
  INDIA.
  Email: suneesh.buxy@gov.in

- Dr C.R. Babu
  Professor Emeritus
  Director of the Centre for Environmental Management of Degraded Ecosystems (CEMDE),
  Department of Environmental Studies,
  University of Delhi
  E-mail: crb26@hotmail.com, crbabu26@gmail.com,
  Phone: 9810586709

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Proposal on Centre of Excellence at ICFRE

Brief on Centre of Excellence

This is regarding the proposal of setting -up of a Centre of Excellence on Sustainable Land Management and South-South Cooperation at Indian Council of Forestry Research and Education, Dehradun.

2. As per the Desertification and Land Degradation Atlas of India, 2016, the current extent of land degradation is estimated to be 96.4 million hectares covering 29.3% of the geographic area of the India. Ministry of Environment, Forest and Climate Change, Government of India has planned to support an initiative to enhance South-South Cooperation by developing a Centre of Excellence at Indian Council of Forestry Research and Education (ICFRE) in order to develop scientific approach, facilitate induction of technology and knowledge sharing for addressing land degradation issues.

3. The proposed Centre of Excellence is being setup at ICFRE, Dehradun keeping in view the expertise and experiences of the Council in implementing national programme and project on sustainable land management.

4. In this context, it may be mentioned here that the objectives and coverage of the Centre of Excellence on Sustainable Land Management and South-South Cooperation will not overlap with projects/ schemes being implemented by the same or another agency.

5. Department of Expenditure, Ministry of Finance has also given in-principle approval in this regard with the following conditions:

i) The announcement does not envisage formation of a new body;

(ii) Any costs for the body shall be met by offsetting savings in the budget of the Ministry. No additional funds will be provided.

Background /Context:

The Hon'ble Prime Minister of India on 9th September 2019, while addressing the High-Level Segment of Fourteenth Conference of Parties (COP 14) to United Nations Convention to Combat Desertification (UNCCD) held in Delhi made an announcement to set up a Centre of Excellence at Indian Council of Forestry Research and Education (ICFRE) in order to further develop scientific approach and facilitate induction of technology on land degradation issues. The main role of the Centre would be to share knowledge and technology amongst developing countries Parties of UNCCD to arrest further land degradation and restoration of degraded lands.

Objectives

The Centre of Excellence shall provide technical support to National and the sub- national (state) level in India and other developing country parties of UNCCD under south-south cooperation for sustainable land management and achieving land degradation neutrality target by 2030.

1. Providing technical support to Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India in achieving the LDN targets.
2. Facilitating MoEF&CC in implementation and monitoring of transformative pilot projects.
3. Providing training to stakeholders for targeting their ongoing interventions in degraded land and uploading related information in online Tracking Mechanism.
4. Networking of national and international institutions working on sustainable land and ecosystem management for knowledge sharing and exchange
5. Providing technical support to country parties in interpretation of land degradation processes classification system and detailed land degradation mapping from satellite images with the help of National Remote Sensing Centre, Space Application Centre, Indian Institute of Remote Sensing, Forest Survey of India and National Bureau of Soil Survey and Land Using Planning etc.
6. Facilitating MoEF&CC in periodic reporting to UNCCD Secretariat through UNCCD PRAIS portal.
7. Development and standardization of protocols for monitoring of land productivity and carbon stocks.
8. Research and mapping/ documentation of ongoing SLM schemes and programmes related to sustainable land management
9. Research on Gender mainstreaming in implementation of sustainable land and ecosystem management programmes/ projects/ schemes for achieving LDN targets
10. Developing Knowledge dissemination hub related to sustainable land management
11. Technical support in working out of financial solutions for implementation of sustainable land and ecosystem management programmes/ projects/ schemes of for achieving LDN
12. Academic programmes including online courses related to sustainable land management
13. Provide technical support to the Ministry of Environment, Forest and Climate Change, Government of India in implementation of Convention (UNCCD)

14. Monitoring of the LDN targets achievements through interactive portal development.
15. Shall contribute to transfer technology in achieving LDN targets and land restoration under South-South cooperation

Indicative Outcome:

I. Formulation of Policies, Strategies and Sustainable Land Management (SLM) Frameworks in relation to Sustainable Development Goals (SDGs), land tenure management and related land rights issues.

