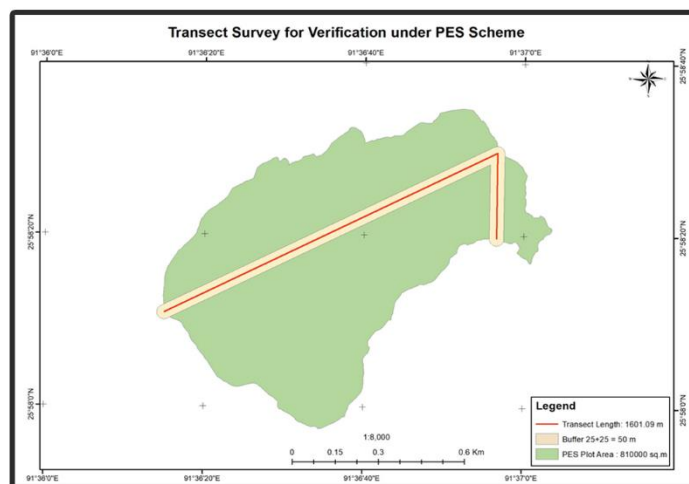


Measurement, Reporting & Verification (MRV) Protocol for Meghalaya PES Scheme



**Centre of Excellence
for
Natural Resource Management & Sustainable Livelihoods**

Under the Community led Landscape Management Project (CLLMP)

**Meghalaya Basin Development Authority (MBDA)
Government of Meghalaya**

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PREFACE

Measurement, reporting and verification (MRV) is an essential part of the framework for implementing 'Payment for Ecosystem Services' (PES) Scheme effectively. MRV is designed to encourage the community members to follow the established scientific practices for ecosystem improvement. MRV helps not only in ensuring sustainable management of the natural resources, but it also creates motivation in the community members to do better and learn from the results of the previous efforts. With successive cycles of MRV, data-based visibility of ecosystem improvement develops, which generates confidence in every stakeholder about the positive impacts of the PES Scheme.

It is encouraging that CoE (NRM & SL) has developed a MRV Protocol for the State's PES Scheme which is a first of its kind framework for monitoring performance based incentive scheme for community forests. I am happy to know that the MRV Protocol involves simple steps which can be implemented by the trained cadre of Village Community Facilitators (VCFs) with minimal technical support from the back-end institution i.e. CoE (NRM & SL). I compliment the CoE Team for developing this much needed MRV Protocol for the recently launched PES Scheme of the State.

Sampath Kumar, IAS
Development Commissioner & CEO, MBDA
Government of Meghalaya

Shillong, August, 2023

FOREWORD

Measurement, Reporting & Verification (MRV) is the set of principles and procedures which is generally put in application for implementing ecosystem improvement programmes wherein contribution of communities for conservation is recognized and they are further motivated by offering them performance based incentives. MRV helps in meeting an important requirement of generating credibility, assurance and sustainability for such initiatives.

The term MRV gained recognition mainly in connection with 'carbon credits' mechanisms of climate change mitigation in the last two decades. MRV framework has evolved for carbon sequestration ecosystem services from forests in a robust manner. Using the same basic principles, MRV framework can be suitably designed for other PES Schemes.

Customization of MRV framework to suit the local circumstances is important for its practical application. Methodologies for MRV should be kept as simple as possible. This helps in keeping the transaction cost of MRV implementation low. With simple technical steps, it is possible to train local youths from the communities in the MRV methodologies and thus execution of MRV process over vast areas can be achieved. MRV Protocol developed for the PES Scheme of Meghalaya has been guided by these considerations. The protocol is expected to further evolve from the feedback when the same is put in use while implementing the State PES Scheme.

I am happy that the MRV Protocol has been developed by the CoE (NRM & SL) as an original framework with the principal objectives of verifying implementation of State PES Scheme on the ground and assessing impacts of the same. I am sure that the MRV Protocol will be of much use as a supportive framework of monitoring of ecosystems in the State with the participation of communities.

Shillong, August, 2023

Dr. Subhash Ashutosh,
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ABBREVIATIONS

Avg	Average
CoE	Centre of Excellence (Natural Resource Management & Sustainable Livelihoods)
CLLMP	Community Led Landscape Management Project
DF	Dense Forest
FCM	Forest Cover Mapping
FMP	Forest Management Plan
FSI	Forest Survey of India
GIS	Geographical Information System
GPS	Global Positioning System
GS	Growing Stock
ha	Hectare
IRS	Indian Remote Sensing
ISFR	India State of Forest Report
LISS	Linear Imaging & Self-scanning Sensor
MDF	Moderately Dense Forest
MRV	Monitoring Reporting Verification
OF	Open Forest
PES	Payment for Ecosystem Services
PFA	PES Field Associate
sq.km.	square kilometre
VCF	Village Community Facilitators
VDF	Very Dense Forest

Units

1 ha	=	10,000 sq m
1 sq km	=	100 ha
1 cubic meter	=	1000000 cm ³
1 cubic meter	=	35.3147 ft ³
1 ton	=	1000 Kg
1 million ton	=	1000000 tons
1 billion ton	=	1000 million tons
1 ton C	=	3.64 tons CO ₂ e

1. Introduction

PES Schemes are designed with the objective of enhancing ecosystem services like improved flow of water in streams, carbon sequestration, prevention of soil erosion, biodiversity enhancement, improved stocking of forests etc. To achieve this, communities are encouraged under a performance-based incentive framework to undertake activities for restoration and enhancement of ecosystems for sustainable forest management, soil & water conservation, afforestation and reforestation, improved cultivation practices on jhum lands etc.

Under the PES framework, the village community members who are willing to join the scheme are required to sign an agreement to abide by the management prescriptions/guidelines given to them while registering their community or private forests or other lands for ecological restoration. Communities are expected to follow long term (30 years under the PES Scheme launched in the State) sustainable management practices in their forests/lands. Measurement, Reporting & Verification (MRV) guidelines therefore are designed in a manner that the observations on the implemented activities and indicators which result in effective protection, conservation and enhancement of forests and effectiveness of other restoration activities are measured and recorded during the verification process.

Often, measurement of ecosystem services per se involves complex methodologies which are generally expensive and need technical expertise and support of R&D laboratories and equipments. Moreover, for operational working of a PES Scheme on a wider scale, there are practical limitations in following a technically advanced approach for measurements and verification mainly due to costs, manpower and technical capacity. Because of these reasons, proxy indicators are often used for assessment and verification of ecosystem services under PES Scheme in several countries where such schemes are under implementation. The bio-physical indicators which are strongly co-related with the desired outcomes are identified for the measurement and verification process. MRV based on proxy indicators works on the premise that if certain established practices aimed at improvement of ecosystems (or checking degradation) are effectively implemented, they will definitely lead to enhancement of ecosystem services whether we are able to actually measure them or not in quantitative terms. Thus, verification of the works carried out by the community members in follow up of the management prescriptions recorded in terms of score based on the criteria (designed for verification) can be a basis for evaluating their performance under the PES Scheme.

