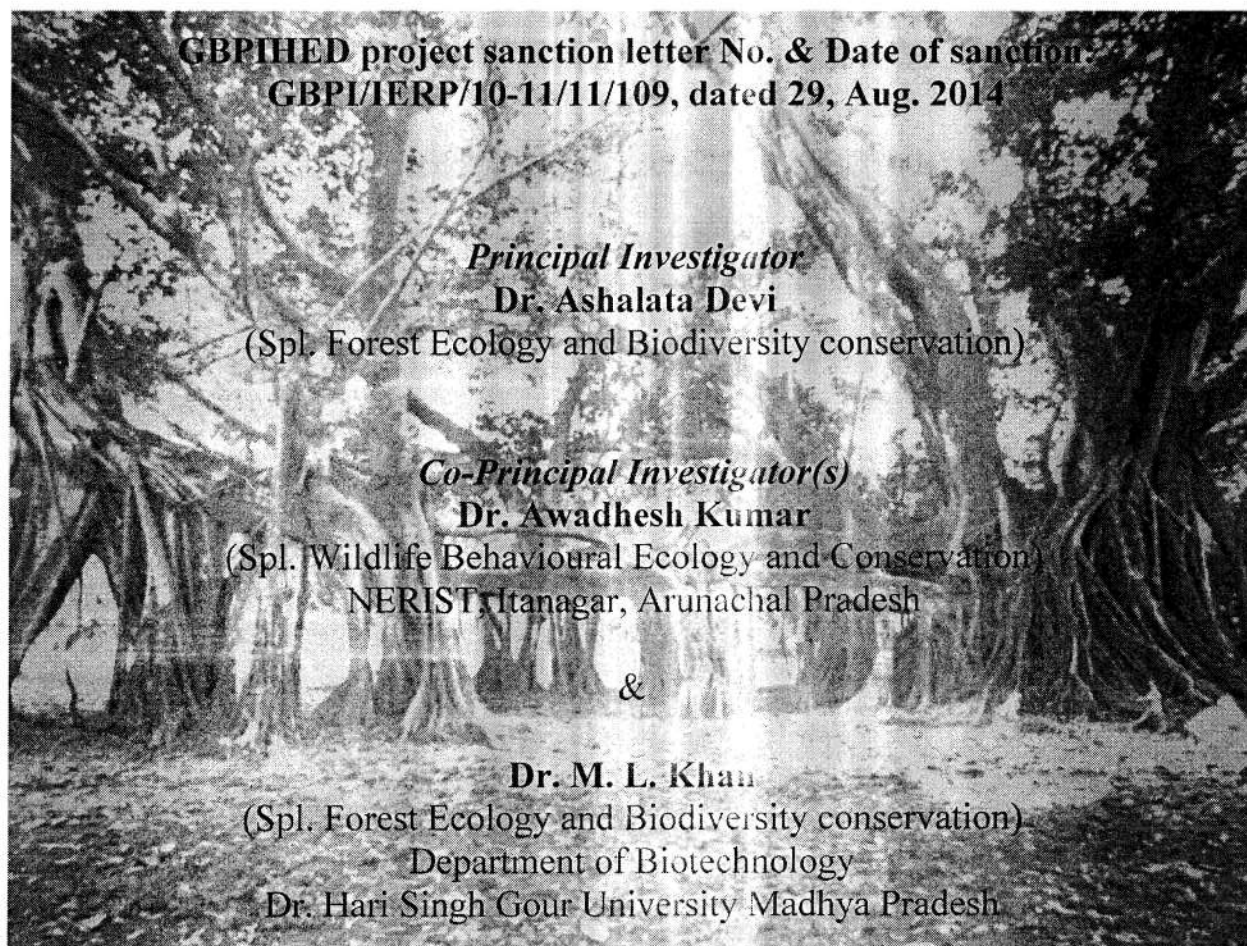


FINAL TECHNICAL REPORT
(26th Dec. 2014 to 25st Dec. 2017)

“Sacred groves of Assam: biodiversity status and strategies for their conservation”



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Summary of the project

The study was conducted to record the sacred groves in different parts of Assam during December, 2014 to December, 2017. In Assam, sacred groves are preserved based on the religious and cultural beliefs of the indigenous community. A semi structured questionnaire was used to investigate the biodiversity status and conservation strategies for protection of the sacred groves. A total of 282 sacred groves were recorded from 32 districts of Assam which are distributed within an altitudinal range of 11 m to 638 m amsl. The area of sacred groves range from 0.01 to 89 ha. Highest number of sacred groves was recorded in Tinsukia district (42) and lowest in five districts with 1 grove each. The total area covered by the sacred groves recorded 671.8 ha. Based on the nature of vegetation and landscape of sacred groves along with the associated deity sacred groves are classified into three categories i.e. Temple groves (272), Traditional groves (7) and Burial groves (3). Having highest number of Temple grove, Temple groves recorded highest area covering 396.5 ha. followed by the Traditional grove with 258.4 ha. and the Burial grove with 16.1 ha. The sacred groves comprised of natural and planted vegetation. A total of 42 plant species (30 trees, 7 shrubs, 2 herbs, 1 grass, 1 climber and 1 liana) belonging to 37 genera under 29 families are being recorded as sacred plants from the Temple groves. Out of these 42 sacred plants, 28 plant species (24 trees, 2 shrubs, 1 herb and 1 liana) are worshipped as whole while 14 plants species (6 trees, 5 shrubs, 1 herb, 1 grass and 1 climber) are used for different rituals and cultural practices. The most common worshipped plant species recorded are *Ficus religiosa* L. and *Aegle marmelos* (L.) Correa. This two sacred plant species are related to deities and gods of Hindus and non-tribal communities. Narikol (*Cocos nucifera* L.), Banana (*Musa paradisiaca* L.), Tamul (*Areca catechu* L.) and Paan (*Piper betle* L.) are most common offered plant species during rituals and cultural ceremonies. The floristic study was conducted in the three selected sacred groves i.e. Nanath sacred grove, Rajbari sacred grove and Bichikri sacred grove. A total of 98 species belonging to 93 genera under 53 family were recorded. Tree species contribute highest species (51%) followed by herbs (24.4%) and shrubs (14.2%). The highest species richness index for tree species was recorded in Rajbari sacred grove (5.8) followed by Nanath sacred grove (5.18) and Bichikri sacred grove (3). However, the species richness index for shrubs species was recorded highest in Bichikri sacred grove (1.56), followed by Nanath sacred grove (1.6) and Rajbari sacred grove (0.34). Also, the species richness index for herbs was recorded highest in Bichikri sacred grove (2.29), followed by Rajbari sacred grove (1.84) and Nanath sacred grove (1.57). The frequency, abundance, density (ha^{-1}), basal area (m^2ha^{-1}) and IVI was calculated of tree

species. The density of tree species was recorded highest in Nanath sacred grove (204) and lowest in Bichikri sacred grove (108) however for shrub species it was highest in Bichikri sacred grove (180) and lowest in Rajbari sacred grove (36). In Rajbari sacred grove, density of herb species was recorded highest (228), followed by Bichikri sacred grove (120) and Nanath sacred grove (45). Tree basal area ($\text{m}^2 \text{ha}^{-1}$) of the sacred groves was recorded highest in Rajbari sacred grove (14.8) followed by Bichikri sacred grove (13.4) and found lowest in Nanath sacred grove (5.8). However, three selected sacred groves showed contagious distribution pattern.

From the study, it was observed that sacred groves of Assam are vulnerable to various anthropogenic and developmental activities though indigenous communities have strong approach of protection with respect to their socio-cultural and religious practices. Out of the 282 sacred groves of Assam, 59% of the sacred groves are highly threatened, 31.2% are moderately threatened and 9.5% are least threatened. The highest conservation status was recorded in Traditional groves and lowest in Temple groves and Burial groves. Most of the sacred groves do not have well fenced boundaries. This allows porous infiltration for extraction of natural resources from the sacred groves. The anthropogenic activities like urbanization and modernization has affected the biodiversity of Temple groves to a larger extent. Hence, there is a need of protection and conservation of the landscape and biodiversity of sacred groves of Assam.

Follow –up action to be taken on the recommendations-

- a. Recognition of sacred groves having dense natural vegetation and landscape as ‘protected area’ and promote sustainable eco-tourism.
- b. Government should search for alternative ways for any developmental activities where sacred groves are to be encroached or destroy.
- c. Assam State Biodiversity Board, Assam should take up initiative for conservation and promotion of sacred groves through awareness campaign and sensitization programme.
- d. Promotion of socio-cultural and religious practices of indigenous communities that strength the conservation of biodiversity at various local levels through public media or workshop.

(PART - II)

1. Preface

The concept of sacred groves reflects the meaning of nature worship performed by various indigenous community across the world. They are considered as “Sacred Natural Sites” as per the definition provided by IUCN. The indigenous communities dedicate a patch of landscape or vegetation to the local deity where they perform various cultural and religious practices since time immemorial. These indigenous practices have enriched the conservation of biodiversity in general and particularly in the sacred groves. In Assam, different indigenous communities play a significant role in management and conservation of sacred groves. The historical epics and legends associated with the sacred groves have made the ethnic communities to conserve and protect the diverse flora and fauna of sacred groves in natural their form. Based on deities associated with the sacred groves, the sacred groves have been classified into three categories i.e. Temple groves, Traditional groves and Burial groves. The area of the sacred groves range from 0.01 ha to 89 ha. approximately. Some of the recorded sacred plant species from the sacred groves are aged old tree species which are linked with the historical epics and legends of Hindus and tribal communities. These sacred plants are consider as incarnation of the god, goddesses or deity and worshipped by the indigenous communities. In temple groves, the leaves, fruits and flowers of trees are offered for the celebrations of the deity. Also, sacrificial activities are conducted in the temple groves associated to female deity. The Temple groves are found to be highest followed by Traditional groves and Burial groves. However, the conservation status was recorded highest in Traditional groves as compared to Temple groves and Burial groves. The extraction of the natural resources from Temple groves have been recorded in many parts of Assam and anthropogenic activities like, urbanization and modernization has been affecting the temple groves. This practices has affected the religious and cultural beliefs of the present generation. Therefore, a proper management and conservation strategies needs to be formulate and taken up for protecting these sacred groves.