II. Monitoring and assessment of land based indicators identified by United Nations Convention to Combat Desertification (UNCCD) and associate reporting to UNCCD through the online Performance Review Assessment of the Implementation System (PRAIS) portal.

III.

IV. Assessment of land degradation status, land degradation neutrality (LDN) targets, drought risk and early warning systems, sand and dust storms, land degradation induce force migration and displacement and gender mainstreaming, good governance of land tenure and land rights.

V. Publication of articles, journals, research papers and books related to sustainable land management.

VI. Availability of information related to best practices on indigenous knowledge for combating desertification, restoring degraded land, mitigating drought, soil and water conservation, carbon sequestration, livelihood improvement, gender empowerment, poverty eradication etc.

VII. Certificate, diploma, degree, doctoral and post-doctoral courses. In subjects related to sustainable land management through

VIII. Collaborate with international agencies for effective knowledge exchange related to assessment of land degradation status, LDN targets, SLM practices, drought risk and early warning system, sand and dust storms, land degradation induce force migration and displacement, gender mainstreaming, good governance of land tenure and land rights, land induced climate change and bio-diversity loss.

IX. Dissemination training and knowledge to international stakeholders on above issues in line with understanding and achievement of SDGs.

X. Availability of compiled information on best practices of sustainable land and ecosystem management worldwide and dissemination to the international stakeholders.

Target Beneficiaries:

The Centre of Excellence on Sustainable Land Management and South-South Cooperation shall have national mandate; however, it will provide necessary technical and capacity building supports to the developing countries Parties of UNCCD on land degradation issues under South-South Cooperation.

Manpower Requirement:

S. No.	Profile/ Division	Senior Consultant	Junior Consultant (A)	Junior Consultant (B)	Total number of positions
Functional Divisions					
1	Land Resources Division	01	01	02	04
2	Climate Change Division	01	01	01	03
3	Biodiversity Division	01	01	01	03
4	IT and Knowledge Management Division GIS & RS Services Division	01	02	-	03
5	International Cooperation Division	01		01	02
6	Communication and Outreach Division		01	01	02
Support Services					
7	Administration & Procurement, Stores & Infrastructure		01	02	03
8	Accounts			02	02
					22

All the Functional Divisions will be headed by the regular staff (either on position or to be engaged on deputation from its sanctioned strength) of ICFRE

Senior Consultant: Contractual engagement @Rs.80,000/- per month (consolidated) with 0% to 8% increase in every year based on the performance.

Junior Consultant (A): Contractual engagement @Rs.60,000/- per month (consolidated) with 0% to 8% increase in every year based on the performance.

Junior Consultant (B): Contractual engagement @Rs.40,000/- per month (consolidated) with 0% to 8% increase in every year based on the performance.

Budget requirement:

Year wise cost estimates along with a break-up of non-recurring and recurring expenses for Phase I of Setting up of Centre of Excellence on Sustainable Land Management and South-South Cooperation and its operationalization are as under:

S. No.	Particulars	Budget Requirements for Phase I (Rs. in Crore)					
Recurring Expenses		Year 1	Year 2	Year 3	Year 4	Year 5	Total
1	Hiring of individual consultants and salary etc.	1.5	1.6	1.75	1.85	2.00	8.70
2	Capacity building programmes including workshops/seminar /training	0.2	0.44	0.48	0.48	0.48	2.08
Total Recurring Expenses		1.7	2.04	2.23	2.33	2.48	10.78
Non-Recurring Expenses		Year1	Year2	Year 3	Year 4	Year 5	Total
Refurbishing of existing building Total area 10,000 (Sq.Ft) Costs @ 2500/Sq.ft		2.50	-	-	-	-	2.50
Laboratory Total area 20,000 (Sq.Ft) Costs @3500/Sq.ft plus Electrical and furniture cost @1150/sq.ft		-	3.00	4.00	2.30	-	9.30
Training facilities Total area 30,000 (Sq.Ft) Costs @ 3500/sq.f plus Electrical and furniture cost @1150/sq.ft		-	5.00	5.00	3.95	-	13.95
Equipment for laboratory and its consumables, spares and other related issues including maintenance; Computers, laptops, Plotters etc and Books for Library including digital library		10.91	-	5.00	4.00	-	19.91
IT infrastructure including Networking set up, productivity Software and other soft wares		1.00	5.00	3.00	-	-	9.00
Roof top solar system Total area 17,000 (Sq.Ft) 1KV required/100Sq.ft @80,000/-		-	-	-	1.00	-	1.00
Total for Non-Recurring		14.41	13.00	17.00	11.25	-	55.66
Total		16.11	15.04	19.23	13.58	2.48	66.44