The MRV framework for PES should meet the following requirements

- it should use indicators/ observations which have strong correlation with the improvement in the ecosystem services.
- cost in the verification process (transaction cost) should be as low as possible.

- the procedure/ methodology followed in the verification should be simple enough so that the same can be adopted by involving local people after training.
- it should not involve advanced technical steps for which skilled man power at high costs are required.
- MRV process should not be destructive to the ecosystems.
- it should be scalable.
- it should not be time intensive.
- it should be adoptable by the communities.
- if need arises, the observations should be re-verifiable.

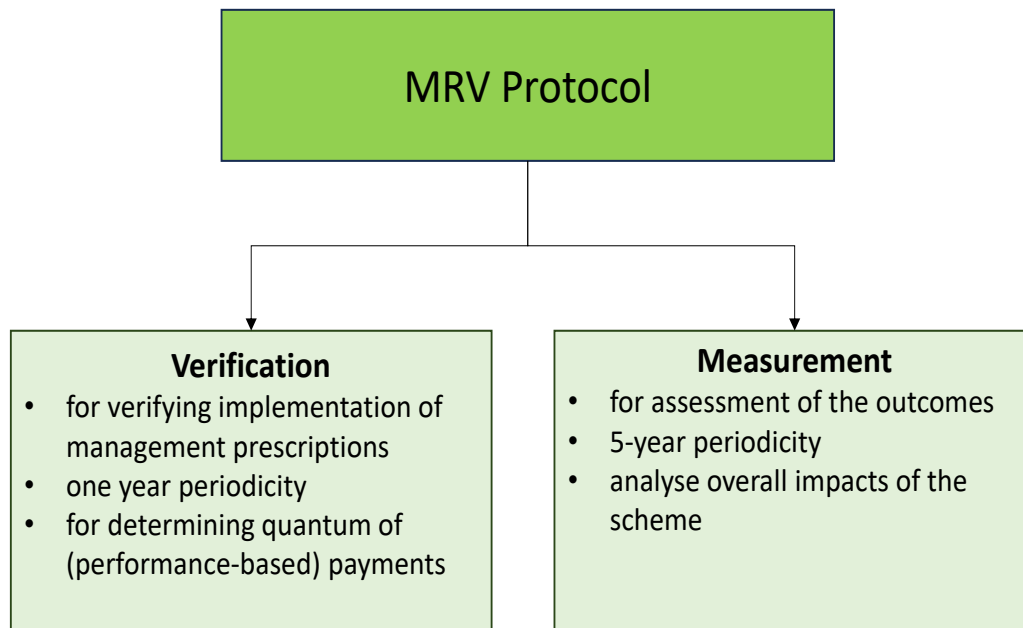
Measurement, Reporting & Verification (MRV) Protocol developed for the PES Scheme of Meghalaya is basically, a set of norms, guidelines, methodological steps and criteria for scoring for verifying effective implementation of the prescriptions/ guidelines given to forest/ land owners registered under the PES Scheme. MRV provides an objective and quantifiable basis for determining performance-based incentives (i.e. the amount of payment due to a participant in the PES scheme). MRV based incentives under PES Scheme generate motivation in the people for effective implementation of the prescribed activities for sustainable management of forests and also telling them about the shortfall and incompleteness in their efforts, if any. On the other hand, MRV also provides an assessment about the impacts of the scheme on the ecosystems.

MRV Protocol for the PES Scheme is based on some pre-identified parameters which are measurable (or countable) and also observations of some changes or signs which indicate improvement as a result of adopted practices in the forests and the activities implemented as per the prescriptions. Based on the measurements and observations, scoring system has been designed. Criteria based on the score determines the quantum of incentive (payment). Higher the score, higher will be the incentive going up to the maximum limit. It is envisaged that verification will be carried out in yearly cycle. The Field Associates, trained in the methodology will carry out 'Verification'. The measurements/observations and scores recorded by them during the Transect Surveys or Spot Surveys (in the hard copy Form) will be entered in the pre-designed Excel sheet with the embedded formulae. The excel sheet will then automatically calculate the amount due to a particular community or individual.

Guidelines for transect survey and the Forms for recording the observations are given in the following sections and Annexures.

2. MRV Protocol

The MRV Protocol designed for the PES Scheme of Meghalaya has two components viz., '**Verification**' and '**Measurement**'. 'Verification' is mainly meant to verify implementation of the prescribed practices aimed at forest/ecosystem improvement in the periodic manner. Whereas, 'measurement' is aimed at assessing the outcome of the PES Scheme in terms of improvements in certain bio-physical parameters such as forest canopy density, growing stock, forest carbon etc. The purpose and scope of these two components are described below.



2.1 Verification - The term 'verification' in the context of PES Scheme of Meghalaya stands for a set of field-based methods to record observations about the implementation of activities prescribed under the guidelines or Management Plan and also certain observations showing improvements or prevention of causal factors of degradation.

The main purpose of verification is to make assessment about the performance of the community/ individual so that the quantum of the next instalment under the PES Scheme can be determined.

The verification has to therefore follow the cycle (periodicity) of instalment which is generally yearly.

The verification is done by 'transect survey' or 'spot survey' methods for which procedures have been laid down. The purpose of 'verification' includes the following

- for determining quantum of payment of PES instalments
- in the cycle of one year

- preferably to be done during Oct to Dec and Feb to April
- based on transect survey or spot survey
- sampling intensity is generally between 5%-15%

2.2 Measurement - Measurement, the other component of MRV Protocol for the PES Scheme is to be carried out in a cycle of 5 years. As the term suggests, under this component of MRV, quantified assessment of outcomes (as a result of PES Scheme) will be done. The purpose of measurement includes the following

- assess outcome of the PES Scheme in improving ecosystem in quantified manner.
- part of the overall incentive may be linked to the outcome at the end of measurement cycle.
- provide credible data for formulating or linking with the REDD+ Project.

Parameters like change in forest cover under different canopy density classes, growing stock, basal area, carbon stock would be measured following scientific methodologies

- satellite data and drone images will be used for assessing canopy density improvement and change in extend of forest cover.
- stratified random sampling (SRS) based design will be used for assessment of growing stock, carbon stock, number of trees species with diameter class distribution etc. Change in the parameters in the intervening cycles will also be analyzed.
- periodicity of measurement will be 5 years.
- sampling intensity will be between 2% to 7%, depending upon the variability.

2.3 Activities covered under the MRV Protocol - The MRV Protocol provides methods and procedures for verification and measurements in respect of following activities aimed at ecosystem restoration and enhancement in Meghalaya.

- (i) Sustainable Management of Community Forests (includes privately owned forests)
- (ii) Afforestation
- (iii) Reforestation
- (iv) Soil & Water Conservation measures
- (v) Transition from Shifting Cultivation to Improved agricultural practices

2.4 Third Party Validation – If decided by the appropriate authority, third party validation of the MRV done internally by the project implementing team, may be carried out. The same MRV Protocol may be followed by the third party in an independent manner to cross-check the ‘verification’ and ‘measurement’ results.