2. Abstract of the project

Sacred groves are the most valuable ecosystems in the world which are protected by indigenous communities in well mannered. Assam, a state in northeast India has rich ethnic diversity. Several indigenous communities of the state have protected the sacred groves through their traditional and cultural beliefs but the extent of sacred groves had not been documented and studied. Therefore, an inventory was conducted using semi structured questionnaire survey in all the districts of Assam from December, 2014 to December, 2017. The aim of the study was to document the sacred groves of Assam, their biodiversity status and strategies for its conservation. A total of 282 sacred groves were recorded from 32 districts of Assam which are distributed within an altitudinal range of 11 m to 638 m amsl. The area of sacred groves was in range from 0.01 to 89 ha. The vegetation of sacred groves comprised of natural and planted trees along with shrubs and herbaceous plants. A total of 42 plant species (30 trees, 7 shrubs, 2 herbs, 1 grass, 1 climber and 1 liana) belonging to 37 genera under 29 families are recorded as sacred plants from the Temple groves. Out of these 42 sacred plants, 28 plant species (24 trees, 2 shrubs, 1 herb and 1 liana) are worshipped as the whole plant while parts of the plant of 14 plant species (6 trees, 5 shrubs, 1 herb, 1 grass and 1 climber) are used for different rituals and cultural practices. The most common worshipped plant species are *Ficus religiosa* L. and *Aegle marmelos* (L.) Correa. This two sacred plant species are related to deities and gods of Hindus and non-tribal communities. Narikol (*Cocos nucifera* L.), Banana (*Musa × paradisiaca* L.), Tamul (*Areca catechu* L.) and Paan (*Piper betle* L.) are most common offered plant species used in rituals and cultural ceremonies. The floristic diversity was studied in the three selected sacred groves namely Rajbari sacred grove, Nanath sacred grove and Bichikri sacred grove. The Margelef's species richness index for tree species was recorded highest in Rajbari sacred grove (5.82) followed by Nanath sacred grove (5.18) and Bichikri sacred grove (3.0). However, the species richness index of shrubs species was recorded highest in Bichikri sacred grove (1.56), followed by Nanath sacred grove (1.6) and Rajbari sacred grove (0.34). Also, the species richness index of herbs was recorded highest in Bichikri sacred grove (2.29), followed by Rajbari sacred grove (1.84) and Nanath sacred grove (1.57). In terms of conservation status of the sacred groves of Assam, 59% of the sacred groves are highly threatened, 31.2% are moderately threatened and 9.5% are less threatened.

3. Highlights of the findings achieved in the project

The major findings of the project includes

1. A total of 282 sacred groves were inventoried from the 32 districts of Assam.
2. The Temple groves recorded highest number of sacred groves followed by Traditional groves and Burial groves.
3. The indigenous communities of Assam plays an important role in conservation of the sacred groves.
4. *Ficus religiosa* L. and *Aegle marmelos* (L.) Correa are the most common worshipped sacred plants recorded from Temple groves.
5. In 'Jaikhata Than' of Barpeta district, *Ficus benghalensis* L. and *Ixora coccinea* L. plant are recorded to be more than 200 years old.
6. The Assamese community believes that during Ambubachi festival, celebrated in every month of June, the temple groves should be closed for 3 days. The legend carries the menstrual cycle of Goddess Kamakhya.
7. The sacred ponds/tanks were recorded from Sibsagar district. This sacred ponds/ tanks harbour rich flora and fauna, as it was preserved since 500 years ago, as per the record of the care taker. Different migratory birds visit to this place during winter season.
8. In 'Bichkri' grove of West Karbi Anglong district, a sacred pond was recorded and local people believe that the pond water rises up during winter season and goes down during summer season. This sacred belief has led in conservation of different species of fishes which are preserved since ancient period.
9. In 'Deo Than' of Jorhat district, different communities tie red ribbons in the sacred tree *Ficus religiosa* L. (Ahot) growing in the grove whereas in the 'Kendurguri devalaya', Assamese communities tie a white ribbon on *Diospyros malabarica* (Desr.) Kostel (Kendu) to fulfil their wishes.

4. Detailed report of work done on the project

(a) Objectives as stated in project proposal

1. Inventory of sacred groves of Assam
2. Study on floristic diversity, community structure and regeneration status of sacred groves

3. Investigation of the biodiversity value and status of the sacred groves
4. Finding of underlying factor of degradation, and
5. Data base management and formulation of conservation strategies of the sacred groves of Assam

(b) Methodology

1. Inventory of sacred groves

For the inventory of sacred groves, an extensive field survey was carried out in different parts of Assam. Through semi structured questionnaire detail information of the sacred groves were recorded. Initially, Assam State Archives, Guwahati was visited and records of sacred groves were reviewed. Due to less available information on sacred groves in archives, an extensive field survey in different districts of the state was conducted using a semi structure questionnaire. A semi-structured questionnaire was prepared to collect information and relevant data on the sacred groves like, history, size, location, nature of vegetation, deity worshipped, spiritual or traditional belief, festival or celebrations, associated taboos and causes of degradation. Gao Buras (Village headman), care takers and priest of sacred groves were personally communicated for identifying the sacred groves located under their area or jurisdiction. Different groups of age people belonged to aged old people, middle aged people and young people were informally interviewed to collect more necessary information regarding their culture, belief, taboos and conservation status in order to find out how far they are conserving or eroding the sacred groves in these modern society. Geographical locations (area of the sacred groves and altitudinal range) of the sacred groves were recorded using GPS Gramin Oregon 550. The recorded areas are an approximate area taken in confidence from the owner and care taker since most of the groves do not have well fenced or proper boundary.

2. Study on floristic diversity, community structure, regeneration status of sacred groves

For studying floristic diversity three sacred groves; Nanath sacred grove, Rajbari sacred grove and Bichikri sacred grove has been selected. Phytosociological study was carried out using random quadrat and standard taxonomic method was followed for identification of plant species. A nested quadrat of 10m x 10m, 5m x 5m size and 1m x 1m size were used for trees, shrubs and

herbaceous plant species, respectively. 50 quadrats were laid for trees and shrubs while 100 quadrats for herbs. All the individuals of tree species within the quadrat were measured and grouped as adults (≥ 30 cm girth at breast height of 1.3 m), saplings (< 30 cm collar circumference at the base and > 20 cm in height) and seedlings (< 20 cm height). For each tree species, density (trees ha⁻¹) and basal area (m²ha⁻¹) were calculated. Species richness (Whittaker, 1972), community quantitative parameters such as frequency, density, abundance and basal area was measured by the formula of Cottam and Curtis (1956). Importance Value Index (Curtis, 1959) was calculated (Mori et al., 1983). Different diversity indices such as Margalef's species richness index (Margalef, 1958), Shannon-Wiener index of diversity (Shannon and Weiner, 1963), Simpson's index of dominance (Simpson, 1949), Evenness index by Pielou (Pielou, 1963), Whitford index (Whitford, 1948) was applied to quantify definite diversity.

The regeneration status of tree species was determined based on the girth size of tree species (Khan *et al.*, 1987; Shankar, 2001; Khumbongmayum, 2006).

Physico-chemical characteristics of the soil like pH, Water Holding Capacity (WHC), conductivity, bulk density, total nitrogen, total carbon, potassium and phosphorus were determined following standard methods to have the information on basic properties of soil of the selected sacred groves.

3. Investigation of the biodiversity value and status of the sacred groves

Based on the information and data recorded from the sacred groves of Assam, the biodiversity value was documented. The conservation status on the sacred groves of Assam were given through people perception towards the sacred groves, nature of protection, restrictions for people and use of sacred groves resources. Study on sacred plants was also conducted to investigate the degree of conservation and preservation by the indigenous communities through their traditional and cultural beliefs on these plants and groves. A semi structure questionnaire was conducted to get the idea of different age class people towards their perception and role in conservation on these sacred groves. People were classified into 3 age groups i.e. 15-25 years; 26-50 years and 60-100 years of age. Gao Buras (Village headman), care takers and priest of the sacred groves were primarily included in this interviewed session.

4. Finding of underlying factor of degradation

Based on the data obtained from objective 1, 2 and 3, the factors for degradation of sacred groves was analyzed. However, to be mentioned, most of the sacred groves are already degraded before being inventoried and documentation.

5. Data base management and formulation of conservation strategies of the sacred groves of Assam.

Based on the data acquired during the inventory of the sacred groves in different districts of Assam, a conservation measures and management plan has been formulated. The conservation measures are intended for the overall protection and conservation of the sacred groves and sacred plants recorded in the sacred groves. The measures are particularly towards the protection of biodiversity of the region as anthropogenic activities is playing a negative role in the sacred groves conservation.