Justifications:

Recurring Expenditure:

- It includes hiring of manpower. It will be done on contractual basis and the remuneration has been taken as per the Ministry's guidelines. These contractual employees will be working under the regular staff of ICFRE in every department.
- Capacity Building, being its one of the core mandate, the Centre of Excellence is required to be supported in the 1st phase for a period of 5 years and thereafter it will be self-sustainable.

Non-recurring Expenditure:

- To begin with the renovation of Building as well as well as Classroom is required. Keeping in view the international standard in mind Hostel accommodation for the international students, faculties etc. needs to be refurbished.
- The Centre of Excellence should have a state of the art laboratory infrastructure having all the laboratory equipment of the relevant field and the Laboratory should also have a demonstrative area having world class facilities. The office as well as classrooms are required to be housed with proper furniture and overall infrastructure are required to be developed.
- Lab equipment and Office equipment is required for practical training and research.
- IT infrastructure is required keeping in view to enhance the capability of training rooms and other allied works including the requirement of hardware and software and development of a state of the art knowledge system.

	Budget Requirements for Phase I (Rs. in Crore)					
	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Recurring Expenses	1.7	2.04	2.23	2.33	2.48	10.78
Non-Recurring Expenses	14.41	13.00	17.00	11.25	-	55.66
Total	16.11	15.04	19.23	13.58	2.48	66.44

Government of Goa
Office of Principal Chief Conservator of Forests
Forest Department
Goa Van Bhawan, Old IPHB Complex;
Altinho, Panaji Goa – 403 001

No.2-76-WL-2021-22-Vol.I-FD/2107 Date: 12/08/2021

To,
Chief Executive Officer
National Authority, CAMPA
New Delhi- 110003

Sub:- Invitation of proposals from States/UTs with regard to facilitating scientific, technological and other assistance as required by State Authorities-reg.

Ref:- MoEF&CC's letter No. 13-28/2018-CAMPA dated 23rd July, 2021

Sir,

Please find enclosed the project proposal for *Study of the short- and long-term impact of Climate Change on Biodiversity of Protected Area in Goa by setting up of Automatic Weather Stations.* Total financial outlay of the project is Rs. 65,000,00/- (Rupees Sixty-Five Lakhs Only). The proposal is submitted for kind consideration/ approval.