3. Verification

'Verification' process is meant for physical on-the-ground assessment of effectiveness and quality of implementation of the prescribed activities in the forests/lands committed under the PES Scheme. Verification is also intended to evaluate the performance in terms of score, based on which quantum of annual instalment of payment under the PES Scheme is determined.

3.1 Objectives of Verification for PES Scheme

- (i) Verify implementation of prescribed practices for protection, conservation and enhancement of forests and other land-based eco-restoration activities under the PES Scheme.
- (ii) Objective assessment of improvement of forests/other lands during the intervening cycles of verification.
- (iii) Carry out evaluation of performance in terms of score for determining quantum of payment in the next instalment due to a participant under the PES Scheme.
- (iv) Provide feedback to the communities for further improvement in their efforts towards sustainable management of forests and other interventions on their lands.

3.2 Field methods of Verification

The following two methods have been prescribed for field verification i.e. Transect Survey and Spot Survey.

3.2.1 Transect Survey

Generally, the 'forests' or 'land' under the PES scheme are large in extent and therefore complete wall-to-wall verification is practically not possible. Verification, therefore is done on sampling basis. A well representative sample criss-crossing the forests/ lands can be created by the 'transect survey'. In the transect survey, on-foot observations are taken in a strip (of say 25 meters wide on either side) along a straight line in a particular direction which is called 'transect line'. A transect line in a forest/land is set by selecting a bearing using a magnetic compass or a mobile app. A transect line generally crosses the patch of forest from one point on the periphery to the diagonally opposite point on the other side of the periphery (except in a large patch of forest where such transect line would be very large).

3.2.2 Spot Survey

If the forest or land to be verified is small (say less than 2 ha), the verification may be done by 'spot survey'. Observations about the activities in small areas can be done by moving around in the whole patch of forest/ land. But in case numerical observation like number of surviving plants is involved then either complete enumeration may be done or transect survey method may be followed even in the small areas.

3.3 Instructions for carrying out Field Verification for PES Activities

- (i) After the 1st Instalment, the next instalment of PES will be released after verification of the activities executed by the PES committee/ individuals in the last one year. Every annual instalment of PES will precede with the verification.
- (ii) According to the methodology, verification is to be done either by Spot Survey or by Transect Survey, depending upon the size of forest/ land. If the area to be verified is less than 2 ha, spot survey should be done and in case it is > 2ha, transect survey should be done.
- (iii) Parameters/ attributes on which observations have to be recorded are given in the Table 2.
- (iv) PFAs are required to collect the observations in the given format, wherein they have to record all the details like Id of the activity site, area, name of the PES beneficiary etc along with their observations during the verification process.
- (v) While carrying out the Transect Survey, each PFA should take observations within a distance of 25 meters on either side of the transect line. Thus, observations will be recorded in the strip of 50m.
- (vi) For the 50 meter wide strip, the PFAs should measure the distance on the ground on a few points only, after that they should take the observations within 25 meters on either side of the transect line by ocular estimate of the width on either side. To maintain their ocular estimate correct, they should measure the distance 25 m on either side using 'measuring tape' at regular interval.
- (vii) For moving in a straight transect line, magnetic compass or a compass app in the mobile should be used for maintaining a particular bearing so that all the transect lines are parallel to each other.
- (viii) For several observations, counts of the parameter/ attributes will have to be recorded, therefore, the PFAs should keep noting the counts by adding 1+1+1..... in the given Form.
- (ix) One or two community members involved in the activity should also accompany the PFAs while undertaking the survey for verification.

3.4 Guidelines for Transect Survey - Observations during a transect survey will be recorded by the PFAs (Verifiers) for verifying different activities implemented by the Communities/ Individuals in the forest/ land committed under the PES Scheme and note down changes in forest with respect to different drivers of degradation.

- i. For transect survey, PFAs have to walk in the straight line using a fixed bearing with the help of compass or the mobile App in the manner shown in the following diagram. While walking they should look on both the sides and take observations within a buffer of 25 m on both sides.

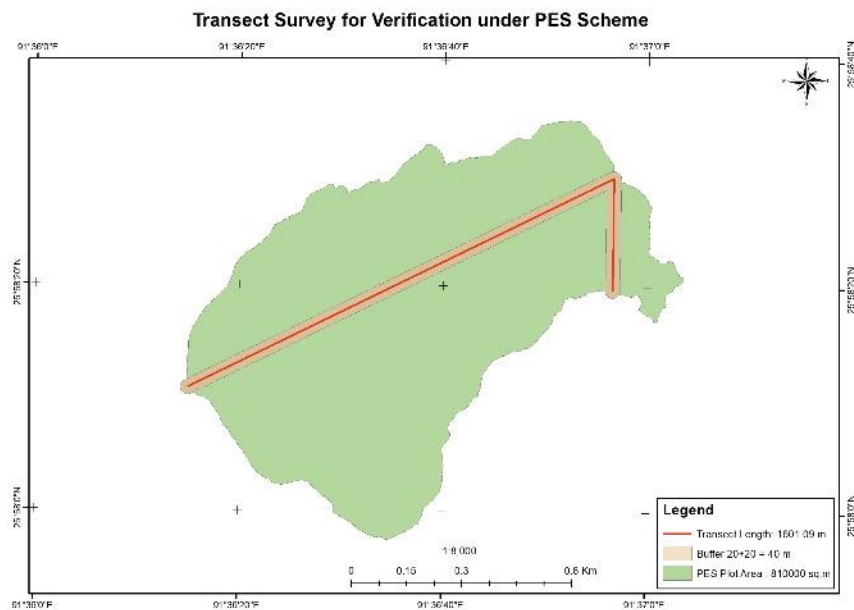


Fig. 1

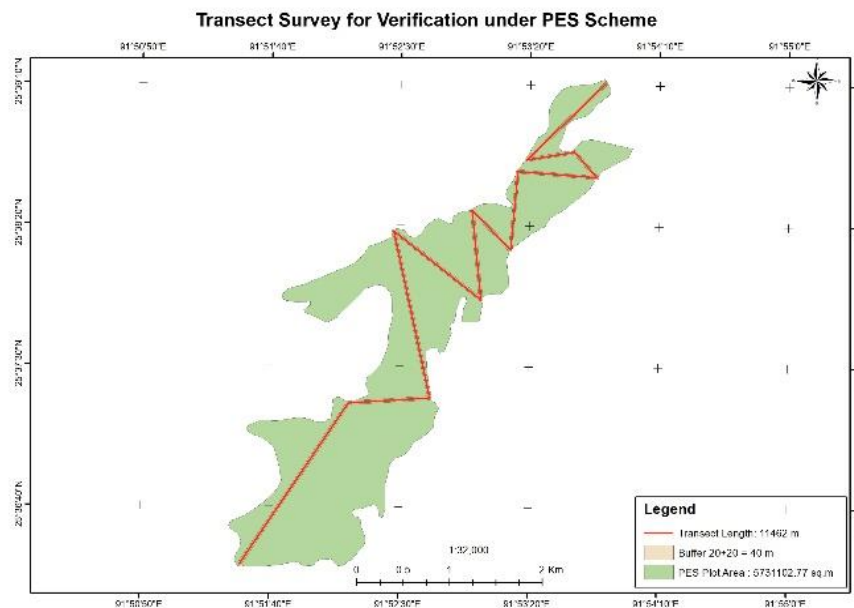


Fig. 2

- ii. Length of Transect Line - Length of transect line for verification should be proportional to the area of forest to be surveyed. It also determines the sampling intensity. It is observed that one uniform sampling intensity for all sizes of the forests leads to much higher length of transect line for the large forest areas which may pose practical difficulties and result in high survey costs. Taking a practical view, the length of transect lines can be rationalized as given in the following table.