(c) Result

Inventory of sacred groves

A total 282 sacred groves are recorded from 32 districts of Assam during December, 2014 to December, 2017. The recorded sacred groves are distributed within an altitudinal range of 11 m to 638 m amsl. The area of sacred groves was ranged from 0.01 to 89 ha. The total area covered by recorded sacred groves is 671.8 ha. Distribution map of recorded sacred groves from each districts of Assam is given in Figure 1. Highest number of sacred groves was recorded in Tinsukia district (42) and lowest in Baksa district, Kamrup metro district, Hojai district and Charaideo district and Udaiguri district having only 1 sacred grove. Based on the nature of vegetation associated and cultural practices to the sacred groves, the sacred groves were classified into three categories, i.e. Temple groves, Traditional groves and Burial groves. The Temple groves are sacred areas where a temple is surrounded by different plant species with more or less definite boundary, where god and goddess of Hindu mythology are worshipped. A total of 271 Temple groves from 32 districts have been recorded ranging from 0.01 ha to 24 ha. at an altitudinal range of 11 m to 937.8 m and the total area covered by the Temple groves is 334.25 ha. These Temple groves are known by different names like, *Ashram*, *Devalaya*, *Dham*,

Doul, Mandir, Sarra, Buddha vihar or *Monastery* and *Than*. The Temple groves are worshipped by the indigenous communities namely, Assamese, Bengali, Bihari, Bodo, Marwari, Nepali, Sonowal kachari and Tiwa.

The Traditional groves are the sacred natural forest spread in larger landscape where strong taboos are present. During the study 7 Traditional groves were recorded from West Karbi Anglong district. The Traditional groves are named based on their village name. The area of Traditional groves range from 64.2 ha. to 89 ha. at an altitudinal range of 105 m to 638.5 m and covers a total area of 323.35 ha. The community involve in this groves are Karbis.

The Burial groves are burial grounds which are sacred areas worshipped by the Ahom community. A total of 3 Burial groves locally known as '*maidam*' were recorded from Dibrugarh, Charaideo and Jorhat district. The total area cover by '*maidam*' was 16.1 ha. distributed in an altitudinal range of 99 m to 109 m amsl.

Study on floristic diversity, community structure and regeneration status of sacred groves

For detailed study on floristic diversity, community structure and regeneration status, three sacred groves namely, Nanath sacred grove, Rajbari sacred grove and Bichikri sacred grove (Table 1) were selected based on the criteria of their natural vegetation coverage and association of indigenous community. A total of 98 plant species belonging to 93 genera under 53 families are recorded from the selected three sacred groves. Trees recorded highest number of species having 50 species belonging to 46 genera under 29 family followed by shrubs with 14 species (14 genera and 11 family) and 24 herb species (24 genera and 17 family). 5 species of climber or vine and 5 species of grass are recorded from these selected sacred groves. In tree species, Leguminosae family (7) recorded highest number of species, followed by Meliaceae and Moraceae having 4 species each. In shrubs, Leguminosae, Apocynaceae and Lamiaceae were the dominant family having 2 species each and in herbs Compositae (4) was the dominant family followed by Amaryllidaceae, Araceae and Lamiaceae with 2 species each.

The Species richness, diversity index, evenness index and whitford index in three selected sacred groves was also calculated and given in Table 2. The Margelef's species richness index of tree species was recorded highest in Rajbari sacred grove (5.82) followed by Nanath sacred grove (5.18) and Bichikri sacred grove (3.0). The species richness index of shrubs species was recorded

highest in Bichikri sacred grove (1.56), followed by Nanath sacred grove (1.3) and Rajbari sacred grove (0.34). The species richness index of herbs was recorded highest in Bichikri sacred grove (2.29), followed by Rajbari sacred grove (1.84) and Nanath sacred grove (1.57).

The frequency, abundance, density (ha^{-1}), basal area (m^2ha^{-1}) and IVI values of tree species is given in Table 3. The density of tree species was recorded highest in Nanath sacred grove (204), followed by Rajbari sacred grove (146) and Bichikri sacred grove (108). The density of shrub species was recorded highest in Bichikri sacred grove (180) followed by Nanath sacred grove (78) and Rajbari sacred grove (36). The density of herb species was recorded highest in Rajbari sacred grove (228) followed by Bichikri sacred grove (120) and Nanath sacred grove (45). However, the basal area ($\text{m}^2 \text{ha}^{-1}$) of the sacred groves was recorded highest in Rajbari sacred grove (14.8) followed by Bichikri sacred grove (13.4) and found lowest in Nanath sacred grove (5.8). In shrub species, basal area ($\text{m}^2 \text{ha}^{-1}$) was recorded highest in Nanath sacred grove (0.02), followed by Bichikri sacred grove (0.003) and Rajbari sacred grove (0.0008). In herb species, basal area ($\text{m}^2 \text{ha}^{-1}$), was recorded highest in 'Nanath' grove (1.68) followed by Bichikri sacred grove (0.64) and Rajbari sacred grove (0.15). The distribution pattern of species recorded contagious distribution in the selected three sacred groves.

Study on regeneration status revealed that in Nanath sacred grove, out of the 25 tree species, 28 % species exhibit 'poor', 25 % species exhibit 'fair', 25 % species exhibit 'good' and 12 % species exhibit 'none' and 4 % species are 'new regenerating'. In Rajbari sacred grove, out of 26 tree species, 50 % species exhibit 'fair', 19 % species exhibit 'good', 15% species exhibit 'none' and 11 % species show 'poor'. In Bichikri sacred grove, out of 15 tree species, 26 % species showed 'good', 26 % species showed 'fair' regeneration, 20% species showed 'none' and 20 % showed 'poor' regenerated (Table 4).

The pH of the sacred groves is slightly acidic to neutral. The lowest pH was recorded in Bichikri sacred grove (5.2) and highest in Rajbari sacred grove (7). The Nanath sacred grove recorded pH of 6.5. The conductivity (ms cm^{-1}) was found in the range of 0.06 to 0.15. The highest conductivity was recorded in Bichikri sacred grove followed by Nanath sacred grove (0.09) and Rajbari sacred grove (0.06). The water holding capacity was recorded highest (44.21%) in Bichikri sacred grove and lowest (32%) in Nanath sacred grove. The total nitrogen (%) does not

show much difference in the three sacred groves. The organic carbon was found highest in Rajbari sacred grove (2.8) followed by Nanath sacred grove (1.53) and Bichikri sacred grove (1.33). The available phosphorus was recorded lowest in Bichikri sacred grove (4.9) followed by Nanath sacred grove (5.8) and Rajbari sacred grove (5.4). The exchangeable potassium was recorded highest in Nanath sacred grove (0.037), followed by Rajbari sacred grove (0.035) and Bichikri grove (0.024).

Investigation of the biodiversity value and status of the sacred groves

Out of the total 282 inventoried sacred groves of Assam, a total of 272 sacred groves are recorded as Temple groves. 153 Temple groves are allied with deity Shiva where Hindus and Bodo community worshipped regularly. During Vedic period, Shiva was a god of mountains and worshipped by the pastoral tribes of Assam (Barman, 1995). Therefore, Shiva is considered as the main deity of Assam. Shiva is known by different names in Assam, i.e. *Dangoria baba* and *Bathow*. The female deity Durga with other avatars of Durga, were also recorded in 56 Temple groves of Assam. Sacrifice of animals like, buffalos and goats are performed in Temple groves associated with female deities to pacify the deity and to protect the society from evils spirits. In addition to animal sacrificed plants like, sugarcane (*Saccharum officinarum* L.) and ash gourd (*Benincasa hispida* Thunb. Cogn.) are also sacrificed during the worship and celebration of the female deity. At 'Gojai Than' a pair of white bird (chicken or duck) is sacrificed on the occasion of Gojai puja. These celebrations were performed since ancient times and still the tradition of celebration in Temple groves is maintained.

The vegetation in Temple groves are comprised of natural and planted trees. Many initiative had already been made from the government for plantation of tree in these groves which has conserved the area from degradation. The management of Temple groves is done by the owner of the grove or by the committee members. The committee members are appointed by the villagers for 3-5 years. In some Temple groves, it has been found that only village people managed the groves. The Temple groves which are of archeological significance are protected under 'The Ancient Monuments and Archaeological Sites and Remains Act, 1958', Govt. of India. The 'Shiva Kunda' and 'Shira jakhala' sacred groves are protected under the Forest department of Assam. A total of 42 plant species (30 trees, 7 shrubs, 2 herbs, 1 grass, 1 climber and 1 liana)