Yours faithfully

Santosh Kumar, IFS
Principal Chief Conservator of Forests
& CEO, State CAMPA

Encl. Project proposal

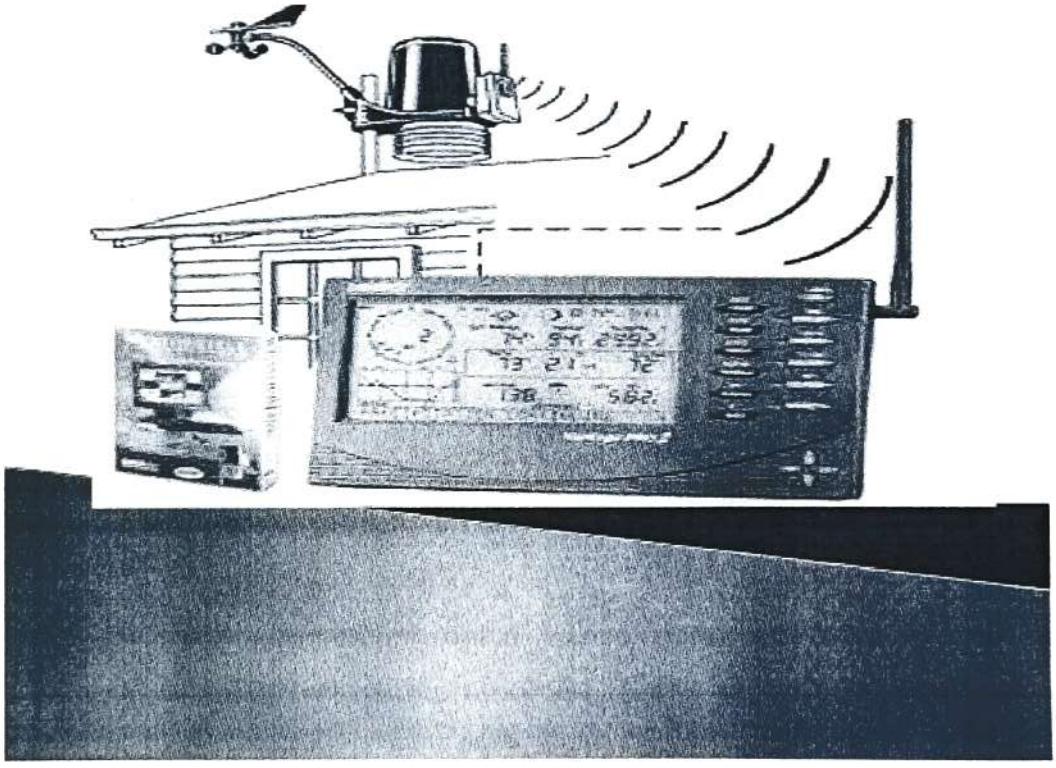
GOVERNMENT OF GOA

FOREST DEPARTMENT

VAN BHAWAN – ALTINHO – PANAJI – GOA

PROJECT PROPOSAL

Study of the Short & Long Term Impact of Weather/Climate Change on Biodiversity of Protected Area in Goa by setting up of Automatic Weather Stations



AUGUST 2021

1. Title of the project:

Study of the short and long term impact of weather and climate change on Biodiversity of Protected Area in Goa by setting up of Automatic Weather Stations.

2. Introduction:

i. Goa is located on the west coast of India between 15° 48' and 14 ° 53' North latitude and 74° 20' and 73° 40' East longitude with a geographical area of 3702 sq. km.

ii. As per the State of the Forest Report published by the Forest Survey of India, the forest cover of Goa is 2,219 sq. km. Which is 60.04% of the State's geographical area.

3. Forest and wildlife of Goa:

i. The forests of Goa are typical of the Western Ghats (Southern Maharashtra and Karnataka).

ii. There is diversity in the forests due to the variation in altitude, aspect, soil characters, slope etc. As per Champion and Seth (1968) Classification of Forest types of India, the forests of Goa fall in the following types:-

(a) Estuarine vegetation consisting of mangrove species along narrow muddy banks of rivers [4 B/TS1 and 4B/TS2]

(b) Strand vegetation along the coastal belts

(c) Plateau vegetation confined especially to the low altitude

   a. Open scrub jungle (5.E7)
   b. Moist mixed deciduous forests [3B/C2]
   c. Secondary moist mixed deciduous forests [3B/C2/2SI)
   d. Sub-tropical Hill forests [8A/C2]

(d) Semi-evergreen and evergreen forest.

   a. Semi-evergreen forests [2A/C2]
   b. Lateritic Semi-evergreen forests [2 E4]
   c. Evergreen forests [1A/C4]

iii. Goa presents a diversity of endemic species, habitats and ecosystems.

iv. Goa is under the influence of two global biomes – the marine biome of the Arabian sea and the terrestrial forest biome of the Western Ghats. Within this geographical canvas are a wide range of ecosystems and habitats e.g. forests, ghats, alluvial plains, coasts, rivers, estuaries, mangroves, wetlands etc.

v. The ecophysiology of the habitats is governed by complex ecological and metereological conditions. There are normal habitats and extreme habitats (like the rock pools and the salt pans).

vi. There are microhabitats which are equally important – e.g. the termite mounds which play a significant role in the decomposition of plant litter. The status of biodiversity in each of these habitats varies, depending naturally on a variety of genetic and environmental factors. Each habitat faces its own peculiar mix of pressures on its biodiversity.

vii. The typical flora and fauna of the State is attached at Appendix I.