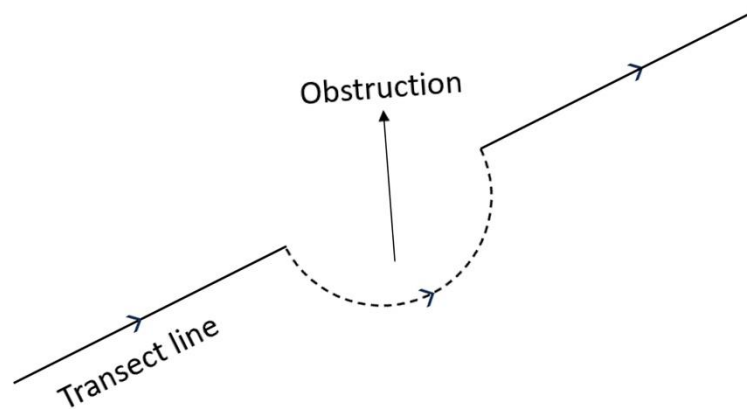
Table 1: Length of Transect Line

Sl. No.	Area of Forest (ha) 'a'	Formula for the length of Transect Line	Sampling Intensity
1	2 to 100	$a \times 20$; subject to minimum of 500 m	8% -10%
2	100 -1000	$a \times 20$; subject to maximum of 7 km	5% - 8%
3	>1000	$a \times 7$; subject to maximum of 14 km	3% - 5%

The length of the transect line actually traversed in the forest should not be less than what it is determined from the above table.

- iii. While moving in a transect line, a compass or a mobile app should be used to keep the line straight in a particular direction. For this, a particular bearing should be set in the compass or mobile app. The bearing for transect should be selected in such a manner that the transect line passes through the maximum forest area to be surveyed as shown in Fig 1. Bearing for the transect should be selected without any bias.
- iv. If the length of the transect line, calculated using the table given in section (ii) above should be covered by selecting a new bearing once the survey party hits the boundary. Selection of new bearing should continue till the length of the transect line is accomplished as shown in Fig 2. If the length of the transect line completes in the middle of the forest area, then the PFA should continue his/her observation till it can again reaches up to the boundary of the forest/land.
- v. Length of transect line traversed within the forest/land should be recorded. Care should be taken to keep record of each segment and at the end, all segments should be totalled.
- vi. While moving on a transect line if an obstruction in the form of cliff, water body, rock etc is encountered then the same should be negotiated either by climbing the cliff or if it is not possible then avoid the obstruction (cliff, water body etc) by circumventing it and again resume the transect line with the same bearing (do not count the length of the circumvented part) as shown in the figure below. If the obstruction appears non-negotiable or it is big in size or towards the end of the transect line then terminate the transect at

that point and select another bearing to complete the transect survey for the remaining distance.



- vii. The transect can be started from any random point on the periphery of the forest/ other lands on any end of the polygon as shown in the above diagrams.
- viii. While making the transect, observations should be recorded on the relevant form.
- ix. The scoring for each observation parameter should be done either instantly or immediately after completion of the transect so that observations recorded in the memory are not lost.
- x. Transect Survey should be done by a team of not less than two persons.
- xi. Photographs of the important observations should be taken while carrying out the transect survey and should be duly referenced on the observation for correct identification.

3.5 Indicators and Parameters for verification

The following table gives the list of indicators and observations for each activity proposed to be included in the PES Scheme. Performance of the community members in implementing activities as per the prescription is evaluated using the observations on these indicators/parameters and the signs of improvement/degradation recorded during the field surveys.

Table 2: Observations, Indicators and Criteria for Scoring

Sl. No.	Activity	Observations for Verification and Scoring	Score	Criteria for scoring	Methodology	Condition for payment	
1	Sustainable Management of Community Forests	a	Prevention of unauthorised felling of trees	24	Average number of felled trees/ ha up to 0.3: 100% Average number between 0.3 and 0.7: 90% Average number between 0.7 and 1.1: 80% Average number between 1.1 and 1.5: 70% Average number between 1.5 and 2.0: 30% Average number more than 2.0: 0%	Transect Survey	70% is the qualifying score 100% payment if score is 90% or above 90% payment if the score is between 80% and 90% 80% if score is between 70% and 80% 0 if score is less than 70%
		b	Encroachment Count of signs that indicate cutting of natural forests for raising plantation or construction	16	Average number of signs/ ha up to 0.3: 100% Average number between 0.3 and 0.7: 90% Average number between 0.7 and 1.1: 80% Average number between 1.1 and 1.5: 70% Average number between 1.5 and 2.0: 30% Average number more than 2.0: 0%	Transect Survey	
		c	Forest Fire Control	26			
		(i) Count of forest fire signs	8	Average number of signs/ ha up to 0.1: 100% Average number between 0.3 and 0.1: 80% Average number between 0.5 and 0.3: 50% Average number >0.5: 0%	Transect Survey & Sample Checking		
		(ii) Forest fire line (creation and maintenance)	8	Width is ≥5m and fire line strip is free of debris (<10%): 100% Width is between 4-5m and fire line strip has not more than 30% debris: 80% Width is between 3-4m and fire line strip has not more than 50% debris: 50% Width is between 3-4m and fire line strip has not more than 70% debris: 30% Unsatisfactory/ not done: 0%	Transect Survey & Sample Checking		
		(iii) Formation of fire-watch patrolling squad	5	Fire-watch patrolling squad have been formed: 100% Patrolling squad not formed: 0%	Meeting with the VPCs and villagers		
(iv) Frequency of patrolling	5	Daily during fire season: 100% Alternate day: 60% Once a week: 20% Patrolling not carried out: 0%					