belonging to 37 genera under 29 families are recorded as sacred plants. Out of these 42 sacred plants, whole plant of 28 plant species (24 trees, 2 shrubs, 1 herb and 1 liana) are worshipped with the conviction of incarnation of some deities while parts of the plant of 14 plants species (6 trees, 5 shrubs, 1 herb, 1 grass and 1 climber) are used in different rituals and cultural practices during the celebrations in the Temple groves. The worship of sacred trees like Ahot (*Ficus religiosa* L.), Tulsi (*Ocimum sanctum* L. and *Ocimum tenuiflorum* L.), Rudraksha (*Elaeocarpus serratus* L.), Bel (*Aegle marmelos* L. Correa) and Ashok (*Saraca asoca* (Roxb.) Willd.) are very common among the Hindu society. Assamese community worship Tulsi plant. Bodo worship Siju plant (*Euphorbia antiquorum* L.) in Bathow puja during Kherai festival. In this occasion, the Bodo community offer fruits, flowers and grains (rice) to worship the sacred plant which is called as the *Bwai Bathow*. The tea tribes also have got a sacred plant called as Karam (*Mitragyna parvifolia* (Roxb.) Korth.) which is worship during Karam puja. It is related to the harvest and the Karam tree symbolises fertility and prosperity of the society. Moraceae recorded highest sacred species (6) followed by Fabaceae (2) and Apocynaceae (2). *Garcinia xanthochymus* Hook.f. ex T. Anderson and *Ardisia elliptica* Thunb. are found to be linked with Vishnu Parva of Mahabharata in 'Hudupara than' of Sonitpur district. *Ficus religiosa* L. (129 individual trees) and *Aegle marmelos* (L.) Correa (86 individual trees) are recorded as the most dominant worship plants. From the semi structured questionnaire, it has been found that the worship plants are incarnation of god of tribal community and Hindus. *Ficus religiosa* L. is considered as the incarnation of different deities or Gods of Hindu mythology and different community worship the same species in their own traditional beliefs. The Bor (*Ficus bengalensis* L.) represented as the *Trimurti* i.e. Lord Brahma, Lord Vishnu and Lord Shiva known for the creation, preservation and destruction of the universe. In 'Deo Than' Assamese and Bengali tie red ribbons or threads in the sacred tree Ahot (*Ficus religiosa* L.) (Figure 2) in relation to thier devotion. While in 'Dangoria baba Than' of Kaliapani at Dibrugarh district (Figure 3) Bengali community offers coconut tied in red cloth to the deity 'Dangoria' incarnation of Lord Shiva to fulfil their wishes. The coconut is also resembled as Lord Shiva and three black marks on it are believed as his eyes. At Barpeta district, 'Ganakuchi Satra' *Ixora coccinea* L. (Figure 4) a scared plant is recorded to be very old. The nearby people believed that this plant was planted by Shri Madhavdev (Vaishnava saint in Assam) who lived there for 18 years. At Barpeta, Jalikata Than

(Figure 5), Ahot (*Ficus benghalensis* L.) is recorded to be approximately 200 years old. Tai-Shan community also has a custom to plant *Ficus religiosa* L. before the construction of 'Buddha vihar', also known as Buddha monastery recorded from Dibrugarh, Tinsukia and Jorhat district. Assamese monastery known as 'Satra' are recorded from Jorhat and Barpeta district. In all the recorded monasteries of Assam, sacrificial activities are not performed. In Temple groves, people offer pigeons and goats when their wish gets fulfilled or to overcome problems related with their prosperity.

Sacred water bodies are important in sacred groves. 8 ponds are recorded from 8 Temple groves, out of which 3 ponds, Hoieswar Devalaya, Nag Shankar mandir and Kalyani Devalaya are recorded from Sonitpur district, where Hoieswar Devalaya and Nag Shankar mandir are protected ponds. 'Rudra Shiva Doui' of Sivasagar district and 'Shiva kunda' of West Karbi Anglong district are the 2 sacred ponds, while 'Bura Madhav' Devalaya pond from Biswanath district are used for fish farming by local people for their livelihood. At 'Nag Shankar mandir' turtles and ducks are protected in the pond preserving as an *ex situ* conservation. In 'Dakhinpath satra' of Majuli, deer and rabbits are domesticated in the form of *ex situ* conservation (Figure 6).

In the area of Traditional groves the elementary entity of the deities are not present. The Karbi tribe believes that the sacred forests are owned by deities and misconduct inside these forests will create problem to their society. They believe that there should not be any misconduct inside the grove and people should enter the groves with bare foot as it is a virgin forest. The deities are commonly known as *Sarpo* and groves are named on the village names. In these groves, celebrations are performed only once a year where animal are sacrificed (goat and hen). Through semi structured questionnaire survey, the local people have informed that wild animals like mongoose, squirrel, pigeon, lizard, bat, snake, goat, tiger, boar, wild pig and fowl also found in natural groves as it is an natural forest.

The forest floor of 'Bichikri' grove of West Karbi Anglong district is covered by undecomposed and partially decomposed litter as the local people do not collect any natural resources from this grove. However, if anyone needs to use the dead and fallen branches for domestic used then they have to take permission from the forest deity '*Sarpo*' by offering betel and areca nuts. 2 sacred ponds are recorded from 'Bichikri' and 'Somope' groves.

In the 'Burial sacred grove', Ahom community worship their ancestors in these '*maidam*' on the auspicious occasion celebrated every year. They believe that worshipping their ancestral forefathers in the '*maidam*' they will get blessing for their family and society to overcome from dangerous events.

Status of sacred groves

Out of the 282 recorded sacred groves of Assam, 166 of the sacred groves are highly threatened, 90 are moderately threatened and 26 are less threatened. The main cause of degradation of vegetation cover in sacred groves are urbanization, developmental activities and change in people attitudes' towards the conservation of sacred grove. Losing faith on cultural and ethical values towards the sacred groves has also resulted to degradation of the sacred groves. The anthropogenic activities, modernization and up gradation of old structure temples to new form of temple has led to cutting of vegetation cover in Temple groves. It was recorded that sacred groves situated in cities are more degraded than the sacred groves found in sub urban and rural areas. The reason for this is due to construction of highways and development of the region for the progress of the society.

Based on the informal interview conducted using semi-structure questionnaire in the area of the three selected sacred groves, it has been found that the conservation of sacred groves was high in Bichikri sacred grove (81%) followed by Rajbari sacred grove (65%) and Nanath sacred grove (50%). In Rajbari and Nanath sacred groves, individuals of the lower age group have very little knowledge on sacred groves. The middle age class wants to conserve the sacred groves but due to modernization and economic problems they are not prepared to engage in conservation activities. However, aged old individuals' share that they have seen their nearby sacred groves as a dense forest during their childhood but, now the sacred groves are left with small area of land having countable number of trees. According to them the present condition of sacred groves is due to over population and immigrants to Assam. They have also mentioned that people are moving more towards modern lifestyle, losing their indigenous traditional values and practices which have resulted in degradation of natural vegetation of sacred groves and their values. It was observed from aged old people living nearby the Rajbari sacred groves, that in past years they frequently visit Rajbari sacred groves for fresh air as it was a dense forest covered with different

plant species of varied habits. But, now the area is being modernized and most of trees have already been cut for development of the grove. A revolution has been observed in recent time, as people are giving more importance to earn and gain monetary accounts. They stated that the natural degradation of forests can be seen from this Temple grove destruction. The Mishing community of Nanath sacred grove and Meitie community of Rajbari sacred grove use medicinal plants available from the Temple groves. But they mentioned that some important medicinal plants that are available before are not present nowadays.

(d) Discussion and analysis

Sacred groves not only serve as the repository of species but also provide various ecosystem services. They maintain the healthy ecosystem or habitat, conserve the viable population of pollinators and predators, preserved the indigenous flora and the cultural and ethical practices developed through indigenous knowledge of generations (Godbole *et al.*, 1998, Khiewtam 1986, Ramakrishnan and Ram 1988, Singh *et al.*, 1998). In India, around 1,00,000 to 1,50,000 sacred groves are distributed in 19 out of 28 states (Malhotra *et al.*, 2001). In north eastern India, it has been revealed through several studies that various ethnic groups have preserved and protected a large number of forest patches and even individual trees and animals (Khumbongmayum 2004). The sacred groves recorded from Meghalaya, Manipur, Arunachal Pradesh, Sikkim and Assam have acquired rich source of biodiversity. Tiwari *et al.* (1998) inventoried 79 sacred groves in Meghalaya and Khumbongmayum *et al.* (2004) inventoried 166 sacred groves in Manipur. The number of sacred groves in Meghalaya has increased to 125 sacred groves as surveyed by the Meghalaya forest department (Meghalaya forest board, 2016). In Arunachal Pradesh the total of 101 sacred groves have been recorded which are called as 'Gompa forest areas' attached to Buddhist monasteries (Khan *et al.*, 2008). However, present study in Assam recorded a total of 282 sacred groves which is higher than the sacred groves recorded from other states of North east India.

Every sacred grove is important in respect to its historical background and associated flora and fauna. All sacred groves are found to be very ancient and are being preserved due to legends associated to the groves. Gadgil and Vartak (1975) had traced the historical link of sacred groves to the pre-agricultural, hunting and gathering society. The present study exhibit, Temple groves

are highest in number with 96.4% followed by Traditional groves with 1.2% and Burial groves having 2.4%. The Temple groves has many historical significance for which it has been conserved. In Puducherry, 123 patches of sacred groves were recorded in around the temples (CPREEC, 2016). It has been recorded that different communities are found to worship more than one deity in sacred groves and in some sacred groves it is seen that only one sacred tree is attached to the temple. The non-tribal community's worship the sacred trees as symbol of Gods or deity. The other important sacred plants recorded in most of the sacred groves of Assam are *Ficus religiosa* L. and *Aegle marmelos* (L.) Correa. This two plants has occupied most of the sacred groves because of its association with the diety. Bel (*Aegle marmelos* (L.) Correa) symbolizes to Lord Shiva and leaves of Bel are offered to Lord Shiva during ritual functions. The Banana plant recorded from Temple groves is also considered as sacred plant and leaves, fruit and stem is used in offering for different ritual activities in the Temple sacred groves. In Ireland, the yew tree (*Taxus baccata* L.) is regarded as sacred and protected in church yards and its use as a symbol of life and death resulted in its being a heraldic icon (Delahunty, 2002). Sacred ponds were also reported from the sacred groves of Assam. In 'Dotobaa' sacred grove in Ghana the god is consider as abode of Oman boson (state god) which is represented by sacred pond "Tadie" and local people believed that the tusk of an elephant can be seen in the pond (Sarfo-Mensah *et al.*, 2010).