4. Protected Area Network of Goa

i. With 20% of its total geographical area dedicated for the proliferation of wildlife, the state of Goa has 6 Wildlife Sanctuaries and 1 National Park. These protected areas are provided with complete protection to the fauna & flora to conserve the unique biodiversity of the State.

ii. These are :

Name of the protected area	**Area**	**Location**
Bhagwan Mahavir National Park	107	Sanguem, Dharbandora
Cotigao Wildlife Sanctuary	86	Canacona
Bondla Wildlife Sanctuary	8	Ponda, Sattari, Dharbandora
Dr. Salim Ali Bird Sanctuary	1.8	Tiswadi
Madei Wildlife Sanctuary	208.48	Sattari
Netravali Wildlife Sanctuary	211.05	Sanguem
Total	755.31	

5. Stakeholders:

i. The stakeholders of this project/ work will be Forest Department, India Meteorological Department, Goa University, Researchers from various Institutions and others.

6. Objective of the project:

i. To ensure real time mapping and monitoring of various weather parameters including temperature, humidity, wind speed, rainfall, etc. through Automatic Weather Station, Rain Gauges for scientific management of Forest and Wildlife areas in Goa.

ii. To ascertain impact of climate change on biodiversity of forests in Goa.

7. Benefits:

i. Forest Department will get real time weather data which will be used for scientific management of forest and wildlife areas and to ascertain and study impact of climate change on Biodiversity.

ii. The study will enable the department to have a clear idea of the water deficient areas in the forests and will provide invaluable data for resolving the problem like availability of water throughout the year for wildlife/ soil and moisture conservation.

iii. Real-time weather data may be input to expert systems, management models or simple applications to support the decisions for scientific management of forest and wildlife areas.

iv. Weather/ Climate data collected over a long period may be used to assess probability and risk of extreme events and to compute statistics of the relevant weather events.

v. In many cases, weather data collected for specialized studies which may provide information related to pest management, and fire danger rating systems etc.

vi. Short and long term data may be shared with specialized Institutions/ Organisations for specific studies.

8. Components of the project:

The following are the requirements and standards for Automatic Weather Station and all the stations will be operating in remote forest regions of Goa.

1. Telecommunications. GSM/GPRS networks will be used wherever they are available whereas satellite communications (such as IRIDIUM or ORBCOMM) may be used where GSM/GPRS networks are unavailable.
2. Power. Solar panels with backup batteries are a useful power source for AWS at remote areas.
3. AWS equipment. The cost of the data loggers and communication devices which can work over in extreme environments e.g., temperature and prolonged time with high humidity values.
4. AWS enclosure. These enclosures are small rooms made of suitable material like laterite stone or properly shielded pre-cast cabins so that inside temperature does not increase considerably, causing malfunction to the electronic equipment or batteries. High rainfall rates can cause water infiltration, so the connector and core hitches exposure to the environment must be minimal.
5. Earthing. AWS equipment is often damaged by lightning strikes. Appropriate conventional or maintenance-free earthing, could be very effective in the long run.
6. Calibration of sensors and maintenance of stations. Though AWS are generally unmanned by design, regular visits to a site are required to check its security, exposure conditions and for performing preventive maintenance. The costs of maintenance, calibration and running expenses for an operating AWS network far outweigh the initial purchase expense, so these expenses are kept in mind before finalising the site and installation of an AWS network. Calibration of sensors would be performed at least once or twice per year.
7. Safety. In remote regions, security of AWS equipment has become a major concern. It is quite common that there are many thefts of solar panels and batteries from the AWS sites. Hence watch and ward are required to be employed.

9. Working Area:

i. The weather station will be located at five locations in forest areas. The following are the ranges that are proposed for the stations:

	Name of the Protected Area	GPS Location of station
1	Bhagwan Mahaveer Wildlife Sanctuary & National Park	15° 22' 39.2" N 74° 13" 48.4" E
2	Bondla Wildlife Sanctuary	15° 26' 20.6" N 74° 06" 09.6" E
3	Cotigao Wildlife Sanctuary	14° 12' 57.89" N 74° 13" 54.94" E
4	Mhadei Wildlife Sanctuary	15° 35' 13.9" N 74° 11" 23.9" E
5	Netravali Wildlife Sanctuary	14° 58' 39" N 74° 07" 59" E

ii. The working areas selected for the station are open areas where there are no obstacles for accurate readings of weather conditions.