Sl. No.	Activity	Observations for Verification and Scoring	Score	Criteria for scoring	Methodology	Condition for payment	
	Sustainable Management of Community Forests	d Forest Enhancement	24				
		(i) Nursery (weeding, protection from animals, planting stock)	8	Nursery created and well maintained (planting stock >50%): 100% Nursery present but between 30-50% planting stock: 80% Nursery present but between 20-30% planting stock: 50% Nursery present but not well maintained: 10% Not present/ unsatisfactory maintenance: 0%	Transect Survey/ Spot Survey	70% is the qualifying score 100% payment if score is 90% or above 90% payment if the score is between 80% and 90% 80% if score is between 70% and 80% 0 if score is less than 70%	
		(ii) Assisted Natural Regeneration (removal of invasive species, protection against disturbances, enhancing seed dispersal, native species encouraged, etc.)	6	Very good: 100% Satisfactory: (above activities partially done): 50% Unsatisfactory/ not done: 0%	Transect Survey/ Spot Survey		
		(iii) Gap Planting (plantation of indigenous species, enrichment plantation, prevention of forest fire, maintenance operations)	4	Very good: 100% Satisfactory: 50% Unsatisfactory/ not done: 0%	Transect Survey/ Spot Survey		
		(iv) Conservation of Biodiversity (including protection of wildlife): In-situ conservation and invasive species removal (preventing felling of trees, ban animal hunting, in-situ conservation, ex-situ conservation, identification of protected areas)	6	Very good: 100% Satisfactory: (above activities partially done): 50% Unsatisfactory/ not done: 0%	Transect Survey/ Spot Survey		
		e Prevention from grazing	10				
		(i) Count of Grazing signs	4	Average number of signs/ ha up to 0.2: 100% Average number between 0.4 and 0.2: 80% Average number between 0.6 and 0.4: 20% Average number >0.6: 0%	Transect Survey		
		(ii) Prevention of Grazing by patrolling and awareness	6	Barriers/ fences created to prevent grazing: 100% Barriers/ fences are satisfactory: 50% Partial grazing still occurring: 20% Rampant grazing taking place: 0%	Transect Survey & Sample Checking		

Sl. No.	Activity	Observations for Verification and Scoring	Score	Criteria for scoring	Methodology	Condition for payment
2	Reforestation	a	40			
			30	Protection is effective: 100% Protection is satisfactory: 80% Protection is satisfactory and grazing is minimal: 60% Protection is moderate: 40% Protection is not effective: 0%	Transect Survey/ Spot Survey	70% is the qualifying score 100% payment if score is 90% or above 90% payment if the score is 80%-90% 80% payment if the score is 70%-80% 0 if score is less than 70%
			10	Patrolling is being regularly carried out with effective outcome: 100% Patrolling is not effective: 0%	Transect Survey/ Spot Survey	
		b	30	Tree planting of native species in blank area covering 60-70% of the total area: 100% Planting of native species in blank area covering between 40-60% of the total area: 60% Planting of native species in blank area covering between 20- 40% of the total area: 40% Tree planting not carried out: 0%	Transect Survey/ Spot Survey	
		c	20	Effectively done: 100% Moderately done: 60% Not satisfactory: 0%	Transect Survey/ Spot Survey	
d	10	Effectively done: 100% Moderately done: 60% Not satisfactory: 0%	Transect Survey/ Spot Survey			
3	Afforestation	a	80	>800 live saplings/ ha: 100% 600-800 live saplings/ ha: 90% 400-600 saplings/ ha: 80% 300-400 saplings/ ha: 70% 200-300saplings/ ha: 60% 100-200 saplings/ ha: 50% < 100 saplings/ ha: 0%	Transect Survey/ Spot Survey	60% is the qualifying score 100% payment if score is 90% or above 90% payment if the score is 80% to 90% 80% payment if the score is 70% to 80% 70% payment if the score is 60% to 70% 0 if score is less than 60% INR 30/ surviving plant/ year Maximum upto 1200 saplings on one ha
		b	10	Fire protection is good: 100% Satisfactory: 80% Moderate: 60% Not satisfactory: 0%	Transect Survey/ Spot Survey	
		c	10	Area is >80% free of weeds: 100% Satisfactory weeding: 70% Moderate weeding: 50% Not satisfactory: 0%	Transect Survey/ Spot Survey	

Sl. No.	Activity	Observations for Verification and Scoring	Score	Criteria for scoring	Methodology	Condition for payment
	Soil & Water Conservation Measures	a	80	contour trenches ≥ 100 m/ ha: 100% contour trenches 80-100 m/ ha: 90% contour trenches 60-80 m/ ha: 80% contour trenches 40-60 m/ ha: 70% contour trenches 20-40 m/ ha: 60% contour trenches 10- 20 m/ ha: 50% contour trenches <20 m/ ha: 0%	Transect Survey/ Spot Survey	60% is the qualifying score 100% payment if the score is 80% or above 90% payment if the score is 70% to 80% 80% payment if the score is 60% to 70% 70% payment if the score is 60% 0 if score is less than 60%
		b	20	Proper stabilisation of soil dug out and maintenance of the trenches: 100% Satisfactory stabilisation and maintenance of the trenches: 50% Unsatisfactory/ not carried out: 0%	Transect Survey/ Spot Survey	INR 180/ meter length of contour trench with stabilization maximum upto 200 m/ ha INR 150/ meter length of contour trench without stabilization
5	Transition from Jhum to Improved Agriculture Practices	a	70	Yes: 100% No: 0%	Spot Survey	70% is the qualifying score 100% payment if score is 90 or above 90% payment if the score is between 80% and 90% 80% if the score is between 70% and 80% 0 if score is less than 70%
		b	10	Undertaken effectively: 100% Partially done: 60% Not done: 0%	Spot Survey	
		c	10	Undertaken effectively: 100% Partially done: 60% Not done: 0%	Spot Survey	
		d	10	Undertaken effectively: 100% Partially done: 60% Not done: 0%	Spot Survey	

4. Measurement

The purpose of measurement under the MRV Protocol is to make assessment of change in the 'forests' under the PES Scheme of the Government of Meghalaya in a periodic manner. The proposed cycle for 'measurement' under the protocol is 5 years. The periodic measurement of forests is aimed at estimating improvement in forest in quantitative terms as an outcome of the interventions implemented under the PES Scheme.

Following parameters have been identified for measurement and assessing impacts of the Scheme.

- i. Forest cover in three canopy density classes and change therein
- ii. Growing stock of the forest
- iii. Basal Area
- iv. Carbon Stock

Broad methodology for the assessment of the above four parameters is presented as follows.

4.1 Forest Cover

Forest Cover of the polygons of forests registered under the PES Scheme will be assessed in a cycle of 4 years using satellite data or images acquired by drone. The important elements of the methodology are

- satellite data – preferably IRS Resourcesat LISS IV data.
- on screen visual analysis of the satellite data and polygonisation.
- 1:12,500 scale.
- three canopy density classes i.e. Very Dense Forest (VDF) (>70%) Moderately Dense Forest (MDF) (>40% to 70%) and Open Forest (OF) (10% to 40%) as shown in Fig 3.
- ground truthing before finalizing the forest cover map.
- canopy density class-wise area figures (in ha).
- change polygon map after the 2nd cycle onwards with respect to previous assessment and change in forest cover, analyzed in the three canopy density classes will provide a quantified impact of the improvement works done by the community members.
- Weighted Forest Cover (WFC) of the forest will be calculated using the following formula

$$\text{WFC} = 0.85 \cdot \text{VDF}_{\text{area}} + 0.55 \cdot \text{MDF}_{\text{area}} + 0.25 \cdot \text{OF}_{\text{area}}$$

% improvement in the WFC over the previous cycle will be computed for quantifying forest cover improvement in a single parameter.