Sacred groves occur in various forms, including burial grounds (Mgumia and Oba 2003; Wadley and Colfer 2004). Many sacred burial grounds have been reported from different parts of India. A Sasan burial sacred grove is reported in Chhotanagpur by Fernandes (1993). In Assam, only 3 Burial groves known as '*maidam*' were inventoried in which the Ahom community worship. All the *maidam* are under 'The Ancient Monuments and Archaeological Sites and Remains Act, 1958', Govt. of India' and they preserve this Burial grove. However, the conservation status was found to be weak since no measures are taken up for the conservation of vegetation cover in this groves.

The sacred groves shelter number of medicinal plants of great value not only for the primary health care of the village communities, but also for the modern pharmacopoeia (Swamy *et al.*, 2003). The tribal communities are dependent on different species of plant and animal for their livelihood and health care, associated with their indigenous folk lore and tradition. During

inventory, the highest conservation status of sacred groves was recorded in Karbi community due to their strong beliefs in socio-religious and associated taboos towards extraction of natural resources. In tribal societies, religion began as conglomeration of ideas, attitudes, creeds and acts of supernaturalism, beyond the realm of the normal (Pal, 2015). It has been reflected from the responses of Karbi community showing very high conservation status in West Karbi Anglong district. The West Karbi Anglong district comprise of dense natural vegetation having high degree of conservation and protection. From the selected sacred groves, the 'Bichikri' sacred grove has highest conservation status as the community have very strong taboos towards the conservation of forest patch. From the three classified sacred grove, Traditional groves are more protected than the Temple grove and Burial groves as the community involvement towards conservation is more in the Traditional groves. The urbanization, modernization and various developmental activities are the main causes of degradation to the Temple grove and Burial groves. In Temple groves, diversion of religion and changes in cultural values had resulted a serious concern towards the conservation and protection of existing sacred groves. In Meghalaya, tribal religion and culture has been largely replaced by Christianity which has led to lessening of beliefs in traditional religion (Ormsby, 2013). This change in people attitudes towards the sacred groves has resulted in encroachment activities and cutting down of trees and resource extraction from the sacred groves to meet their subsistence requirements. The sacred groves situated in urban areas are more effected from the vegetation destruction. Rajesh (2016) stated that fragmentation of the groves, migration of young generations towards urban area, erosion of cultural and religious beliefs and taboos are some of the factors for disappearance and reduction of sacred groves.

The floristic diversity conducted in three selected sacred groves recorded a total of 98 species belonging to 93 genera under 53 family. Tree species contribute highest species (51%) followed by herbs (24.4%) and shrubs (14.2%). In tropical forests, trees form the major structural and functional basis of forest ecosystems and serve as important indicators of changes and stressors of the landscape (Jayakumar and Nair, 2013). Quantitative study on tree species diversity is an important aspect as it provides resources and habitat for many species (Cannon *et al.*, 1998). Altitudinal gradients comprise of climatic variables which influence the distribution of plant species (Korner, 2007). The plant species recorded from Nanath and Rajbari sacred groves are

almost similar because of their same altitudinal range. However, in Bichikri sacred grove the species composition varies because of variation in altitude, micro climatic and edaphic condition. The dominant species from the Nanath sacred grove is *Mangifera indica* L., in Rajbari sacred grove it is *Toona ciliata* M. Roem. and in Bichikri sacred grove it is *Tectona grandis* L.f. This plant was recorded as a sacred plant in Temple groves. The flowers are used in worship Lord Shiva especially on the Shivaratri day (Sahu *et al.*, 2013). The Nanath sacred grove is a Temple grove where Lord Shiva is worship for which *Mangifera indica* L. is recorded as a dominant species. In Rajbari sacred grove, *Toona ciliata* M. Roem is a sacred plant species related with the existence of human life on earth and used in rituals for Meitei community (Khumbongmayum *et al.*, 2004) residing near the sacred grove because of which it is recorded as a dominant species. *Tectona grandis* L.f. was also recorded from other sacred groves of India (Madhav and Gadgil, 1976). The dominating plant species only determine the structure of a community and not any other characteristic (Odum, 1971). The plant species richness and species diversity index in the sacred groves followed the order of trees>herbs>shrubs. The structure of a vegetation unit depends upon the species composition, their relative number, and diversity (Rawat and Chandra, 2014). A population structure characterized by the presence of sufficient number of seedlings, saplings, and young trees implies satisfactory regeneration behavior, while inadequate number of seedlings and saplings of tree species in a forest indicates 'poor' regeneration (Saxena *et al.*, 1984). Overall 'good' regeneration status was recorded in Bichikri sacred grove while 'fair' regeneration status was recorded in Nanath and Rajbari sacred grove. From this, it can be stated that *in situ* conservation in Nanath sacred grove and Rajbari sacred grove is needed to maintain an appropriate population size of different stage of individuals for sustaining good future regeneration status. *In situ* conservation helps in maintaining the microclimate habitats and enhance nutrient cycling (Vipat and Bharucha, 2014). The vegetation cover of the sacred groves improves the soil stability, soil fertility, ultimately improving the soil properties of that area and also prevents soil erosion (Asokan *et al.*, 2015). The distribution of species occurred in the three selected sacred groves exhibit contagious distribution. In Meghalaya sacred groves also, plant species showed contagious distribution (Upadhaya *et al.*, 2003). The study on soil physico-chemical characteristics determines that there was not much difference in the physical properties of the three selected sacred groves as most of the physical properties depend on the inherent soil

material, amount of rainfall received, and location of the area. The variations in the Sodium and Potassium values indicate that the chemical properties of the soils would throw more light on the organic content, mineral content and other variations in the soil properties (Chandy *et al.*, 2014). The study on the sacred groves of Assam states that the state harbour rich source of biodiversity in the sacred groves which are preserved by various indigenous communities. However, due to various anthropogenic activities, sacred groves of Assam is also vulnerable to encroachment, development activities, resource harvesting and erosion of beliefs among the younger generation. Therefore, proper conservation management and strategies are required to formulate for the protection of the sacred groves in Assam.

(e) Table; Charts

Table 1: Details of the selected three sacred groves

Name of the sacred grove	District	Deity	Tribe	Location/	Alt. (amsl)	Area cover
Rajbari	Hojai	Shiva	Meitei	26°02'07.4''N 92°47'16.9''E	67 m	1.6 ha
Nanath	Hojai	Shiva	Mishing	26°07'59.5''N 92°46'28.5''E	68 m	2.4 ha
Bichikri	West Karbi Anglong	Bichikri	Karbi	25°57'75.2''N 92°30'38.9''E	445 m	*16 ha

*Approximate area cover is recorded because of no fencing.

Table 2. Species richness, diversity index, concentration of dominance and evenness index in three selected sacred groves of Assam

Parameters	N	R	B	N	R	B	N	R	B
	Trees			Shrubs			Herbs		
Species richness	25	26	15	6	2	8	7	11	12
No. of genera	24	25	15	6	2	8	7	11	12
No. of families	16	17	12	4	2	7	6	10	10
Species diversity index	5.18	5.8	3.0	1.3	0.3	1.5	1.5	1.8	2.29
Shannon- Wiener diversity index (H')	2.97	2.94	2.34	1.6	0.68	1.95	1.75	1.89	2.34
Simpson diversity index (C _D)	0.94	0.93	0.89	0.66	0.52	0.84	0.81	0.84	0.89
Evenness index (e)	0.64	0.68	0.65	0.4	0.23	0.43	0.46	0.34	0.49
Whitford index	0.29	0.34	0.27	0.21	0.18	0.23	0.32	0.47	0.26

N – Nanath; R – Rajbari; B - Bichikri

Table 3. Tree diversity encountered in the three sacred groves of Assam and their community quantitative values.

Scientific name	Family	F (%)	A	D (ha ⁻¹)	BA (m ² ha ⁻¹)	IVI
Nanath sacred grove					0.12	13.61
<i>Aegle marmelos</i> (L.) Correa	Rutaceae	6	2.3	14	0.17	8.00
<i>Albizia procera</i> (Roxb.) Benth.	Leguminosae	4	1	4	0.67	37.96
<i>Albizia saman</i> (Jacq.) Merr.	Leguminosae	18	1.4	26	0.17	19.46
<i>Artocarpus heterophyllus</i> Lam.	Moraceae	10	1.8	18	0.11	4.51
<i>Azadirachta indica</i> A. Juss.	Meliaceae	2	1	2	0.09	9.06
<i>Bauhinia racemosa</i> Lam.	Leguminosae	6	1	6	0.14	16.85
<i>Cinnamomum tamala</i> (Buch.-Ham.) T. Nees & Libermann.	Lauraceae	10	1.4	14	0.08	14.0
<i>Cocos nucifera</i> L.	Arecaceae	10	1	10	0.11	14.36
<i>Dalbergia sissoo</i> DC.	Leguminosae	6	2.6	16	0.06	4.55
<i>Dillenia indica</i> L.	Dilleniaceae	2	2	4	0.04	8.78
<i>Eucalyptus globulus</i> Labill.	Myrtaceae	4	2.5	10	0.19	9.39
<i>Ficus benghalensis</i> L.	Moraceae	4	1.5	6	0.24	6.69
<i>Gmelina arborea</i> Roxb.	Lamiaceae	2	1	2	0.73	17.6
<i>Lagerstroemia speciosa</i> (L.) Pers.	Lythraceae	4	1	4	0.39	15.19
<i>Mangifera indica</i> L.	Anacardiaceae	6	1.3	8	0.15	5.22
<i>Mesua ferrea</i> L.	Calophyllaceae	2	1	2	0.12	12.14
<i>Mimusops elengi</i> L.	Sapotaceae	8	1	8	0.08	7.38
<i>Moringa oleifera</i> Lam.	Moringaceae	4	1.5	6	0.54	16.29
<i>Murraya koenigii</i> (L.) Spreng.	Rutaceae	4	2	8	0.06	11.51
<i>Plumeria rubra</i> L.	Apocynaceae	6	2	12	1.20	23.13
<i>Polyalthia longifolia</i> (Sonn.) Thwaites	Annonaceae	2	1	2	0.06	4.62
<i>Santalum album</i> L.	Santalaceae	2	2	4	0.10	4.33