10. Financial implications:

i. The project will be implemented by the Goa Forest Department.

ii. The following are the financial requirements for the Automatic Weather Station project:

Sr. No.	Particulars	Quantity	Amount (in Rs. Lakh)
1	Telecommunications		
	GSM/ GPRS network establishment expenses	5	1.00
2	Power		
	Solar panels and storage battery	5	5.00
3	AWS equipment		
	Data loggers & devices	5	40.00
4	AWS enclosure		
	Construction of cabin	5	10.00
5	Earthing		
	Lightning arresters	5	5.00
6	Calibration of sensors		
	Computers for data collection	5	2.00
7	Safety		
	Fencing, fire equipment etc	5	2.00
	Total		**65.00**

Appendix I

List of important flora of Goa

Sl. No.	Scientific Name	Local/ Vernacular Name
1.	*Acacia catechu*	Khair
2.	*Adina cordifolia*	Hedu
3.	*Agele marmelos*	Bel.
5.	*Albizia lebbak*	Shiras
6.	*Albizzia odoratissima*	Kaloshiras
7.	*Alstonia scholaris*	Satvan
4.	*Amoora lawii*	Burumbi
8.	*Anacardium occidentale*	Kaju.
9.	*Anogeissus latifolia*	Dhaoda
10.	*Aporusa lindleyana*	Salai
11.	*Artocarpus integrifolia*	Phanas
12.	*Artocarpus lakoocha*	Otamb
13.	*Azadirachta indica*	Nimb
14.	*Barringtonia acutangula*	Men kumbyo
15.	*Bauhinia racemosa*	Apto.
16.	*Bauhinia wahilli*	Mavli
17.	*Bombax ceiba*	Savar
18.	*Bridelia retusa*	Khatem Asan.
19.	*Buchnania lanzan*	Chara
20.	*Butea monospermum*	Palas.
21.	*Callicarpa tomentosa*	Phalyo.
22.	*Callophylum inophyllum*	Undi.
23.	*Calycopteris floribunda*	Uski.
24.	*Carallia brachiata*	Panshi, Makad bhiran,
25.	*Careya arborea*	Kumbyo
26.	*Caryota urens*	Birlo mad
27.	*Cassia fistula*	Bayo, Balo.
28.	*Ceiba pentandra*	Savar
29.	*Cinnamomum zeylanicum*	Tikhi
30.	*Corypha umbraculifera*	Karetel
31.	*Dalbergia latifolia*	Shisham
32.	*Derris scandens*	Kanranj
33.	*Dillenia pentagyna*	Karmal.
34.	*Diospyros Montana*	Goiunda, Govimelu.
35.	*Diospyros paniculata*	Kuri.
36.	*Embelica officinalis*	Amla, Awalo
37.	*Erythrina indica*	Pongaro.
38.	*Ficus arnotianna*	Asti payr
39.	*Ficus asperrima*	Kharvat
40.	*Ficus bengalensis*	Vad
41.	*Ficus glomerata*	Rumad
42.	*Ficus Hispida*	Kalaumbar
43.	*Ficus religiosa*	Pipal.
44.	*Ficus tsiela*	Basri.
45.	*Flacourtia jangomonas*	Jangli Jagam.
46.	*Flacourtia montanna*	Chafra
47.	*Garcinia gummigutta*	Dhar ambo.
48.	*Garcinia indica*	Bhiran
49.	*Gmelina arborea*	Shivan
50.	*Grewia tillifolia*	Dhaman
51.	*Helicters isora*	Kivan
52.	*Holarrhena antidysentrica*	Kudo
53.	*Holigarnia arnottiana*	Bibo
54	*Holoptelia integrifolia*	Vamolo
55.	*Hopea wightiana*	Pav.
56.	*Hydnocarpus laurifolia*	Khast, Kavat.
57.	*Lagerstroemia lanceolata*	Nano
58.	*Lagerstroemia parviflora*	Taman
59.	*Lannea coromandalica*	Moi

60.	*Leea indica*	Jino
61.	*Luta graveolens*	Arod
62.	*Macaranga peltata*	Chandado.
63.	*Mallotus phillipinensis*	Bems, Sendri.
64.	*Mangifera indica*	Ambo
65.	*Manilkara hexandra*	Kirni
66.	*Melia azedarach*	Firnage nimb.
67.	*Mesua ferrea*	Nagchampho.
68.	*Mimusops elengi*	Onval