Forest Cover Map of Bataw
Khliehriat Block, East Jaintia Hills

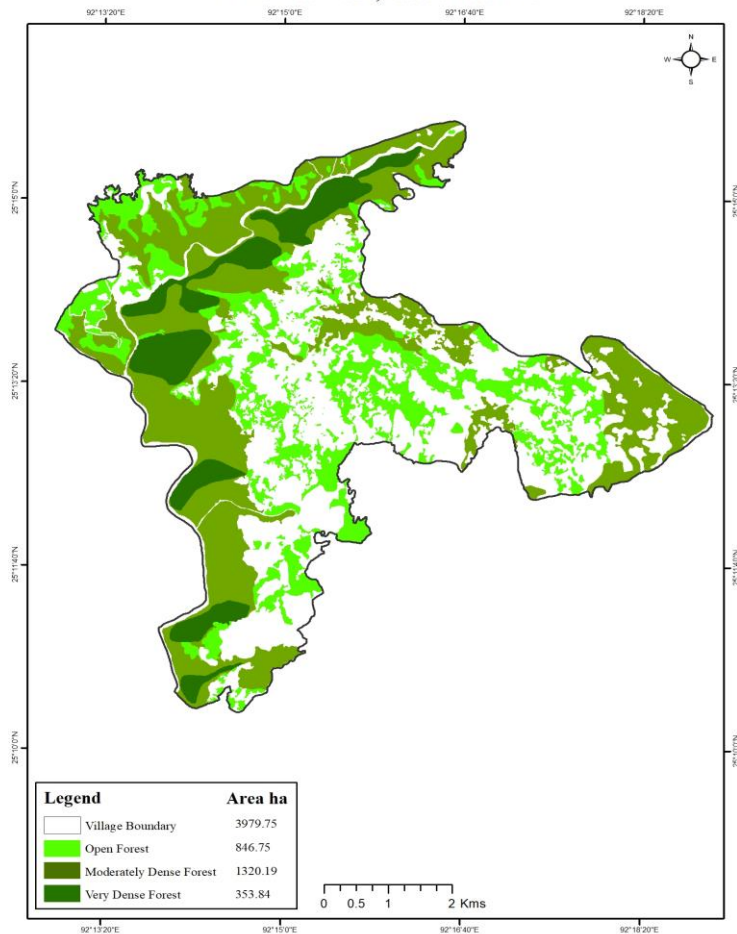


Fig. 3

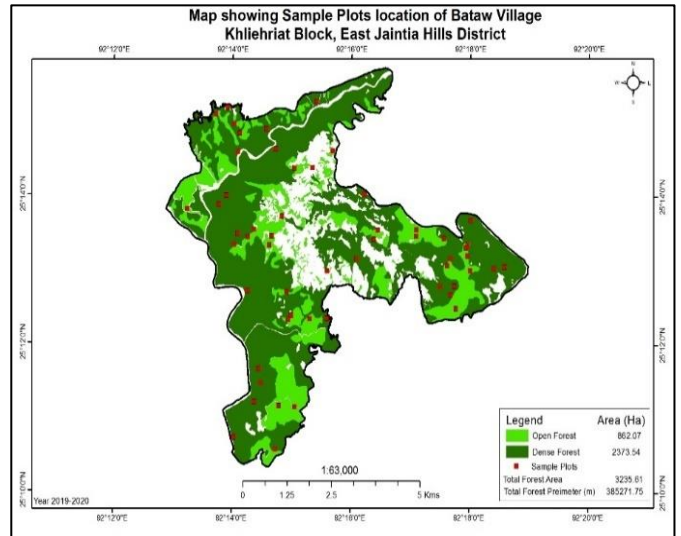
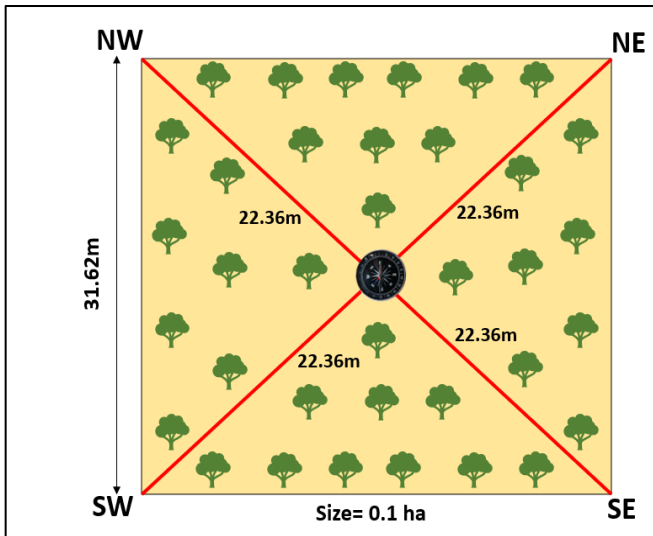
4.1.1 Drone Images – Record of images acquired with the help of Drones will be maintained. Depending upon the resources available, Drone images of the scale 1:500 to 1:2000 will be acquired for each polygon of forest (or land) under PES every year. This will help in maintaining a time series of images. The Drone images would be of help in Forest Cover Mapping also and would corroborate other analysis showing improvement of forest over a period of time.

4.2 Growing Stock

Growing stock of a forest is a measure of volume of merchantable timber available in the forest. If forests are well protected and managed then growing stock increases in a natural way according to the growth potential of forest. Growing stock is correlated with the content of biomass and carbon in the forest. Periodic measurements of Growing stock is a standard way to monitor improvement in forest health. Important points defining the methodology to estimate growing stock of forest are given as follows.

- stratified random sampling approach to be followed.
- forest cover density map to be used for stratification on the open forest and dense forest as two strata. VDF & MDF to be merged to create DF stratum.
- sampling intensity in the range of 3% to 8% depending upon the variability.

- minimum 20 sample plots in a forest of even small size (say 5 ha). In a large forest the number of sample plots may go upto 80 in a forests of size 100 ha or more.
- each sample plot is to be of 0.1 ha size, the shape of the sample plot may be square.
- standard method (as followed for preparing FMP) is to be followed for laying down the sample plots and taking measurements on the sample plot.
- calculation of growing stock will be done using quarter-girth formula.



4.3 Basal Area

Basal area is the area of cross section of tree stems measured in sqm. Basal area can be easily measured using wedge prism. Basal area is a robust parameter which has high correlation with the stocking of trees in a forest and therefore with forest cover density. It is easy to measure using Wedge Prism or by direct measurement of girth of trees (which is done in the forest inventory exercise).

- to be derived from the sample plot data for forest inventory or can be measured using Wedge Prism.
- average basal area/ ha and average basal area/ tree along with average number of tree/ ha would be determined for every cycle.
- increase in basal area in successive cycles will indicate improvement in forests.