<i>Spondias pinnata</i> (L. f.) Kurz	Anacardiaceae	2	1	2	0.05	9.92
<i>Tamarindus indica</i> L.	Leguminosae	4	3	12	0.01	5.32
<i>Tectona grandis</i> L.f.	Lamiaceae	4	1	4	0.12	13.61
Rajbari Sacred grove						
<i>Aegle marmelos</i> (L.) Correa	Rutaceae	4	1	4	0.07	7.17
<i>Aquilaria malaccensis</i> Benth.	Leguminosae	2	1	2	0.12	4.14
<i>Albizia procera</i> (Roxb.) Benth.	Leguminosae	4	1	4	0.10	7.38
<i>Artocarpus heterophyllus</i> Lam.	Moraceae	2	1	2	0.15	4.40
<i>Cassia fistula</i> L.	Leguminosae	2	1	2	0.14	4.29
<i>Azadirachta indica</i> A. Juss.	Meliaceae	6	1	6	0.03	10.26
<i>Bombax ceiba</i> L.	Malvaceae	6	1	6	0.99	16.70
<i>Chukrasia tabularis</i> A. Juss.	Meliaceae	2	1	2	0.11	4.10
<i>Citrus limon</i> (L.)	Rutaceae	4	1	4	0.02	6.80
<i>Cocos nucifera</i> L.	Araceae	4	1	4	0.05	7.04
<i>Ficus religiosa</i> L.	Moraceae	6	1	6	7.80	62.59
<i>Gmelina arborea</i> Roxb.	Lamiaceae	4	1.5	6	0.02	8.20
<i>Fitchi chinensis</i> Sonn.	Sapindaceae	2	1	2	0.08	3.93
<i>Madhuca longifolia</i> var. <i>latifolia</i> (Roxb.) A. Chev.	Sapotaceae	2	2	4	0.19	6.04
<i>Mangifera indica</i> L.	Anacardiaceae	4	1	4	0.12	7.53
<i>Minusops elengi</i> L.	Sapotaceae	4	3	12	0.04	12.45
<i>Moringa oleifera</i> Lam	Moringaceae	4	1.5	6	0.15	9.10
<i>Phoenix dactylifera</i> L.	Araceae	4	2.5	10	0.31	12.8
<i>Plumeria rubra</i> L.	Apocynaceae	2	1	2	0.17	4.49
<i>Polyalthia longifolia</i> (Sonn.) Thwaites	Annonaceae	2	1	2	0.08	3.90
<i>Psidium guajava</i> L.	Myrtaceae	2	2	4	0.03	4.95
<i>Saraca asoca</i> (Roxb.) Willd.	Leguminosae	2	1	2	0.22	4.87
<i>Tectona grandis</i> L.f.	Lamiaceae)	6	1.3	8	0.99	18.07

<i>Terminalia chebula</i> Retz.	Combrataceae	4	1	4	0.13	7.58
<i>Toona ciliata</i> M. Roem.	Meliaceae	10	3	30	2.54	47.52
<i>Ziziphus jujuba</i> Mill.	Rhamnaceae	8	1	8	0.02	13.52
Bichikri sacred grove						
<i>Ardisia arborea</i> Koord. & Valetton	Primulaceae	2	5	10	0.91	18.41
<i>Artocarpus chama</i> Buch.-Ham.	Moraceae	4	1	4	1.29	17.99
<i>Cratava nurvala</i> Buch.-Ham.	capparidaceae	4	1.5	6	0.35	12.84
<i>Dillenia pentagyna</i> Roxb	Dilleniaceae	4	1	4	0.43	11.58
<i>Dysoxylum excelsum</i> Blume	Meliaceae	6	1	6	0.56	16.77
<i>Ficus religiosa</i> L.	Moraceae	2	1	2	3.98	33.83
<i>Garcinia pedunculata</i> Roxb. ex Buch.-Ham.	Clusiaceae	4	1	4	0.47	11.90
<i>Gmelina arborea</i> Roxb.	Lamiaceae	12	1	12	0.56	29.30
<i>Hedychium wardii</i> C.E.C.Fisch.	Zingiberaceae	2	1	2	0.45	7.56
<i>Lindera erythrocarpa</i> Makino	Lauraceae	8	1.2	10	0.33	21.09
<i>Maesa indica</i> (Roxb.) A. DC.	Primulaceae	6	1.3	8	0.48	17.97
<i>Mangifera indica</i> L.	Anacardiaceae	6	1.3	8	0.70	19.61
<i>Neolamarckia cadamba</i> (Roxb.) Bosser	Rubiaceae	8	1	8	0.73	22.19
<i>Shorea robusta</i> Gaertn.	Dipterocarpaceae	2	4	8	1.11	18.06
<i>Tectona grandis</i> L.f.	Lamiaceae	16	1	16	0.99	40.8

Table 4. Regeneration status, IVI and Density (ha^{-1}) of plant species recorded in selected three sacred groves of Assam.

Species	Nanath sacred grove				Rajbari sacred grove				Richikiri sacred grove									
	Seedling		Sapling		Trees		Regeneration Status		Seedling		Sapling		Trees		Regeneration Status			
	IVI	Density	IVI	Density	IVI	Density	IVI	Density	IVI	Density	IVI	Density	IVI	Density	IVI	Density		
<i>Aegle marmelos</i>	9.4	6	13.5	12	13.6	14	Fair	-	-	7.1	4	-	-	-	-	-	-	
<i>Albizia procera</i>	9.9	1	3	1	10.5	4	New	8.9	6	9.6	4	7.3	4	-	-	-	-	
<i>Aquilaria malaccensis</i>	-	-	-	-	-	-	-	-	-	-	-	4.1	2	-	-	-	-	
<i>Ardisia ciliata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	18.4	10	Fair	-	
<i>Artocarpus heterophyllus</i>	10.6	12	6.8	4	19.4	18	Fair	7.6	4	6.8	2	4.4	2	-	-	-	-	
<i>Azadirachta indica</i>	7.3	2	7.8	6	4.5	2	Poor	13.8	12	13.1	12	10.2	6	-	-	-	-	
<i>Bauhinia racemosa</i>	7.3	1	8.4	6	9	6	Poor	-	-	-	-	-	-	-	-	-	-	
<i>Bombax ceiba</i>	-	-	-	-	-	-	-	6.1	4	9.6	4	16.7	6	-	-	-	-	
<i>Cassia fistula</i>	-	-	-	-	-	-	-	7.8	4	7.5	2	4.2	6	-	-	-	-	
<i>Chukrasia tabularis</i>	-	-	-	-	-	-	-	6.1	4	7.1	2	4.1	2	-	-	-	-	
<i>Chinamonium tamala</i>	3.0	4	7.3	4	16.8	14	Poor	-	-	-	-	-	-	-	-	-	-	
<i>Citrus limon</i>	-	-	-	-	-	-	-	6.8	6	11.3	4	6.8	4	-	-	-	-	
<i>Cocos nucifera</i>	7.2	4	-	-	14	10	None	-	-	-	-	7.0	4	-	-	-	-	
<i>Crateva nurvala</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Dalbergia sissoo</i>	-	-	-	-	6.2	4	None	-	-	-	-	-	-	-	-	-	-	
<i>Dillenia pentagyna</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Dillenia indica</i>	8.9	4	-	-	4.5	4	Fair	-	-	-	-	-	-	-	-	-	-	
<i>Dysoxylum excelsum</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Eucalyptus globulus</i>	3	0	-	-	8.7	10	Poor	-	-	-	-	-	-	-	-	-	-	
<i>Ficus benghalensis</i>	1	0	6.8	4	9.3	6	None	-	-	-	-	-	-	-	-	-	-	
<i>Ficus religiosa</i>	-	-	-	-	-	-	-	5.6	2	6.1	2	62.5	6	-	-	-	-	
														5.7	2	33.8	2	Poor

(f) Figures:



Figure 1: Map showing recorded number of sacred groves in each district of Assam



Figure 2: Red Ribbon tied in Ahot (*Ficus religiosa* L.) in 'Deo Than' at Jorhat district.

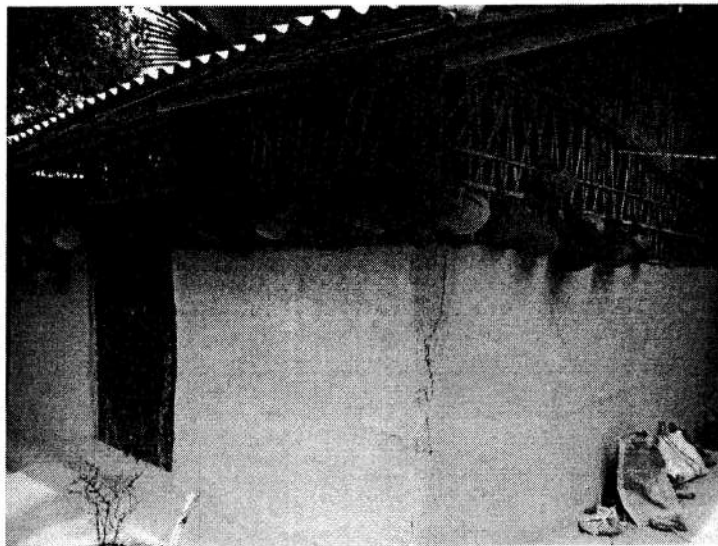


Figure 3: Coconut offered to Dangoria baba in 'Dangoria baba Than' of Kaliapani at Dibrugarh.