List of important fauna of Goa

Sr. No.	Zoological Name	English Name	Local Name
1	*Axis axis*	Spotted deer	Cheetal
2	*Bandicota indica*	Bandicoot rat	Kolindar
3	*Bos gaurus*	Gaur or Indian bison	Gavvo redo, Gavvo
4	*Canis aureaus*	Jackal	Kolo
5	*Cervus unicolor*	Sambar	Meru.
6	*Cuon alpinus*	Wild dog	Kolsundo, Deucolo
7	*Cynopterus brachyotis*	Indian fulvous fruit bat	Pakho
8	Delphinus tropicalis linn	Common Dolphin	Gaddo redo
9	*Felis bengalensis*	Leopard cat	Wagatti
10	*Felis chaus*	Jungle cat	Baul,
11	*Funambulus palmarum*	Three striped palm squirrel	Chani, Khar.
12	*Herpestes edwardsii*	Common grey mongoose	Mungoos, Munghas,
13	*Hyaena hyaena*	Striped hyaena	Yeul , Bhalu
14	*Hysterix indica*	Porcupine	Sal, Salinder
15	*Lepus nigricollis*	Black napped Hare	Soso
16	*Loris tardigradus*	Slender loris	Van manus
17	*Lutra lutra*	Common Otter	Udh,
18	*Lutra perspicillata*	Smooth coated Otter	Udh
19	*Macaca radiata*	Bonnet macaque	Khete, Makod.
20	*Manis crassicaudata*	Indian pangolin	Therio
21	*Megaderma spasma*	Indian false vampire bat	Vagul
22	*Melursus ursinus*	Sloth bear	Aswal, Vashel.
23	*Muntiacus muntjak*	Barking deer	Bhekaro
24	*Mus booduga*	Indian field mouse	Undir
25	*Otompos wronghtoni*	Wronghton's freetailed bat	Vagul
26	*Panthera pardus*	Leopard	Bibto Vag, Biblo.
27	*Panthera tigris*	Tiger	Danyo or Pattacho Vag
28	*Paradoxurus hermaphorditus*	Palm civet cat	Katanoor
29	*Petaurista petarauista*	Common flying squirrel	Ud pakho.
30	*Phocoena phoecoena*	Porpoise	
31	*Pipistrellus dormeri*	Dormers bat	Vagul
32	*Presbytis entellus*	Common Langur	Vanor
33	*Pteropus giganteus*	Flying Fox	Pakho

GOVERNMENT OF ASSAM
FOREST DEPARTMENT
OFFICE OF THE CHIEF EXECUTIVE OFFICER :: STATE CAMPA :: ASSAM
LANKESHWAR :: JALUKBARI :: GUWAHATI : 781014

Phone No. (Off.):
E-mail pccfcampa@gmail.com

No.FG.27/CAMPA/APO/2021-22 Dated: Guwahati, the 14th Sept./2021

To,

The Assistant Inspector General of Forest
Govt. of India,
National Authority
Ministry of Environment, Forest & Climate Change
Hall No.1, 4th Floor, Block No.3, CGO Complex,
Lodhi Road, New Delhi-110003

Sub: Proposals for facilitating scientific, technological and other assistance under wildlife wing of State CAMPA, Assam.

Ref: Govt. of India's letter No.13-28/2018-CAMPA, dtd.26.07.2021.

Sir,

With reference to the letter cited above, I am directed to submit herewith the proposals for facilitating scientific, technological and other assistance pertaining to Wildlife wing of Assam Forest Department, under Agenda Item No.16, Para 3 (i) of the minutes of the 13th Executive Committee (EC) Meeting of National CAMPA held on 7th June, 2021. The following proposals received from the PCCF (WL), Assam vide letter No.FD/WL/D/CAMPA/Pt-II/2014-15, dtd.06.08.2021 and No.FD/WL/D/CAMPA/Misc./2020, dtd.24/8/2021 (copies enclosed) may kindly be considered for your approval:

Sl. No.	Item	Quantity	Unit Rate (In Rs. Lakhs)	Amount (in Rs. Lakhs)	Justification
1	Unmanned Aerial vehicles with Infrared camera	15	4	60	UAVs assist in monitoring, surveillance, survey and mapping which is required for both floral and faunal attributes. The infrared camera shall aid in night time surveillance.
2	GSM based Camera Traps	50	0.4	20	These cameras serve as an early warning system in context of wild animal movement, especially near railway tracks and human habitations wherein information is conveyed directly to a mobile phone through an application, thereby averting conflict scenarios.
3	Camera traps	500	0.25	125	For routine passive monitoring of wildlife and estimation of wildlife populations.
4	Range Finders	200	0.18	36	These are required for measuring distance from the observer to the wild animal during Distance sampling for estimating population size. Can also aid in measuring height of trees.
5	Compass for the line transect sampling	200	0.09	18	These are required for measuring angle between the observer and the wild animal during Distance sampling for estimating population size. This can also be used as a survey tool.

6	Mobile phones for M-STriPES application	100	0.20	20	M-STrlPES application is used for documenting patrol efforts as well as gathering ecological data and are required in every anti-poaching camp. Quantities supplied earlier were limited.
7	Night vision devices/FLIR (forward looking infra red)	20	4	80	This device is used for detecting the movement of poachers as well as wildlife during night time and can help prevent any untoward incident.

Yours faithfully,

(Suman Mohapatra, IFS)
Addl. Principal Chief Conservator of Forests &
Chief Executive Officer, State CAMPA, Assam
Lankeshwar, Jalukbari, Guwahati - 14

Copy to:

1. The Principal Secretary to the Govt. of Assam, Environment & Forests Department Dispur for favour of kind information.
2. The Principal Chief Conservator of Forests & Head of Forests Force, Assam, Aranya Bhawan, Panjabari, Guwahati-37 for favour of kind information.
3. The Principal Chief Conservator of Forests, Wildlife, Assam, Aranya Bhawan, Guwahati-37 for favour of kind information.

Addl. Principal Chief Conservator of Forests &
Chief Executive Officer, State CAMPA, Assam
Lankeshwar, Jalukbari, Guwahati – 14

o/c

Subject:- Deployment of three additional post at ROHQ under the NICSI project' Yearly Maintenance, Enhancement and up-Gradation of Forest Clearance module of PARIVESH'

1. This in reference to the yearly Maintenance, Enhancement and up-Gradation of Forest Clearance module of PARIVESH through NICSI with a total cost of ₹2,31,96,128/- for the duration from April, 2021 to 31 stMarch, 2022. The National Authority of CAMPA has approved the project and released a sanction letter of ₹2,09,16,247/- (after deducting the unspent balance of ₹22,79,881/-) to NICSI dated on 07/05/2021. The copy of sanction letter seen at **page No 318-320 /c** .

2. The FC Division was requested to deployment of three (3 Nos.) additional Manpower through NICSI at Ministry RO(HQ) for the coordination with various IRO's for the implementation of FC module of PARIVESH in the ministry as well as various IROs to the Technical Dir NIC (**Pg. 362 /c**)

3. As per the request of FC Division the technical Director has submitted following financial estimate of three additional manpower in the existing ongoing project vide his note as page No. 368/c.

S. No	Manpower Details	Nos	Place of Posting (Nos.)	Cost per person per month (Rs.)	Deploying period (months)	Date of deployment (From / To)	Tentative User Rate (Rs.) Total cost for 9/7 months (inclusive of NICSI, Service Tax etc.)
1	Office Assistance Support Graduate (6 years & above relevant experience)	1	MoEFCC RO HQ , New Delhi	50,875/-	9	01.07.2021 to 31.03.2021	50,875 X 9 = 4,57,875/-
2	Office Assistance Support Graduate (2 to less than 4 years relevant experience)	1	MoEFCC RO HQ , New Delhi	43,547/-	7	01.09.2021 to 31.03.2021	42,547 X 7 = 3,04,829/-
3	Office Assistance Support	1	MoEFCC RO HQ , New Delhi	40,306/-	7	01.09.2021 to 31.03.2021	40,306 X 7 = 2,82,142/-

	Graduate (0 to less than 2 years relevant experience)						
Total							**10,44,828/- (Inclusive of GST and NICSI charges)**

If agreed the proposal may be discussed in the forthcoming EC meeting of national Authority. Submitted for kind consideration please.