4.4 Forest Carbon Stock

Forest Carbon Stock is a measure of amount of carbon stored in a forest. There are five pools of carbon stock in forests as mentioned below.

- above ground biomass
- below ground biomass
- dead wood
- litter
- soil organic carbon

Estimation of carbon stock in each of the above pool can be done using carbon factor given in terms of tonnes of Carbon per ha. The carbon factors are given forest type wise for each canopy density category. The carbon factors are given in the ISFR published by FSI biennially. For estimating carbon stock therefore, first forest type has to be ascertained and then forest cover area figures have to be arranged in different canopy density categories. Multiplying the area figures with the respective carbon factors and then summing up will yield forest carbon estimate for the given forest. Another way of estimating forest carbon stock is to use biomass expansion factors for each pool (except soil organic carbon) then compute the total biomass, multiply the total biomass with the density to get the biomass in weight and then calculate the carbon stock by multiplying the biomass weight by 0.47 (IPCC default value).

- To be estimated using biomass expansion factors/ carbon factors for VDF, MDF & OF forests for each forest type given in the ISFR.
- Canopy density wise area of forest to be derived from the forest cover map.

KEY FOR SCORING

Form I (a)

Verification Under PES Scheme
Sustainable Management of Community Forests
Transect Survey

Sl. No.	Criteria	Observations				
1.	Forest fire line (creation and maintenance)	Width is \geq 5m and fire line strip is free of debris (<10%): 100%	Width is 4-5m and fire line strip has less than 30% debris: 80%	Width is 3-4m and fire line strip has less than 50% debris: 50%	Width is 3-4m and fire line strip has more than 70% debris: 30%	Unsatisfactory/not done: 0%
	Formation of fire-watch patrolling squad	Yes: 100%		No: 0%		
	Frequency of patrolling	Daily during fire season: 100%		Alternate day: 60%	Once a week: 20%	Patrolling not carried out: 0%
2.	Nursery (weeding, protection from animals, planting stock)	Nursery created and well maintained (planting stock>50%): 100%	Nursery present but between 30%-50% planting stock: 80%	Nursery present but between 20%-30% planting stock: 50%	Nursery present but not well maintained: 10%	Not present: 0%
	Assisted Natural Regeneration (removal of invasive species, protection against disturbances, enhancing seed dispersal, native species encouraged)			Very good: 100%	Satisfactory: (above activities partially done): 50%	Unsatisfactory/not done: 0%
	Gap Planting (plantation of indigenous species, enrichment plantation, prevention of forest fire, maintenance operations)			Very good: 100%	Satisfactory: 50%	Unsatisfactory/not done: 0%
	Conservation of Biodiversity (including protection of wildlife): In-situ conservation and invasive species removal (preventing felling of trees, ban animal hunting, in-situ conservation, ex-situ conservation, identification of protected areas)			Very good: 100%	Satisfactory: (above activities partially done): 50%	Unsatisfactory/not done: 0%
3.	Prevention of grazing by patrolling and awareness	Barriers/ fences created to prevent grazing: 100%	Barriers/ fences are satisfactory: 50%	Partial grazing still occurring: 20%		Rampant grazing taking place: 0%

KEY FOR SCORING

Form-1 (b)

Verification Under PES Scheme
Reforestation
Transect Survey/ Spot Survey

Sl. No.		Observations				
1.	Closure of identified area from grazing, cutting of trees and bushes etc and other human activities	Protection is effective: 100%	Protection is satisfactory: 80%	Protection is satisfactory and grazing is minimal: 60%	Protection is moderate: 40%	Protection is not effective: 0%
	Patrolling by community members	Patrolling is being regularly carried out with effective outcome: 100%		Patrolling is not effective: 0%		
2.	Tree Planting of native species in blank areas	Tree planting of native species in blank area covering 60%-70% of the total area: 100%	Planting of native species in blank area covering between 40%-60% of the total area: 60%	Planting of native species in blank area covering between 20%- 40% of the total area: 40%	Tree planting not carried out: 0%	
3.	ANR and moisture conservation measures for inducing regeneration of dormant root stock (removal of invasive species, hoeing, etc)	Effectively done: 100%	Moderately done: 60%	Not satisfactory: 0%		
4.	Fire protection measures like watch, debris removal on the periphery, etc.	Effectively done: 100%	Moderately done: 60%	Not satisfactory: 0%		

KEY FOR SCORING

Form-1 (c)

**Verification Under PES Scheme
Afforestation
Transect Survey/ Spot Survey**

Sl. No.		Observations				
1.	Fire protection measures (watch, debris removal on the periphery, creation of patrol group)	Fire Protection is good: 100%	Fire protection is satisfactory: 80%	Fire protection is moderate: 60%	Fire protection is not satisfactory: 0%	
2.	Weeding	Area is >80% free of weeds: 100%	Satisfactory weeding: 70%	Moderate weeding: 50%	Not satisfactory: 0%	

KEY FOR SCORING

Form-1 (d)

**Verification Under PES Scheme
Soil & Water Conservation Measures
Transect Survey/ Spot Survey**

Sl. No.		Observations						
1.	Total length of contour trenches	contour trenches ≥ 100 m/ ha: 100%	contour trenches 80-100 m/ ha: 90%	contour trenches 60-80 m/ ha: 80%	contour trenches 40-60 m/ ha: 70%	contour trenches 20-40 m/ ha: 60%	contour trenches 10-20 m/ ha: 50%	contour trenches < 20 m/ ha: 0%
2	Maintenance of the trenches	Proper stabilisation of soil dug out and maintenance of the trenches: 100%		Satisfactory stabilization and maintenance of the trenches: 50%			Unsatisfactory/ not carried out: 0%	

KEY FOR SCORING

Form-1 (e)

**Verification Under PES Scheme
Transition from Jhum to Improved Agricultural Practices
Spot Survey**

Sl. No.		Observations		
1.	Practice of slash and burn on the land has stopped (Certificate from Nokma/ Headman to verify that the land was under shifting cultivation until last year)	Yes: 100%	No: 0%	
2.	No construction of houses or any other building done	Undertaken effectively: 100%	Partially done: 60%	Not done: 0%
3.	Whether orchard or tree plantation created on the land	Undertaken effectively: 100%	Partially done: 60%	Not done: 0%
4.	Improved agriculture practices like SALT, Organic Farming, use of vermi-compost being done on the land	Undertaken effectively: 100%	Partially done: 60%	Not done: 0%

Forms

Form-2 (a)

**Verification Under PES Scheme
Sustainable Management of Community Forests
Transect Survey**

Part-I

(i) District: (ii) Village: (iii) Block:
(iv) Name of the Activity:
(v) Id of the Activity:
(vi) Undertaken by PES Committee or Individual:
(vii) Name of Nokma/ Headman (if PES Committee)/ Individual:
(viii) Area (ha): _____ (ix) Amount disbursed so far (INR): _____
(x) Instalment (for which verification is being done):
(xi) Transect Length (m): _____

Part-II (a)