Figure 4: *Ixora coccinea* L. recorded from 'Ganakhuchi satra' at Barpeta district.



Figure 5: *Ficus benghalensis* L. tied with white thread in 'Jalikata Than' at Barpeta district.

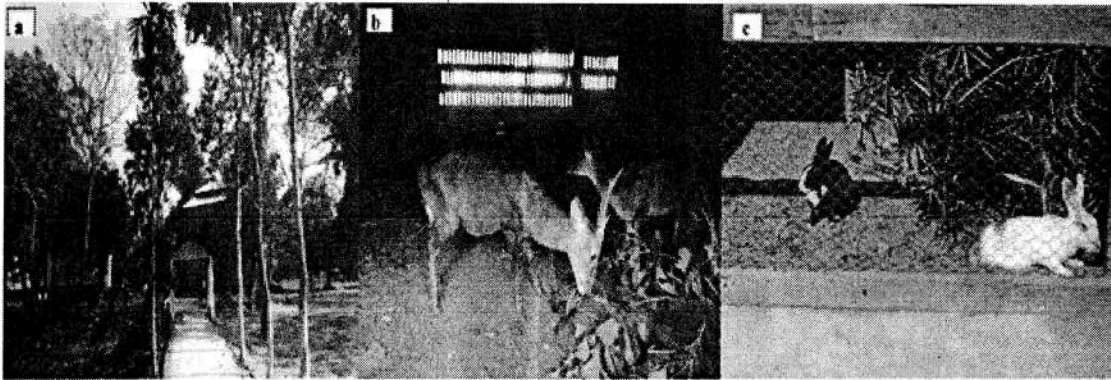


Figure 6: Dakhinpath satra sacred groves in Majuli (a); *Rusa unicolor* (b) and Rabbit (c) are domesticated in the form of *ex situ* conservation.

(g) Likely impact of the work on the scientific potential of our country

1. Sacred groves of Assam conserved a total area of 671.8 ha which harbours rich diversity of flora and fauna which are distributed along varied landscape.
2. The floristic study of the sacred groves gives an idea of the rich species composition and their significance and conservation status.
3. Ecological services provided by sacred groves need to be quantified and estimated.
4. Sacred plants species comprehend the linkage between socio-cultural and religious practices and importance of plant species associated with indigenous community.
5. Several sacred trees of Assam are preserved from ancient times, therefore the carbon stock of sacred trees can be estimated.
6. The preservation of the sacred pond and tanks protects a number of organisms which has enrich the diversity of the groves.
7. Sacred groves of Assam are vulnerable to various developmental and anthropogenic factors resulting to degradation in terms of cultural and biological diversity. Therefore, formulation of conservation measures is needed in consensus with the participation of indigenous community for the protection and conservation of sacred groves of Assam.
8. Need to promote the significance of sacred groves through awareness and sensitization particularly to the young generations in order to recognize them the strong bond prevailing between the sacred groves and community wellbeing which helps to conserve biodiversity.

(PART - III)

1. Recommendation including remedial measures relevant to the environmental problems studied under the scheme.

- a. Some of the sacred groves of Assam are rich in floristic diversity however; they need regulatory measures and attention for sustaining their richness. At the same time, immediate action is required to restore the threatened and degraded sacred groves.
- b. Some of the important sacred groves having dense natural vegetation may be earmarked as protected sites'' and promote sustainable eco-tourism.
- c. Particularly Temple groves are in threats of degradation due to various anthropogenic activities. The cutting of trees has been observed in the Temple groves in spite of having traditional belief and taboos.
- d. Proper management and disposal of any items offered to the deities particularly in Temple groves need scientific intervention for maintaining sustainable environment in and around the sacred groves. In Tilinga Mandir sacred grove, people tie bells on the iron bars of the temple wall which are removed time to time by care taker but dump inside the temple causing a great concern for the environment.
- e. Sacred ponds also form important strata of sacred groves and harbor a rich diversity of vivid organisms. Hence this aquatic ecosystem and heritage must be maintained and protected by the government taking assurance of local people.
- f. Based on the outcomes of the present study, it is recommended conducting an awareness campaign on the status and biodiversity values of sacred groves among the people of Assam.
- g. Sensitization programme for the conservation and protection of sacred groves should highlight the linkage between socio-cultural and religious values of different communities of the state and conservation of biodiversity.

2. List of research papers published/accepted in the research work done under the scheme (Two copies of each of the reprints/accepted/ submitted paper also to be enclosed)


One article published: Shilpa Baidya and Ashalata Devi. 2018. Role of indigenous communities in conservation of sacred plants of Assam. (M. Amirthalingam Ed.) C. P. R. Environmental Education Centre, MoEF, Govt. of India. Pp. 17-34.

3. Whether any research fellow associated with the scheme has been awarded PH.D., etc., or any other higher degree and if so, name of the fellow and the title of the thesis may be given.

Yes. The Junior Research Fellow (JRF) Miss. Shilpa Baidya has been enrolled for the Ph. D program at Department of Environmental Science, Tezpur University.

The tentative title of the study is "Ecological study on structure and function of sacred groves in Assam."

Date: 11/6/18


Signature of **Dr. Ashalata Devi**
(Seal) **Associate Professor & PI**
Dept. of Environmental Science
Tezpur University

Note:

1. Fifteen copies are to be submitted on A-4 size paper (thesis size) properly stitched and bound along with executive Summary of the project comprising of 2 pages including follow-up action to be taken on the recommendations.
2. Cover page should include the title of the project, file number, names and addresses of the Investigators.

G.B. PANT INSTITUTE OF HIMALAYAN ENVIRONMENT & DEVELOPMENT

UTILIZATION CERTIFICATE

(IERP Projects in the Himalaya Region)

(To be sent in duplicate)

For the year (from 26th December 2016 to 25th December 2017)

- | | | |
|---|---|------------|
| 1. Title of the Project/Scheme | : Scared groves of Assam: biodiversity status and strategies for their conservation | |
| 2. Name of the organization & Principal Investigator | : Tezpur University
Dept. of Environmental Science
Dr. Ashalata Devi | |
| 3. GBPIHED letter no. & date of sanctioning the project | : GBPI/IERP/10-11/11/109, dated 29 th , Aug, 2014 | |
| 4. Amount brought forward from the previous financial year quoting letter no. & date on which the approval to carry forward the said amount was given | : Rs. 12,782 | |
| 5. Amount received from GBPIHED during the financial year (please give No. and dates of sanctions showing the amount paid) | : No. and date
amount | Sanctioned |
| | 1 Nil | |
| | 2 | |
| | 3 | |
| | <hr/> | |
| | Total : Nil | |
| 6. Total amount that was available for expenditure (including commitments incurred during the financial year. (Serial Nos. 4+5) | : Rs. 12,782 | |
| 7. Actual expenditure (excluding commitments) during the financial year. | : Rs. 10,169 | |
| 8. Unspent balance refunded, if any (please give details of cheque No. etc.) | : | |
| 9. Balance amount available at the end of financial year | : Rs. 2,613 | |
| 10. Amount allowed to be carried forward to the next financial year vide letter No. and Date. | : | |

[1]



Finance Officer
Tezpur University


Certified that expenditure of Rs. 10,169 mentioned against column 7 was actually incurred on the project for the purpose for which was sanctioned.

Place:

Date:

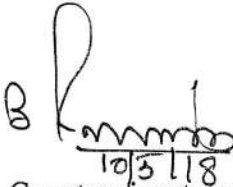
For SURAJIT CHAKRABORTY & CO.
CHARTERED ACCOUNTANTS


CA. SURAJIT CHAKRABORTY
(Proprietor)
Membership No.- 305054


Signature of Principal
Investigator

Dr. Ashalata Devi
Associate Professor & PI
Dept. of Environmental Science
Tezpur University


(seal)


Counter signature
of account officer/
finance officer
Finance Officer
Tezpur University

(seal)


Signature of
Registrar
Registrar
Tezpur University

(seal)


Signature of head of
the department/
institution
Head
Deptt. of Environmental
Tezpur University
Napaam : Tezpur

(seal)

Our Ref. No.

Date:

**ACCEPTED AND COUNTERSIGNED
COMPETENT AUTHORITY, GBPIHD**

G.B. PANT INSTITUTE OF HIMALAYAN ENVIRONMENT & DEVELOPMENT

STATEMENT OF EXPENDITURE (IERP Projects in the Himalayan Region)

Statement showing the expenditure of the period from 26th December, 2016 to 25th December, 2017.

Sanction No. & date: GBPI/IERP/10-11/11/109, dated 29th August 2014

1. Total outlay of the project Rs. 9,96,600
2. Date of the start of the project: 26-12-14
3. Duration: 3 years
4. Date of completion: 25-12-17
5. (a) Amount received during the year: Nil
 - (b) Unspent amount carried forward from previous year: Rs 10,169
 - (c) Bank interest received, if any Rs 2,613
 - (d) Total amount available for expenditure Rs. 12,782

6. Position of grant received, spent and balance/excess expenditure at the close of the financial year

	Amount received + amount carried forward	Amount spent	Balance/ Excess expenditure
(I) Salaries/ wages of staff			
Research Associate (s)			
Sr. Research Fellow (s)			
Junior Research Fellow (s)			
Lab Assistant/ Technician (s)			
Field Assistant (s)			
Field Attendant (s)			
Arrear amount			
Total	Nil	Nil	Nil
(II) Permanent Equipment purchased (item wise)			
Herbarium Cabinet (2)			
Total	Nil	Nil	Nil
(III) Expendable items			
Total	Nil	Nil	Nil
(IV) Travel	Nil	Rs. 3,455	Rs. -3,455
Total	Nil	Rs. 3,455	Rs. -3,455


[1]


Finance Officer
Tezpur University


(V) Consumable	Nil	Nil	Nil
Total	Nil	Nil	Nil
(VI) Other cost of the project (item wise)	Nil	Nil	Nil
Total	Nil	Rs. 6,714	Rs. -6,714
(VII) Contingencies	Nil	Rs. 6,714	Rs. -6,714
Total			
(VIII) Institutional charges, if any			
(IX) unspent balance from the previous year with Bank interest, if any	Rs. 12,782	Rs. 10,169	Rs. 2,613
Grand Total	Rs. 12,782	Rs. 10,169	Rs. 2,613


7. (a) State the amount and the item, in which excess expenditure incurred with reasons.

(b) State the amount and the item in which less expenditure incurred.


 Signature of Principal Investigator
 Dr. Ashalata Devi
 Associate Professor & PI
 Dept. of Environmental Science
 Tezpur University
 (seal)

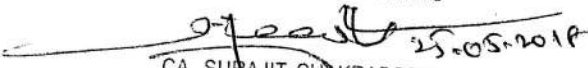

 Counter signature of account officer/finance officer
Finance Officer
Tezpur University
 (seal)


 Signature of Registrar
Registrar
Tezpur University
 (seal)


 Signature of Head of the department/ institution
Head
 Deptt. of Environmental Science
 Tezpur University
 Napaani : Tezpur
 (seal)

[2]

For SURAJIT CHAKRABORTY & CO.
 CHARTERED ACCOUNTANTS


 CA. SURAJIT CHAKRABORTY
 (Proprietor)
 Membership No.- 305054

G.B. PANT INSTITUTE OF HIMALAYAN ENVIRONMENT & DEVELOPMENT**STATEMENT OF EXPENDITURE
(IERP Projects in the Himalayan Region)**

Statement showing the expenditure of the period from 26th December, 2017 to 31st March, 2018.

Sanction No. & date: GBPI/IERP/10-11/11/109, dated 29th August 2014

1. Total outlay of the project Rs. 9,96,600

2. Date of the start of the project: 26-12-14

3. Duration: 3 years

4. Date of completion: 25-12-17

5. (a) Amount received during the year:

3rd Installment Rs. 3, 48, 612

(b) Unspent amount carried forward from previous year Rs. 2, 613

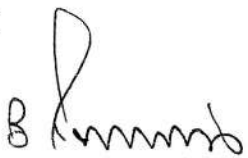
(c) Bank interest received, if any

(d) Total amount available for expenditure Rs. 3,51,225

6. Position of grant received, spent and balance/excess expenditure at the close of the financial year

	Amount received + amount carried forward	Amount spent	Balance/ Excess expenditure
(I) Salaries/ wages of staff			
Research Associate (s)			
Sr. Research Fellow (s)			
Junior Research Fellow (s)		Rs. 2,19,484	3,848
Lab Assistant/ Technician (s)			
Field Assistant (s)		Rs 65,000	5,000
Field Attendant (s)			
Arrear amount		Rs. 35,226	
Total	Rs.3,11,226	Rs. 3,19,710	Rs. -8,484
(II) Permanent Equipment purchased (item wise)			
Herbarium Cabinet (2)			
Total	Nil	Nil	Nil
(III) Expendable items			
Total	Nil	Nil	Nil
(IV) Travel	Rs.20,000	Rs. 11,535	Rs. 8,465
Total	Rs. 20,000	Rs. 11,535	Rs. 8,465

[1]


Finance Officer
Tezpur University


(V) Consumable	Rs. 17,386	Rs. 19,075	Rs. -1,689
Total	Rs. 17,386	Rs. 19,075	Rs. -1,689
(VI) Other cost of the project (item wise)	Nil	Nil	Nil
Total	Nil	Nil	Nil
(VII) Contingencies	Nil	Nil	Nil
Total	Nil	Nil	Nil
(VIII) Institutional charges, if any			
(IX) unspent balance from the previous year with Bank interest, if any	Rs.2,613	Nil	Rs. 2,613
Grand Total	Rs. 3,51,225	Rs. 3,50,320	Rs. 905

7. (a) State the amount and the item, in which excess expenditure incurred with reasons.

In 'salary' and 'consumable' heads excess expenditure of Rs. 8,484 and Rs. 1,689 has been occurred respectively.


(b) State the amount and the item in which less expenditure incurred.

In 'travel head' less expenditure was incurred due to late received of amount. The balance amount is adjusted with the exceeded amount in 'salary' and 'consumable' heads


Signature of Principal Investigator
Dr. Ashalata Devi
Associate Professor & PI
Dept. of Environmental Science
Tezpur University
(seal)



Counter signature
of account officer/
finance officer
Finance Officer
Tezpur University
(seal)


Signature
of
Registrar
Registrar
Tezpur University
(seal)


Signature of Head of
the
department/ institution
Head
Deptt. of Environmental Science
Tezpur University
Napaam : Tezpur
(seal)

[2]

For SURAJIT CHAKRABORTY & CO.
CHARTERED ACCOUNTANTS


CA, SURAJIT CHAKRABORTY
(Proprietor)
Membership No.- 305054

01/09/2018


G.B. PANT INSTITUTE OF HIMALAYAN ENVIRONMENT & DEVELOPMENT

**CONSOLIDATED STATEMENT OF EXPENDITURE
(JERP Projects in the Himalaya Region)**

Statement showing the expenditure of the period from 26th December 2014 to 31st March 2018

Sanction No. & date : GBPI/JERP/10-11/1/109, dated 29th August 2014

1. Total outlay of the project Rs. 9,96,600.00
2. Date of start of the project: 26-12-14
3. Duration: 3 years
4. Date of completion: 25-12-17
5. (a) Amount received during the financial year :
1st instalment Rs. 3,14,000.00
2nd instalment Rs. 2,73,635.00
3rd instalment Rs. 3,48,612.00
- (b) Unspent amount carried forward from previous financial year
- (c) Bank interest received, if any Rs 2,613
- (d) Total amount available for expenditure (a+b+c) Rs. 9,38,860.00


**Finance Officer
Tezpur University**

6. Position of grant received, spent and balance/excess expenditure at the close of the financial year.

	1 st installment Amount received	2 nd installment Amount received + amount carried forward	3 rd installment Amount received + amount carried forward	Total amount received	Amount spent				Total (Rs.)	Balance/excess expenditure
					1 st year (2014-15)	2 nd year (2015-16)	3 rd year (2016-17)	4 th year (2017-18)		
(D) Salaries/wages of staff										
Research Associate (s)										
Sr. Research Fellow(s)										
Junior Research Fellow (s)	1,44,000	1,24,258	2,51,226	5,19,484	1,29,258	1,44,000	-	2,54,710	5,27,968	-8,484
Lab Assistant/Technician (s)										
Field Assistant (s)	60,000	60,000	60,000	1,80,000	55,000	60,000	-	65,000	180,000	
Field Attendant (s)										
Total	2,04,000	1,84,258	3,11,226	6,99,484	1,84,258	2,04,000	-	3,19,710	7,07,968	-8,484
(II) Permanent Equipment purchased (item wise)										
Herbarium cabinet (2)	20,000.00	-	-	20,000	-	-	-	-	-	20,000.00
Total	20,000.00	-	-	20,000	-	-	-	-	-	20,000.00

[1]


Finance Officer
 Tezpur University

(III) Expendable items																				
Total																				
(IV) Travel and POL (Vehicle expenses)	30,000	30,000	20,000	80,000	65,055	34,777	3455	11,535	1,14,822	-34,822										
Total	30,000	30,000	20,000	80,000	65,055	34,777	3455	11,535	1,14,822	-34,822										
(V) Consumable	30,000	29,377	17,386	76,763	29,377	29,999	-	19,075	78,451	-1,688										
Total	30,000	29,377	17,386	76,763	29,377	29,999	-	19,075	78,451	-1,688										
(VI) Other cost of the project (item wise)																				
Total																				
(VII) Contingencies	30,000	30,000	-	60,000	30,000	-	6,714	-	36,714											
Total	30,000	30,000	-	60,000	30,000	-	6,714	-	36,714											
(VIII) Institutional Charges, if any																				
Total																				
(IX) Bank interest				2,613																
GRAND TOTAL, (I TO IX)				9,38,860					9,37,955											2613 905

7. (a) State the amount and the item, in which excess expenditure incurred with reasons.

(b) State the amount and the item in which less expenditure incurred.

(c) Balance in hand on Rs 905

Signature of Principal Investigator
 Dr. Ashalata Devi
 Associate Professor & PI,
 Dept. of Environmental Science
 Tezpur University
 (seal)

Counter signature of Account Officer/Finance Office
 Finance Officer
 Tezpur University
 (seal)

Signature of Registrar
 Registrar
 Tezpur University
 (seal)

Signature of Head of the Department/Institution
 Head of the Department
 Dept. of Environmental Science
 Tezpur University
 Napaan : Tezpur
 (seal)

For SURAJIT CHAKRABORTY & CO.
 CHARTERED ACCOUNTANTS

CA. SURAJIT CHAKRABORTY
 Proprietor
 25.05.2017
 Telephone: 9110000000