Sl. No.		Count	Total Count
1.	Felling of trees Count of felled trees (during the last 1 year)		
2.	Construction/ Encroachment Count of signs that indicate cutting of natural forests for raising plantation or construction		
3.	Forest Fire Count of forest fire signs		
4.	Grazing Count of grazing signs		

Part-II (b)

Sl. No.	Criteria	Observations				
1.	Forest fire line (creation and maintenance) (tick mark)	Width is $\geq 5m$ and fire line strip is free of debris (<10%)	Width is 4-5m and fire line strip has less than 30% debris	Width is 3-4m and fire line strip has less than 50% debris	Width is 3-4m and fire line strip has more than 70% debris	Unsatisfactory/ not done
	Formation of fire-watch patrolling squad (tick mark)	Yes		No		

	Frequency of patrolling (tick mark)	Daily during fire season	Alternate day	Once a week	Patrolling not carried out

2.	Nursery (weeding, protection from animals, planting stock) (tick mark)	Nursery created and well maintained (planting stock>50%)	Nursery present but between 30%-50% planting stock	Nursery present but between 20%-30% planting stock	Nursery present but not well maintained	Not present

3.	Assisted Natural Regeneration (removal of invasive species, protection against disturbances, enhancing seed dispersal, native species encouraged) (tick mark)		Very good	Satisfactory: (above activities partially done)	Unsatisfactory/ not done
	Gap Planting (plantation of indigenous species, enrichment plantation, prevention of forest fire, maintenance operations) (tick mark)		Very good	Satisfactory	Unsatisfactory/ not done
	Conservation of Biodiversity (including protection of wildlife): In-situ conservation and invasive species removal (preventing felling of trees, ban animal hunting, in-situ conservation, ex-situ conservation, identification of protected areas) (tick mark)		Very good	Satisfactory: (above activities partially done)	Unsatisfactory/ not done

4.	Prevention of grazing by patrolling and awareness (tick mark)	Barriers/ fences created to prevent grazing	Barriers/ fences are satisfactory	Partial grazing still occurring	Rampant grazing taking place

Verification Under PES Scheme
Reforestation
Transect Survey/ Spot Survey

Part-I

(i) District: (ii) Village: (iii) Block:
(iv) Name of the Activity:
(v) Id of the Activity:
(vi) Undertaken by PES Committee or Individual:
(vii) Name of Nokma/ Headman (if PES Committee)/ Individual:
(viii) Area (ha): _____ (ix) Amount disbursed so far (INR): _____
(x) Instalment (for which verification is being done):
(xi) Transect Length (m): _____

Part-II

Sl. No.		Observations				
1.	Closure of identified area from grazing, cutting of trees and bushes etc and other human activities (tick mark)	Protection is effective	Protection is satisfactory	Protection is satisfactory and grazing is minimal	Protection is moderate	Protection is not effective
		Patrolling is being regularly carried out with effective outcome		Patrolling is not effective		
2.	Tree Planting of native species in blank areas (tick mark)	Tree planting of native species in blank area covering 60%-70% of the total area	Planting of native species in blank area covering between 40%-60% of the total area	Planting of native species in blank area covering between 20%-40% of the total area	Tree planting not carried out	
3.	ANR and moisture conservation measures for inducing regeneration of dormant root stock (removal of invasive species, hoeing, etc) (tick mark)	Effectively done		Moderately done	Not satisfactory	
4.	Fire protection measures like watch, debris removal on the periphery, etc. (tick mark)	Effectively done		Moderately done	Not satisfactory	

Verification Under PES Scheme
Afforestation
Transect Survey/ Spot Survey

Part-I

(i) District: (ii) Village: (iii) Block:
(iv) Name of the Activity:
(v) Id of the Activity:
(vi) Undertaken by PES Committee or Individual:
(vii) Name of Nokma/ Headman (if PES Committee)/ Individual:
viii) Area (ha): _____ (ix) Amount disbursed so far (INR): _____
(x) Instalment (for which verification is being done):
(xi) Transect Length (m): _____

Part-II (a)

Sl. No.		Count	Total Count
1.	Planting of tree saplings as per the management guidelines (prescriptions) and the number of surviving plants per ha (Count of surviving plants)		

Part-II (b)

Sl. No.		Observations			
1.	Fire protection measures (watch, debris removal on the periphery, creation of patrol group) (tick mark)	Fire Protection is good	Fire protection is satisfactory	Fire protection is moderate	Fire protection is not satisfactory
2.	Weeding (tick mark)	Area is >80% free of weeds	Satisfactory weeding	Moderate weeding	Not satisfactory

Verification Under PES Scheme
Soil & Water Conservation Measures
Transect Survey/ Spot Survey

Part-I

(i) District: (ii) Village: (iii) Block:
(iv) Name of the Activity:
(v) Id of the Activity:
(vi) Undertaken by PES Committee or Individual:
(vii) Name of Nokma (if PES Committee)/ Individual:
viii) Area (ha): _____ (ix) Amount disbursed so far (INR): _____
(x) Instalment (for which verification is being done):

Part-II (a)

Sl. No.		Count	Total Count
1.	Number of contour trenches		

Part-II (b)

Sl. No.		Observation						
1.	Total length of contour trenches (tick mark)	contour trenches ≥100 m/ ha	contour trenches 80-100 m/ ha	contour trenches 60-80 m/ ha	contour trenches 40-60 m/ ha	contour trenches 20- 40 m/ ha	contour trenches 10- 20 m/ ha	contour trenches <20 m/ ha
2	Maintenance of the trenches (tick mark)	Proper stabilisation of soil dug out and maintenance of the trenches		Satisfactory stabilization and maintenance of the trenches		Unsatisfactory/ not carried out		

Verification Under PES Scheme
Transition from Jhum to Improved Agricultural Practices
Spot Survey

Part-I

(i) District: (ii) Village: (iii) Block:
(iv) Name of the Activity:
(v) Id of the Activity:
(vi) Undertaken by PES Committee or Individual:
(vii) Name of Nokma/ Headman (if PES Committee)/ Individual:
viii) Area (ha): _____ (ix) Amount disbursed so far (INR): _____
(x) Instalment (for which verification is being done):

Part-II

Sl. No.		Observations		
1.	Practice of slash and burn on the land has stopped (Certificate from Nokma/ Headman to verify that the land was under shifting cultivation until last year) (tick mark)	Yes	No	
2.	No construction of house or any other building done (tick mark)	Undertaken effectively	Partially done	Not done
3.	Whether orchard or tree plantation created on the land (tick mark)	Undertaken effectively	Partially done	Not done
4.	Improved agriculture practices like SALT, Organic Farming, use of vermi-compost being done on the land (tick mark)	Undertaken effectively	Partially done	Not done

Field Kit for Verification

1. GPS
2. Magnetic Compass
3. Measuring Tape
4. First Aid Kit
5. Hat
6. Bag
7. Machete
8. Water bottle

Field Kit for Measurement

1. GPS
2. Magnetic Compass
3. Measuring Tape
4. Digital Weighing Machine
5. First Aid Kit
6. Hat
7. Bag
8. Machete
9. Water bottle
10. Ropes